GHANA EDUCATION SERVICE
(MINISTRY OF EDUCATION)

REPUBLIC OF GHANA

MATHEMATICS CURRICULUM FOR BASIC 7 – 10
(COMMON CORE PROGRAMME)

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NaCCA NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

Mathematics Curriculum for B7- B10

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FOREWORD

The Ministry of Education, acting through the National Council for Curriculum and Assessment (NaCCA) has, in recent times, been working on curriculum and assessment reforms to improve the quality and relevance of learning experiences in pre-tertiary schools in Ghana. This curriculum, known as the Common Core Programme (CCP), is a sequel to the Kindergarten-Primary standards-based school curriculum, the implementation of which commenced with the 2019/2020 academic year. The CCP is carefully designed for learners in Basic 7 to Basic 10 (JHS 1 – SHS 1) as part of a holistic learning experience that prepares them for post-secondary education, the world of work or both. The curriculum focuses on building character and nurturing values, in addition to ensuring a seamless progression for all learners from JHS to SHS and creates clear pathways for academic and career-related programmes from Basic 11 to Basic 12 (SHS2 - SHS3).

In the twenty-first century, memorisation of facts and figures is no longer a sufficient learner attribute. Therefore, the CCP focuses on the acquisition of the 4Rs (Reading, wRiting, aRithmetic and cReativity) and core competencies to afford learners the ability to apply knowledge innovatively to solve everyday problems. Personal projects, community projects and community service have been integrated into the CCP as part of a comprehensive assessment programme, including assessment of knowledge, skills, attitudes and values that mainly emphasise what learners can do. It is hoped that the content of this curriculum will promote better high school education that meets the varied learning needs of the young people in the country and addresses the shortfalls in the current school curriculum in relation to learning and assessment.

The Ministry of Education is committed to ensuring that our schools develop globally competitive high school graduates who have the requisite employable skills and workplace ethos. The CCP curriculum will, therefore, play an important role in this regard. The Ministry will support the effective implementation of the CCP to include capacity development of all teachers to ensure improved learning experiences and outcomes for our young people.

Dr. Matthew Opoku Prempeh (MP)
The Honourable Minister of Education

ACKNOWLEDGEMENTS

This Common Core Programme (CCP) curriculum was developed together with the National Pre-tertiary Learning Assessment Framework (NPLAF) and Teacher's and Learner's Resource Packs. All these documents were developed by the National Council for Curriculum and Assessment (NaCCA), under the oversight and strategic direction of the Ministry of Education (MoE) with support from some agencies of the MoE and other relevant stakeholders.

NaCCA, acting on behalf of the Ministry of Education (MoE), would like to express its sincere gratitude to all its partners who participated in the professional conversations and discussions during the course of the development of the CCP curriculum.

NaCCA also extends special commendations to the leadership of the Ghana Education Service (GES), National School Inspectorate Authority (NaSIA), National Teaching Council (NTC), Commission for Technical and Vocational Education and Training (Commission for TVET) and other agencies of the MoE.

Additionally, NaCCA acknowledges the contributions of staff from various Universities and Colleges of Education as well as teachers and learners within the Ghana Education Service.

Special thanks go to those who also contributed to shaping this curriculum content through the consultation process, including the national stakeholder engagement conducted in Accra in February, 2020.

Contents

INTRODUCTION

In the first four years of high school education, learners are expected to take a Common Core Programme (CCP) that emphasises a set of high, internationally benchmarked career and tertiary education readiness standards. Learners need to acquire these for post-secondary education, the workplace or both. The standards articulate what learners are expected to know, understand and be able to do by focusing on their social, emotional, cognitive and physical development. The (CCP) runs from Basic 7 through Basic 10.

The common core attributes of the learner, which describe the essential outcomes in the three domains of learning (i.e. cognitive, psychomotor and affective), are at the centre of the CCP (see Figure 1). Inspired by the values which are important to the Ghanaian society, the CCP provides an education of the heart, mind and hands concerning the learner's lifetime values, well-being, physical development, metacognition and problem-solving abilities. Ultimately, this will produce character-minded learners who can play active roles in dealing with the increasing challenges facing Ghana and the global society.

The features that shape the common core programme are shown in Figure 1. These are:

- learning and teaching approaches – the core competencies, pedagogical approaches and the 4Rs;
- learning context – engagement service and project;
- learning areas – mathematics, science, computing, languages (English, Ghanaian Language, French and Arabic), career technology, social studies, physical and health education, creative arts and design, and religious and moral education.

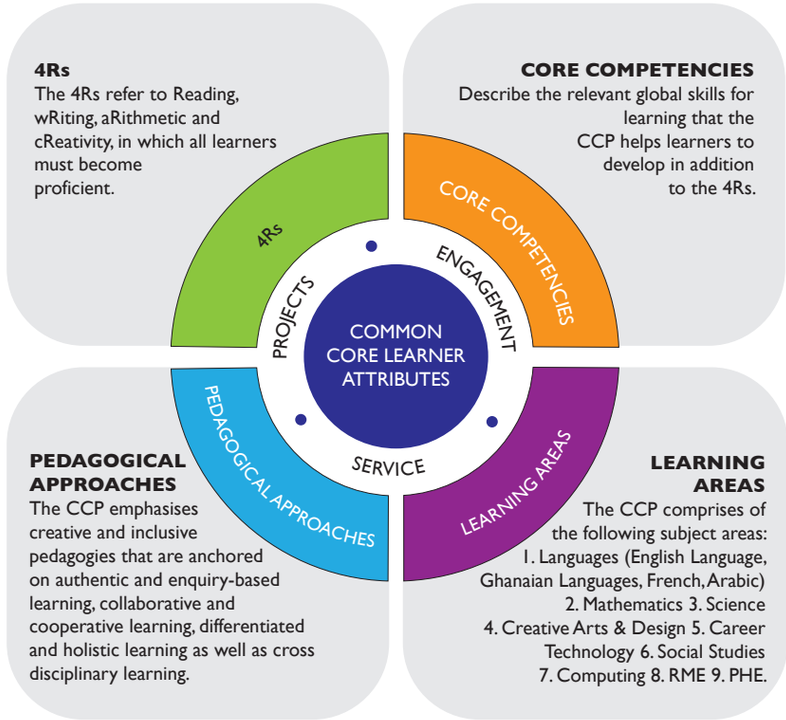


Figure 1: CCP Learner Attributes

Learning and Teaching Approaches

The core competencies: Describe the relevant global skills for learning that the CCP helps learners to develop in addition to the 4Rs. The global skills for learning allow learners to become critical thinkers, problem-solvers, creators, innovators, good communicators, collaborators, digitally literate, and culturally and globally sensitive citizens who are life-long learners with a keen interest in their personal development.

Pedagogical approaches: The CCP emphasises creative and inclusive pedagogies that are anchored on authentic and enquiry-based learning, collaborative and

cooperative learning, differentiated learning, and holistic learning as well as cross-disciplinary learning.

The 4Rs across the curriculum: The 4Rs refer to Reading, wRiting, aRithmetic and cReativity, which all learners must become fluent in.

Learning Context

The CCP emphasises engagement of learners in the classroom activities and projects (in and outside the classroom). These projects can involve individual or group tasks which all learners are required to complete by the end of Basic 10. The CCP project provides learners with contexts to demonstrate creativity and inventiveness in various areas of human endeavour. Community service offers opportunities for learners to nurture, love and care for, and solve problems in their community.

Learning Areas

The CCP comprises the following learning areas:

- Languages (English Language, Ghanaian Languages, French, Arabic)
- Mathematics
- Science
- Creative Arts and Design (CAD)
- Career Technology
- Social Studies
- Computing
- Religious and Moral Education (RME)
- Physical and Health Education (PHE)

This document sets out the standards for learning mathematics in the Common Core Programme (CCP). The standards in the document are posited in the expectation that the CCP (B7 – B10) will offer quality education for all types of learners. The design of this curriculum is based on the features of the CCP as shown in Figure 1. It emphasises a set of high internationally benchmarked career and tertiary education readiness standards. Learners need to acquire these competencies in mathematics for post-secondary education, workplace training or both. The curriculum has been designed to be user friendly and it provides a detailed preamble that covers the rationale, philosophy, aims, profile of expected learning behaviours (i.e. knowledge, skills, attitudes and values), pedagogical approaches, core competencies and the 4Rs, assessment practices and instructional expectations.

RATIONALE

Mathematics forms an integral part of our everyday lives and it is a universal truth that development is hinged on mathematics. Mathematics is the backbone of social, economic, political, and physical development of a country. It is a never-ending creative ideology, which seeks to promote discovery and understanding. It consists of a body of knowledge which attempts to explain and interpret phenomena and experiences. Mathematics has changed our lives and it is thus vital to Ghana's future development.

To provide quality mathematics education, teachers must facilitate learning in the mathematics classroom. This will provide the foundations for discovering and understanding the world around us and lay the grounds for mathematics and mathematics-related studies at higher levels of education. Learners should be encouraged to understand how mathematics can be used to explain what is occurring, predict how things will behave and analyse the causes and origin of phenomena in our environment. The mathematics curriculum has considered the desired outcomes of education for learners at the basic level of education. Mathematics is also concerned with the development of attitudes and it is therefore important for all citizens to be mathematically and technologically literate for sustainable development. Mathematics, therefore, ought to be taught using hands-on and minds-on approaches which learners will find as fun and adopt mathematics as a culture.

PHILOSOPHY

Teaching Philosophy

Ghana believes that an effective mathematics education needed for sustainable development should be inquiry-based. Thus, mathematics education must provide learners with opportunities to expand, change, enhance and modify how they view the world. It should be pivoted on learner-centred teaching and learning approaches that engage learners physically and cognitively in the knowledge-acquiring process, in a rich and rigorous inquiry-driven environment.

Learning Philosophy

Mathematics learning is an active contextualised process of constructing knowledge based on learners' experiences. Learners are information constructors who operate as researchers. Teachers serve as facilitators by providing the enabling environment that promotes the construction of learners' knowledge, based on their previous experiences. This makes learning more relevant to the learner and leads to the development of critical thinkers and problem solvers.

AIMS

General Aim

The curriculum is aimed at developing individuals to become mathematically literate, problem solvers, think creatively, possess the confidence and competence to participate fully in the affairs of the Ghanaian society as responsible local and global citizens.

Specific Aims

The aims of teaching and learning Mathematics are to encourage and enable learners to:

1. recognise that mathematics permeates the world around us
2. appreciate the usefulness, power and beauty of mathematics
3. enjoy mathematics and develop patience and persistence when solving problems
4. understand and be able to use the language, symbols and notations of mathematics
5. develop mathematical curiosity and use inductive and deductive reasoning when solving problems
6. become confident in using mathematics to analyse and solve problems both in school and real-life situations develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics
7. develop abstract, logical and critical thinking abilities to reflect critically upon their work and the works of others.

PROFILE OF EXPECTED LEARNING BEHAVIOURS

A central aspect of this curriculum is the concept of three integral learning domains that should be the basis for instruction and assessment. These are:

- Knowledge, Understanding and Application
- Process Skills
- Attitudes and Values

Knowledge, Understanding and Application

Under this domain, learners acquire knowledge through some learning experiences. They may also show understanding of concepts by comparing, summarising, rewriting, etc. in their own words and constructing meaning from instruction. The learner may also apply the knowledge acquired in some new contexts. At a higher level of learning behaviour, the learner may be required to analyse an issue or a problem. At higher levels, the learner may be required to synthesise knowledge by integrating a number of ideas to formulate a plan, solve a problem, compose a story, or a piece of music. Further, the learners may be required to evaluate, estimate and interpret a concept. At the last level, which is the highest, learners may be required to create, invent, compose, design and construct. These learning behaviours "knowing", "understanding", "applying", "analysing", "synthesising", "evaluating" and "creating" fall under the domain "Knowledge, Understanding and Application".

In this curriculum, learning indicators are stated with action words to show what the learner should know and be able to do. For example, the learner will be able to describe something. Being able to "describe" something after teaching and learning has been completed means that the learner has acquired "knowledge". Being able to explain, summarise, and give examples etc. means that the learner has understood the concept taught.

Similarly, being able to develop, defend, etc. means that the learner can "apply" the knowledge acquired in some new context. You will note that each of the

indicators in the curriculum contains an **"action word"** that describes the behaviour the learner will be able to demonstrate after teaching and learning has taken place. "Knowledge, Understanding and Application" is a domain that should be the prime focus of teaching and learning in schools. Teaching in most cases has tended to stress knowledge acquisition to the detriment of other higher level behaviours such as applying knowledge.

Each action word in any indicator outlines the underlying expected outcome. Each indicator must be read carefully to know the learning domain towards which you have to teach. The focus is to move teaching and learning from the didactic acquisition of "knowledge" where there is fact memorisation, heavy reliance on formulae, remembering facts without critiquing them or relating them to real world – surface learning – to a new position called – deep learning. Learners are expected to deepen their learning by knowledge application to develop critical thinking skills, explain reasoning, and to generate creative ideas to solve real life problems in their school lives and later in their adult lives. This is the position where learning becomes beneficial to the learner.

The keywords and explanation and the key words involved in the "Knowledge, Understanding and Application" domain are as follows:

Knowing: The ability to remember, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is the ability to remember or recall material already learned and this constitutes the lowest level of learning.

Understanding: The ability to explain, summarise, translate, rewrite, paraphrase, give examples, generalise, estimate or predict consequences based upon a trend. Understanding is generally the ability to grasp the meaning of some concepts that may be verbal, pictorial, or symbolic.

Applying: This dimension is also referred to as "Use of Knowledge". Ability to use knowledge or apply knowledge, apply rules, methods, principles, theories, etc. to situations that are new and unfamiliar. It also involves the ability to produce, solve, plan, demonstrate, discover etc.

Analysing: The ability to break down material/information into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant points etc., ability to recognise unstated assumptions and logical fallacies; ability to recognise inferences from facts etc.

Synthesising: The ability to put parts or ideas together to form a new whole. It involves the ability to combine, compile, compose, devise, plan, revise, organise, create, generate new ideas and solutions.

Evaluating: The ability to appraise, compare features of different things and make comments or judgment, criticise, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some material based on some criteria.

Creating: The ability to use information or materials to plan, compose, produce, manufacture or construct other products.

From the foregoing, creating is the highest form of thinking and learning and is therefore the most important behaviour. This, unfortunately, is the area where most learners perform poorly. In order to get learners to develop critical thinking, it is advised that you do your best to help your learners to develop analytical skills and processes as we have said already.

Attitudes, Values and Process Skills

To be effective, competent and reflective citizens, who will be willing and capable of solving personal and societal problems, learners should be exposed to situations that challenge them to raise questions and attempt to solve problems. Learners therefore need to acquire positive attitudes, values and psychosocial skills that will enable them participate in debates and take a stand on issues affecting them and others. The mathematics curriculum thus focuses on the development of attitudes and values.

The mathematics curriculum aims at helping learners to acquire the following:

1. **Commitment**: determination to contribute to national development.
2. **Tolerance**: willingness to respect the views of others.

3. **Patriotism**: readiness to defend the nation.
4. **Flexibility** in ideas: willingness to change opinion in the face of more plausible evidence.
5. **Respect for evidence**: willingness to collect and use data on one's investigation, and also have respect for data collected by others.
6. **Reflection**: The habit of critically reviewing ways in which an investigation or observation has been carried out to see possible faults and other ways in which the investigation or observation can be improved upon.
7. **Comportment:** conforming to acceptable societal norms.
8. **Co-operation:** the ability to work effectively with others.
9. **Responsibility:** the ability to act independently and make decisions; morally accountable for one's action; capable of rational conduct.
10. **Environmental awareness:** being conscious of one's physical and socio-economic surroundings.
11. **Respect for the rule of law:** obeying the rules and regulations of the land.

The teacher should ensure that learners cultivate the above attitudes and skills as basis for living in the nation as effective citizens.

Values

At the heart of this curriculum is the belief in nurturing honest, creative and responsible citizens. As such, every part of this curriculum, including the related pedagogy, should be consistent with the following set of values.

Respect: This includes respect for the nation of Ghana, its institutions and laws and the culture and respect among its citizens and friends of Ghana.

Diversity: Ghana is a multicultural society in which every citizen enjoys fundamental rights and responsibilities. Learners must be taught to respect the views of all persons and to see national diversity as a powerful force for national development. The curriculum promotes social cohesion.

Equity: The socio-economic development across the country is uneven. Consequently, it is necessary to ensure an equitable distribution of resources based on the unique needs of learners and schools. Ghana's learners are from diverse backgrounds which require the provision of equal opportunities to all, and that, all strive to care for each other.

Commitment to achieving excellence: Learners must be taught to appreciate the opportunities provided through the curriculum and persist in doing their best in whatever field of endeavour as global citizens. The curriculum encourages innovativeness through creative and critical thinking and the use of contemporary technology.

Teamwork/Collaboration: Learners are encouraged to be committed to team-oriented working and learning environments. This also means that learners should have an attitude of tolerance to be able to live peacefully with all persons.

Truth and Integrity: The curriculum aims to develop learners into individuals who will consistently tell the truth irrespective of the consequences, be morally upright with the attitude of doing the right thing even when no one is watching. Also, be true to themselves and be willing to live the values of honesty and compassion. Equally important is the practice of positive values as part of the ethos or culture of the workplace, which includes integrity and perseverance. These values must underpin the learning processes to allow learners to apply skills and competencies in the world of work.

The action words provided in the learning indicators in each content standard, should help you to structure your teaching and learning to achieve the desired learning outcomes. Check the learning indicators to ensure that you have given the required emphasis to each learning domain in your instruction and assessment.

ASSESSMENT

Assessment is a process of collecting and evaluating information about learners and using the information to make decisions to improve their learning. Assessment may be formative, summative, diagnostic, or evaluative depending on its purpose. It is integral to the teaching-learning process, promotes learner-centred, learning and improves instruction. In CCP, it is suggested that assessment involves assessment for learning, assessment of learning and assessment as learning, which are described in the subsequent paragraphs.

Assessment for Learning (AfL)

Assessment for Learning (AfL) is the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learner is in their learning, where they need to be (the desired goal), and how best to get them there. AfL is one of the most suitable methods for improving learning and raising standards (Black & William, 1998). Assessment for Learning also refers to all the activities undertaken by teachers and/or by their learners, which provide information to be used as feedback to modify teaching and learning activities in which they are engaged. AfL can be achieved through processes such as sharing criteria with learners, effective questioning, and feedback.

AfL, therefore, provides timely feedback to ensure individual learners are assisted during the teaching and learning process using various strategies and questioning to measure the learning that has actually taken place. It is a continuous process that happens at all stages of the instructional process to monitor the progress of a learner and to offer feedback or change teaching strategies to achieve performance standards of a lesson.

Assessment as Learning (AaL)

Assessment as Learning develops and supports learners' sense of ownership and efficacy of their learning through reflective practices. This form of self-assessment helps in building the competencies of learners to achieve a deeper understanding of their own learning and what they are taught.

Assessment of Learning (AoL)

Assessment of learning provides a picture of the achieved standards of the teacher and the performance of learners at the terminal stage of the learning process. This information provides data for accountability and educational decisions such as grading, selection and placement, promotion and certification. Through AoL, stakeholders such as parents and guardians are informed about the extent learners have attained expected learning outcomes at the end of their grade or programme.

What do we assess?

- Emphasis in assessment in the CCP is on the Common Core Learner Attributes, which are essential outcomes in the three domains of learning (i.e. cognitive, psychomotor and affective).
- Knowledge and skills with emphasis on the 4Rs in the learning areas.
- Core competencies with an emphasis on attitudes and values developed through the learning and its context as well as the pedagogical approaches.

The process is illustrated diagrammatically in Figure 2.

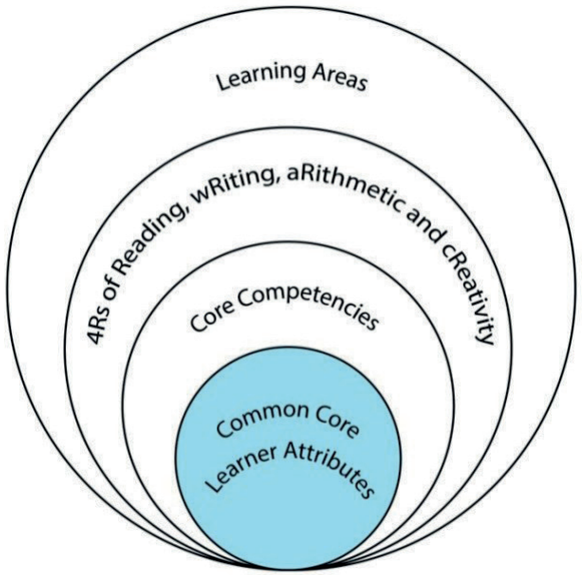


Figure 2. Essential Assessment Features

How do we monitor progress?

School Based Assessments (SBA) covers all forms/modes of assessment including AfL, AaL and AoL (see Table 1), that can be undertaken by any school-level actor (learner, teacher, headteacher) to monitor the learner's achievement over a period of time. Data collection and keeping records of the data are central to the conduct of SBA.

Table 1: Modes of Assessment

Assessment for Learning	Assessment of Learning	Assessment as Learning
Class exercises	Class Assessment Task (CAT)	Portfolio
Quizzes	End of term	Journal entries
Class tests (written, oral, aural and/or practical)	End of year	Project work
Class Assessment Task (CAT)		Checklist
		Questionnaire

The following are samples of relevant records that can be kept on the learner's progress:

- Student's Progress Record (Cumulative Record)
- Student's Report Card
- School Based Assessment Termly Recording Register

Details of guidelines on SBA can be found in the National Pre-tertiary Learning Assessment Framework (NPLAF) document (Ministry of Education, 2020a) and the School-Based Assessment Guidelines (Ministry of Education, 2020b).

Reporting School-Based Assessment (SBA) in the CCP

The CCP uses a criterion-referenced model of presenting and reporting school-based assessment data. School-based assessment throughout the four-year duration of CCP is done against criteria linked to performance standards and not against the work of other learners. The CCP provides

levels of proficiency to be attained, and descriptors for all grade levels of the programme (see Table 2). These levels and descriptors cannot be changed by individual schools and are, therefore, common to all learners as well as learning areas nationwide. For each assessment criterion or (benchmark for the level of proficiency), a number of descriptors are defined as shown in Table 2.

Table 2: Benchmarks, levels of proficiency and the grade level descriptors

Level of Proficiency	Benchmark	Grade Level Descriptor
1: Highly Proficient (HP)	80% +	Learner shows high level of proficiency in knowledge, skills and values and can transfer them automatically and flexibly through authentic performance tasks.
2: Proficient (P)	68-79%	Learner demonstrates sufficient level of proficient knowledge, skills and core understanding; can transfer them independently through authentic performance tasks
3: Approaching Proficiency (AP)	54-67%	Learner is approaching proficiency in terms of knowledge, skills and values with little guidance and can transfer understanding through authentic performance tasks
4: Developing (D)	40-53%	Learner demonstrates developing level of knowledge, skills and values but needs help throughout the performance of authentic tasks
5: Emerging (E)	39% and below	Learner is emerging with minimal understanding in terms of knowledge, skills, and values but needs a lot of help.

Reporting School-Based Assessment (SBA) in the CCP

The grading system presented, shows the letter grade system and equivalent grade boundaries. In assigning grades to learners' test results, or any form of evaluation, the above grade boundaries and the descriptors may be applied. The descriptors (Highly Proficient [HP], Proficient [P], Approaching Proficiency [AP], Developing [D], Emerging [E]), indicate the meaning of each grade.

In addition to the school-based assessment (SBA), a national standards assessment test is conducted in Basic 8 to provide national-level indicators on learners' achievement.

CREATIVE PEDAGOGICAL APPROACHES

The CCP emphasises creative and inclusive pedagogies that are anchored on authentic and enquiry-based learning, collaborative and cooperative learning, differentiated learning, holistic learning, cross-disciplinary learning (i.e. the 4Rs across the Curriculum) as well as developing the core competencies. This section describes some of the creative pedagogical approaches required for the CCP.

The creative pedagogical approaches include approaches, methods and strategies for ensuring that every learner benefits from appropriate and relevant teaching and learning episodes which are timely assessed, and feedback provided to the learner and other stakeholders such as parents and education authorities. This includes the type and use of appropriate and relevant teaching and learning resources to ensure that all learners achieve the expected level of learning outcomes.

The curriculum emphasises:

- the creation of learning-centred classrooms through the use of creative approaches to teaching and learning as strategies to ensuring learner empowerment and independent learning.
- the positioning of inclusion and equity at the centre of quality teaching and learning.
- the use of differentiation and scaffolding as teaching and learning strategies for ensuring that no learner is left behind
- the use of Information Communications Technology (ICT) as a pedagogical tool
- the identification of subject specific instructional expectations needed for making learning in the subject relevant to learners
- the integration of assessment for learning, as learning and of learning into the teaching and learning process and as an accountability strategy
- the use questioning techniques that promote deeper learning

Learning-Centred Pedagogy

The learner is at the centre of learning. At the heart of the curriculum is learning progression and improvement of learning outcomes for Ghana's young people with a focus on the 4Rs – Reading, wRiting, aRithmetic and cReativity. It is expected that at each curriculum phase, learners would be offered the essential learning experiences to progress seamlessly to the next phase. Where there are indications that a learner is not sufficiently ready for the next phase, a compensatory provision through differentiation should be provided to ensure that such a learner is ready to progress with their peers. At the high school, the progression phases are B7-B9, and B10–B12

The curriculum encourages the creation of a learning-centred classroom with the opportunity for learners to engage in meaningful "hands-on" activities that bring home what they are learning in school and what they know from outside of school. A learning-centred classroom is a place for learners to discuss ideas and through the inspiration of the teacher actively engage in looking for answers working in groups to solve problems. This also includes researching for information and analysing and evaluating the information obtained. The learning-centred classroom approach aims to develop learner autonomy so that learners can take ownership of their learning. It provides the opportunity for deep and profound learning to take place.

The teacher should create a learning atmosphere that ensures:

- Learners feel safe and accepted.
- Learners are given frequent opportunities to interact with varied sources of information, teaching and learning materials and ideas in a variety of ways.
- The teacher assumes the position of a facilitator or coach who helps learners to identify a problem suitable for investigation via project work.
- Problems are connected to the context of the learners' world to offer authentic opportunities for learning.

- Subject matter discussed focuses on the problem, not the discipline plan to solve the problem in question.
- Learners responsibly define their learning experience and draw up a plan to solve the problem in question
- Learners collaborate whilst learning.
- Learners demonstrate the results of their learning through a product or performance.

It is more productive for learners to find answers to their questions rather than for teachers to provide the answers and their opinions in a learning-centred classroom.

Inclusion

Inclusion entails access and learning for all learners especially those disadvantaged. All learners are entitled to a broad and balanced curriculum in every school in Ghana. The daily learning activities to which learners are exposed should ensure that the learners' right to equal access to quality education is being met. The curriculum suggests a variety of approaches that address learners' diversity and their special needs in the learning process. These approaches, when used in lessons, will contribute to the full development of the learning potential of every learner. Learners have individual needs and different learning styles, learning experiences and different levels of motivation for learning. Planning, delivery and reflection on daily learning episodes should consider these differences.

The curriculum therefore promotes:

- learning that is linked to the learners' backgrounds and their prior experiences, interests, potential and capacities;
- learning that is meaningful because it aligns with learners' abilities (e.g. learning that is oriented towards developing general capabilities and solving the practical problems of everyday life); and
- the active involvement of the learners in the selection and organisation of learning experiences, making them aware of their importance in the process and also enabling them to assess their learning outcomes.

Differentiation

This curriculum is to be delivered through the use of creative approaches.

Differentiation and Scaffolding are pedagogical approaches to be used within the context of the creative approaches.

Differentiation is a process by which differences among learners (learning styles, interest and readiness to learn etc.) are accommodated so that all learners in a group have the best possible chance of learning. Differentiation could be by task, support and outcome. Differentiation ensures that learners benefit adequately from the curriculum through:

- Task
- One-on-one support
- Outcome
    - ***Differentiation by task*** involves teachers setting different tasks for learners for different ability e.g. in sketching the plan and shape of their classroom some learners could sketch with freehand while others trace the outline plan of the classroom.
    - ***Differentiation by support*** involves the teacher providing targeted support to learners who perform below the expected standards or are at risk of not reaching the level of learning outcome expected. This support may include a referral to a guidance and counselling officer for academic support.
    - ***Differentiation by outcome*** involves the teacher allowing learners to respond at different levels. In this case, identified learners are allowed more time to complete a given task.

Scaffolding

Scaffolding in education refers to the use of a variety of instructional techniques aimed at moving learners progressively towards a deeper understanding and ultimately greater independence in the learning process.

It involves breaking up the learning episode, experience or concepts into smaller parts and then providing learners with the support they need to learn each part. The process may require a teacher assigning an excerpt of a longer text to learners to read, engaging them to discuss the excerpt to improve comprehension of its rationale, and guiding them through the keywords/ vocabulary to ensure learners have developed a thorough understanding of the text before engaging them to read the full text. Common scaffolding strategies available to the teacher include:

- giving learners a simplified version of a lesson, assignment, or reading, and then gradually increasing the complexity, difficulty, or sophistication over time;
- describing or illustrating a concept, problem, or process in multiple ways to ensure understanding;
- giving learners an exemplar or model of an assignment, they will be asked to complete;
- giving learners a vocabulary lesson before they read a difficult text;
- clearly describing the purpose of a learning activity, the directions learners need to follow, and the learning goals they are expected to achieve;
- explicitly describing how the new lesson builds on the knowledge and skills learners were taught in a previous lesson.

Information Communication Technology (ICT)

ICT has been integrated into this curriculum as a teaching and learning tool to enhance deep and independent learning. Some of the expected outcomes that this curriculum aims to achieve through ICT use for teaching and learning are:

- Improved teaching and learning processes.
- Improved consistency and quality of teaching and learning.
- Increased opportunities for more learner-centred pedagogical approaches
- Improved inclusive education practices by addressing inequalities in gender, language, ability.
- Improved collaboration, creativity, higher order thinking skills.
- Enhanced flexibility and differentiated approach of delivery.

The use of ICT as a teaching and learning tool helps to provide learners access to a wide variety of information online. It also provides the framework for analysing data to investigate patterns and relationships in a geographical context. Once learners have made their findings, ICT can then help them organise, edit and present information in many different ways.

Learners need to be exposed to the various ICT tools around them including calculators, radios, cameras, phones, television sets and computer and related software like Microsoft Office packages – Word, PowerPoint and Excel, as teaching and learning tools. Thus, exposure to ICT use in exploring learning will build their confidence and increase their levels of motivation to apply ICT in later years, both within and outside of education. ICT use for teaching and learning is expected to enhance the quality and learners' level of competency in the 4Rs.

CORE COMPETENCIES

In using this curriculum, we hope that certain core competencies will be developed in learners to help them develop our country, Ghana. These competencies include:

Critical Thinking and Problem Solving (CP)

This competency helps in developing learners' cognitive and reasoning abilities to enable them to analyse issues and situations leading to the resolution of problems. This skill helps learners to draw on and demonstrate what they have learned, and from their own experiences, analyse situations and choose the most appropriate out of several possible solutions. It requires that learners embrace the problem at hand, persevere and take responsibility for their learning.

In studying mathematics, assessing evidence and interpreting these sources are particularly important in developing critical thinking and problem-solving skills.

Creativity and Innovation (CI)

This competency promotes in learners, entrepreneurial skills through their ability to think of new ways of solving problems and developing technologies for addressing barriers at hand. It requires the ingenuity of ideas, arts, technology and enterprise. Learners who possess this competency can think independently and creatively as well.

Communication and Collaboration (CC)

This competency promotes in learners, skills in making use of language, symbols and texts to exchange information about themselves and their life experiences. Learners actively participate in sharing their ideas, engage in dialogue with others by listening to and learning from them in ways that respect and value the multiple perspectives of all persons involved.

Cultural Identity and Global Citizenship (CG)

This competency develops learners who put country and service foremost through an understanding of what it means to be active citizens by inculcating in them, a strong sense of social and economic awareness. Learners make use of the knowledge, skills, and attitudes acquired to contribute effectively towards the socio-economic development of the country and on the global stage. They build skills to critically analyse cultural and global trends, identify and contribute to the global community.

Personal Development and Leadership (PL)

This competency improves self-awareness, self-knowledge and skills, builds and renews self-esteem, while identifying and developing talents, fulfilling dreams and aspirations. They learn from the mistakes and failures of the past and develop other people or meet other people's needs. It involves recognising the importance of values such as honesty and empathy, seeking the well-being of others, distinguishing between right and wrong, fostering perseverance, resilience and self-confidence; exploring leadership, self-regulation and responsibility and developing a love for lifelong learning.

Digital Literacy (DL)

This competency helps learners to discover, acquire and communicate through ICT to support their learning and to make use of digital media responsibly.

INSTRUCTIONAL EXPECTATIONS

The following are the major roles the teacher is expected to play in the implementation of the curriculum:

1. Guide and facilitate learning by generating discourse among learners and challenging them to accept and share responsibility for their learning, based on their unique individual differences.
2. Select mathematics content, adapt and plan lessons to meet the interests, knowledge, understanding, abilities, and experiences of learners. It should be noted that in the standards-based curriculum, lessons are not expected to be limited to only specific objective(s) but should broadly cover the processes of learning for the learners to cumulatively engage in activities/experiences to demonstrate what they know and can do (i.e. the indicators) as well as develop such core competencies.
3. Work together as colleagues within and across disciplines and grade levels to develop communities of STEM learners who exhibit the STEM skills including mathematical inquiry, attitudes and social values conducive to mathematics learning.
4. Use multiple methods and systematically gather data about learners' understanding and abilities to guide mathematics teaching and learning, with arrangements to provide feedback to both learners and parents.
5. Design and manage learning environments that provide learners with the time, space, and resources needed for learning mathematics.
6. Aid learners to make sense of problems and persevere in solving them, including using higher order reasoning and problem-solving skills.
7. Get learners to think critically about tasks and their solutions by asking questions and challenging each other's views until a consensus is reached.
8. Encourage learners to present their own ideas in ways that make sense to others and critique each other's reasoning.
9. Enable learners to work together to represent real-life situation mathematics in multiple ways (e.g. oral, text, pictures, diagrams, equations, etc.).
10. Support learners to use appropriate technologies to solve problems embedded in their culture and the larger society.
11. Provide opportunities for learners to realise that it is necessary to be precise when sharing mathematical ideas. Also, allow them to support each other to improve on their precision.
12. Guide learners to look for and express patterns or regularity in repeated reasoning.
13. The remaining part of the document presents the details of the standards and indicators for each grade level.

STRUCTURE AND ORGANISATION OF THE CURRICULUM

The curriculum is organised under key headings and annotations.

Strands are the broad learning areas of the content to be studied.

Sub-strands are the sub-divisions of the broad learning areas or strands.

Content standards are the expected level of knowledge, skill and/or attitude that a learner must attain at each grade level.

Indicators are the distinct outcomes that learners must exhibit for each content standard at each level of learning.

Exemplars clearly explain the distinct outcomes or indicators. They support and guide the facilitator/teacher in helping learners to achieve the content standards.

A unique annotation is used to label the class, strands, sub-strands, content standards, learning indicators and exemplars in the curriculum for the purpose of easy referencing. The annotation is defined in Figure 3:

The Standards in mathematics are organised under the following four strands:

1. **Number**
2. **Algebra**
3. **Geometry and Measurement**
4. **Handling Data.**

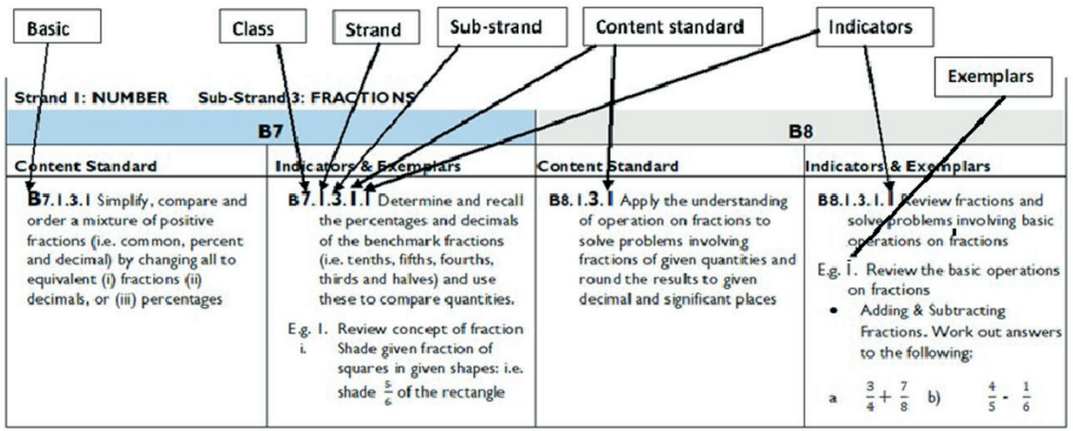


Figure 3

Table 3 shows Strands, sub-strands, Scope and Sequence of the B7 – B10

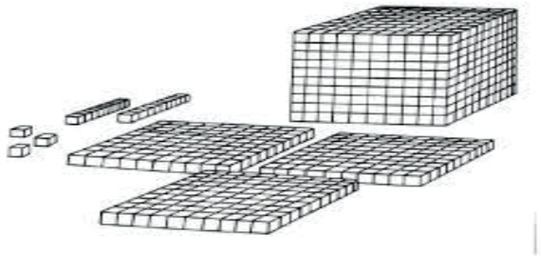
Table 3

S/N	STRAND	SUB-STRAND	CONTENT STANDARDS			
			B7	B8	B9	B10
1.	**Number**	Number and Numeration Systems	1	2	2	2
2.		Number Operations	3	3	3	3
3.		Fractions, Decimals and Percentages	3	1	1	1
4.		Ratios and Proportion	1	1	1	1
5.	**Algebra**	Pattern and Relationships	1	1	1	1
6.		Algebraic Expressions	1	1	1	1
7.		Variables and Equations	1	1	1	1
8.	**Geometry and Measurement**	Shapes and Space	2	2	1	2
9.		Measurement	2	2	2	2
10.		Position and Transformation	1	1	1	1
11.	**Handling Data**	Data	2	2	2	2
12.		Chance or Probability	1	1	1	1
13.		**Total**	19	18	17	17

BASIC 7

STRAND 1: NUMBER

SUB-STRAND 1: NUMBER AND NUMERATION SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.1.1 Demonstrate understanding and the use of place value for expressing quantities recorded as base ten numerals as well as rounding these to given decimal places and significant figures.	**B7.1.1.1.1 Model number quantities more than 1,000,000,000 using graph sheets, isometric papers and multi-base blocks** **E.g. 1.** Model number quantities up to 1,000,000,000 (one billion) using graph sheets or multi-base ten materials. For instance, with multi-base blocks one cube = 100,000, one rod = ten of the cubes (1,000,000) and a flat =10,000,000, and a block =100,000,000 as shown below.  i. Determine how many blocks will make a billion. **E.g. 2.** Use multiples of 10s, 50s, 100s and 200s to represent numbers in multiples of ways (make sure each figure is used) i. 5,560 = 20×200 + 10×100 +11×50 + 1×10; or = 15×200 + 20×100 +10×50 + 6×10; etc. **E.g. 3**. Use tokens (or paper-made currency notes) such as GH¢20, GH¢50, GH¢100 and GH¢200 to work out how many of each denomination would be required to model given amount up to one billion. i. Workout how many GH¢200 will make GH¢185, 000,000, GH¢1,890,750,000, etc. ii. Determine combinations of GH¢50, GH¢100 or GH¢200 notes that make GH¢1,000,000 (make sure each denomination is used);	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>B7.1.1.1.2 Compare and order whole numbers more than1,000,000,000 and represent the comparison using “>, <, or=”
E.g. 1.Skip count forwards and backwards in 25s, 50s and 250s beginning from 1000.
E.g. 2. Identify numbers which are for instance, 500,000 more than or less than a given 8-digit or 9-digit number.
i. 1,296,300,000 is 500,000 more than 1,295,800,000 and 1,295,300,000 is 500,000 less than 1,295,800,000
E.g. 3. Use phrases such as “is equal to”, “is greater than” and “is less than’ as well as their symbols such as “>”, “<” and “=” to compare any two numbers.
i 1,300,850,700 = 1,300,850,700
5,223,487,637 >5,113,487,637 etc.
E.g. 4. Identify, read and write numbers in given positions in a number chart.
<table><tr><td>187,500</td><td>687,500</td><td>1,187,500</td><td>1,687,500</td></tr><tr><td>2,187,500</td><td>2,687,500</td><td>3,187,500</td><td>3,687,500</td></tr><tr><td>4,187,500</td><td>4,687,500</td><td>5,187,500</td><td>5,687,500</td></tr></table>For instance, which number is on the right of 3,187,500? Write the number in words.</td><td>• Identify and analyse different points of views of speakers (CC7.5)
• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)</td></tr>
<tr><td></td><td>B7.1.1.1.3 Round (off, up, down) whole numbers more than 1,000,000,000 to the nearest hundred-thousand, ten-thousands, thousands, hundreds and tens
E.g. 1. Round off whole numbers up to over 1,000,000,000 to the nearest hundred-thousands, ten-thousands, thousands, hundreds, etc.
i. 1,879,653 is 1,900,000 to the nearest hundred thousand and 1,880,000 to the nearest ten thousand
E.g. 2. Explain the differences between the “round up” and “round down” concepts.
When rounding up, we consider the larger number, while when rounding down, we consider the smaller of the two. The table below may bring out the meaning of the concept.</td><td>Personal Development and Leadership (PL); Creativity and Innovation (CI)
• Ability to monitor team members to ascertain progress (PL6.5)</td></tr>
</table>

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>
<table>
<tr><th>2,846,655</th><th>Round up</th><th>Round down</th><th>Round off</th></tr>
<tr><td>To the nearest thousand</td><td>2,847,000</td><td>2,846,000</td><td>2,847,000</td></tr>
<tr><td>To the nearest ten thousand</td><td>2,850,000</td><td>2,840,000</td><td>2,850,000</td></tr>
<tr><td>To the nearest hundred thousand</td><td>2,900,000</td><td>2,800,000</td><td>2,800,000</td></tr>
</table>
E.g. 3. Express whole numbers to significant figures (i) 857,386,321
• five significant figures (5sf)
• four significant figures (4sf)
• three significant figures, (3sf) etc.
</td><td>• Reflect on work and explore the thinking behind thoughts and processes (CI6.10).</td></tr>
<tr><td></td><td>
B7.1.1.1.4 Round decimals to the nearest tenth, hundredth, thousandths, etc.
E.g. 1 Round (off, up and down) decimals to the nearest tenths, hundredths, thousandths…….
i. Round 486.3685 as indicated in the table below
<table>
<tr><td>Number</td><td>Round to the nearest tenths</td><td>Round to the nearest hundredths</td><td>Round to the nearest thousandths</td></tr>
<tr><td>486.3685</td><td>486.4</td><td>486.37</td><td>486.369</td></tr>
<tr><td>0.0605368</td><td>0.1</td><td>0.06</td><td>0.061</td></tr>
<tr><td>78.4604783</td><td>Round up</td><td>Round off</td><td>Round down</td></tr>
<tr><td>nearest tenths</td><td>78.5</td><td>78.5</td><td>78.4</td></tr>
<tr><td>nearest hundredths</td><td>78.47</td><td>78.46</td><td>78.46</td></tr>
<tr><td>nearest thousandths</td><td>78.461</td><td>78.460</td><td>78.460</td></tr>
</table>
</td><td>• Implement strategies with accuracy (CP6.7).</td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.1.1.5 Express decimal numerals to given significant and decimal places **E.g. 1** Explain when zero (0) is significant in a decimal numeral i. 0.360 (3sf) ii. 7.021 (4sf) **E.g. 2.** Round the following numbers to the given significant figures: 0.00234567 and 84.40995000 to i. 3sf ii. 4sf iii. 6sf	• Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1).**
	E.g. 3. Express decimal numbers to a given number of decimal places i. 745.9674 correct to - three decimal places - two decimal places - one decimal place ii. Musa measured the length of his teacher's table and corrected his measurement to 2 decimal places as 0.76m. State the possible actual readings Musa might have obtained. iii. Investigate similar problems on significant figures.	• Preparedness to make better decisions using information **(DL5.6).**

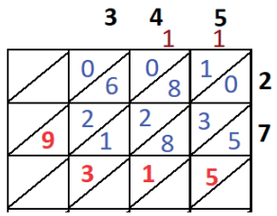
STRAND 1: NUMBER

SUB-STRAND 2: NUMBER OPERATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.2.1 Apply mental mathematics strategies and number properties used to solve problems	**B7.1.2.1.1 Multiply and divide given numbers by powers of 10 including decimals and benchmark fractions** **E.g. 1**. Recall multiplication facts up to 144 and related division facts. **E.g. 2.** Recall decimal names of given benchmark fractions converted to decimals or percentages (and vice versa) **E.g. 3.** Find the product of a given decimal number when it is multiplied by 10, 100, 1000, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ etc. i. 105.25×1000 ii. $105.25 \times \frac{1}{100}$	**Creativity and Innovation (CI)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**
	B7.1.2.1.2 Apply mental mathematics strategies and number properties used to perform calculations. **E.g. 1.** Apply the halving and doubling techniques to determine the product of two given numbers. i. 28×5, think $14 \times 10 = 140$ ii. 125×4, think $(125 \times 2) \times 2 = 250 \times 2 = 500$ **E.g. 2.** Apply the distributive property to determine the product of two given numbers i. 7×15, think $7 \times (10 + 5) = 70 + 35 = 105$ ii. 18×6, think $(20 - 2) \times 6 = (20 \times 6) - (6 \times 2) = 120 - 12 = 108$	**Creativity and Innovation (CI)** • Ability to merge simple/ complex ideas to create novel situations or things**(CI5.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.2.1.3 Apply mental mathematics strategies to solve word problems. **E.g. 1.** Play mental mathematics games: - learners use mental strategies to perform the following; i. addition using words like plus, add, calculate the sum, increase a number by, and find the total; ii. subtraction using words like minus, take away, find the difference of, and what must be added to make; iii. multiplication using words like times, multiply, find the product, square, and what must be divided by … to give …; iv. division using words like divide, share, how many times does it go into? and what must be multiplied by … to give … **E.g. 2.** Play mental mathematics games: Find the cost of three 5 kg bags of rice at ¢2.00 per kg. i. What is the cost of 1 dozen of eggs at 80 pesewas each? ii. 8 × 99. iii. 28 × 25. iv. How many 21cm pieces can I cut off a string one metre long? v. What fraction of a litre is 250ml? vi. The area of a square board is 81 cm^2. What is its perimeter? vii. Two angles of a triangle add up to 98°. What is the size of the third angle? viii. How many minutes are there from 10.15 a.m. to noon? ix. What is 60 pesewas as a decimal of ¢2.40?	**Creativity and Innovation (CI);Critical thinking and problem solving (CP)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)** • Ability to merge simple/ complex ideas to create novel situations or things **(CI5.2)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to try new alternatives and different approaches **(CI5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.7.1.2.2 Demonstrate an understanding of addition, subtraction, multiplication and division of (i) whole numbers, and (ii) decimal numbers, to solve problems.	**B7.1.2.2.1 Add and subtract up to four-digit numbers.** **E.g. 1**. Use partitioning (or expanded form) and place value system to add and subtract whole and decimal numbers. i) Add 785 and 9,342 785 = 700 + 80 + 5 + 9,342 = 9000 + 300 + 40 + 2 10,127 = 9000 +1000 +120 +7 ii) Add 327.6 and 54.13 $327.60 = 300 + 20 + 7 + \frac{6}{10} + \frac{5}{100}$ $+ 54.13 = 50 + 4 + \frac{1}{10} + \frac{3}{100}$ $381.73 = 300 + 70 + 11 + \frac{7}{10} + \frac{3}{100}$ iii) Subtract 7.85 from 93.6 $93.60 = 90 + 3 + \frac{6}{10} + \frac{5}{100}$ $- 7.85 = 7 + \frac{8}{10} + \frac{5}{100}$ $85.75 = 80 + 5 + \frac{75}{100}$	**Critical thinking and problem solving (CP)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.**1) • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B71.2.2.2 Multiply or divide multi-digit numbers by 1- and 2- digit numbers **E.g. 1** Use partitioning/expanded form to multiply and divide efficiently i) Multiply 584 by 8 584 = (500 + 80 + 4) × 8 = × 8 4,000 + 640 + 32 4,672 = 4,672 **E.g. 2.** Multiply whole numbers using the vertical place value method or lattice method: i. Place value method: 345 × 27 = 345 × 27 2,415 + 6,900 9,315 Lattice method: Draw a 2 by 3 lattice for solving 345 × 27.  **E.g. 3** Use the distributive property to multiply 325 by 15. = 325 × (10 + 5) = (325 × 10) + (325 × 5) = 3,250 + 1,625 = 4,875	**Critical thinking and problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4 Investigate and determine basic division facts including divisibility test. i) determine how a given number is divisible by 2,3, 4, 5, 6, 7 8, 9,10, etc. For example, a number is divisible by 3 if the sum of its digits is divisible by 3. So, 72 is divisible by 3 because 7+2 = 9. Hence since 9 is divisible by 3, then 72 is divisible by 3. Also, to find out if a number is divisible by 7, take the last digit in the number then double it and subtract from the rest of the number. If the answer is 0 or a multiple of 7, then the number is divisible by 7. So, 595 is divisible by 7 because 5 × 2 =10 and 59 – 10 = 49. Therefore, 595 is divisible by 7.	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**
	B7.1.2.2.3. Create and solve story problems involving decimals on the four basic operations. **E.g. 1**. Solve word problems. i) A group of two hundred and fifteen men and seven hundred and eighty-four women went to watch a concert. An amount of GH¢25.00 was collected at the gate from each person. How much money was collected altogether? ii) Mrs Adamu bought 13.6kg of meat. Mrs Anderson bought 2.4kg of meat less than Mrs Adamu. How many kilogrammes of meat did they buy all together? iii) Ebo weighs 28.6kg. His father weighs four times as heavy. What is the total weight of Ebo and his father? iv) Mrs Armah bought 45.75 metres of linen for her five children. If they share the material equally, how many metres of linen did each receive?	**Critical thinking and problem solving (CP); Personal Development and Leadership(PL)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)** • Ability to serve group members effectively **(PL6.1)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>

E.g. 2 Solve word problems on data presented in a table

i) In preparation towards an open day anniversary, a school's Management Committee approved the following budget on some projects.

Activity	Cost (GH¢)
Painting school building	4,580
Mending cracks on the basketball pitch	3,050
Restock the library with new books	2,690
Buying of choir robes	5,340
Buying prizes for awards	4,270

(a) How much was approved for painting the school building and buying choir robes?

(b) How much more was to be spent on mending the cracks on the basketball pitch than restocking the library with new books?

(c) How much was spent on buying prizes for awards if twice the amount approved was spent on this activity?

</td><td></td></tr>
<tr><td rowspan="2">B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving problems.</td><td rowspan="2">

B7.1.2.3.1 Illustrate with examples the meaning of repeated factors using counting objects such as bottle tops or bundle sticks.

E.g. 1 Model repeated factors using counters or bottle tops.

i. **3 × 3 × 3, is repeated factors, and each factor is 3.**

E.g. 2 Explain what is meant by a power of a number.

i. $2 \times 2 \times 2 \times 2 \times 2 = 2^5 = 32$

E.g. 3 Explain the features of the power 2^3

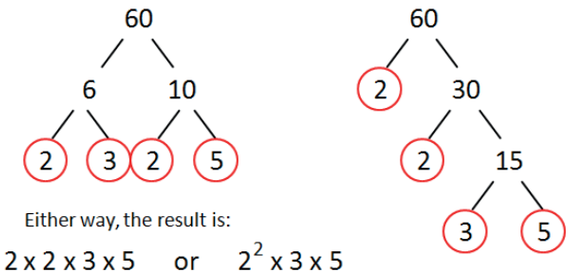
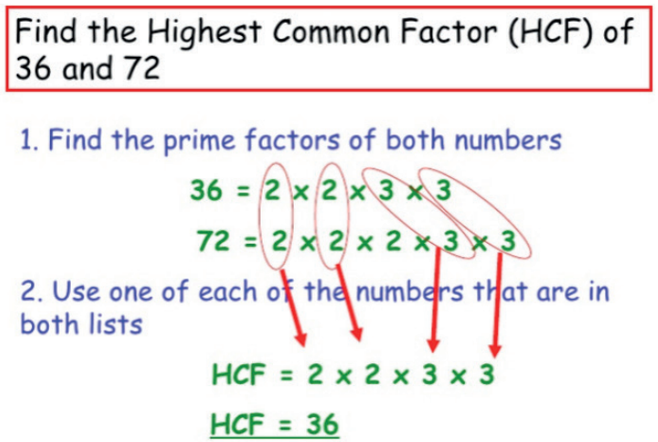
The 2 in 2^3 is the base, while the 3 in 2^3 is the exponent or index

</td><td>Creativity and Innovation (CI); Critical thinking and Problem Solving (CP)</td></tr>
<tr><td>

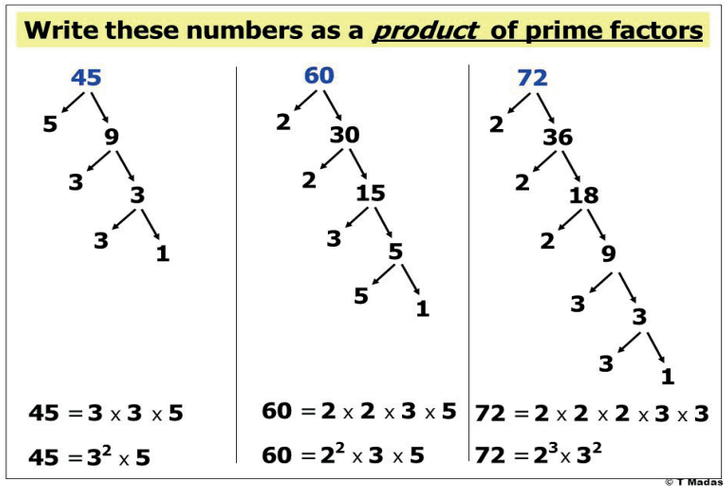
- Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**
- Ability to visualise alternatives, see possibilities, and identify problems and challenges **(CI5.4)**

</td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.2.3.2 Express a given number as a product of a given number or numbers, as well as, in the form of a power or two such numbers as product of powers **E.g. 1** **i.** $32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5$ **ii.** $81 = 3 \times 3 \times 3 \times 3 = 3^4$ **iii.** $49 = 7 \times 7 = 7^2$ **iv.** $16 \times 27 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 = 2^4 \times 3^3$	• Identify important and appropriate alternatives **(CP6.3)**
	B7.1.2.3.3 Show that the value of any natural number with zero as its exponent or index is 1 and use it to solve problems. **E.g. 1** Verify why the value of any natural number with exponent zero is 1. Verification: $\frac{x}{x} = 1$, but from indices, $\frac{x}{x} = x^\circ$, hence for any natural number Thus: if we have $\frac{4}{4}$, the result is 1. This can also be done using powers of numbers. That is, $\frac{4}{4} = 2^2 \div 2^2 = 2^{2-2} = 2^0 = 1$. Therefore, any natural number with an exponent of 0 is 1. Also, if we have $\frac{27}{27}$ the result is 1. This can also be done using powers of numbers. That is, $\frac{27}{27} = 3^{3\div3} = 3^{3-3} = 3^0 = 1$ Therefore, any natural number with an exponent of 0 is 1.	**Creativity and Innovation (CI)** • Look and think about things differently and from different perspectives **(CI6.7)**
	B7.1.2.3.4 Find the value of a number written in index form. **E.g. 1** **i.** $5^3 = 5 \times 5 \times 5 = 25 \times 5 = 125$ **ii.** $3^4 = 3 \times 3 \times 3 \times 3 = 9 \times 9 = 81$ **iii.** $6^3 = 6 \times 6 \times 6 = 36 \times 6 = 216$ **iv.** $\frac{1}{2^5} = \frac{1}{2 \times 2 \times 2 \times 2 \times 2} = \frac{1}{32}$	Interpret and apply learning in new contexts **(CI6.9)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.2.3.5 Apply the concept of powers of numbers (product of prime) to find Highest Common Factor (HCF). **E.g. 1** Expand a given number using product of prime concept.  Either way, the result is: $2 \times 2 \times 3 \times 5$ or $2^2 \times 3 \times 5$  	**Creativity and Innovation (CI)** • Interpret and apply learning in new contexts **(CI6.9)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Find the HCF using prime factorisation	

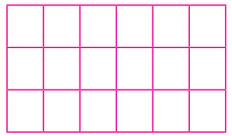


So the highest common factor for 36 and 72 = 36

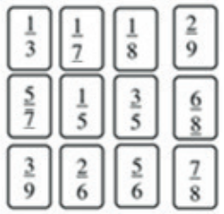
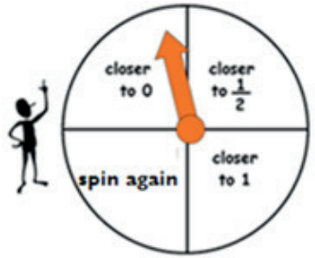
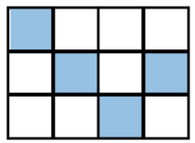
So the highest common factor for 45, 60 and 72 = 3

STRAND 1: NUMBER

SUB-STRAND 3: FRACTIONS, DECIMALS AND PERCENTAGES

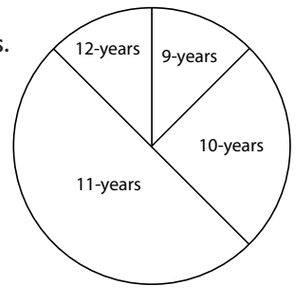
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages	**B7.1.3.1.1 Determine and recall the percentages and decimals of given benchmark fractions (i.e. tenths, fifths, fourths, thirds and halves) and use these to compare quantities.**  **E.g. 1.** Review the concept of fractions. i. Shade given fraction of squares in given shapes: i.e. shade $\frac{5}{6}$ of the rectangle. ii. Write down 3 fractions equivalent to $\frac{2}{3}$ iii. Express the fraction in its simplest form: $\frac{6}{10} = \frac{3}{5}$ iv. Convert to mixed numbers: $\frac{12}{5}$ v. Convert to improper fractions: $2\frac{5}{9}$ **E.g. 2.** Work out common, and decimal fractions and percent equivalences of given benchmark fractions to complete a table.	**Critical thinking and Problem Solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

Common	$\frac{1}{10}$	**A**	$\frac{1}{4}$	$\frac{1}{3}$	**B**	**C**	$\frac{2}{3}$
Percent	10%	20%	**D**	**E**	50%	**F**	**G**
Decimal	0.1	**H**	**I**	**J**	**K**	0.4	**L**

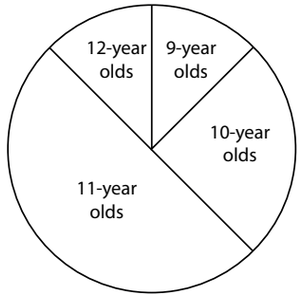
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Identifying fractions which are (i) closer to half; (ii) closer to one; and (iii) closer to zero in games with fraction cards and fraction wheel. Spin the fraction wheel and pick the right fraction to win a fraction card. [**Note:** cards picked should not be replaced].   **E.g. 4.** Simplify, compare and order common fractions. i. Determine the fraction which is the simplest form of a given set of fractions. Example, what is the simplest form of the fraction represented by the diagram below?  , $\frac{4}{10}, \frac{4}{12}, \frac{7}{8}, \frac{1}{3}$ and $\frac{1}{4}$, ii. Which symbol (<, = or >) makes the sentence "$\frac{3}{5} \ldots \frac{2}{3}$" true? iii. Find which fraction is greater: $\frac{7}{12}$ and $\frac{8}{10}$,	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.3.1.2 Compare and order fractions (i.e. common, percent and decimal fractions up to thousandths) limit to the benchmark fractions. **E.g. 1.** Arrange in descending order, the following fractions $\frac{5}{6}, \frac{3}{4}$ and $\frac{7}{8}$. **E.g. 2.** Find which decimal fractions is greater: 0.99 is greater than 0.977 **E.g. 3.** Order the decimal numbers 0.098, 0.985 and0.123 from least to greatest. **E.g. 4.** Compare and order common and decimal fractions and percent, and express them in one form (i.e. either common, decimal or percent). For instance, to order 0.832, $\frac{3}{8}$ and 38% from least to largest; we have $0.832 = \frac{832}{1000} = 83.2\%$, $\rightarrow \frac{375}{1000} = = 37.5\%$, $38\% = \frac{38}{100} = 0.38\%$, Hence the order from least to the largest is, $\frac{3}{8}$ 38% and 0.832.	**Communication and Collaboration(CC); Critical thinking and problem solving (CP)** • Ability to work with all group members to complete a task successfully **(CC9.6)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems	**B7.1.3.2.1 Explain the process of addition and subtraction of two or three unlike and mixed fractions.** **E.g. 1.** To add mixed fractions, i.e. $2\frac{2}{5}$ and ,$1\frac{2}{3}$ we first add the whole numbers and then add the fractions; i.e. $2 + 1 + \frac{2}{5} + \frac{2}{3} = 3 + \frac{6}{15} + \frac{10}{15} = 3\frac{6+10}{15} = 3\frac{16}{15} = 4\frac{1}{15}$ **E.g. 2.** To subtract mixed fractions, i.e. $-2\frac{4}{5} - 1\frac{2}{3}$, we first subtract the whole numbers and then subtract the fractions; i.e. $(2 - 1) + \frac{4}{5} - \frac{2}{3} = 1\frac{12-10}{15} = 1\frac{2}{15}$ Alternatively, we may change the mixed fractions to improper fractions first.	**Communication and Collaboration(CC); Critical thinking and problem solving (CP)** • Understand and use interpersonal skills**(CC9.2)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.1.3.2.2 Solve problems involving addition or subtraction of fractions.	**Critical thinking and problem solving (CP); Digital Literacy**
	E.g. 1. Solve word problems involving addition or subtraction of fractions. i. $3\frac{1}{3}$ feet are cut off a board that is $12\frac{1}{4}$ feet long. How long is the remaining part of the board? ii. The Musa family decided to hike to a waterfall, approximately $8\frac{5}{8}$ kilometres away. After an hour the lake was still $5\frac{1}{3}$ kilometres away. How far did the group hike so far? iii. If you add 2 fractions and the sum is greater than ½, what can you say about the fractions.	• Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)**
B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems	**B7.1.3.3.1 Explain the process of multiplying a fraction (i.e. common, percent and decimal fractions up to thousandths) by a whole number and by a fraction.** **E.g. 1.** To multiply a whole number by a fraction, the multiplication is read as 'times'. For instance, $3 \times 2\frac{2}{3}$ means 3 times $3\frac{2}{3}$ or 3 groups of $2\frac{2}{3}$ i.e. $3 \times (2 + \frac{2}{3})$ or $3 \times \frac{8}{3}$. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results. Find (i). $15 \times \frac{2}{3}$. (ii). $12 \times \frac{3}{8}$. **E.g. 2.** To multiply a fraction by a whole number, the multiplication is read as 'of'. for instance, $\frac{2}{3} \times 5$ means $\frac{2}{3}$ of 5 or i.e. $\frac{2}{3} \# \frac{5}{1} = \frac{2 \# 5}{3 \# 1} = \frac{10}{3} = 3\frac{1}{3}$. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results. [Note: (ii) and (iii) can be alternated] Find (i). $\frac{2}{3} \times 240$ (ii). $\frac{3}{8} \times 480$	**Critical thinking and problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Calculate the following (when necessary, round your answer to the nearest tenth): a. 28% of 40 b. 234% of 8 c. 3½ % of 50 d. 0.2% of 15000 e. 8.25% of 62 **E.g. 4.** To multiply a fraction by a fraction, the multiplication is read as 'of'. For instance, $\frac{2}{3} \times \frac{1}{2}$ means $\frac{2}{3}$ of $\frac{1}{2}$ or i.e. $\frac{2}{3} \times \frac{1}{2} = \frac{2}{6} = \frac{1}{3}$. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results. [Note: (ii) and (iii) can be alternated] Find i). $\frac{2}{3} \times \frac{3}{5}$ ii). $\frac{3}{8} \times \frac{5}{6}$	
	B7.1.3.3.2 Find a fraction of given quantity (i.e. money or given quantity of objects) **E.g. 1.** To multiply a given quantity by a fraction is just like multiplying by a whole number, so the multiplication is read as 'of'. For instance, $\frac{2}{3} \times$ GH¢60 means $\frac{2}{3}$ of GH¢60 i.e. $\frac{2}{3} \times \frac{60}{1} = \frac{2 \times 60}{3 \times 1}$ = GH¢40. **E.g. 2.** There are 132 learners in a class. If $\frac{2}{3}$ of the learners are girls, how many boys are in the class? **E.g. 3.** The graph shows the ages of learners in a Primary 5 class. i) Approximately, what fraction of the learners are 10 years old? ii) How many learners are 11 years old if there are 32 learners in the class?  	**Critical thinking and problem solving (CP);** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
$\frac{5}{8} \div \frac{1}{2}$ $\frac{1}{4} \div 3 \rightarrow (\frac{1}{3} \times \frac{1}{4}) \div 3 \times \frac{1}{3} = \frac{1}{12}$	**B7.1.3.3.3 Explain the process of dividing a fraction (i.e. common, percent and decimal fractions up to thousandths) by a 1-digit whole number and by a fraction.** **E.g. 1.** To divide a whole number by a fraction, the division means 'how many times the fraction goes into the whole number' or the product of the fraction and which number makes 3? For instance, $3 \div \frac{1}{4}$ means how many $\frac{1}{4}$s can be obtained in 3, or $3 = \frac{1}{4} \times$ *What?* The quotient can be obtained by multiplying both dividend by divisor the reciprocal of the divisor. For $3 \div \frac{1}{4}$, the reciprocal of the divisor is $\frac{4}{1}$, hence $3 \div \frac{1}{4} \rightarrow (3 \times \frac{4}{1}) \div (\frac{1}{4} \times \frac{4}{1}) = 12$, and for $\frac{1}{4} \div 3$, the reciprocal of the divisor is $\frac{1}{3}$, hence $\frac{1}{4} \div 3 \rightarrow (\frac{1}{3} \times \frac{1}{4}) \div 3 \times \frac{1}{3} = \frac{1}{12}$ Divide: i). $5 \div 1\frac{2}{3}$ ii). $\frac{5}{8} \div \frac{1}{2}$	**Critical thinking and problem solving (CP)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)** • Ability to explain plans for attaining goals **(CP6.2)**
	B7.1.3.3.4 Determine the result of dividing a quantity (i.e. money or objects) or a fraction by a fraction **E.g. 1.** A set of stacked plates for serving snacks at a party weighs 10 kg. If each plate in the stack weighs $\frac{1}{4}$ kg, how many plates are in the stack? To divide by a fraction, multiply both dividend by divisor the reciprocal of the divisor, hence $10 \div \frac{1}{4} \rightarrow (10 \times \frac{4}{1}) \div (\frac{1}{4} \times \frac{4}{1}) = 40$ $(10 \times \frac{4}{1}) \div (1) = (10 \times \frac{4}{1}) = 40$	**Critical thinking and problem solving (CP)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. A class was given litres of fruit juice to share equally. If there are 38 learners in the class, how many millilitres of fruit juice will each student get? **E.g. 3.** The graph shows the ages of learners in a Primary 5 class. How many learners are in the class if there are twelve 10-year-old learners in the class?  	

STRAND 1: NUMBER

SUB-STRAND 4: NUMBER: RATIOS AND PROPORTION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.4.1 Demonstrate an understanding of the concept of ratios and its relationship to fractions and use it to solve problems that involve rates, ratios, and proportional reasoning	**B7.1.4.1.1 Find ratio and use ratio language to describe relationship between two quantities.** **E.g. 1.** Determine ratio of given quantities. i. There are 60 boys and 120 girls in a school. So the ratio of boys to girls in the school is $\frac{60}{120} = \frac{1}{2} = 1:2$) **E.g. 2** Express two quantities as a ratio. i. The ratio of wings to beaks in the bird house at the Kumasi Zoo is 2:1, because for every 2 wings there is 1 beak. **E.g. 3** Describe quantities with ratio language. i. The ratio of Musa to Alhasan's age is 1:2. If Alhasan is 50 years old and his son, Musa is 25 years old, we can say that • Alhasan is twice as old as his son. • Musa is half the age of his father.	**Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Can vary the level of detail and the language use when presenting to make it appropriate to the audience **(CC8.5)**
	B7.1.4.1.2 Use the concept of a unit rate associated with a ratio a:b with b ≠ 0, and use rate language in the context of a ratio relationship. **E.g. 1** Write given ratios as unit rate $\frac{a}{b}$. i. This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is $\frac{3}{4}$ cups of flour for each cup of sugar. ii. Aisha polishes 8 square yards of floor tiles every 7 minutes, so there are $\frac{8}{7}$ square yards per minute.	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>

E.g. 2 Work out rates and use them in solving problems.

i. If 2 litres of coca cola cost GH¢18.00, find the cost of (a) 1.5 litres (b) 3 litres (c) 7 litres

E.g. 3 Use tables/diagrams to explain the concept of rate that compares two different quantities measured in different units.

i. The table shows the weight and cost of meat at Salaga Market. If 3kg of meat costs GH¢ 60.00, use the information to complete the table.

<table>
<tr><td>Meat (kg)</td><td>2</td><td>3</td><td>5</td><td>12</td></tr>
<tr><td>Cost (GH¢)</td><td></td><td>60.00</td><td></td><td></td></tr>
</table>

</td><td></td></tr>
<tr><td></td><td>

B7.1.4.1.3 Make tables of equivalent ratios (written as common fractions) relating quantities that are proportional.

E.g. 1. Kafui, Adoley and Jantuah shared an amount of money in the ratio of their ages. Kafui is 36 years old, Adoley is 48years and Jantuah is 24years old. If Jantuah received GH¢24000.00, how much money did they share?

Solution

<table>
<tr><th>Names</th><th colspan="4">Equivalent Ratios</th></tr>
<tr><td>Kafui</td><td>36</td><td>18</td><td>9</td><td>3</td></tr>
<tr><td>Adoley</td><td>48</td><td>24</td><td>12</td><td>4</td></tr>
<tr><td>Jantuah</td><td>24</td><td>12</td><td>6</td><td>2</td></tr>
</table>

Hint: Any of these ratios can be used for the calculation.

$2 \rightarrow 24000$

$9 \rightarrow x$

$9 \times 24000 =$

$9 \times 12000 =$

$x = 108{,}000$, hence, the amount of money shared = GH¢108,000.00

</td><td>

Critical Thinking and Problem solving (CP)

- Ability to effectively define goals towards solving a problem **(CP6.1)**
- Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

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<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td rowspan="2"></td><td>B7.1.4.1.4 Use the proportional reasoning to find missing values in the tables, and plot pairs of values on the coordinate plane.

E.g. 2 Find the missing value marked x in a table of equivalent ratios.
<table><tr><td>3</td><td>10</td></tr><tr><td>6</td><td>x</td></tr><tr><td>9</td><td>30</td></tr><tr><td>y</td><td>40</td></tr></table>$\frac{x}{6} = \frac{10}{3}$ means the value of $x = \frac{10}{3} \times 6 = \frac{60}{3} = 20$</td><td>Critical Thinking and Problem solving (CP)

• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)</td></tr>
<tr><td>B7.1.4.1.5 Find a percent of a quantity as a rate per 100 (e.g. 30% of a quantity means times the quantity).

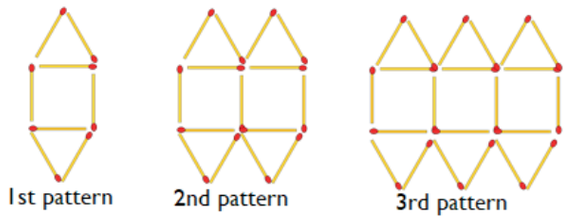
i. A salesman gets paid 35% commissions. How much commission does he make on sales of GH¢700.00?
ii. Yaw paid GH¢80.00 for a shirt that was on sale at a discount of 20%. What was the original price?
iii. A cell phone which regularly sells for GH¢450.00 is on sale for 40% off. How much would you pay for the phone?
iv. A woman put GH¢520.00 into a savings account for one year. The rate of interest on the account was 6%. How much was the interest for the year?</td><td>Critical Thinking and Problem solving (CP)

• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)

• Preparedness to recognise and explain results after implementation of plans (CP6.6)</td></tr>
</table>

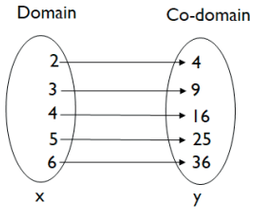
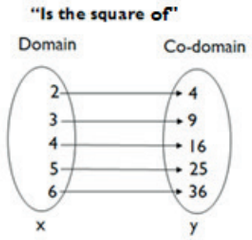
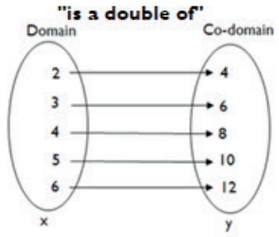
STRAND 2: ALGEBRA

SUB-STRAND 1: PATTERNS AND RELATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.	**B7.2.1.1.1 Extend a given relation presented with and without symbolic materials and explain how each element differs from the preceding one.** **E.g. 1** Extend a given symbolic relation.  1st pattern 2nd pattern 3rd pattern i. Study the pattern made with match sticks above and draw the fifth pattern. ii. How does each pattern differ from the pattern that comes before it? iii. Copy and complete the table for the number of sticks in each pattern. **E.g. 2** Study the pattern of numbers below and complete the table. i. What are the missing numbers in the co-domain?	**Creativity and Innovation (CI)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)** • Ability to examine alternatives in creating new things **(CI5.1)** • Ability to visualise alternatives, see possibilities, and identify problems and challenges **(CI5.4)**

Pattern No.	1	2	3	4	5	6	7
Number of sticks	8	15					

Domain	1	2	3	4	5	6	7
Co-domain	4	7	10		16		

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Extend a given number relation. i. If the next number in the domain is 9, what will be the corresponding number in the co-domain?  	
	B7.2.1.1.2 Describe the rule for a given relation using mathematical language such as one more, one less, one more than twice, etc. **E.g. 1** Describe given relations   **E.g. 2** Describe the rule for a relation using mathematics language. This table shows the pattern of cost of packed breakfast for workers on a field trip. Number of workers 1 2 3 4 5 6 ? Cost of breakfast 3 6 9 12 15 18 120 i) Explain the pattern of how the cost of breakfast changes as more workers go on the trip(describe the rule); ii) Use the pattern to determine how many workers went on the trip if the cost of breakfasts is GH¢120.00	**Creativity and Innovation (CI)** • Imagining and seeing things in a different way **(CI6.4)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 3 State the rules in words to represent a given relation.

Term/Input (x)	1	2	3	4	5	x	Rule for n in words
Result/Output A	5	10	15	20			$x \rightarrow$5 times x
Result/Output B	0	4	8	12			$x \rightarrow$4 times one less x
Result/Output C	4	7	10	13			$x \rightarrow$1 more than thrice x
Result/Output D	2	6	8	10			$x \rightarrow$ twice 1more than x
Result/Output E	5	11	17				$x \rightarrow$

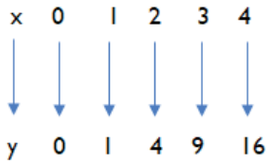
B7.2.1.1.3 Identify the relation or rule in a pattern/mapping presented numerically or symbolically and predict subsequent elements

Creativity and Innovation (CI); Critical Thinking and Problem solving (CP)

E.g. 1. Determine the rule for a given symbolic pattern.

Shape number	1	2	3	4	5	6	7	8	9	10	50
Number of matchsticks	3	5	7	9	11						
Rule for the pattern	Number of matchsticks = Shape number × _____ + _____										

- Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2 Determine the rule for a given numerical pattern.	• Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)**
		• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
	i. Find the rule	• Recognise and generalise information and experience; search for trends and patterns **(CI6.8)**
		
	ii. Find the rule and determine the value of n	
	E.g. 3. Determine an element when given the rule.	
	i. The result of in the mapping $x \rightarrow 2x + 3$ is 3. Find the value of x.	
	ii. The result of in the mapping $x \rightarrow -2x + 5$ is 45. Find the value of x.	
	iii. Copy the table below and use the rule to find the missing values of n.	
		

Shape number (x)	1	2	3	4	5	6	7	8	9	10	50
Number of matchsticks	5	8	11	14	17						n
Rule for the pattern	the rule is 3x + 2										

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.2.1.1.4 Locate points on the number plane, draw a table of values of a given relation, draw graphs for given relations and use them to solve problems.	**Critical Thinking and Problem solving (CP)**
	E.g. 1 Make a table of values for a given rule: I. Draw a table for the mapping defined by the rule on the domain {-2, -1, 0, 1, 2, 3} **Rule:** $x \rightarrow 2x + 1$	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2).**

x	-2	-1	0	1	2	3
y	-3				5	

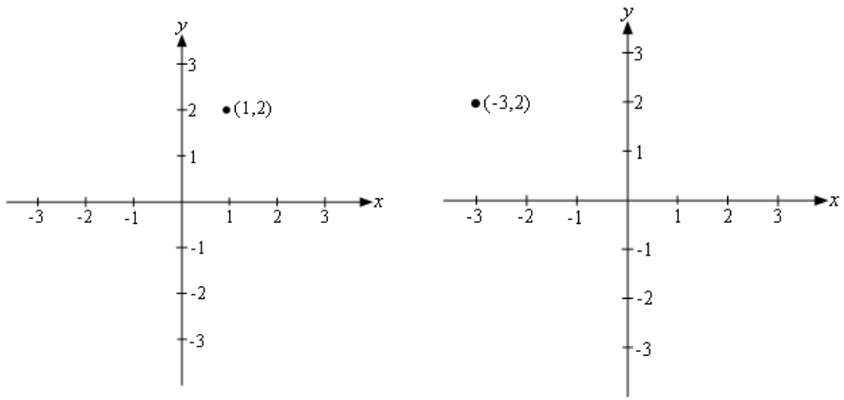
ii. Draw a table for the mapping defined by the rule on the domain {-2, -1, 0, 1, 2, 3}

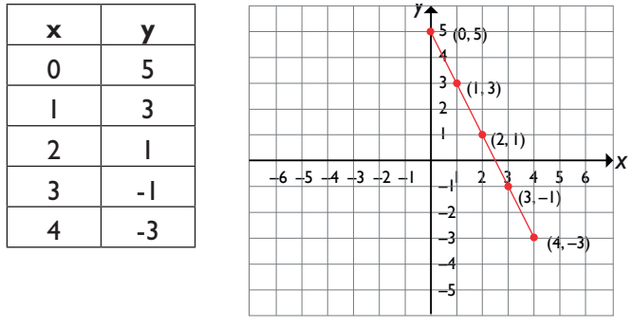
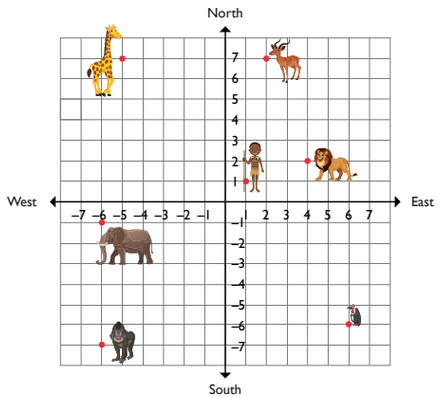
Rule: $x \rightarrow x^2 + 2$

x	-2	-1	0	1	2	3
y	6			3		

E.g. 2. Locate points on the number plane – (1, 2) and (-3, 2)

• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2).**



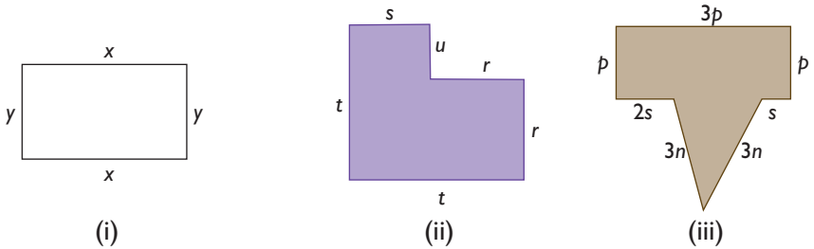
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3 Draw graphs for given relations i. Plot the table of values on a number plane.  	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2).**
	E.g. 4 Use knowledge of identifying and plotting points in a number plane to solve problems. The number plane shows the location of animals.  Use the plane to answer the questions that follow. i. If Faako walks 7 units west and 8 units south, which animal does he see? ii. Which animal is closest to Faako? iii. Which animal is located at the point (2, 7)? iv. What is point at which the giraffe is located?	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2).**

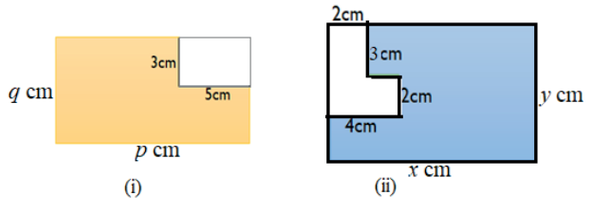
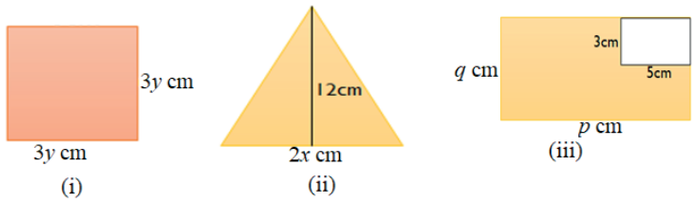
x	y
0	5
1	3
2	1
3	-1
4	-3

STRAND 2:ALGEBRA

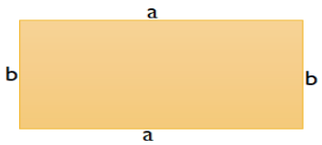
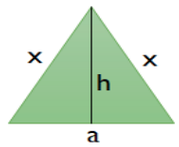
SUB-STRAND 2: ALGEBRAIC EXPRESSIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.	**B7.2.2.1.1 Create simple algebraic expressions using simple logic to translate a set of instructions into an algebraic expression.** **E.g. 1.** Form algebraic expressions for given mathematical statements. If x represents an unknown number, then i. 10 more than a number $x \rightarrow x + 10$ ii. 5 less than a certain number $x \rightarrow x - 5$ iii. 3 times a number $x \rightarrow 3x$ iv. Half of a certain number $\boldsymbol{x} \rightarrow \frac{1}{2}x$ or $\frac{x}{2}$ v. 2 more than 5 times a certain number $x \rightarrow 5x + 2$ vi. When 8 times a certain number x is subtracted from 5 and the result is multiplied by 2 $\rightarrow 2(5 - 8x)$ **E.g. 2.** Form algebraic expressions from real life situations. i. Afrako is 3 years older than Maako. If Maako is 8 now years old, what is Afrako's age? ii. Agbolosu and Tetteh were given GH¢400.00 to share. Tetteh had GH¢35.00 more than Agbolosu. Write an expression for Tetteh's share. iii. Find the profit a woman makes if she buys a basket of oranges for x cedis and sells it for y cedis. iv. Find the area of a rectangle which is t metres long and q metres wide. v. Find the perimeter of a rectangle which is x metres long and y metres wide.	**Critical Thinking and Problem solving (CP)** • Ability to effectively define goals towards solving a problem **(CP6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.2.2.1.2 Perform addition and subtraction of algebraic expressions with rational coefficients. **E.g. 1.** Add algebraic expressions. i. Write each of these expressions in its simplest form: 1. $x + x$ 2. $y + y + y +$ 3. $s + s + s + t + t + k + k + k$ ii. Simplify the following expressions: 1. $4x + 3x + x$ 2. $5x + 4x + 2x + 3x$ 3. $3abc + 4abc + 2abc$ iii. Write an expression for the perimeter of the following shapes:  (i) (ii) (iii) **E.g. 2.** Subtract algebraic expressions. i. Write each of these expressions in its simplest form. 1. $5x - 2x$ 2. $3x - 4x - 2x$ 3. $7x - 4x - x$	**Critical Thinking and Problem solving (CP)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to explain plans for attaining goals **(CP6.2)**

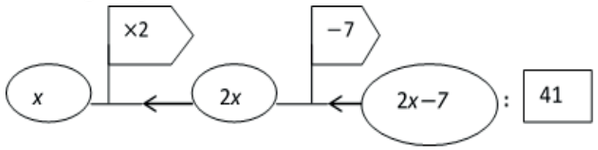
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Adding and subtracting algebraic expressions. i. Simplify the following expressions: 1. $5x + 4 - 9y + 3x + 2y - 7$ 2. $2p - 3q + 3p + 5q$ 3. $4x + 7 - 2x - 4$ 4. $7xy + 5x - 4x + 2xy - 3$ ii. Write an expression for the perimeter of the shaded region 	
	B7.2.2.1.3 Perform multiplication and division of algebraic expressions with rational coefficients. **E.g. 1.** Solve multiplication of algebraic expressions. i. Simplify the following expressions 1. $4p \times 8p^2$ 2. $5xy^2 \times 4x^4 y^3$ 3. $-2a \times 4c \times 5b$ 4. $-3xy \times 5y$  ii. Write an expression for the area of the shapes above.	**Critical Thinking and Problem solving (CP)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 1. Solve division of algebraic expressions. Simplify the following expression: i. $\frac{12x^3y^2}{16xy^4}$ ii. $\frac{-30abc}{6ab^3c^{-2}}$ iii. $\frac{18x^5y^2}{24x^7y^2}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	B7.2.2.1.4 Substitute values to evaluate algebraic expressions.	**Critical Thinking and Problem solving (CP)**
	E.g. 1. Simplify the following expressions and substitute the values to evaluate them, if $x = 2$, $y = 4$,$p = 3$ *and* $z = -1$,. I. $3xy \times 5y$ II. $7xy + 5x - 4x + 2xy - 3$ III. $4p \times 8z^2$ IV. $5x + 4 - 9y + 3x + 2y - 7$ **E.g. 2.** Simplify the following expressions and substitute the values to evaluate them, if x=2, y=4, a=3, b=2, z=1 and c= –1, i. $\frac{12x^3y^2}{16xy^4}$ ii. $\frac{-30abc}{6ab^3c^2}$ iii. $\frac{18x^5y^2}{24x^3y^2}$ iv. $\frac{8xyz}{16xy}$ v. $\frac{5ab^2}{ab}$ vi. $\frac{21x^7}{3x^4}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	i. If x=5, a=8, b=3, h=6, find the parimeter and area of the following shapes:  	
	B7.2.2.1.5 Use properties of the four operations to simplify algebraic expressions with rational coefficients. **E.g. 1.** Simplify algebraic expressions involving the four operations. i. $3xy \times 2 + \frac{6x^2y^3}{2y^2}$ ii. $\frac{7x + 4x - 2x}{3x}$ iii. $3x^2y + 2xy^2 - 4x^2y - 6xy^2$ iv. $(15p^3q^2 \times 12x^5y^3) \div (36pq \times 45xy)$ v. $\frac{7x^2 + 2x^2}{3x^2}$ vi. $7a - 7a^3 + 14a^4$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

STRAND 2: ALGEBRA

SUB-STRAND 3: VARIABLES AND EQUATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.2.3.1 Demonstrate an understanding of linear equations of the form x + a = b (where a and b are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.	**B7.2.3.1.1 Translate word problems into linear equations in one variable and vice versa** **E.g. 1.** : Use a flag diagram for equations and their inverses to solve equations. i. Think of a number, double it and subtract 7. The result is 41. What was the original number? The flag diagram is:  i.e. $2x - 7 = 41$ To solve the equation, move in the opposite direction and do the inverse of the operations.  $2x - 7 = 41$ +7 +7 $2x = 48$ ÷2 ÷2 $x = 24$	• Ability to effectively define goals towards solving a problem **(CP6.1)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2 Translate word problems to linear equations. i. The sum of the ages of two friends is 25, and the older one is 4 times that of the younger one. Write this as a mathematical sentence? i.e. let the age of the younger one be x ∴ the age of older one = $4x$ $4x + x = 25$ ii. Adaako and Afrakoma shared 40 oranges. Afrakoma had 6 more than Adaako. Write a mathematical sentence for this word problem. i.e. let x represent Adaako's share. Afrakoma's share is $x + 6$ and their share put together gives ∴ $x + (x + 6) = 40$ **E.g. 3.** Write word problems for given linear equations. i. $x + x = 15$ i.e. the sum of two equal numbers is 15 ii. $2x - 4 = 12$ i.e. when 4 is taken away from 2 times a certain number, the result is 12. iii. $\frac{2}{3}x = 4$ i.e. two-thirds of a certain number is 4.	
	B7.2.3.1.2 Model and solve linear equations using concrete materials (e.g., counters and integer tiles) and describe the process orally and symbolically. **E.g. 1.** Model and solve linear equations set with objects on a balance. i. ***Solution***: $x + 3 = 7$ $-3 \quad -3$ $x = 4$ 	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

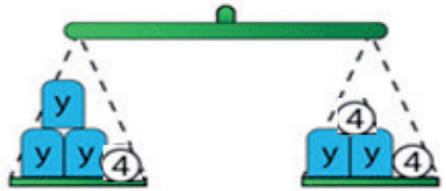
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

ii. ***Solution***:

$$\begin{array}{rcl} 5x + 1 & = & 3x + 5 \\ -3x & & -3x \\ 2x + 1 & = & 5 \\ -1 & & -1 \\ 2x & = & 4 \\ x & = & 2 \end{array}$$

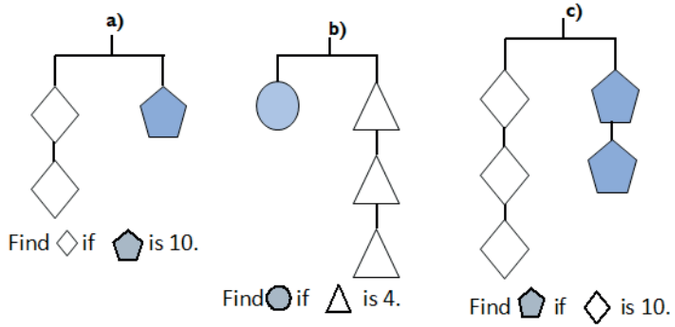
iii. ***Solution***:

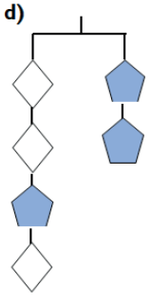
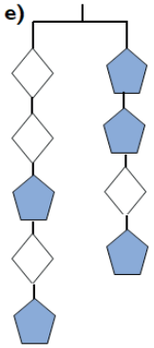
$$\begin{array}{rcl} 3y + 4 & = & 2y + 8 \\ -2y & & -2y \\ y + 4 & = & 8 \\ -4 & & -4 \\ y & = & 4 \end{array}$$



E.g. 2. Model and solve linear equations set with shapes on a balance

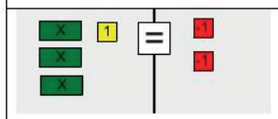
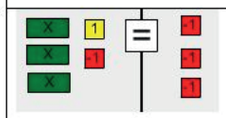
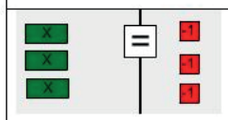
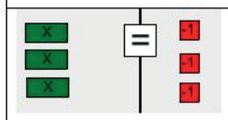
i. In each balance the mass of one shape is given in grams. Find the mass of the other shape.

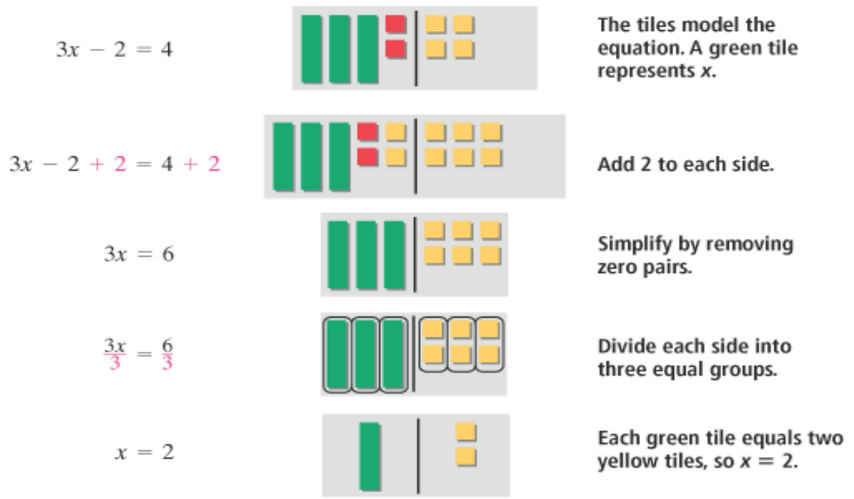


CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	ii. In each balance the mass of one rhombus is 12 grams. Find the mass of the pentagon. d)  e)  iii. Use the three equations below to find the value of ● + ♦ × △ ● + ● + ● = 60 ● + ♦ + ♦ = 40 ♦ + △ + △ = 20	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.2.3.1.3 Model linear equations, then write mathematical expressions and describe the process of solving the equation using algebraic tiles.	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

E.g. 1

Model	Algebraic	Description
	$3x+1=-2$	3 times a number plus 1 equals -2.
	$3x+1=-2$ $-1=-1$	Subtract 1 from both sides.
	$3x=-3$	3 times a number equals -3.
	$\frac{3x}{3}=\frac{-3}{3}$	Divide both sides by 3.
	$x=-1$	$x=-1$

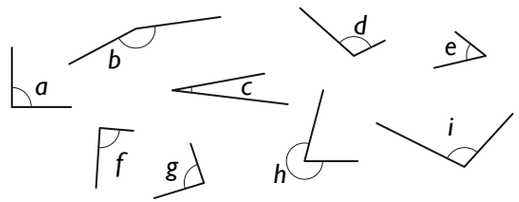
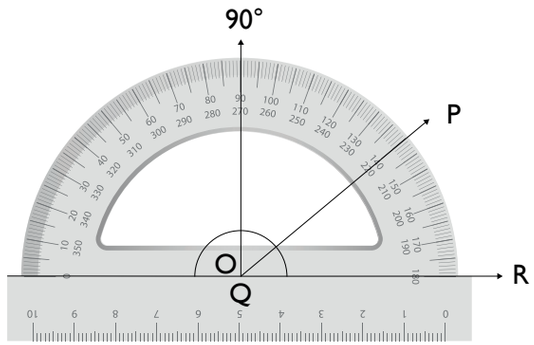
<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td rowspan="2"></td><td>E.g. 2
 
</td><td>• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem (CP5.5)</td></tr>
<tr><td>B7.2.3.1.4 Solve linear equations in one variable

E.g. 1. Using the idea of balance solve simple linear equations.
$3x + 5 = 20$
$3x + 5 - 5 = 20 - 5$
$3x = 15$
$x = 5$

Solve the following simple linear equations
i. $4x + 1 = 3x + 7$
ii. $7w + 3 = 2w + 18$
iii. $5r - 3 = r - 1$
iv. $20 - 3k = k + 12$
v. $6z + 4 = 28$</td><td>• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)</td></tr>
</table>

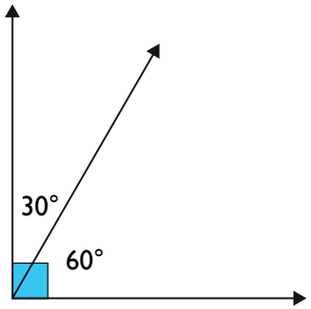
STRAND 3: GEOMETRY AND MEASUREMENT

SUB-STRAND 1: SHAPE AND SPACE

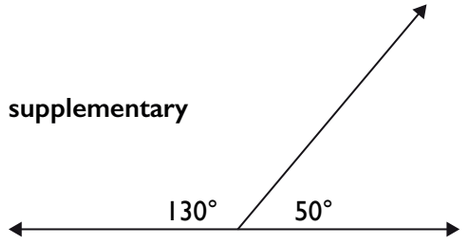
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.3.1.1 Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems	**B7.3.1.1.1 Measure and classify angles according to their measured sizes – right, acute, obtuse and reflex.** **E.g. 1.** Sort angles into those which are right, acute, obtuse or reflex angles from photocopied worksheets with several angles to measure. (Note: angles are not drawn to scale)  **E.g. 2.** Use a protractor to draw angles such as 30°, 45°, 60°, 75°, 90°, 120°, 150°, 270°, 300°, etc.  	**Creativity and Innovation (CI)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.1.1.2 Apply the fact that (i) complementary angles are two angles that have a sum of 90°, and (ii) supplementary angles are two angles that have a sum of 180° to solve problems.	**Creativity and Innovation (CI)** • Ability to merge simple/ complex ideas to create novel situations or things **(CI5.2)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**

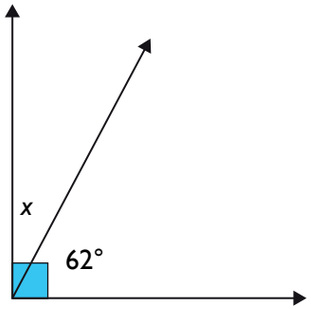
complementary



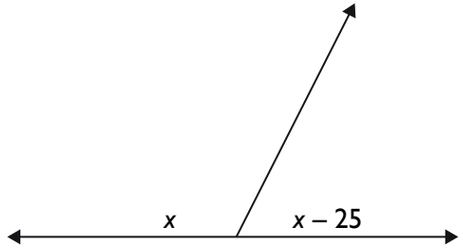
supplementary

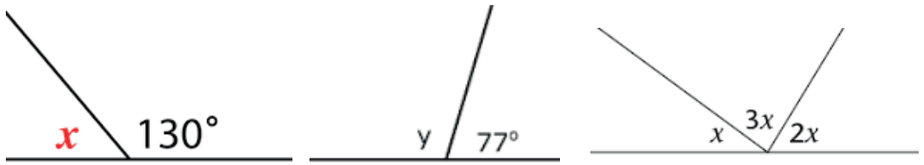
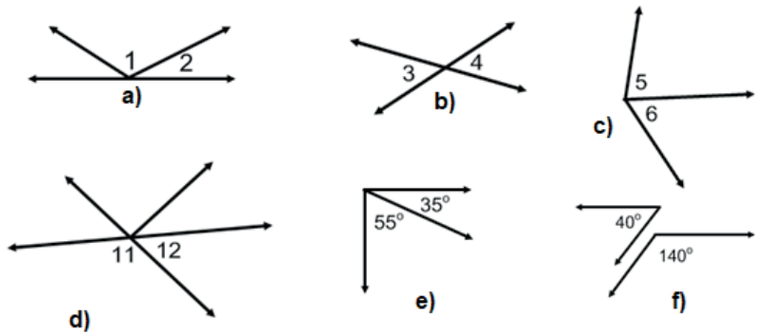
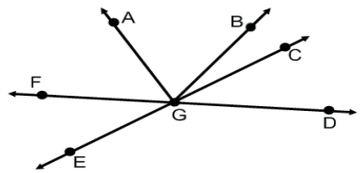


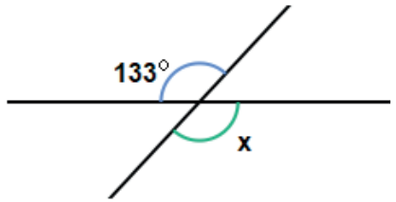
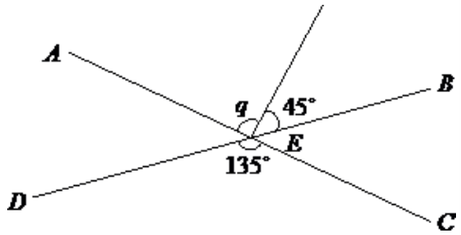
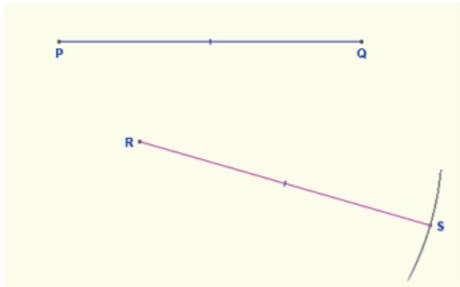
E.g. 1. Determine the missing angle marked *x*.

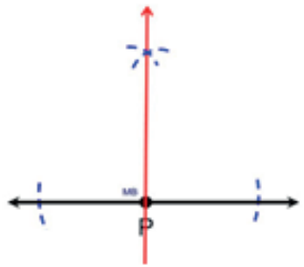
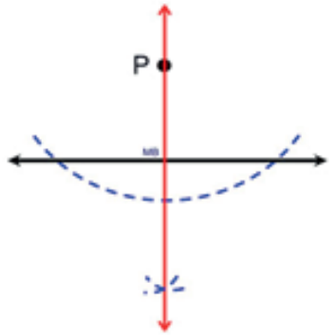


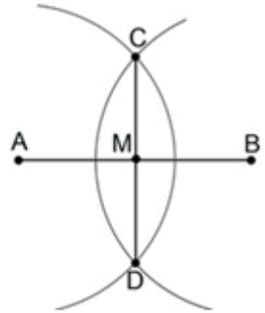
E.g. 2. Determine the missing angle marked *x*

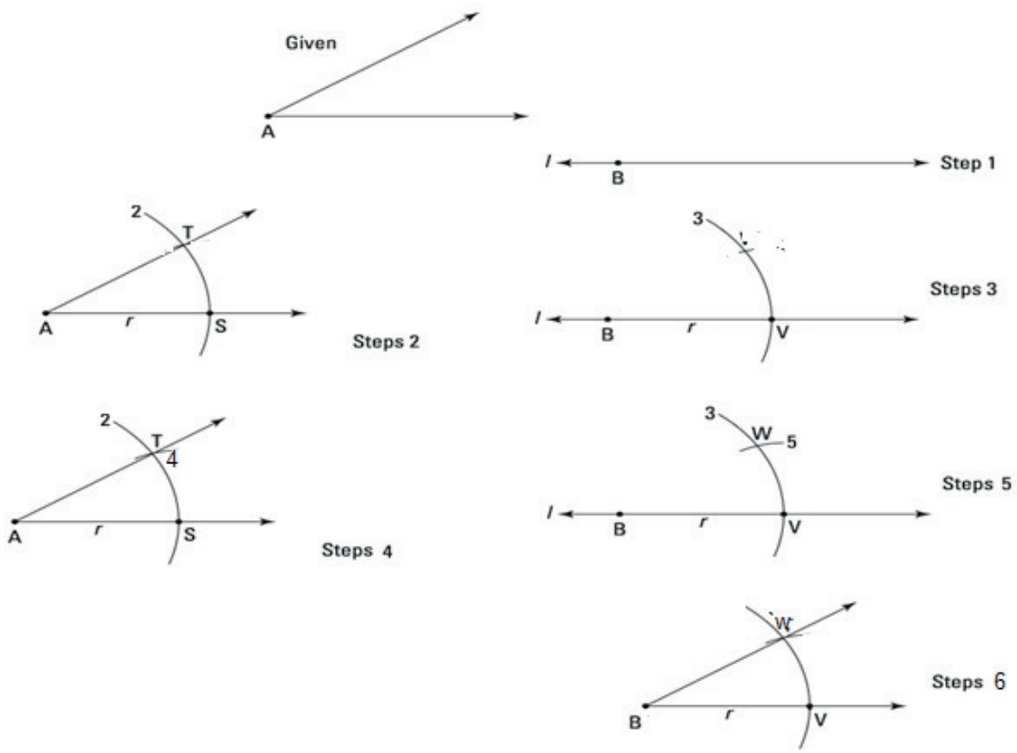


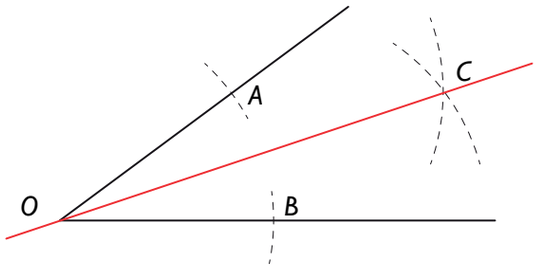
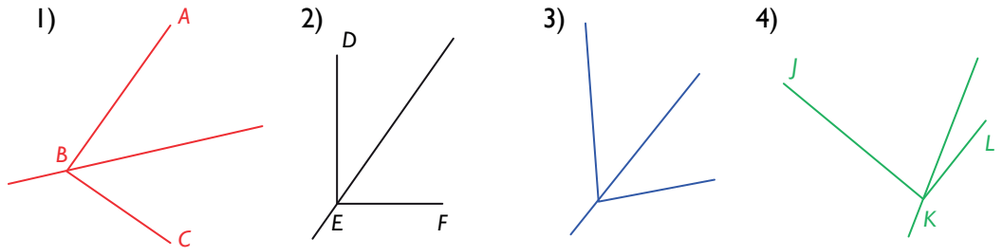
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.1.1.3 Use adjacent, supplementary and vertically opposite angles to solve problems	**Creativity and Innovation (CI)**
	E.g. 1 Determine the angle(s) marked with letters in the adjacent and/or supplementary angles below.  	• Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**
	E.g. 2 Identify each pair of angles as adjacent, vertically opposite, complementary or supplementary.  	
	E.g. 3. Use the figure at the right to identify and label the following angles i. two acute vertical angles. ii. two obtuse vertical angles. iii. a pair of adjacent angles iv. a pair of complementary angles. v. an angle supplementary to *ΔFGE*  	• Ability to try new alternatives and different approaches **(CI5.5)**

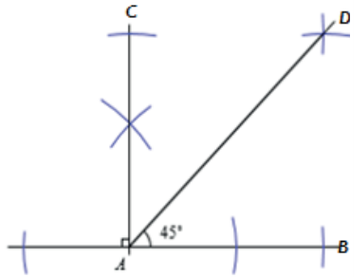
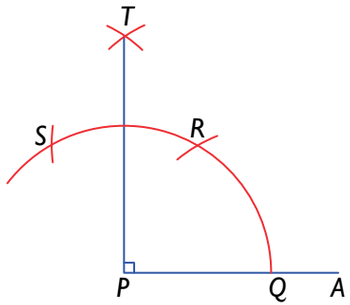
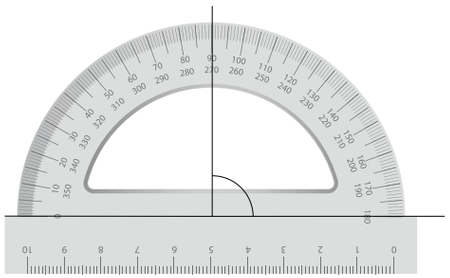
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4 Use adjacent, vertically opposite, complementary or supplementary to solve problems. Determine the angle(s) marked with letters.  	
B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: 30°, 45°, 60°, 75° and 90°	**B7.3.1.2.1 Construct a line segment perpendicular to another line segment.** **E.g. 1.** Use a pair of compasses and a ruler to construct a copy of a given line segment. For instance line segment RS is a copy of PQ. 	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)** • Preparedness to recognise and explain results after implementation of plans **(CP6.6)**

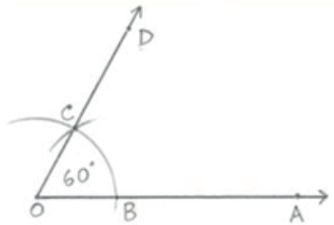
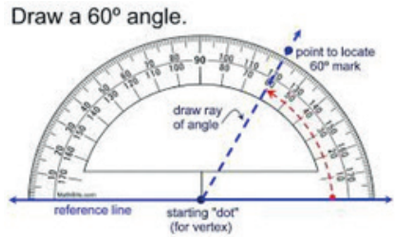
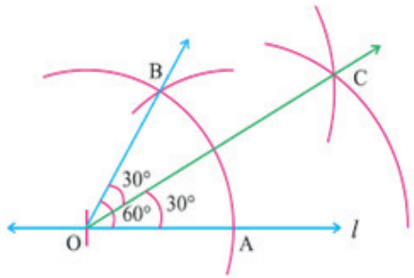
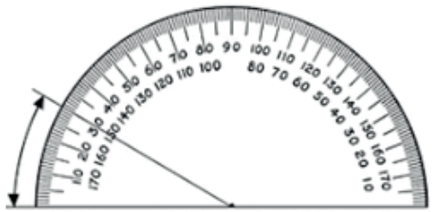
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Use a pair of compasses and ruler to construct a perpendicular at a point on a line segment, and drop a perpendicular from a given point outside a line segment. (i) A perpendicular at a point on a line segment:  (ii) A perpendicular from a given point outside a line segment: 	

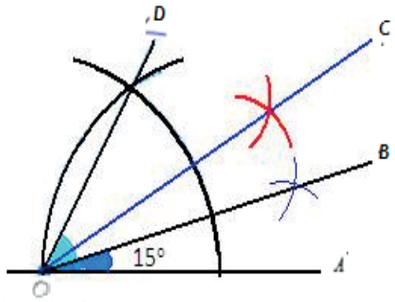
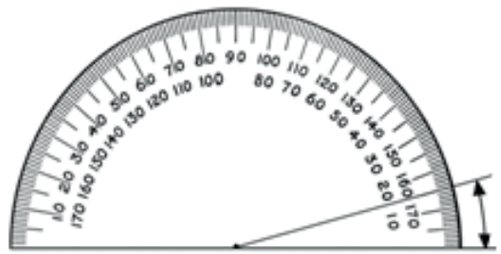
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.1.2.2: Construct the perpendicular bisector of a line segment **E.g. 1.** Use a pair of compasses and a ruler to construct a perpendicular bisector of a given line segment. (The line segment is a perpendicular bisector of) The point of intersection between $\overline{AB}$ and $\overline{CD}$, M, is the midpoint of $\overline{AB}$.  **E.g. 2.** Draw and bisect the following lines: i) $\overrightarrow{AB}$ = 8cm ii) $\overrightarrow{AB}$ = 5.5cm	**Critical Thinking and Problem solving (CP)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

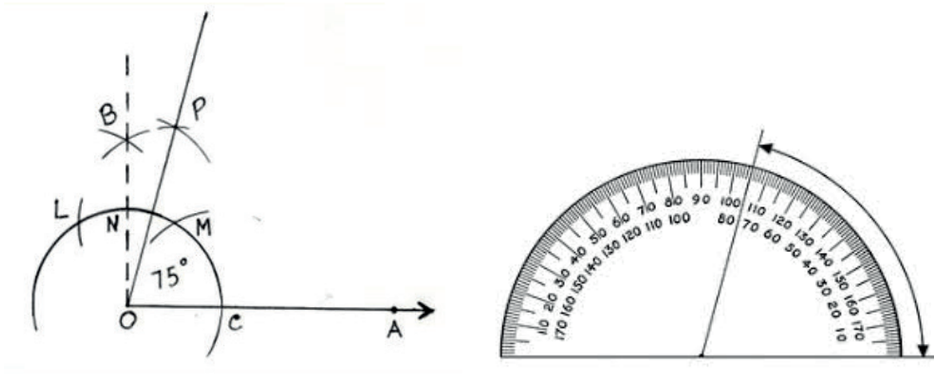
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.1.2.3: Copy and bisect angles **E.g. 1.** Use a pair of compasses and a ruler to copy a given angle (i.e. draw a line and locate point *B*; copy the arc *ST* and transfer using *B* as the centre to obtain *VW*, join to *B and W* to obtain the copied angle.  	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Perform geometric construction to bisect a given angle ($\angle BOA$)to obtain the two equal angles $\angle BOC$ and COA  (i) Sketch any acute angle and label it . (ii) Copy the angle, measure and record its value. (iii) Sketch any angle and ask a colleague to copy the angle. **E.g. 3.** Which of the angles has a correct angle bisector? 	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	7.3.1.2.4: Construct angles of 90° and 45° **E.g. 1.** Use a pair of compasses and a ruler to construct an angle of (raise a perpendicular at a point) on a given line segment and verify using the protractor. (The line segment *PT* is perpendicular to *PA* therefore ∠*APT* = 90°)    **E.g. 2.** Construct an angle of 45° by bisecting an angle of 90° (i.e. bisect ∠*BAC* = 90° to obtain ∠*BAD* = 45°: line |*AD*| is the angle bisector of the right angle). (i) Construct ∠*ABC* =45° such that |*AB*| = 5*cm* and	*BC*	= 6*cm*: bisect ∠*ABC*=45° (ii) Construct ∠*ABC* =90° and bisect it.	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	7.3.1.2.5: Construct angles of 60˚ and 30˚ **E.g. 1.** Use a pair of compasses and a ruler to: a) Construct an angle of 60˚ at a point on a given line segment ($\angle AOD = 60^\circ$) and verify with the protractor:   **E.g. 2.** Construct an angle of 30˚ by bisecting an angle whose measure is 60˚ (i.e. bisect $\angle AOB = 60^\circ$ to obtain $\angle AOC = \angle COB = 30^\circ$: line $\lvert OC \rvert$ is the angle bisector)  	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	7.3.1.2.6: Construct angles whose measures are15° and 75°.	**Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)**
	E.g. 1. Construct an angle of 15° by bisecting an angle of 30° (i.e. bisect $\angle AOD = 60°$ to obtain $\angle AOC = 30°$ and then bisect $\angle AOC = 30°$ to obtain $\angle AOB = 15°$)	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)**
	 	
	E.g..2 Construct the following: i) $\angle PQR = 7\frac{1}{2}°$ ii) $\angle ABC = 60°$ iii) $\angle KLM = 30°$ iv) $\angle RST = 15°$	

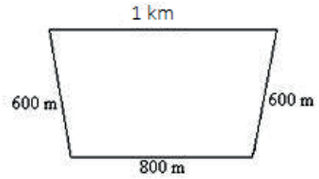
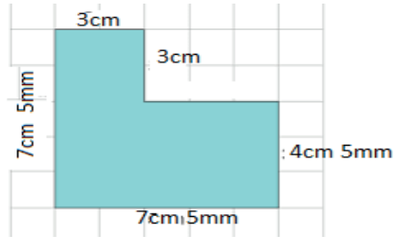
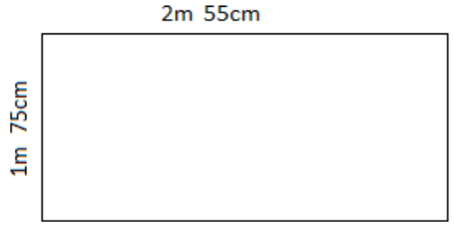
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Use a pair of compasses and a ruler to construct an angle of 75° at a point on a given line segment [i.e. construct a right angle ∠*AOB* = 90°); bisect the arc *MN* and join *O* through *P* to obtain ∠*AOP* 75°]	• Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group **(CC8.1)**
		
	E.g. 4: Construct and bisect	
	B7.3.1.2.7: Describe examples of perpendicular line segments, perpendicular bisectors and angle bisectors in the environment.	
	E.g. 1. Identify angle bisectors and perpendicular bisectors in structures and artefacts such as buildings, water tanks, boxes, etc. in the environment	
	E.g. 2. Estimate the measure of the size of angles in artefacts, tools, and structures.	

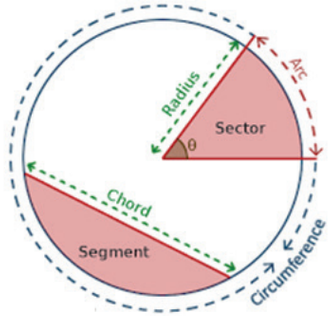
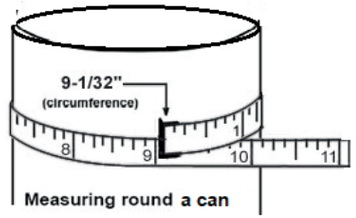
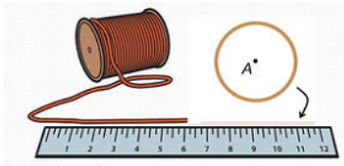
STRAND 3: GEOMETRY AND MEASUREMENT

SUB-STRAND 2: MEASUREMENT

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td rowspan="4">B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (π) to find the circumference of a circle.</td>
<td colspan="2">B.7.3.2.1.1 Calculate the perimeter of given shapes whose dimensions are in two units (i.e. cm and mm, m and cm, or km and m)</td>
<td rowspan="4">Communication and Collaboration (CC); Critical Thinking and Problem solving (CP)

• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)

• Demonstrate behaviour and skills of working towards group goals (CC9.1)</td>
</tr>
<tr>
<td>E.g. 1. Calculate the perimeter of a shape with dimensions given in km and m by converting to the smaller unit and adding the distance around the shapes.</td>
<td> 
</td>
</tr>
<tr>
<td>E.g. 2. Calculate the perimeter of a shape with dimensions given in cm and mm by converting to decimal fractions in the larger unit (i.e. 7cm 5mm = 7.5cm).</td>
<td> 
</td>
</tr>
<tr>
<td colspan="2">E.g. 3. Calculate the perimeter of a shape with dimensions given in m and cm by converting to decimal fractions in the larger unit (i.e. 1m 75cm = 1.75m).
 
</td>
</tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.2.1.2 Use the relationships between the diameter and the circumference to deduce the formula for finding the circumference of a circle and use it to solve problems. **E.g. 1.** Identify the named parts of a circle – radius, diameter, circumference, arc, sector, etc.  **E.g. 2.** Measure the radius, diameter and circumference of circular objects like base or cross section of cylindrical objects like cans, tyres, bowls, etc., roundabouts, etc. and describe the measuring tools used.    	**Creativity and Innovation (CI); Critical Thinking and Problem solving (CP)** • Ability to effectively define goals towards solving a problem**(CP6.1)** • Identify important and appropriate alternatives**(CP6.3)** • Exhibit strong memory, intuitive thinking; and respond appropriately**(CI6.1)** • Identify important and appropriate alternatives**(CP6.3)** • Exhibit strong memory, intuitive thinking; and respond appropriately**(CI6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 3. Explain the relationship between the diameter and circumference of a circle by:

i. Recording the measured diameter and circumference of various circles;

ii. Completing the table for the measured values; and

iii. Observing the results of c ÷ d.

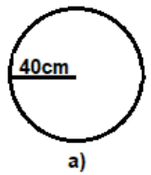
Circle	Circumference (c)	Diameter (d)	c ÷ d
Tin A	13	4	13 ÷ 4 =
Tin B	38	12	38 ÷ 12 =

iv. Conclude that the result of c ÷ d or the ratio of the circumference of a circle to its diameter is named π (and pronounced pi). The ratio itself is approximately $\frac{22}{7}$ or 3.141592+. [*Read more on the internet about the pi – who discovered it, and its value*].

E.g. 4. Use the relationship between the diameter and circumference of a circle (i.e. $\pi = \frac{C}{D} = \frac{C}{2r}$) to solve problems.

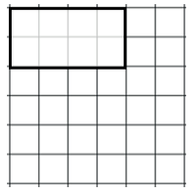
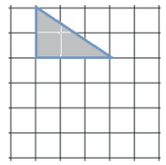
i. The radius of a circle is 140 cm. What is the (a) diameter (b) circumference? [Take $\pi = \frac{22}{7}$]

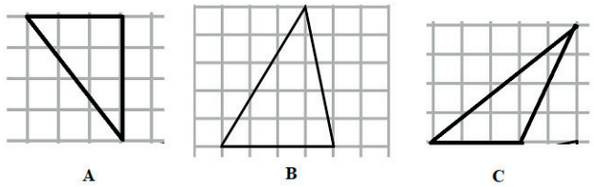
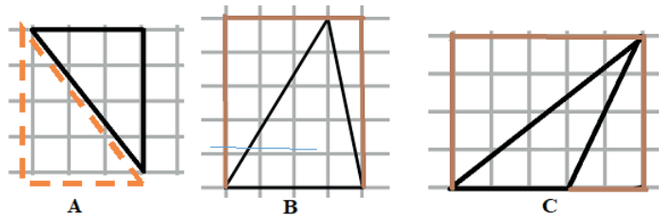
ii. Find the circumference of the circles below whose radii are given and round your answer to the nearest tenth [take π = 3.142]:

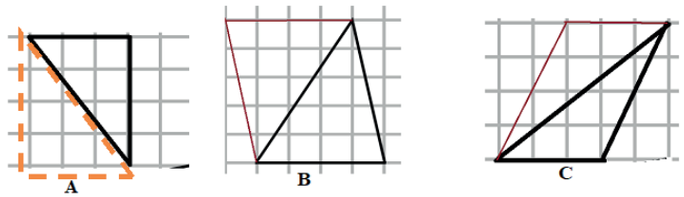
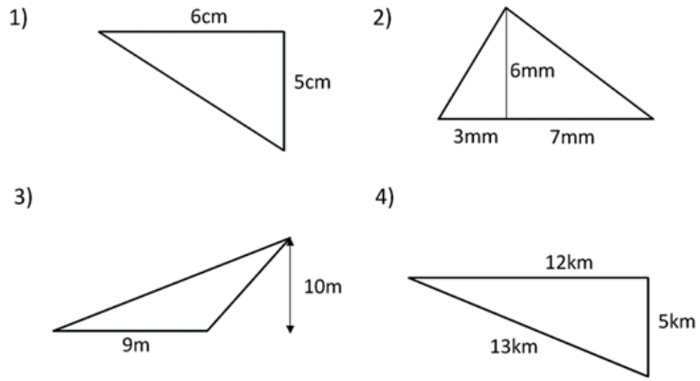


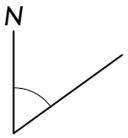
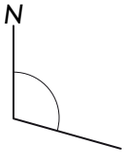
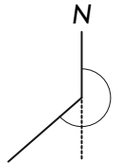
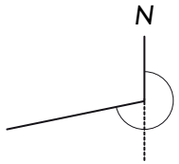
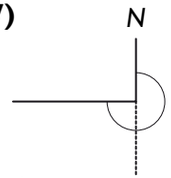
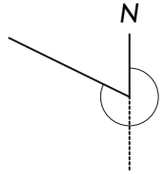
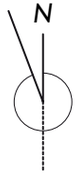
a)

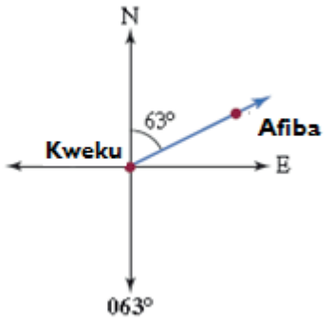
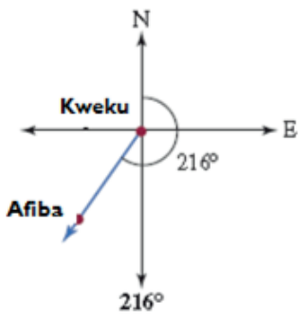
b)

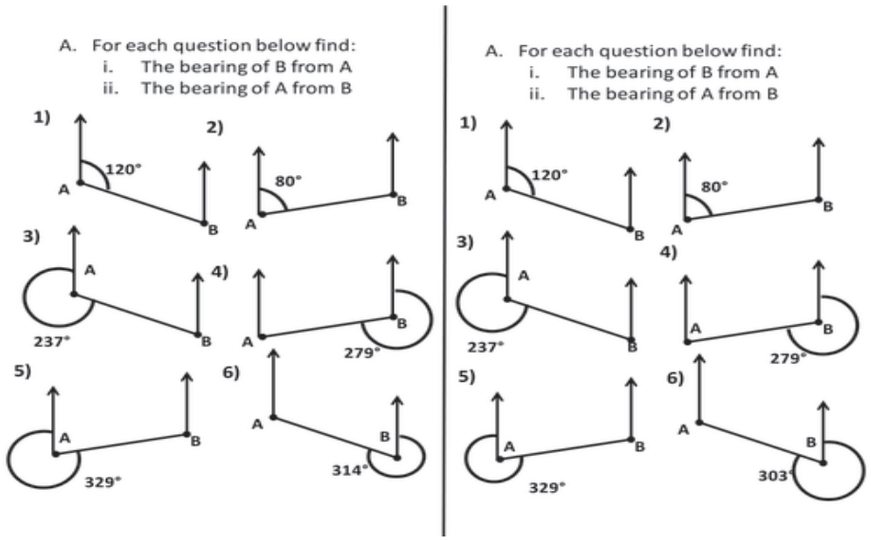
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.2.1.3 Draw in a square grid rectangles and triangles with given dimensions. **E.g. 1.** i) Draw a rectangle whose area is twice as large as the one drawn on the grid. ii) Draw a rectangle which is twice as wide as and one and a half times as long as the one in the grid.  **E.g. 2.** i) Draw in the dot square grid another triangle whose area is 3 square units. **E.g. 3** i) What is the area of the triangle in the square grid? ii) How many different triangles which have the same area as the one in the grid can you draw?  	**Creativity and Innovation (CI); Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)** • Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.7.3.2.2 Derive the formula for determining the area of a triangle and use it to solve problems	**B7.3.2.2.1 Use the relationships between a triangle and a rectangle (or parallelogram) to deduce the formula for determining the area of a triangle.** **E.g. 1.** Determine the number of unit squares enclosed by the triangles below. i. What is the perpendicular height of each triangle? ii. What is the area of each of the triangles? iii. How does the perpendicular heights of each triangle help you in calculating its area?  A B C **E.g. 2** Spot the *RECTANGLE* enclosing the triangles to find the unit squares in each triangle. Notice the base and height of the triangle.  A B C Area of a triangle = $\frac{1}{2}$ (Area of the rectangle = $\frac{1}{2}$base × perpendicular height)	• Understand roles during group activities **(CC9.3)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to explain plans for attaining goals **(CP6.2)** • Create simple logical ideas to think through problems **(CP5.3)**

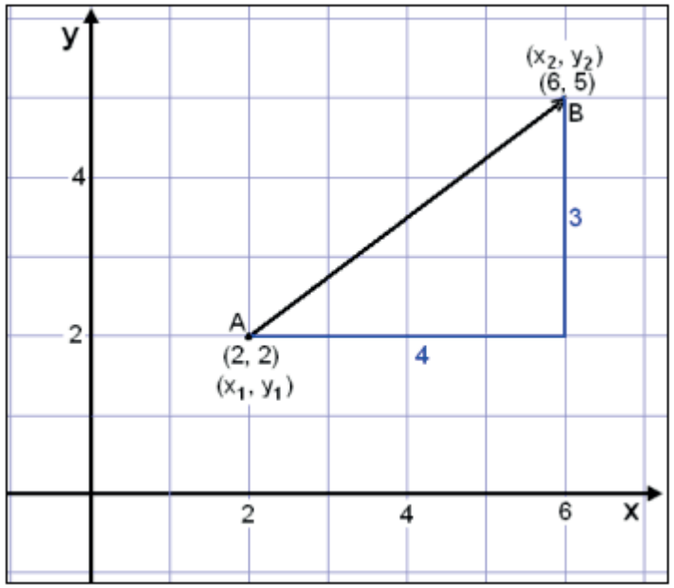
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Spot the Parallelogram from which the triangle was formed.  Area of the triangle = (Area of the parallelogram)= (base of parallelogram) × height = b × h	
	B7.3.2.2.2 Determine the area of a triangle. **E.g. 1.** Calculate the area of the triangles:  	**Communication and Collaboration (CC)** • Ability to effectively define goals towards solving a problem **(CP6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases	**B7.3.2.3.1 Describe the bearing of a point from another point** **E.g. 1.** Use a protractor to find the marked angles. For each diagram write the three-digit bearing. **1)**  Angle ..... Bearing ..... **2)**  Angle ..... Bearing ..... **3)**  Angle ..... Bearing ..... **4)**  Angle ..... Bearing ..... **5)**  Angle ..... Bearing ..... **6)**  Angle ..... Bearing ..... **7)**  Angle ..... Bearing ..... **8)**  Angle ..... Bearing ..... **9)**  Angle ..... Bearing	**Critical Thinking and Problem solving (CP)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Recognise true bearings as the angle measured in the clockwise direction from the North **E.g. 3.** Express the following vectors graphically (i) $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ (ii) $\overrightarrow{BC} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ and measure each angle. **E.g. 4.** Draw the following vectors (i) $\overrightarrow{AB}$ = (3km,060) (ii) $\overrightarrow{QR}$ = (5km,120) and measure each angle. The bearing of Afiba from Kweku is 060°  The bearing of Kweku from Yaw is 216°  	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)** • Implement strategies with accuracy **(CP6.7)**

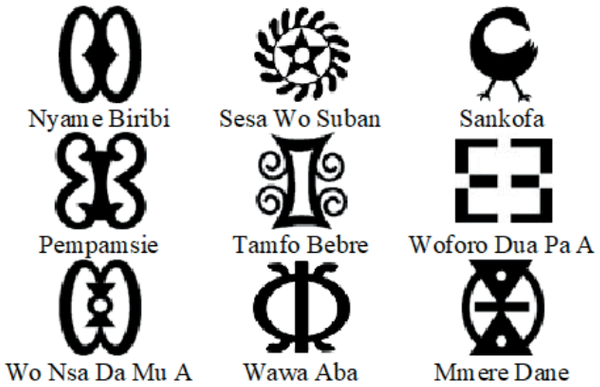
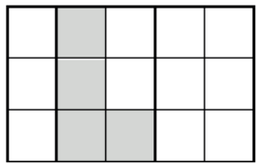
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.2.3.2 Explain how to find the back bearing when the direction of travel has a bearing which is less than 180° and/ or greater than 180°. **E.g. 1**  **E.g. 2.** The bearing of P from Q is 060°.What is the bearing of Q from P. **E.g. 3.** The bearing of P from Q is 145°.What is the bearing of Q from P.	**Critical Thinking and Problem solving (CP)** • Ability to select alternative(s) that adequately meet selected criteria **(CP6.5)**

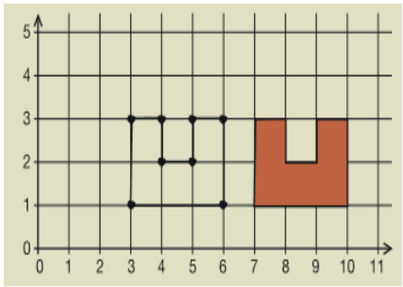
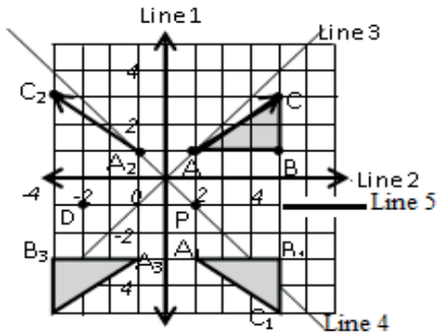
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.2.3.3 Distinguish between scalar and vector quantities	**Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)**
	E.g. 1. Read on scalar quantity and vector quantity on the internet. **E.g. 2.** Group these examples under scalar quantity and vector quantity, weight, force, velocity time, speed, distance, mass, volume, energy, work momentum etc. Eg.3 Identify a vector as a movement (distance) along a given bearing **E.g. 4.** Draw a vector given its length and bearing E.g. $\overrightarrow{TS}$ = (6km, 245°). **E.g. 5.** Identify the distance along a vector as its magnitude and the 3 – digit clockwise angle from the north as its bearing **E.g. 6** Identify a zero vector as a point with no magnitude and direction.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to work with all group members to complete a task successfully **(CC9.6)**
	B7.3.2.3.4Represent vector in the column (component) form and determine its magnitude and direction.	**Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)**
	E.g. 1. Write each of the following as column vectors using graph. (i) $\overrightarrow{AB}$ = (5km, 030°), $\overrightarrow{CD}$ = (25km, 150°) **E.g. 2.** Use any other method apart from graph to write the following as column vectors: (i) $\overrightarrow{XY}$ = 10km, 270°) (ii) $\overrightarrow{ST}$ = (70km, 090°) and find it magnitude and direction.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to work with all group members to complete a task successfully **(CC9.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.2.3.5 Convert vectors in the column (component) form to the Magnitude–Bearing form and vice versa	**Critical Thinking and Problem solving (CP); Communication and Collaboration (CC)**
	E.g. 1. Use the Pythagorean theorem to find the length or the magnitude of a vector. $\lvert\overrightarrow{AB}\rvert = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$  **E.g. 2** Find the magnitude and the direction of the following vectors (i) $\overrightarrow{AB} = \begin{pmatrix}12\\15\end{pmatrix}$ (ii) $\overrightarrow{PQ} = \begin{pmatrix}15\\9\end{pmatrix}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to work with all group members to complete a task successfully **(CC9.6)**

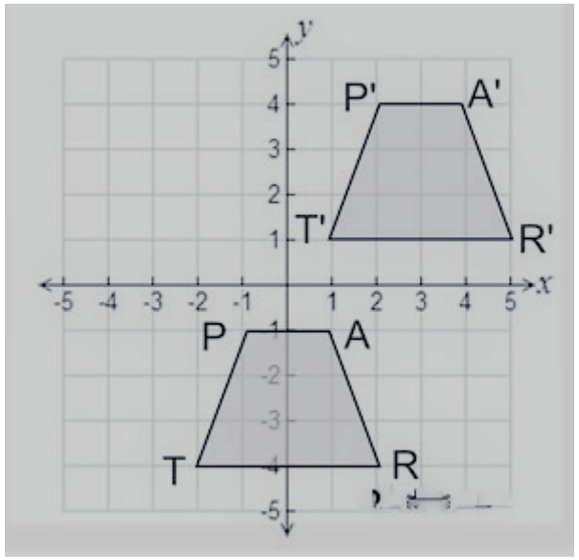
STRAND 3: GEOMETRY AND MEASUREMENT

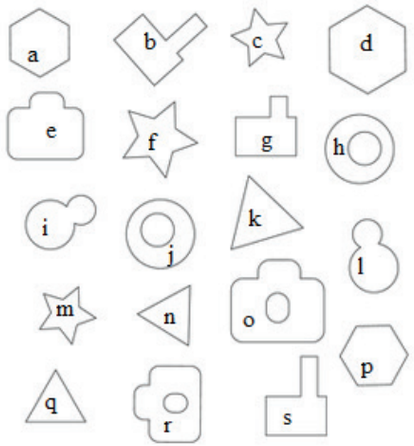
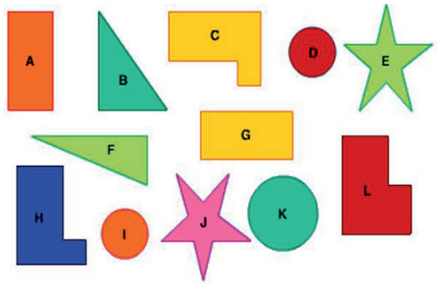
SUB-STRAND 3: POSITION AND TRANSFORMATION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.3.3.1 Perform a single transformation (i.e. reflection and translation) on a 2D shape using graph paper (including technology) and describe the properties of the image under the transformation (i.e. congruence, similarity, etc.)	**B7.3.3.1.1 Determine shapes in real life that have reflectional (or fold) symmetries.** **E.g. 1.** Identify examples of designs (or objects) in everyday life that have reflectional (or fold) symmetries (e.g. adinkra symbols).  Nyame Biribi, Sesa Wo Suban, Sankofa Pempamsie, Tamfo Bebre, Woforo Dua Pa A Wo Nsa Da Mu A, Wawa Aba, Mmere Dane **E.g. 2.** In how many different ways can one more square be shaded in the shape below so that it can have a line of symmetry? 	**Critical Thinking and Problem solving (CP); Creativity and Innovation (CI)** • Create simple logical ideas to think through problems **(CP5.3)** • Identify important and appropriate alternatives **(CP6.3)** • Preparedness to recognise and explain results after implementation of plans **(CP6.6)** • Imagining and seeing things in a different way **(CI6.4)** • Recognise and generalise information and experience; search for trends and patterns **(CI6.8)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.3.1.2 Plot points and shapes (i.e. plane figures) on a coordinate plane and draw their images under reflection in given lines **E.g. 1.** Plot points and shapes (i.e. plane figures) with given coordinates in the number plane. i. Plot the points A (3, 1), B (3, 3), C (4, 3), D (4, 2), E (5, 2), F (5, 3), H (6, 3), and I (6, 1).  **E.g. 2.** Identify points with given coordinates and lines (i.e. constant lines parallel to the *x*-axis or *y*-axis) in the number plane. Draw and label the axes of the coordinate plane and label the lines such as Line 1 is *y*-axis or *x*=0; Line 2 is *x*-axis or *y*=0; Line 3 is *y*=*x*; Line 5 is , etc.  	**Creativity and Innovation (CI); Digital Literacy (DL)** • Reflect on work and explore the thinking behind thoughts and processes **(CI6.10)** • Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Plot given points (or shape) the number plane and draw its images under reflection in (i) the *x*-axis, (ii) *y*-axis and (iii) *y*=*x* i. (a) Draw point A_2 (-1, 1) as the image of point A (1, 1) under a reflection in the *y* axis (or line *x*=0)[(b) Draw point P (1, -1) as the image of point A (1, 1) under a reflection in the *x* axis (or line *y*=0) and [(c) Draw point A2 (-1, 1) as the image of point P (1, -1) under a reflection in the line *y*=*x*. ii. Draw triangle A'B'C' as the image of triangle ABC under the reflection *x*=0, *y*=0, *y*=*x* and any other line. iii. Compare the images **E.g. 4.** Derive the coordinate rules i. If (a, b) is reflected on the *x*-axis, its image is the point (a, -b) ii. If (a, b) is reflected on the *y*-axis, its image is the point (-a, b) iii. If (a, b) is reflected on the line *y* = *x*, its image is the point (b, a) iv. If (a, b) is reflected on the line *y* = -*x*, its image is the point (-b, -a) **NB:** Reflection can occur over a line and/ or in a point.	• Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)** • Preparedness to make better decisions using information **(DL5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.3.1.3 Plot points and shapes (i.e. plane figures) on a coordinate plane and draw their images under translation by a given vector. **E.g. 1.** As people go down a slide, they undergo a translation.  **E.g. 2.** Plot point(s) and shapes (i.e. plane figures) in acoordinate plane using a translating vector and describe the changes in the vertices as well as the direction of the movement.  ii. Draw a shape and its image under a translation by a given vector. iii. Describe a single movement or transformation that takes the shape PART to the image P'A'R'T	**Digital Literacy (DL);Creativity and Innovation (CI)** • Preparedness to make better decisions using information **(DL5.6)** • Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.3.3.1.4 Verify the concept of congruent and similar shapes in coordinate plane using properties of both the object(s) and image(s); and in real life situations (carpet designs, fabric pattern) **E.g. 1.** Verify which shapes are similar and which are congruent. **E.g. 2.** Which of the following shapes are congruent?   	**Creativity and Innovation (CI)** • Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)**

STRAND 4: HANDLING DATA

SUB-STRAND 1: DATA

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.4.1.1 Select, justify, and use appropriate methods to collect data (quantitative and qualitative), display and analyse the data (grouped/ungrouped) presented in frequency tables, line graphs, pie graphs, bar graphs or pictographs and use these to solve and/or pose problems	**B7.4.1.1.1- Select and justify a method to collect data (quantitative and qualitative) to answer a given question.** **E.g. 1.** In small groups, learners discuss and write down how they would make decisions in the following situations, what facts they would take into account and how they would collect these 'facts: (a) The type of drinks to buy for a class party. (b) The make of football boots to buy for the school team. (c) Do people who eat more fufu develop pot belly? (d) The number of desks in each classroom. (e) The amount of money B6 students spend on bus fare to school every month. (g) Buy a mobile phone from an online shop. **E.g. 2.** Lead a discussion on the methods of data collection below and ask them to identify which method they will use to gather the facts for each situation (i.e. in **E.g. 1.** above) • questionnaires, • interview, • observation, • experiments, • survey • databases, • electronic media or internet	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** **Digital Literacy (DL)** • Ability to work with all group members to complete a task successfully **(CC9.6)** • Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Identify important and appropriate alternatives **(CP6.3)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

B7.4.1.1.2- Design and administer a questionnaire for collecting data to answer questions and record the results.

E.g. 1. Conduct a survey (within a small group of learners) by producing a question form (such as the one below) and collecting real information.

Class Survey Question Form

1)	Hello, What's your name? _____
2)	How old are you? _____
3)	What's your favourite school subject? _____
4)	What's your worst subject? _____
5)	What's the most important school subject? _____
6)	What is your favourite hobby _____
7)	What's your favourite day of the week? _____
8)	How much do you spend on bus fare to school every day? _____

E.g. 2. Use a table (like the one below) to organise the data obtained with the question form (or questionnaire).

Name	Age	Favourite subject	Worst subject	Important subject	Favourite hobby	Favourite weekday	Daily bus fare (cedis)

Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)

- Demonstrate behaviour and skills of working towards group goals **(CC9.1)**
- Effectively perform multiple roles within the group **(CC9.7)**
- Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
- Identify important and appropriate alternatives **(CP6.3)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.4.1.1.3- Organise and present data from a survey into a table and/or chart, and analyse it to solve and/or pose problems.	**Critical Thinking and Problem solving (CP); Personal Development and Leadership (PL); Digital Literacy (DL); Creativity and Innovation (CI)**

E.g. 1. Use tallies to organise into a frequency table marks obtained in a mathematics test by students in a class.

10	7	4	5	6	8	7	6	7	5	3	4	6
5	4	5	4	6	5	6	7	6	3	4	5	8
6	7	5	9	4	6	6	1	7	7	9	5	1
5	2	7	10	8	6	7	4	1	6	6		

i. Complete the frequency table below for the data recorded in the mathematics test.

Marks	**Tally**	**Frequency**
1	///	3
2	/	1
3		
4		
Total		

ii. Draw a bar graph to illustrate the data in the frequency table.

iii. Write your conclusion about the students' scores in the test and/or pose questions on the graph.

- Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
- Implement strategies with accuracy **(CP6.7)**
- Demonstrate a sense belongingness to a group **(PL5.2)**
- Preparedness to make better decisions using information **(DL5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Use tallies to organise into a frequency table, the data below which was obtained by a group of learners for the number of people living in households around their houses.	• Implement strategies with accuracy **(CP6.7)**

3	4	2	4	3	2	2	5	4	3	2	6	3	5
4	1	2	6	3	5	5	2	4	1	5	4	2	
4	3	4	2	4	4	6	2	4	3	4	2	4	

i. Complete the frequency table below for the data recorded from the survey of people living in households around their houses.

No./ Household	Tally	Frequency	Angle of sector
1	//	2	$\frac{2}{40} \times 360 = 18^c$
2	//// ////	10	
3	//// //	7	
4	//// //// ///	13	
5	////	5	
6	///	3	

ii. Draw a pie chart to illustrate the data in the frequency table (i.e. in **E.g. 1** above).

iii. Write your conclusion about the number of people living in the households and/or pose questions on the pie chart.

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
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E.g. 3. Draw a graph or chart for data organised in a frequency table and use it to answer and/or pose questions. For instance,
i. The table below shows how Fakor spends his day. Complete the blanks in the table with information on how you spend your day. Draw a double bar graph to compare how you spend your day with Fakor.
<table>
<tr><td>Activity</td><td>School</td><td>Sleeping</td><td>Homework</td><td>Eating</td><td>Other</td></tr>
<tr><td>No. of hours</td><td>8</td><td>8</td><td>3</td><td>1</td><td>4</td></tr>
<tr><td>No. of hours</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
ii. The table below shows the amount of rainfall recorded in millimetres per month in the two towns in Ghana. Draw a double bar chart to represent the data, write your conclusion and/or pose questions based on the chart.
<table>
<tr><td></td><td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td><td>Sep</td><td>Oct</td><td>Nov</td><td>Dec</td></tr>
<tr><td>Kumasi</td><td>5</td><td>10</td><td>15</td><td>20</td><td>50</td><td>45</td><td>55</td><td>35</td><td>40</td><td>50</td><td>35</td><td>10</td></tr>
<tr><td>Oda</td><td>3</td><td>10</td><td>13</td><td>25</td><td>40</td><td>50</td><td>60</td><td>50</td><td>40</td><td>45</td><td>35</td><td>8</td></tr>
</table>
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<td>
• Evaluate the quality and validity of information (DL5.5)
• Interpret and apply learning in new contexts (CI6.9)
</td>
</tr>
</table>

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td>B7.4.1.2 Determine the measures of central tendency (mean, median, mode) for a given ungrouped data and use it to solve problems</td>
<td>
B7.4.1.2.1 Calculate the mean for a given ungrouped data and use it to solve problems

E.g. 1. Find the mean for a data set by dividing the sum of all the items in the data set by the by the number of items.
i. The mean for the data set {8, 9, 7, 6, 8,10} is $\frac{8+9+7+6+8+10}{6} = 8$
ii. Find the mean for the data set below which is the marks obtained out of a total of 5 in a mathematics class test.
<table>
<tr><td>3</td><td>4</td><td>2</td><td>4</td><td>3</td><td>2</td><td>2</td><td>5</td><td>4</td><td>3</td></tr>
<tr><td>4</td><td>1</td><td>2</td><td>6</td><td>3</td><td>5</td><td>5</td><td>2</td><td>4</td><td>1</td></tr>
</table>
E.g. Find the mean for a data set (in a frequency table) by dividing the sum of all the items in the data set by the by the number of items.
i. Find the mean for the marks obtained out of a total of 5 in a mathematics class test presented in the frequency table:
<table>
<tr><td>Score</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Frequency</td><td>2</td><td>6</td><td>4</td><td>5</td><td>3</td></tr>
</table>
ii. Find the mean of the ages of children at a party presented in the frequency table:
<table>
<tr><td>Ages (x):</td><td>1</td><td>3</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Frequency (f):</td><td>2</td><td>5</td><td>6</td><td>10</td><td>8</td><td>5</td><td>3</td><td>1</td></tr>
</table>
E.g. 3. Solve problems involving calculating the mean or average.
i. A shop keeper sold the following loaves of bread over the last 6 days: 25, 48, 25, 33, 57, 50. What was the average number of loaves sold each day?
ii. Sena has had the following scores in five of the common core subjects this term: 75, 87, 90, 88, 79. If she wishes to have an average score of 85, what must she score on the sixth test? i.e. Set up the problem like this: (75 + 87 + 90 + 88 + 79 + □) ÷ 6 = 85
</td>
<td>
Critical Thinking and Problem solving (CP)

• Implement strategies with accuracy (CP6.7)

• Ability to effectively define goals towards solving a problem (CP6.1)

• Ability to explain plans for attaining goals (CP6.2)
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<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
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B7.4.1.2.2 Calculate the median for a given ungrouped data and use it to solve problems

E.g. 1. Find the **median** for a data set by arranging the items in the set in an array and identifying the middle item.

i. Find the median of 19, 29, 36, 15, and 20. (i.e. the middle item in the array 15, 19, 20, 29, 36 is 20). *NB. since there are 5 values (odd number), 20 is the median (middle number)*

ii. Find the median for the data set 8, 9, 7, 6, 8, and 10. (i.e. the middle item in the array 6, 7, 8, 8, 9, and 10 is 8). NB. since there are 6 values (even number), we must average those two middle numbers to get the median value

E.g. 2. Find the **median** for a data set (in a frequency table).

iii. Find the median mark obtained in a mathematics class test presented in the frequency table:

Score	1	2	3	4	5
Frequency	2	6	4	5	3

NB. Since there are 20 values, the 10th and 11th scores are the middle numbers and they are both 3, so the median value is 3.

iv. Find the median ages of children at a party presented in the frequency table:

Ages (*x*):	1	3	5	6	7	8	9
Frequency (f):	2	5	6	10	8	5	3

NB. Since there are 39 values, the 20thage is 6, so the median value is 6.

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Critical Thinking and Problem solving (CP)

- Ability to effectively define goals towards solving a problem **(CP6.1)**
- Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
- Implement strategies with accuracy **(CP6.7)**

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STRAND 4: HANDLING DATA

SUB-STRAND 2: CHANCE OR PROBABILITY

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.4.2.1 Identify the sample space for a probability experiment involving single events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems	**B7.4.2.1.1 Demonstrate understanding of likelihood of a single outcome occurring by providing examples of events that are impossible, possible, or certain from personal contexts.** **E.g. 1.** Describe each outcome using words like: impossible, possible, or certain. i. The dog will fly tomorrow (impossible). ii. Someone in the class would be a teacher in the future (possible). iii. Ghana will still be an African country tomorrow (certain). **E.g. 2.** Ask learners to work in groups to discuss the outcome of the following events using words like: impossible, possible, or certain A. A coin lands heads side up. B. The day after Monday will be Tuesday. C. A new-born baby will be a girl. D. It will rain in Winneba in the first week of January.	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Personal Development and Leadership (PL)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Demonstrate a sense belongingness to a group **(PL5.2)** • Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.4.2.1.2 Classify the likelihood of a single outcome occurring in a probability experiment as impossible, possible, or certain **E.g. 1.** Discuss the following outcomes of throwing a dice using words like impossible, possible, or certain. A. Obtaining the number 1 B. Obtaining the number 7 C. Obtaining the number 4  **E.g. 2** Discuss the following outcomes of throwing two dice using words like *impossible*, *possible*, or *certain.* A. Obtaining a total of 12 B. Obtaining a total of 2 C. Obtaining a total of 13 	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** • Implement strategies with accuracy **(CP6.7)** • Can appreciate the importance of including all team members in discussions and actively encourage contributions from them **(CC9.5)** • Identify words or sentences in context appropriately **(CC7.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B7.4.2.1.3 Calculate the probability of the event and express the probability as fractions, decimals, percentages and/or ratios.	**Critical Thinking and Problem solving (CP)**
	E.g. 1. Calculate the probabilities and complete the table.	• Implement strategies with accuracy **(CP6.7)**

Name:		Score:		
Probability with a single dice 				
The probability of rolling:	Fractions	Decimals	Percentages	Ratios
1. factors of 60	1			
2. a multiple of 3	$\frac{1}{3}$			
3. factors of 2	$\frac{1}{3}$			
4. divisors of 12	$\frac{\square}{\square}$	0.83		
5. a 3 or greater	$\frac{2}{3}$			
6. factors of 8	$\frac{\square}{\square}$			1:2
7. factors of 6	$\frac{2}{3}$			
8. divisors of 30	$\frac{5}{6}$			
9. a 3 or smaller.	$\frac{\square}{\square}$		50	

BASIC 8

STRAND 1: NUMBER

SUB-STRAND 1: NUMBER AND NUMERATION SYSTEMS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.1.1 Demonstrate understanding and the use of place value for expressing quantities in standard form and rounding numbers and decimals to significant figures and a given number of decimal places	**B8.1.1.1.1 Apply the understanding of place value to read and write in number quantities over 1,000,000,000.** **E.g. 1.** Read and write numbers in words and vice versa. (i) 2,408,321: Two million, four hundred and eight thousand, three hundred and twenty-one. (ii) the numeral part of the serial number on a currency note TD1567451, i.e., 1567451: One million, five hundred and sixty-seven thousand, four hundred and fifty-one.	**Communication and Collaboration (CC)** • Demonstrate behaviour and skills of working towards group goals **(CC9.1)**
	B8.1.1.1.2. Skip count forwards and backwards in 10,000s, 100,000s, 500,000s, etc. **E.g. 1.** Count forward in 500,000s up to the fifth number. (i) 200,000, 700,000, .. **E.g. 2.** Count backwards in 100,500s up to the fifth number. (I) 1,800,000, 1,699,500, 1,599,000, ..	
	B8.1.1.1.3. Compare and order whole numbers using ">, <, and =" **E.g. 1.** Identify numbers which are 100,000, 1,500,000, etc. more or less than given 8 to 9-digit number.	**Critical Thinking and Problem solving (CP)** • Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.1.1.1.4 Express integers of any size into standard form **E.g. 1.** Write integers as a power of 10: (i) $1 = 10^0$ $10 = 10^1$ $100 = 10^2$ $1000 = 10^3$ **E.g. 2.** Write multiples of 10 in standard form: (I) $10 = 1 \times 10$ $100 = 1 \times 10^1$ $1000 = 1 \times 10^3$ etc. **E.g. 3.** Write integers in standard form: (i) $26 = 2.6 \times 10$ (ii) $375 = 3.75 \times 10^2$ (iii) $8{,}765{,}049 = 8.765049 \times 10^6$	**Critical Thinking and Problem solving (CP)** • Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)**
	B8.1.1.1.5 Express integers in a given number of significant and decimal places **E.g. 1.** Express any given integer to a given number of significant figures. (i) Express 56734 correct to two significant figures as 57000. **E.g. 2.** Express 975.8674, correct to (i) two decimal places; (ii) three decimal places.	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.1.1.1.6 Create and solve word or real-life problems on place values **E.g. 1.** Solve word or story problems. (i) Adom earns Gh¢2500.00 a month after tax and his elder brother Arko earns three times as much. How much is their total income after five years if there are no increases in their earnings?	**Creativity and Innovation (CI)** • Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)**
B8.1.1.2 Apply the concepts and vocabulary of sets on sets of factors of numbers to identify perfect squares, determine their square root and solve real life problems involving union and intersection of two sets	**B8.1.1.2.1. Use the concept of sets to identify perfect squares and determine the square roots. Use the knowledge on sets and sets of factors of numbers to solve problems** **E.g. 1.** Identify perfect squares or perfect numbers. (i) List sets of multiples of numbers and identify a set of perfect numbers among them 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, … 2, 4, 6, 9, 12, 16, 18, … 4, 8, 12, 16, 20, 24, … Perfect squares 4, 9, 16, 25, 36, ….. **E.g. 2** Use the knowledge on odd numbers to determine the square root of perfect numbers. (i) Determine the square root of 49. Think subtract the consecutive odd numbers starting from 1 from 49 until the remainder is zero. Then count the number of odd numbers subtracted as the square root of the given number.	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Ability to select alternative(s) that adequately meet selected criteria **(CP6.5)**

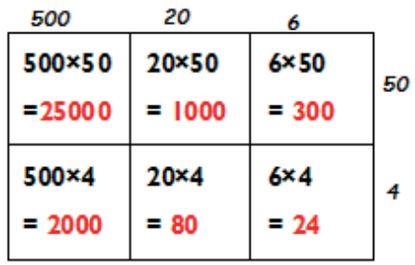
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.1.1.2.2. Use the knowledge on sets and sets of factors of numbers to solve real life problems involving union and intersection **E.g. 1.** Identify the set of factors of given numbers. (i) List the factors of 42 and 36 and determine their common factors: 42: 1, 2, 3, 6, 7, 14, 21 and 42 36: 1, 2, 3, 4, 6, 9,12,18 and 36 The common factors: 1, 2, 3 and 6. **E.g. 2.** Solve story and real-life problems involving union and intersection of sets (i) There are 80 farmers in a certain village who grow maize and rice or both. Out of the 80 farmers, 50 grow maize and 60 grow rice. (a) Represent the information on a Venn diagram. (b) If *x* of them grow both crops, write an equation in *x* and solve for it.	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Ability to select alternative(s) that adequately meet selected criteria **(CP6.5)**

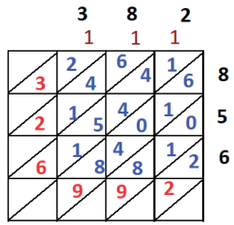
STRAND 1: NUMBER

SUB-STRAND 2: NUMBER OPERATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.2.1 Apply mental mathematics strategies and number properties used to solve problems	**B8.1.2.1.1 Multiply and divide by power of 10 including decimals and the benchmark fractions** **E.g. 1.** Recall multiplication facts up to 144 and related division facts. **E.g. 2.** Recall decimal names of the benchmark fractions converted to decimals or percentages (and vice versa). **E.g. 3.** Determine a product when a decimal number is a multiple of 10, 100, 1000, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ etc. **B8.1.2.1.2 Apply mental mathematics strategies and number properties to do calculation** **E.g. 1.** Apply halving and doubling to determine the product given product of two given numbers.	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
	B8.1.2.1.3 Apply mental mathematics strategies to solve word problems. **E.g. 1.** Play mental maths word games. **E.g. 2.** Play mental maths word games: This should provide opportunities for learners to use mental strategies, short methods and sundry tables to develop fluency in solving problems.	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.2.2 Apply the understanding of the addition, subtraction, multiplication and division of (i) whole numbers within 10,000, and (ii) decimals up to 1/1000, to solve problems and round answers to given decimal places.	**B8.1.2.2.1 Add and subtract more than four-digit numbers.** **E.g. 1.** Use partitioning (or expanded form) and place value system to add and subtract whole and decimal numbers. (i) Add 896854 and 76329 896854 = 800,000 + 90000 + 6000 + 800 + 50 + 4 +76329 = 70000 + 6000 + 300 + 20 + 9 973183 = 900000 + 70000 + 3000 + 100 + 80 + 3 (ii) Add 3627.6 and 854.13 3627.60 + 854.13 = 3000 + 600 + 20 + 7 + $\frac{60}{100}$ + 800 +5 0 +4 + $\frac{1}{10}$ + $\frac{3}{100}$---- 3000 + 800 + 600 + 20+ 50 + 7 + 4 + $\frac{60}{100}$ + $\frac{1}{10}$ + $\frac{3}{100}$---- = 3000+1400+ 70+ 11+ $\frac{7}{10}$ + $\frac{3}{100}$ 3000 + (1000 + 400) + 70 + (10+1) + $\frac{70}{100}$ + $\frac{3}{100}$ 4481.73 4000 + 400 + 80 +1 + $\frac{73}{100}$	**Critical Thinking and Problem solving (CP)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)** • Ability to select alternative(s) that adequately meet selected criteria **(CP6.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	(iii) Subtract 37.85 from 193.60 $193.60 - 37.85 = 100 + 90 + 3 + \frac{6}{10} + \frac{0}{100} - (30 + 7 + \frac{85}{100})$ $= 100 + 90 + 3 + \frac{60}{100} - 30 - 7 - \frac{85}{100}$ $= 100 + 90 - 30 + 3 - 7 + \frac{60}{100} - \frac{85}{100}$ $= 100 + 60 - 7 + 3 + \frac{60}{100} - \frac{85}{100}$ $= 100 + 53 + 2 + \frac{160}{100} - \frac{85}{100}$ $155.75 = 155 + \frac{75}{100}$	
	B8.1.2.2.2 Multiply or divide multi-digit numbers by 2- and 3-digit numbers. **E.g. 1.** Use the area model (Expand and Box method) to multiply and divide efficiently.  $\therefore 526 \times 54 = 25{,}000 + 2{,}000 + 1{,}000 + 300 + 80 + 24$ $= 28{,}404$	• Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Multiply whole numbers using the vertical place value method: (i.e. 657 × 27 =) 657 × 27 4599 + 1314 17739 **E.g. 3.** Multiply whole numbers using the lattice method: That is to solve 382 × 856: Make a 3 by 3 lattice and set up the solution as follows: 382 × 856 = 326,992  **E.g. 3.** Use the distributive property to multiply 325 × 15 = 325 × (10 + 5) = (325 × 10) + (325 × 5) = 3,250 + 1,625 = 4,875 **E.g. 4.** Investigate and determine basic division facts including divisibility test (i) Determine how a given number is divisible by 3,4,5, 6, 7, 8,9,10, etc.	

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<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
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B8.1.2.2.3. Create and solve story problems involving decimals on the four basic operations.
E.g. 1. Solve word problems
i) Kofi bought 8 notebooks at GH₵12.00 each. Ama bought 12 pens at GH₵ 5.00 each. How much altogether they spend on the items?
ii) A man gave an amount of GH₵ 2477.25 to be shared equally among his three children. How much did each receive?
iii) On Adwoa's birthday, the father bought her a pack of chocolate containing 250 bars. If Adwoa took 90 bars of the chocolates and gave the rest to her four friends to share equally, how many bars of chocolates did each receive?
iv) Mrs Yaboi bought 25.25 metres of cloth for her five children. If they share the material equally, how many metres of cloth did each receive?

E.g. 2. Solve word problems on data presented in a table.
i) In preparation towards a speech day celebration, a school's management committee approved the following budget on some projects:
<table>
<tr><th>Activity</th><th>Cost (GH₵)</th></tr>
<tr><td>Painting school building</td><td>2,940.00</td></tr>
<tr><td>Mending cracks on the netball pitch</td><td>4,250.00</td></tr>
<tr><td>Restock the computer laboratory with new computers</td><td>9,990.00</td></tr>
<tr><td>Buying of new cadet uniforms</td><td>8,740.00</td></tr>
<tr><td>Buying prizes for awards</td><td>5,270.00</td></tr>
</table>
(a) How much was approved for painting the school building and buying of new cadet uniforms?
(b) How much less was to be spent on mending the cracks on the netball pitch than restocking the computer lab with new computers?
(c) How much was spent on buying prizes for awards if twice the amount approved was spent on this activity?
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Communication and Collaboration (CC); Creativity and Innovation (CI)
• Exhibit strong memory, intuitive thinking; and respond appropriately (CI6.1)
• Explain ideas in a clear order with relevant detail, using correct construction and structure of speech (CC8.2)
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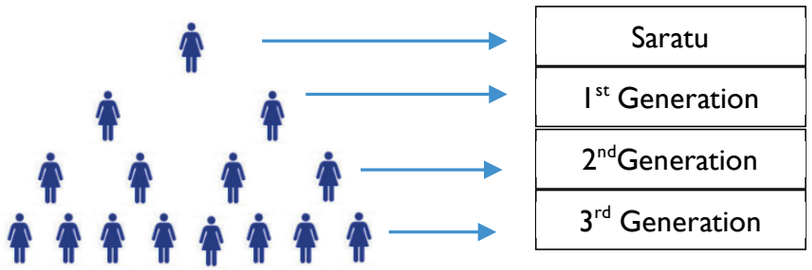
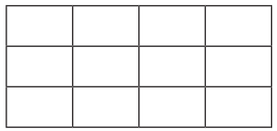
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.2.3 Demonstrate understanding and the use of the laws of indices in solving problems (including real life problems) involving powers of natural numbers	**B8.1.2.3.1 Identify and explain the laws of indices** **E.g. 1.** State the Laws of Indices. For real numbers m, n and valid bases a, b, the following basic laws hold i. Law1: $a^m \times a^n = a^{(m+n)}$ ii. Law 2: $\frac{a^m}{a^n} = a^{(m-n)}$ For applying the above Law, if we choose both $m = 1$ and $n = 1$, then we get: $\frac{a^1}{a^1} = a^{(1-1)} = a^\circ = 1$ iii. Law 3: $(a^m)^n = a^{m \times n} = a^{mn}$ iv. Law 4: $(ab)^n = a^n b^n$	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Creativity and Innovation (CI)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
	B8.1.2.3.2 Apply the laws of indices to simplify and evaluate numbers involving powers of numbers. (PEDMAS) **E.g. 1.** Use the laws of indices to solve problems involving powers of number. i) Simplify $2^5 \times 16^2$ ii) Simplify $\frac{27}{3^2}$ iii) Simplify $y = x^{(a-b)} \times x^{(b-c)} \times x^{(c-a)} \times x^{(-a-b)}$ iv) Simplify and evaluate $(\frac{16}{81})^{-\frac{3}{4}}$ v) Evaluate $(5^2)^3$	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.1.2.3.3 Solve exponential equations **E.g. 1.** Solve these equations i. $25 = 5^{2x}$ ii. $2x^{+3} = 16$ iii. $\frac{2^5}{2^3} = 2^{2x}$ iv. $\frac{1}{27} = 3^x$	• Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event **(CP5.10)**
	B8.1.2.3.4 Solve real life problems involving powers of natural numbers. **E.g. 1.** Solve real-life problems on populations. While studying her family's history, Saratu discovers records of ancestors 12 generations back. She wonders how many ancestors she has had in the past 12 generations. She starts to make a diagram to help her figure this out. The diagram soon becomes very complex.  i. Make a table and a graph showing the number of ancestors in each of the 12 generations. ii. Write an equation for the number of ancestors in a given generation n.	• Exhibit strong memory, intuitive thinking; and respond appropriately **(CI6.1)** • Explain ideas in a clear order with relevant detail, using correct construction and structure of speech **(CC8.2)**

STRAND 1: NUMBER

SUB-STRAND 3: FRACTIONS, DECIMALS AND PERCENTAGES

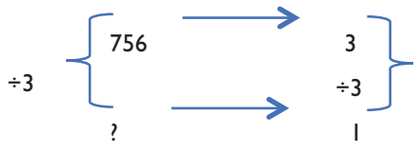
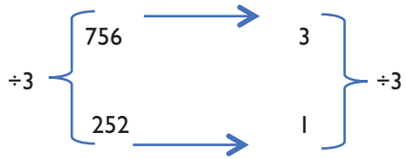
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.3.1 Apply the understanding of operation on fractions to solve problems involving fractions of given quantities and round the results to given decimal and significant places	**B8.1.3.1.1 Review fractions and solve problems involving basic operations on fractions** **E.g. 1.** Review the concept of fractions.  i. Shade given fraction of squares in a shape or find the fraction shaded in the shape: i.e. shade $\frac{3}{4}$ of the rectangle. ii. Write down 3 fractions equivalent to $\frac{2}{3}$ iii. Express the fraction $\frac{6}{10}$ in its simplest form. iv. Express $\frac{12}{5}$ as a mixed number. v. Express $2\frac{5}{9}$t as an improper fraction. **E.g. 2.** Review the basic operations on fractions. i. Adding and subtracting fractions. Work out answers to the following: a) $\frac{3}{4}+\frac{7}{8}$ b) $\frac{4}{5}-\frac{1}{6}$ ii. Multiplying and dividing fractions. Work out answers to the following: a) $\frac{2}{3}\times\frac{3}{4}$ b) $\frac{5}{2}\div 2\frac{1}{2}$	**Critical Thinking and Problem solving (CP)** • Create simple logical ideas to think through problems **(CP5.3)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

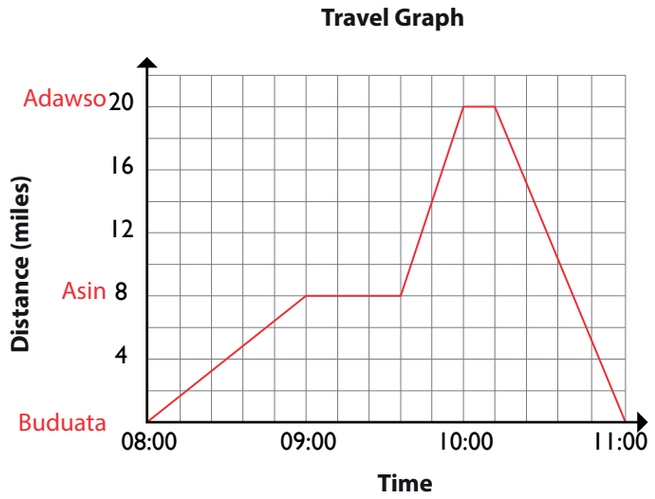
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.1.3.1.2 Add and/or subtract, multiply and/or divide given fractions, by using the principle of the order of operations (the rule of BODMAS or PEMDAS), and apply the understanding to solve problems. **E.g. 1.** . Use the order of operations (BODMAS or PEDMAS) to simplify whole number expressions with more than two operations. PEDMAS is Parenthesis, Exponents, Multiply/Divide (going from left to right), Add/Subtract (going from left to right). i. $21 \div 3 + (3 \times 9) \times 9 + 5$ ii. $18 \div 6 \times (4 - 3) + 6$ iii. $3^4 \div 9 + 40 - 2^3 \times 3^2 \div 9$ **E.g. 2.** Use the order of operations (BODMAS or PEDMAS) to simplify whole number expressions with more than two operations. a) $\frac{3}{4} + \frac{5}{8} \times \frac{4}{5} - \frac{1}{6}$ b) $\frac{3}{4} \div \frac{5}{8} + (\frac{4}{5} - \frac{1}{2})$ c) $(\frac{3}{4} + \frac{5}{8}) \times \frac{4}{11} - \frac{1}{2}$	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**
	B8.1.3.1.3. Review word problems involving basic operations on fractions and related concepts. **E.g. 1.** Solve word problems involving fractions. i. Determine the (i) perimeter and (ii) area of a rectangle whose sides measure $1\frac{1}{3}$cm by $3\frac{3}{4}$cm. ii. Faako answers 42 out of 60 questions correctly. What percentage of her answers are correct? iii. In a school $\frac{2}{3}$ of the students eat from the school feeding programme, bring their packed lunch, and the rest go home to eat. What fraction of the students go home for lunch? iv. Esi and Fusena prepared an orange drink by mixing orange squash and water. Esi's drink was made of $\frac{2}{7}$ orange squash and Fusena's was made up of $\frac{1}{4}$ orange squash. Whose drink tastes stronger of orange?	• Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event **(CP5.10)**

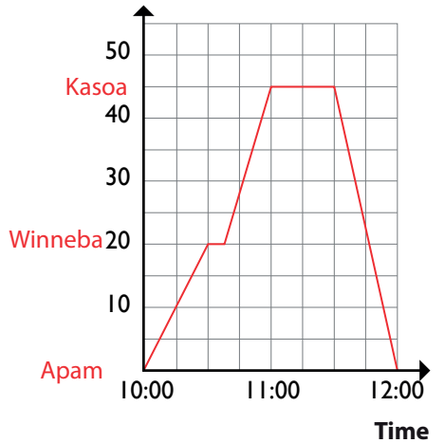
STRAND 1: NUMBER

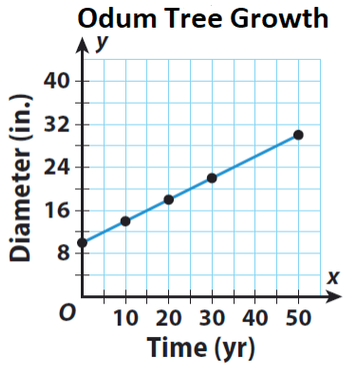
SUB-STRAND 4: NUMBER - RATIOS AND PROPORTION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.4.1 Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems	**B8.1.4.1.1 Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.**	**Critical Thinking and Problem solving (CP), Creativity and Innovation (CI), Personal Development and Leadership (PL)**
	E.g. 1. Convert (cm to m; km to m; mm to cm; etc.) one unit of measure to another using ratio reasoning. • 1m = 100cm is a conversion factor, and we can write from it the ratios $\frac{1\,m}{100\,cm}$ and $\frac{100\,cm}{1\,m}$, with each being equivalent to 1. Then, to convert a measurement in metres into centimetres, we can multiply it by the ratio 1m/100cm. **E.g. 2.** Manipulate and use units appropriately to solve problems. • Agbo walks 4km to school every day. He uses 60 minutes. Rukiya uses 45 minutes to cover 4200m. Which of the two learners is faster?	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
	B8.1.4.1.2 Solve unit rate problems including those involving unit pricing and constant speed; and speed translation. **E.g. 1.** If it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Salamatu is a drummer for a band. She burns 756 calories while drumming for 3 hours. She burns the same number of calories each hour. How many calories does Salamatu burn per hour? **Solution** • The ratio of calories burned to hours drumming is 756:3. • Let's find an equivalent ratio that shows how many calories are burned in 1 hour. • A ratio where one of the terms is 1 is called a unit rate. We can divide the number of hours by 3 to get to 1 hour.  756 ÷ 3 = 252 Calories burned hours  Salamatu burns 252 calories per hour of drumming.	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
Notes: put a passage for the graph	**B8.1.4.1.3 Apply the knowledge of speed to draw and interpret travel graphs or distance-time graphs.** **E.g. 1.** Draw a graph for a passage on a distance time graph. i) A trader travels in a car from Buduata to Adawso. The distance between the two towns is 20 miles. After 60 minutes, the trader makes a stop at Assin which is 8 miles from Buduata. 36 minutes later, he continues his journey to Adawso in 24 minutes. After resting for 12 minutes, he makes a return journey to Buduata in 48 minutes.  (a) How long at Asin? 36 mins or 0.6 hr (b) How far is it from Asin to Adawso? 12 miles (c) Average speed from Asin to Adawso? S = d/t = 12/0.4 =30 mph (d) Average speed on return journey? S = d/t = 20/0.8 = 25 mph (e) Average speed for whole journey? S = d/t = 40/3 = $13\frac{1}{3}$ mph	Implement strategies with accuracy (CP) **(CP6.7)** Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

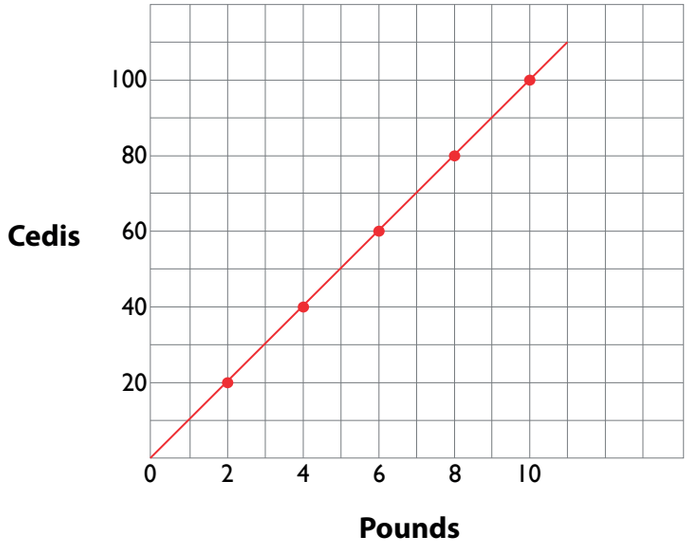
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Interpret a given travel graph  (a) Time of arrival at Winneba. 10:30 (b) Distance from Apam to Kasoa. 45 km (c) How long at Kasoa? 30 mins (d) Average speed: Apam to Kasoa. S = d/t = 45/1 = 45 km/hr (e) Average speed: return journey. S = d/t = $40/\frac{1}{3}$ = 90 km/hr	
	B8.1.4.1.4 Recognise and represent proportional relationships between quantities by deciding whether two quantities are in a proportional relationship. (e.g. by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin). **E.g. 1.** Use given tables to check proportional relationships. Proportional Time (min.) / Distance (ft.): 0/0; 2/6; 4/12; 6/18 $\frac{2}{6} = \frac{6}{18}$ Ratios are equivalent. Non-Proportional Time (min.) / Distance (ft.): 0/4; 2/10; 4/16; 6/22 $\frac{1}{5}$ $\frac{2}{10} \neq \frac{6}{22}$ $\frac{3}{11}$ Ratios are not equivalent.	• Ability to monitor team members to ascertain progress**(PL6.5)** • Ability to try new alternatives and different approaches**(CI5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Use graphs to check proportional and non-proportional relationship  The graph shows a non-proportional relationship because the straight line does not go through the origin.	
	B8.1.4.1.5 Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. **E.g. 1.** We can find the constant of proportionality from a table of values, equations and a graph. In a table, simplify any one of the ratios. Chaperones: 1, 2, 3, 4, 5 Students: 12, 24, 36, 48, 60 $K = \frac{y}{x} = \frac{36}{3} = 12$ **E.g. 2.** An ant travels $\frac{9}{8}$ inches in 45 seconds and $\frac{27}{8}$ inches in 2 minutes and 15 seconds. What is the constant of proportionality?	• Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 3.

Ratio is constant for all points on the graph 1:10. So the constant of proportionality (k) = 10

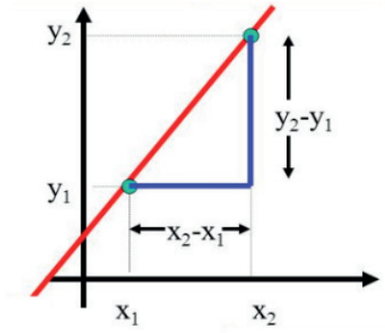


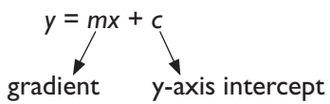
Create a table using the points from the graph.

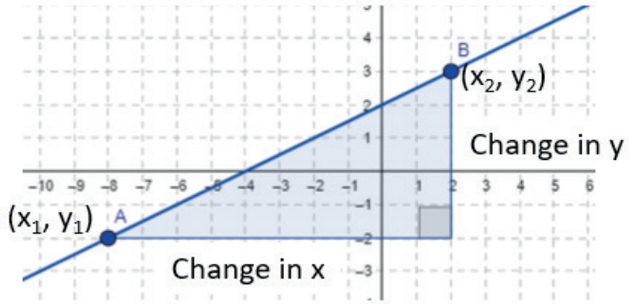
Total price (y)	**20**	**40**	**60**	**80**	**100**
Total pounds (*x*)	2	4	6	8	10
Divide total price by total pounds	10	10	10	10	10

STRAND 2: ALGEBRA

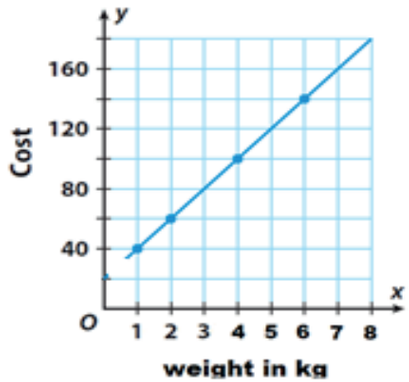
SUB-STRAND 1 PATTERNS AND RELATIONS

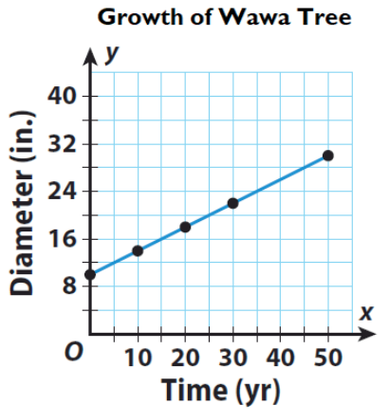
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.2.1.1 Demonstrate the ability to draw table of values for a linear relation, graph the relation in a number plane, determine the gradient of the line and use it to write equation of a line of the form y = mx + c.	**B8.2.1.1.1 Calculate the gradient of a line and use it to write equation of a line of the form y = mx + c.** **E.g. 1** Explain the concept of gradient using real life examples and to discover the practical meaning of gradient.   The gradient is the measure of how steep the hill the rider is climbing is(left picture). The gradient is the slope (or steepness) of the roofing of the building (right picture). **E.g. 2.** Determine the formula for calculating the gradient of a line.  The formula for calculating the gradient of a straight line is given as: $\frac{\triangle y}{\triangle x} = \frac{y_2 - y_1}{x_2 - x_1}$	**Critical Thinking and Problem solving (CP)** **Personal Development and Leadership (PL)** **Creativity and Innovation (CI)** Generate hypothesis to help answer complex problems **(CP5.4)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Determine the gradient when given two coordinates. Find the gradient of a line which passes through the point; i. A(1,1) and B(7,2) ii. P(-2,4) and Q(3,5) iii. C(3,-2) and D(-3,4) **E.g. 4.** Determine the gradient of a straight line when its equation is given.  Find the gradient from the equations of the straight lines below: i. $y = 5x + 13$ ii. $2x - 8y + 3 = 0$ iii. $y = -3x + 12$	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 5. Determine the gradient from a graph.  Gradient = $\frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{Change in y}}{\text{Change in x}}$ Determine the gradient of the line in the graph. From the graph, the coordinates are A (-8,-2), B (2,3). $m = \frac{-2-3}{-8-2} = \frac{-5}{-10} = \frac{1}{2}$ The gradient of the line is $\frac{1}{2}$	
	E.g. 6 Determine the slope-intercept form of the equation of a straight line **Hint: The equation of a straight line in slope-intercept form is $y = mx + c$** i. Find the equation of a line with slope 2 and *y*-intercept -3. Hence find the value of *y* when *x* is 4. ii. Find the equation of a line in slope-intercept form having *y*-intercept $\frac{7}{2}$ and slope $-\frac{5}{2}$ iii. Find the equation of a line with slope $\frac{1}{2}$ and *y*-intercept 4.	• Ability to monitor team members to ascertain progress **(PL6.5)** • Ability to try new alternatives and different approaches **(CI5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 7 Determine the point-slope form of the equation of a straight line **Hint: The point-slope form of the equation of a straight line is $y-y_1 = m(x-x_1)$** i. Find the equation of a line with slope $\frac{2}{3}$ that passes through the point (3, -1). ii. Find the equation of a line that passes through the point (3, -7) and has the slope $m = \frac{5}{4}$ iii. Find the equation of a line which passes through the points (5, 4) and (-10,-2). iv. Write the equation $5x + 4y - 3 = 0$ in the form. Hence state the gradient and the intercept.	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.2.1.1.2 Use graph of a linear relation to determine subsequent missing elements in the ordered pairs of the relation. **E.g. 1.** Use information from a graph to find missing elements  The graph represents the relation $y = 20x$, where y is the cost (in Ghana cedis) of the weight (in kilograms) of meat sold in a market. Use the graph to find: i. the cost of 3.5kg of meat ii. the weight of meat that can be bought with GH¢80.00. iii. Using the relation from the graph, how many kilograms of meat can be bought at a cost of GH¢240.00?	• Ability to monitor team members to ascertain progress **(PL6.5)**

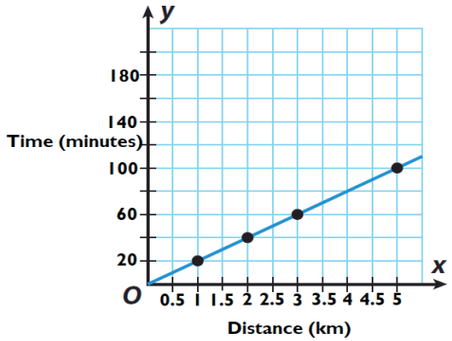
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Use information from a graph to find missing elements:  The diameter of a Wawa tree is currently 10 inches when it is measured at chest height. After 50 years, the diameter is expected to increase by an average growth rate of $\frac{2}{5}$ inch per year. The equation $y = (\frac{2}{5})x + 10$ gives you y, the diameter of the tree in inches, after x years. i. Use the graph to complete the table below. ii. What will be the diameter of the tree in 100 years?	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

x (years)	0	10	20	30	50
Y(diameter in inches)					

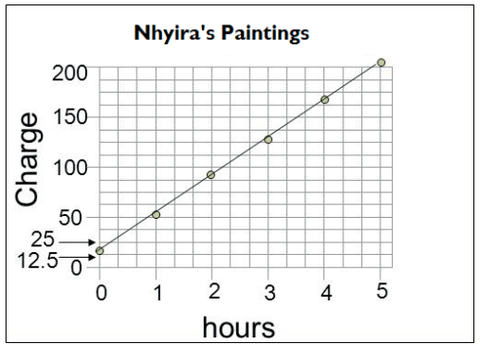
	B8.2.1.1.3 Use graphs of linear relations to solve real life problems. **E.g. 1.** Draw graphs for real life problems. i. Every morning, you go for a walk. The distance you walk can be modelled by the equation $d = \frac{1}{3}h$ where d is the distance walked in kilometres and h is the number of hours you've walked. Make a table for the relation and draw a graph with the values to see how far you've walked after 6 hours.	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	Copy and complete the table for the relation:	

Distance	1	2	3	4	5
Time					



E.g. 2. Nhyira paints portraits of people for a living. The graph below shows how much she charges based on how long it takes her to paint the portrait. Use the graph to answer the questions that follow.



i. How much does she charge for a portrait that takes 3 hours to paint?

ii. If she charges GH¢175.00, how many hours did she use to paint the portrait?

iii. How many hours will she require to paint a portrait that costs GH¢300.00?

- Ability to monitor team members to ascertain progress **(PL6.5)**

STRAND 2: ALGEBRA

SUB-STRAND 2 ALGEBRAIC EXPRESSIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.2.2.1 Solve problems involving algebraic expressions (including multiplication of binomial expressions) factorise given expressions and substitute values to evaluate algebraic expressions.	**B8.2.2.1.1 Use the distributive property to remove brackets and solve multiplication of binomial expression.** **E.g. 1.** Expand these expressions: • $6(x + 3)$ • $-5x(3x + 4)$ • $3(x + 4) - 2(x - 5)$ • $2(6 - 5x) - 3(2 + 2x) - 4(3x - 1)$ • $8 - (4 - d) - (6 - d)$ • $(e + f - g) - (e - f + g)$ **E.g. 2.** Multiply binomial expressions **Simplify** i. $(a + 2)(a + 3)$ ii. $(2x + y)(2x - y)$ iii. Multiply $(3x - 2y)$ by $(3x + 2y)$ iv. $(2x + 3)^2$ v. $(x - 2x)^2$ vi. $(a + 2)^2$	**Critical Thinking and Problem solving (CP)** **Creativity and Innovation (CI)** **Personal Development and Leadership (PL)** • Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.2.2.1.2 Perform addition, subtraction, multiplication and division of algebraic expressions including fractions. **E.g. 1** Solve problems based on multiplication and division of algebraic fractions. Simplify: a $\frac{a}{7}\times\frac{b}{8}$ b $\frac{p}{14}\times\frac{6}{p}$ c $\frac{x-3}{8}\times\frac{12}{x-3}$ d $\frac{5x^2}{x^2-2x}\times\frac{x^2-4}{x^2+2x}$ Simplify**:** a $\frac{3x-3}{4x-4}$ b $\frac{4x-8}{6}\div\frac{x-2}{3}$ c $\frac{x+1}{x+2}$ d $\frac{2x}{3}\div\frac{y}{5}$ **E.g. 2.** Solve problems based on addition and subtraction of algebraic fractions Simplify the following: i. $\frac{a-b}{3}+\frac{3a}{2}$ ii. $\frac{2a}{3}-\frac{a-b}{2}$ iii. $\frac{5}{6r}-\frac{3}{4r}$ iv $\frac{2x-1}{3}-\frac{x+3}{2}$ v. $\frac{3a+5b}{4}+\frac{a+b}{8}$ vi. $\frac{2x}{6}+\frac{2x-3y}{3}-\frac{x+y}{2}$	• Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)** • Demonstrate a sense belongingness to a group **(PL5.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.2.2.1.3 Substitute values to evaluate algebraic expressions including fractions and use these to solve problems. *if* $x = 2, y = -2, z = 3, c = 1$ *and* $d = -1$, Simplify, then substitute in the value to evaluate the following expressions: i. $\frac{3}{x+1} - \frac{2}{x-1}$ ii. $\frac{1}{x-1} + \frac{2}{x+1}$ iii. $\frac{12xy}{7} \times \frac{14}{20}$ iv $\frac{3ab}{15c^2d^2} \times \frac{10d}{9a^2}$ v. $\frac{6x^2 + 2xy}{5z} \times \frac{15z^2}{3x+y}$ vi. $5x + 7z^2 - 4d + 3y_2$	
	B8.2.2.1.4 Factorise given expressions involving the four operations and use the experiences gained to solve problems. **E.g. 1.** Factorise the following expressions. i. Common factors • $3ax + 6ay$ • $54 - 81x$ • $100x - 25x^2$ ii Method of grouping • $2ap + aq - bq - 2bp$ • $ab - by - ay + y^2$ • $3x^2 + 2xy - 12xy - 8yz$	• Ability to merge simple/ complex ideas to create novel situations or things **(CI5.2)**

STRAND 2: ALGEBRA

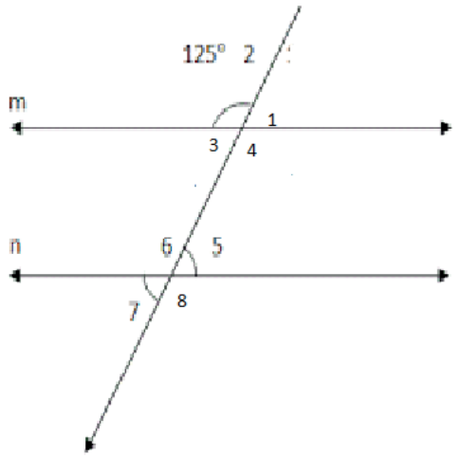
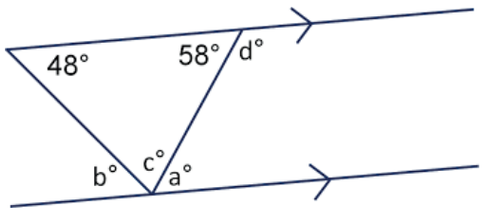
SUB-STRAND 3 VARIABLES AND EQUATIONS

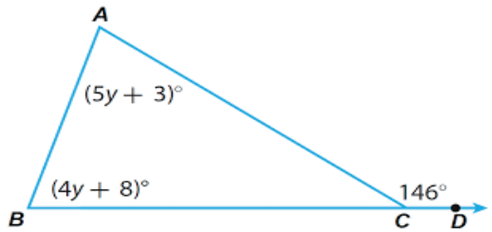
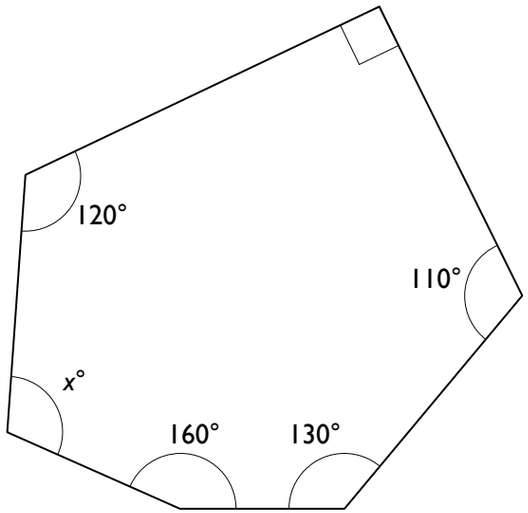
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.2.3.1 Demonstrate an understanding of linear inequalities of the form x + a ≥ b (where a and b are integers) by modelling problems as a linear inequalities and solving the problems concretely, pictorially, and symbolically.	**B8.2.3.1.1 Translate word problems into linear inequalities in one variable and vice versa** **E.g. 1.** Make mathematical sentences involving linear inequalities from word problems. i. Think of a whole number less than 17 i.e. $x < 17$ ii. Eight less than the product of –3 and a number is greater than –26. Write and solve an inequality to represent this relationship. i.e. $-3x - 8 > -26$ iii. Kwaakye's profit for March of GH¢ 32 was at least GH¢ 12 less than his February profit. What was his February profit? i.e. March profit was at least GH¢12 less than February's profit. GH¢$23 \geq -12 + p$	**Critical Thinking and Problem solving (CP)** **Creativity and Innovation (CI)** • Ability to visualise alternatives, see possibilities, and identify problems and challenges **(CI5.4)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	B8.2.3.1.2 Solve simple linear inequalities **E.g. 1.** Use the idea of balancing to solve simple linear inequalities. i. $x - 13 > 29$ ii. $4x - 9 > -5$ iii. $14 < 8 - 2x$ iv. $3x \leq 8 + x$ v. $x - 4 > 1$ vi. $10 - x < 12$ vii. $x - 3 \geq 2$ viii. $2x - 5 \leq 35 - x$	

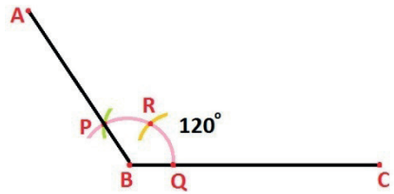
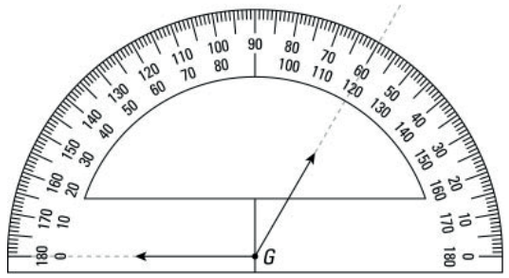
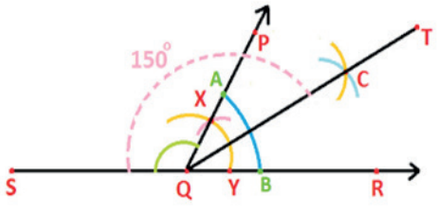
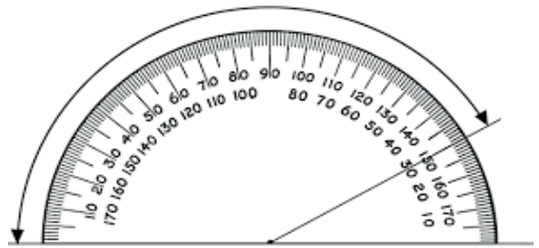
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.2.3.1.3 Determine solution sets of simple linear inequalities in given domains **E.g. 1.** Find solution sets for the following linear inequalities i. If $x < 4$ for whole numbers, then the domain is whole numbers and the solution set = {0, 1, 2, 3} ii. $2x > 24$ iii. $x + 4 \leq 3x - 16$ iv. $9 - 5x < 6$	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2)**

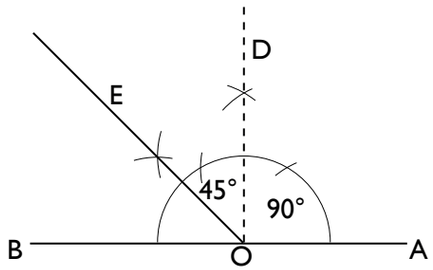
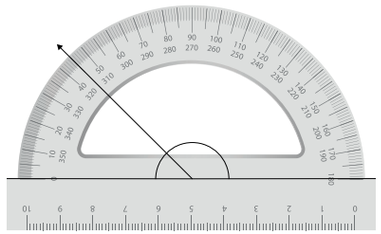
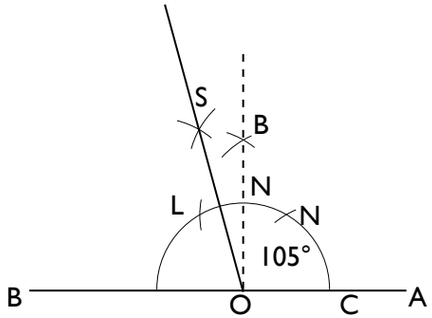
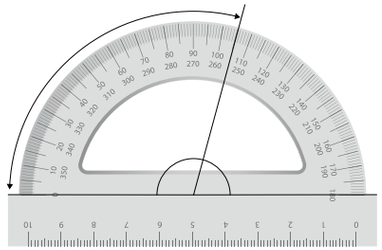
STRAND 3: GEOMETRY AND MEASUREMENT

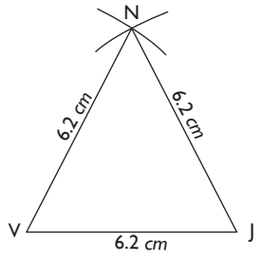
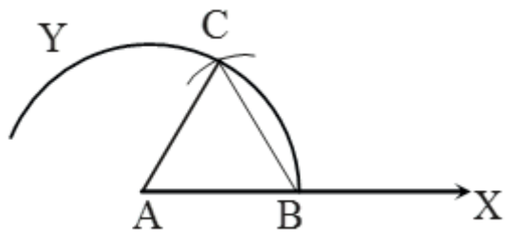
SUB-STRAND 1: SHAPES AND SPACE

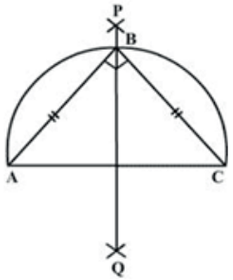
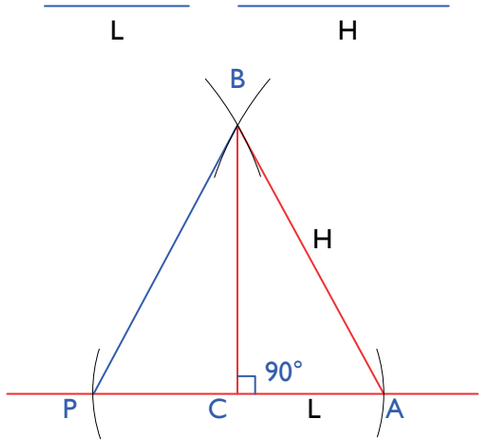
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.3.1.1 Demonstrate understanding and use of the relationship between parallel lines and alternate and corresponding angles and use the sum of angles in a triangle to deduce the angle sum in any polygon.	**B8.3.1.1.1 Draw and determine the values of alternate and corresponding angles** **E.g. 1.** Draw the diagram and calculate the values of the angles marked 1, 3,4,5,6,7,8  **E.g. 2.** Calculate the value of the angles a, b, c, and d  	**Creativity and Innovation (CI)** • Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)** • Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)**

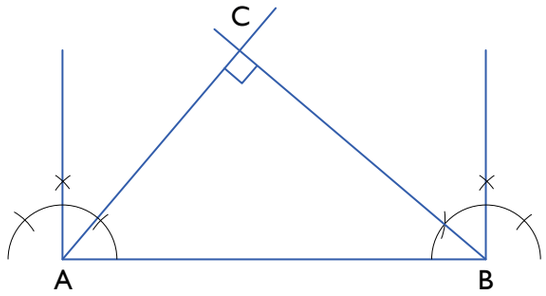
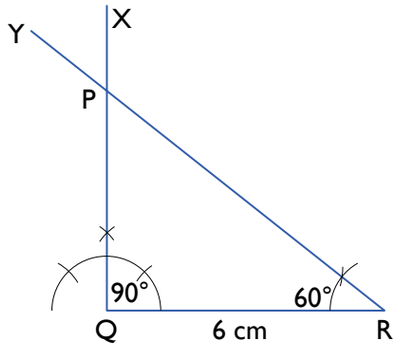
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.1.1.2 Determine the values of angles in a triangle using knowledge of the sum of interior angles in a triangle and other properties. **E.g. 1.** Calculate the values of *y* and the angles in the triangle  **E.g. 2.** Deduce the formula for the sum of interior angles in a polygon and determine the value of an angle in a regular hexagon. **E.g. 3.** Use the formula for finding the sum of interior angles in a polygon (n-2)180 to determine the value of *x* in the hexagon.  	• Imagining and seeing things in a different way **(CI6.4)**

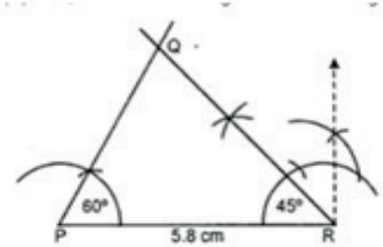
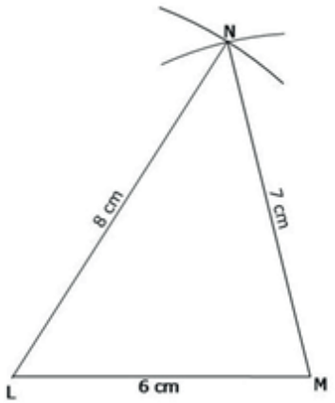
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (75°, 105°, 60°, 135° and 150°), and construct triangles and find locus of points under given conditions	**B8.3.1.2.1 Construct and bisect angles of 120°, 105°, 135° and 150°** **E.g. 1.** Use a pair of compasses and a ruler to perform geometric construction of an angle ($\angle CBA$) =120° [Draw a semi-circle over the point B to meet |BC| in Q and using the same radius and Q as centre to make the arcs R and P respectively) and confirm the value using a protractor.   **E.g. 2** Use a pair of compasses and a ruler to perform geometric construction of an angle of ($\angle SQC$) 150° and measure with a protractor to confirm.  	**Creativity and Innovation (CI)** • Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)** • Reflect on work and explore the thinking behind thoughts and processes **(CI6.10)**

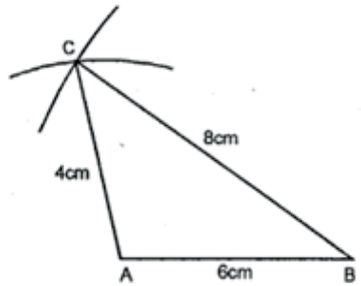
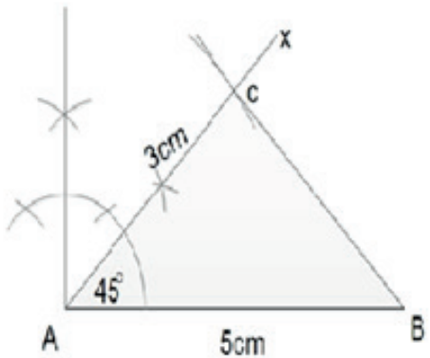
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Use a pair of compasses and a ruler to perform the geometric construction of an angle($\angle AOE$) 135° and measure with a protractor to confirm.   **E.g. 4.** Use a pair of compasses and a ruler to perform geometric construction of an angle of 105° and measure with a protractor to verify.  	
	B8.3.1.2.2: Construct scalene triangles, isosceles triangles, equilateral triangles, obtuse-angled triangle, and acute-angled triangles in different orientations under given conditions.	• Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)** • Reflect on work and explore the thinking behind thoughts and processes **(CI6.10)**

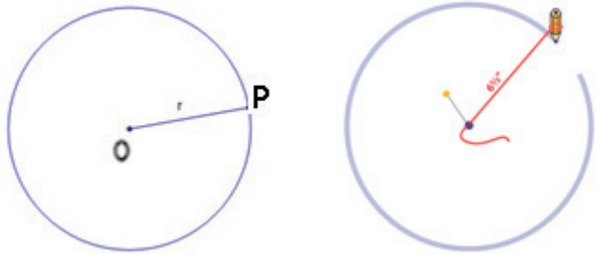
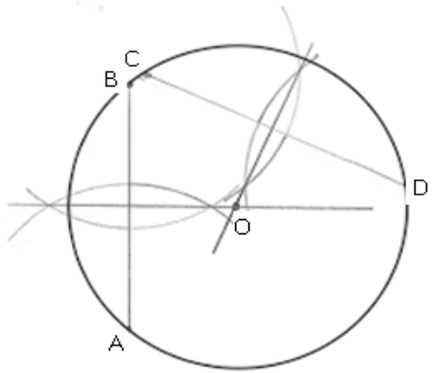
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 1. Use a pair of compasses and a ruler to construct an equilateral triangle when a side is given and justify why it is an equilateral triangle (i.e. draw the line segment *VJ* = 6.2*cm* and use this radius at V and J respectively to strike arcs to intersect in N. Verify the measure of the size of the angle with a protractor)  	
	E.g. 2. Use a pair of compasses and a ruler to construct an equilateral triangle by using point A as a centre and constructing an arc to meet in $\overrightarrow{AX}$ in B, and then using the same radius to incribe an arc (construct 60^0angle) at point C and joining A to C and B to C.  	

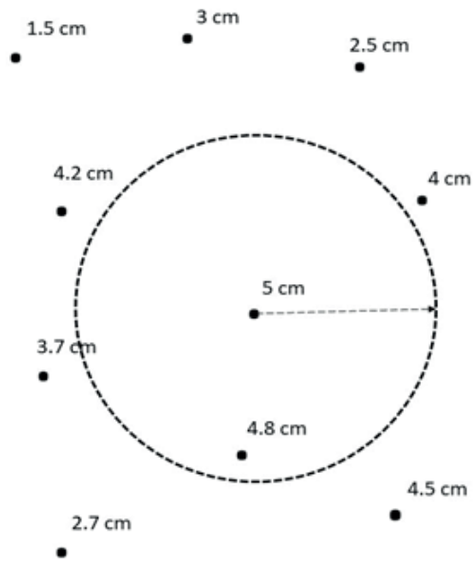
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Use a pair of compasses and a ruler to perform geometric construction of an isosceles right-angled triangle when the base line is given. In triangle ABC, PQ is a perpendicular bisector of AC=7cm, ABC is a semi-circle and BC=BA 	
	E.g. 4. Use a pair of compasses and a ruler to perform geometric construction of an isosceles triangle when all the sides are given. i.e. construct Triangle PAB, such that CA = CP = L = 3.5 cm. CB is a perpendicular bisector of PA. AB = PB = H = 9 cm. What can you say about <BAP and <BPA? 	

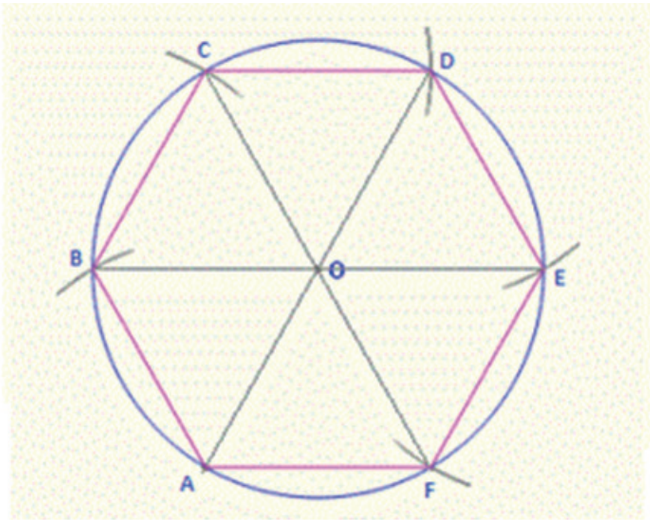
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 5. Use a pair of compasses and a ruler to perform geometric construction of an isosceles triangle when the base angles and base side are known. In triangle ABC, <CAB = <CBA = 45°, AB = 7 cm, find the length of AC and BC.  **E.g. 6** Use a pair of compasses and a ruler to construct acute-angled triangles, obtuse-angled triangles and right-angled triangles when a side and two angles are given. (In Triangle PRQ, QR = 6 cm, <PRQ = 60° and <PQR = 90°; Triangle PRQ is a right-agled triangle or a scalene triangle)  	

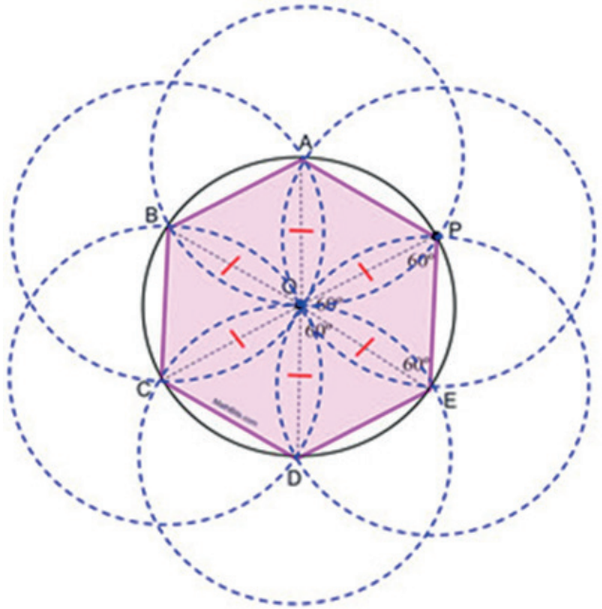
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	(In Triangle PRQ, PQ = 5.8 cm, <QPR = 60° and <QRP = 45°; Triangle PRQ is an acute angled triangle or scalene triangle)  **E.g. 7** Use a pair of compasses and a ruler to construct triangles when all the sides are given. i. Draw the line segment LM = 6cm. ii. Taking a radius of 8cm, draw an arc of circle with centre L. iii. Draw another arc of circle with centre M and radius 7cm to intersect the first arc. Name the point of intersection N. iv. Join the point L and N. Join the points M and N. hence triangle MNL is the required triangle.  	

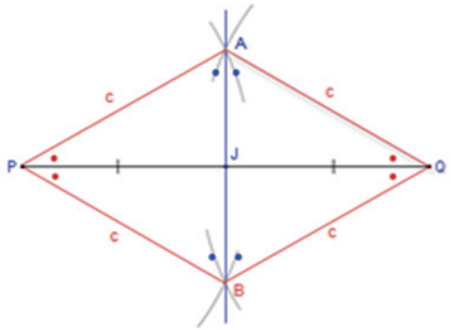
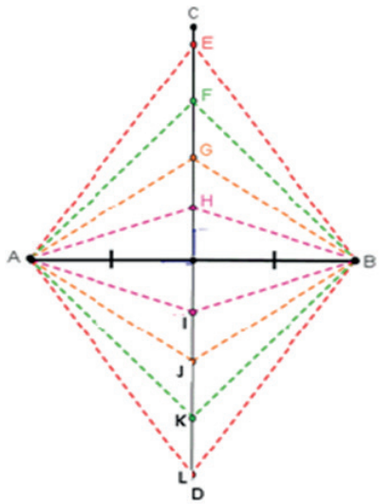
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	In triangle ABC, AC = 4cm, AB = 6cm and BC = 8cm. Measure the value of the angles (what is the name of this triangle?)  E.g.8 Use a pair of compasses and a ruler to construct triangles when two sides and one angle are given In triangle ABC, ∠CAB = 450, AC = 3cm and AB = 5cm  	

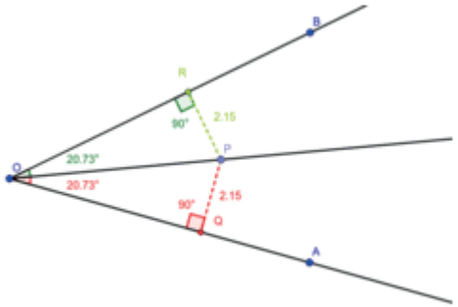
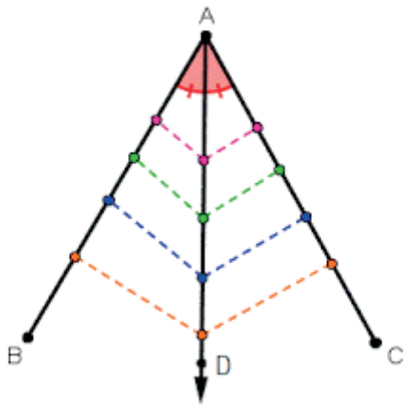
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.1.2.3: Construct loci under given conditions including: (i) the locus of sets of points from a fixed point; (ii) the locus of points equidistant from two fixed points; (iii) the locus of points equidistant from two intersecting straight lines, and (iv) the locus of points equidistant from two parallel lines. **E.g. 1.** Describe the locus of a circle by tracing the path of a point P which moves in such a way that its distance from a fixed point, say O, is always the same to construct circles.  **E.g. 2.** Perform geometric construction to locate the entre of a circle by locating the intersection of the perpendicular bisectors of any two chords on the circle. Find the centre of the circle 	• Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)** • Reflect on work and explore the thinking behind thoughts and processes **(CI6.10)**

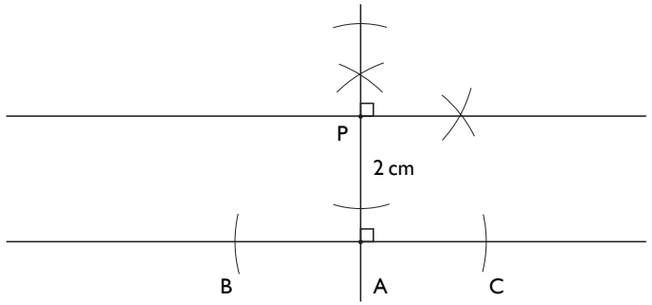
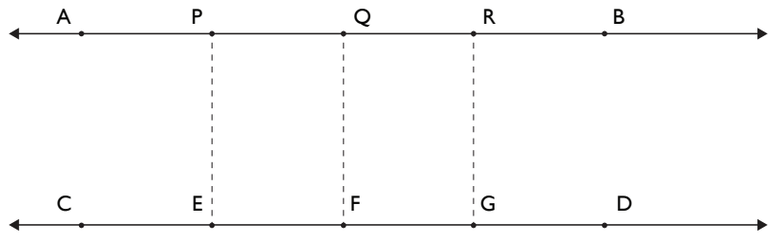
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Draw circles of given radii at the points as centre and chord.  	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Construct a regular hexagon within a circle given the length of a side. Use a pair of compasses and a ruler to construct a hexagon ABCDEF such that |AB| = 6cm. Find the measure of the angles AOB and compare its value to ∠*AFG*, ∠*DOE*, ∠*DOC*, ∠*EOF* and ∠*BOC*. What is your observation? 	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 5. Use intersecting circles to construct a regular hexagon and measure it sides. Perform geometric construction of hexagon ABCDEF using the method of intersecting circles. Take |OA| = 5cm. Measure and compare the sides of the hexagon. Find the measure of the angle AOB and compare its value to ∠*AFG*, ∠*DOE*, ∠*DOC*, *EOF* and ∠*BOC*. What is your observation?  	

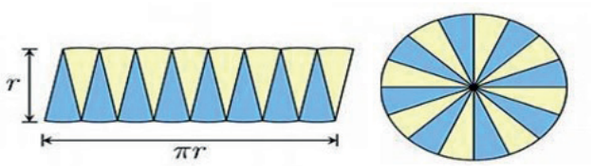
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 6. Construct a perpendicular bisector (mediator) as a locus and explain why the perpendicular bisector is a locus. The line segment AB is a perpendicular bisector of PQ since line segments **AP, AQ, PB, QB** are all congruent.  Any point on line CD is of equal distance from the two fixed points A and B.  	

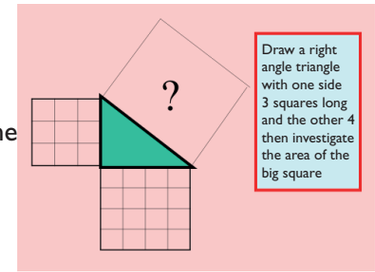
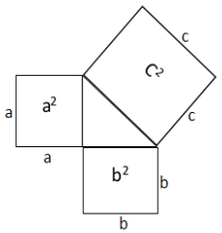
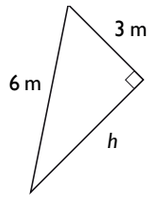
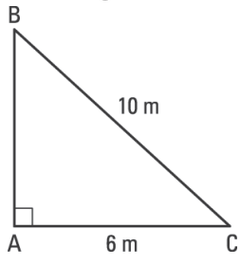
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 7 Construct an angle bisector as a locus of points equidistant from two lines that meet and explain why the angle bisector is a locus.  AD is a mediator (angle bisector) of the angle BAC 	

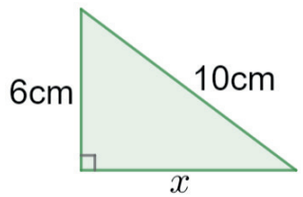
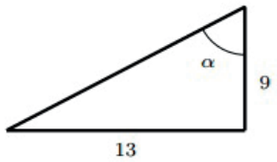
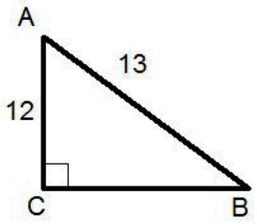
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 8 Construct parallel lines as a locus (i.e. tracing the path of a point say P which moves in such a way that its distance from line BC is always the same).  E.g. 9 Perform geometric constructions to prove that two given lines are parallel. Show that two given lines AB and CD are parallel (i.e. locate three points P, Q and R) draw perpendicular to AB at PQ and R to intersect CD at E, F and G respectively.  Measure the lengths of PE, QF, and RG. The perpendicular distance between two parallel lines is the same everywhere.	

STRAND 3 GEOMETRY AND MEASUREMENT

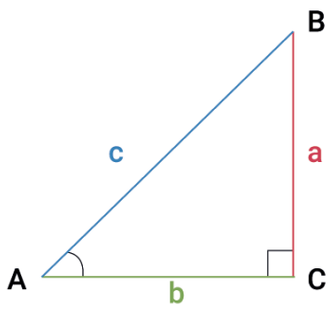
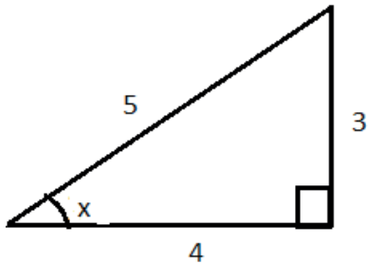
SUB-STRAND 2: MEASUREMENT

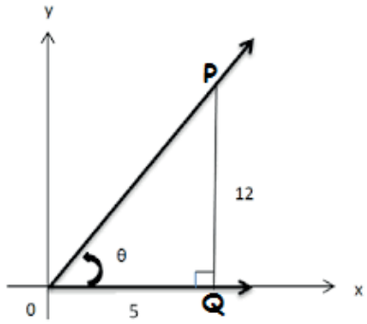
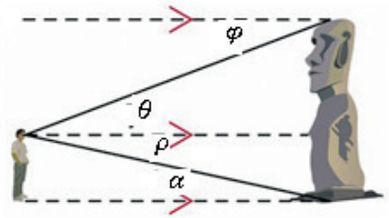
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.8.3.2.1 Apply the Pythagoras theorem, the primary trigonometric ratios and the formulas for determining the area of a circle to solve real problems	**B8.3.2.1.1 Use the relationship between the diameter and circumference of a circle to deduce the formula for finding its area, and use this to solve problems.**	**Critical Thinking and Problem solving (CP)** **Personal Development and Leadership (PL)**
	E.g. 1. Divide a circle into sectors (minimum of 16) then cut the sectors and arrange to form a rectangle to deduce the area of the circle. Thus, length of the rectangle = πr width = r  $\therefore A = \pi r \times r = \pi r^2$	• Create simple logical ideas to think through problems **(CP5.3)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**
	E.g. 2. Solve problems on area of a circle. i) Find the area of a circle whose radius is 14cm (Take $\pi = \frac{22}{7}$). ii) Find the area of a semi-circle whose radius is 7cm (Take $\pi = \frac{22}{7}$) iii) Two circles have a common centre; the small circle has radius 7cm, the big circle has radius 14cm. Find the shaded area. (Take $\pi = \frac{22}{7}$).	• Provide new insight into controversial situation or task **(CP5.7)**

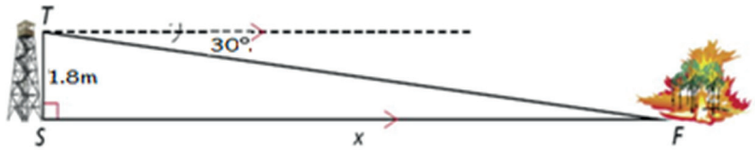
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.2.1.2 Establish the relationship between the hypotenuse '*c*' and the two other sides '*a*' and '*b*' of a right-angled triangle (i.e. $a^2 + b^2 = c^2$) and use it to solve problems.	
	E.g. 1. Construct squares on the three sides of a right-angled triangle in a square grid and compare the area of the square on the hypotenuse to the squares on the other two sides to state the relationship between the hypotenuse '*c*' and the two other **sides** '*a*' and '*b*' of a right-angled triangle i.e. $a^2 + b^2 = c^2$ 	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	E.g. 2 Using a pair of compasses and ruler, construct squares on the three sides of a right-angled triangle and measure the area of the square on the hypotenuse and compare to the squares on the other two sides to state the relationship between the hypotenuse '*c*' and the two other **sides** '*a*' and '*b*' of a right-angled triangle i.e. $a^2 + b^2 = c^2$. 	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2)**
	E.g. 3 Solve problems involving the Pythagoras theorem. i. Determine the missing side marked h in the figure. ii. Find the height AB.  	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.2.1.3 Use the Pythagorean theorem to solve problems on right-angled triangles. **E.g. 1.** An isosceles triangle has equal sides, 6cm long and a base of 4cm long. Find the altitude of the triangle. **E.g. 2.** Find the length of each of the diagrams indicated below:    i) the length x ii) the length CB iii) the longer length	• Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event **(CP5.10)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.2.1.4 Use the Pythagoras theorem to calculate the area of a triangle in real life problems. **E.g. 1.** A boat travels 2m south and then 9m east. How far is the boat from its starting point? **E.g. 2.** Yeboah hangs a picture frame of width 15cm on the wall. The distance from the nail to the edge of the picture frame is 10cm. (i) Find the length of the wire used to hang the picture frame. (ii) Find the area of the triangle. **E.g. 3.** A ladder leans against a vertical wall of height 13m. If the foot of the ladder is 6m away from the wall, calculate the length of the ladder. **E.g. 4.** The length of a side of an equilateral triangle is 12cm. Find: i. the height of the triangle ii. the area of the triangle iii. the perimeter of the triangle	• Ability to select alternative(s) that adequately meet selected criteria **(CP6.5)** • Ability to mentor peers **(PL6.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.2.1.5 Establish the relationship between the basic trigonometric ratios and solve problems involving right-angled triangles. **E.g. 1** Identify and recognise the three primary trigonometric ratios. i. Establish the sine, cosine and tangent of an angle in a right-angled triangle **SOH – CAH - TOA**  $\text{sine } of\ \angle A = \sin A = \frac{Opposite}{Hypotenuse} = \frac{a}{c}$ $\text{cosine } of\ \angle A = \cos A = \frac{Adjacent}{Hypotenuse} = \frac{b}{c}$ $\text{tangent } of\ \angle A = \tan A = \frac{Opposite}{Adjacent} = \frac{a}{b}$ i. Find sin *x*, cos *x* and tan *x* in the diagram  	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)** • Implement strategies with accuracy **(CP6.7)**

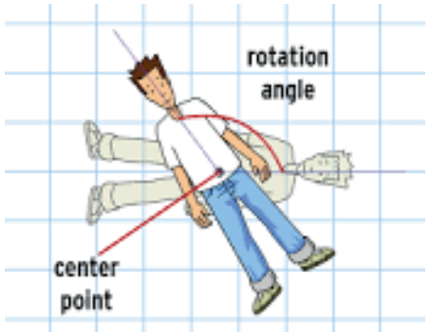
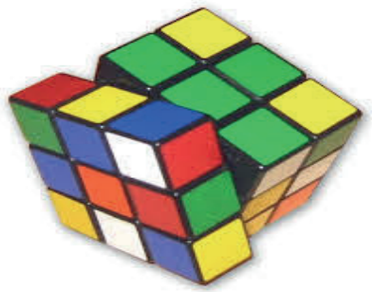
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	ii. Write two trignometric ratios of the angle marked θ in the diagram below:  **E.g.** 2 Explain the angles of elevation and depression in real life situations.  ii. Identify angles of elevation and depression from the diagram  	• Ability to help group work on relevant activities **(CC9.4)**

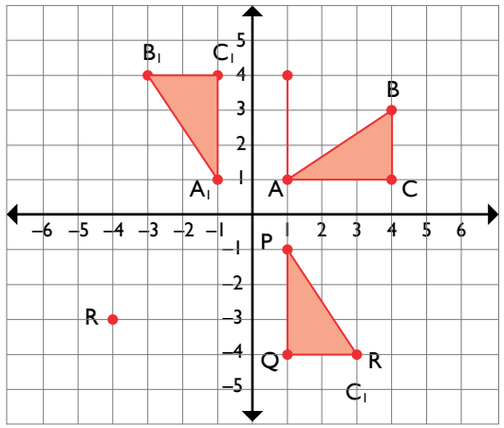
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Use trig ratios and the Pythagoras theorem to solve problems involving angles of elevation and depression. i. A hunter on top of a tower sees a fire at an angle of depression of 30°. The height of the tower is 18m. What is the distance between the fire and the hunter? Round off your answer to 2 significant figures.  	
B8.3.2.2 Demonstrate understanding of addition and subtraction of vectors and their applications in solving basic problems	**B8.3.2.2.1 Add, subtract and find the scalar multiplication of vectors in the component form.** **E.g. 1** Add vectors using the graphical method. **E.g. 2.** Add and subtract vectors in their corresponding components. If $\overrightarrow{AB} = \begin{pmatrix} a \\ b \end{pmatrix}$ and $\overrightarrow{BC} = \begin{pmatrix} c \\ d \end{pmatrix}$ then $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$ $= \begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a+c \\ b+d \end{pmatrix}$	**Critical Thinking and Problem solving (CP)** • Generate hypothesis to help answer complex problems **(CP5.4)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	If $\overrightarrow{AB} = \begin{pmatrix} a \\ b \end{pmatrix}$ and $\overrightarrow{BC} = \begin{pmatrix} c \\ d \end{pmatrix}$ then $\overrightarrow{AC} = \overrightarrow{AB} - \overrightarrow{BC}$ $= \begin{pmatrix} a \\ b \end{pmatrix} - \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a - c \\ b - d \end{pmatrix}$ **E.g. 3** Multiply a vector by a scalar $k\begin{pmatrix} x \\ y \end{pmatrix} = k\begin{pmatrix} kx \\ ky \end{pmatrix}$ **E.g. 4.** If p = $\begin{pmatrix} -1 \\ 2 \end{pmatrix}$, q = $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$, and r = $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$, find (i) 3q–2p (ii) r–3p (ii) q–p+2r	
	B8.3.2.2.2 Demonstrate understanding of vector equality. **E.g. 1.** Investigate the properties of equal vectors. i. If a= $\begin{pmatrix} 3 \\ 5 \end{pmatrix}$, b= $\begin{pmatrix} 7 \\ 2 \end{pmatrix}$ and c = $\begin{pmatrix} -3 \\ -4 \end{pmatrix}$, Calculate, if $\|p\|$= a + ½(b–c) ii. If M = N, find the value of *x* and *y* given that M= $\begin{pmatrix} x-2 \\ x-y \end{pmatrix}$ and N= $\begin{pmatrix} 1 \\ 2x-1 \end{pmatrix}$	• Generate hypothesis to help answer complex problems **(CP5.4)**

STRAND 3 GEOMETRY AND MEASUREMENT

SUB-STRAND 3: POSITION AND TRANSFORMATION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.3.3.1 **Perform a single transformation (i.e. rotation) on a 2D shape using graph paper (including technology) and describe the properties of the image under the transformation (i.e. congruence)**	**B8.3.3.1.1 Understand rotation and identify real-life situations involving rotation.** **E.g. 1**. Identify examples of rotation situations in everyday life and the nature of rotational movements as clockwise and anti-clockwise.  	**Critical Thinking and Problem solving (CP)** **Creativity and Innovation (CI)** **Digital Literacy (DL)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.3.3.1.2 Draw rotation image in a coordinate plane and determine the angle of rotation. **E.g. 1.** Rotate a shape through a given centre of rotation and angle of rotation using rotation rules. **E.g. 2.** Determine the angle of rotation using the points of an object, its images and centre. i. State the object points and its corresponding image points under a given rotation. ii. Draw points of shapes under a clockwise or anti-clockwise rotation through a given angle about the origin (90°, 180°, 270°).  	• Identification of requirements of a given situation and justification of more than one creative tool that will be suitable **(CI5.3)** • Ability to visualise alternatives, see possibilities, identify problems and challenges **(CI5.4)** • Ability to try new alternatives and different approaches **(CI5.5)**
	B8.3.3.1.3 Investigate the concept of congruent shapes. **E.g. 1.** Use multiple and varied examples of rotation on coordinate planes to verify congruent shapes based on their properties.	• Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)**

STRAND 4: HANDLING DATA

SUB-STRAND 1: DATA

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.4.1.1Select, justify, and use appropriate methods to collect data (quantitative and qualitative), use the data (grouped/ungrouped) to construct and interpret frequency tables, bar charts, pie charts, and pictograms to solve and/or pose problems.	**B8.4.1.1.1 Identify types of given data including numerical, categorical, ungrouped and grouped data** **E.g. 1.** Discuss, in small groups, information collected in the process of investigation which may be numeric. i. Numeric (and discrete): the number of Nissan cars sold by Japan Motors, Ghana in a year; the number of children in a family; the number of learners in B8 class. ii. Numeric (and continuous): the weights of babies in a crèche (e.g. 4.5kg) which contains fractional values. **E.g. 2.** Discuss (in groups) information collected in the process of investigation which may be non-numeric. i. Non-numeric (cannot be quantified): sex (male or female); income group, movie type, age group, marital status, boxers' weight class, etc. ii. Sort out the examples of the non-numeric information in (i) with values that can be put on ordinal scale (boxers' weight class; age group) iii. Sort out the examples of the non-numeric information in (i) that can be put into categories (Categorical data): sex (male or female); marital status; income group, etc. **E.g. 3.** i. The scores for 11 learners in a class test are 25, 30, 35, 40, 45, 26, 29, 50, 45, 37 and 47 (these **individual** scores are **not grouped** in any way). ii. Find out those in the **group** 25 to 35 (i.e. 5) and those in the **group** 36 to 50 (i.e. 6) Data is now **grouped.**	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** **Personal Development and Leadership (PL)** **Digital Literacy (DL)** • Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.4.1.1.2 Select and justify a method to collect data (quantitative and qualitative) to answer a given question.	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)**
	E.g. 1. To study how eating cream crackers affects one's output of work (productivity), identify which method can be used to gather the facts for each of the following situations. (i.e. refer to methods stated in **E.g. 2** of **B7.4.1.1.1)** i. Will eating twice a person's normal number of cream crackers increase their productivity? ii. Are people who eat more cream crackers more productive? iii. Does a group of students study better when cream crackers are present or absent?	• Create simple logical ideas to think through problems**(CP5.3)** • Demonstrate behaviour and skills of working towards group goals**(CC9.1)** • Understand and use interpersonal skills**(CC9.2)**
	E.g. 2. Select any study to be undertaken and design an appropriate form to be used in collecting data.	• Understand roles during group activities **(CC9.3)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

B8.4.1.1.3 Organise data (grouped/ungrouped), present it in frequency tables, line graphs, pie graphs, bar graphs and/or pictographs (representations include info graphics, waffle diagrams, box and whisker plots and stem and leaf plots) and analyse it to solve and/or pose problems.

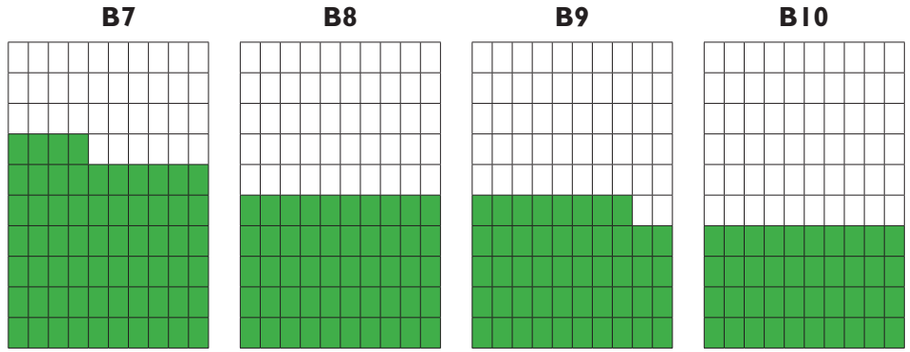
E.g. 1. The following set of raw data shows the lengths, in millimetres, measured to the nearest mm, of 40 leaves taken from plants of a certain species.

40	54	25	50	58	45	47	49	30	28
52	31	52	41	47	44	46	39	51	59
49	38	43	48	43	43	40	51	40	56
31	53	44	37	35	37	33	38	46	36

(i) Copy and complete the frequency distribution table below, using the data set above.

Lengths (mm)	Tally	Frequency
25 – 29		
30 – 34		
35 - 39		
40 – 44		
45 – 49		
50 – 54		
55 – 59		

- Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)**
- Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**
- Preparedness to recognise and explain results after implementation of plans **(CP6.6)**
- Create simple logical ideas to think through problems **(CP5.3)**
- Demonstrate behaviour and skills of working towards group goals **(CC9.1)**
- Understand and use interpersonal skills **(CC9.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2 A cleaner of a small office spent GH¢120.00 of his salary on food; GH¢80.00 on rent; GH¢40.00 on clothing, GH¢110.00 on transport and saved GH¢50.00. Organise the data and draw (i) a bar chart and (b) a pie chart to represent the data. **E.g. 3** The waffle chart (i.e. a 10 × 10 cell grid in which each cell represents a percentage point summing up to total 100%) shows that the average score obtained by B7 learners in a mathematics test conducted, is 64%. i. Read and record the average scores obtained by B8, B9 and B10.  ii. In a mathematics quiz Cordei scored **75%**, Kofi scored **80%**, Maama scored **35%**, Kpakpo scored **70%** and Adjoa scored **50%.** Draw a waffle chart to represent the data.	• Understand roles during group activities **(CC9.3)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Make a stem and leaf plot (a stem-and-leaf display or stem-and-leaf plot is a method for presenting quantitative data in a graphical format to assist in visualising the shape of a distribution and giving a great idea about the distribution of the data.)	

i. The data below are scores for 14 B8 learners in a test graded out of a maximum of 100. Make a stem and leaf plot to represent the data.

23, 58, 62, 62, 63, 65, 67, 71, 71,72, 80, 82, 82, 82

(**Note:** *that though there are no scores for 30s and 40s,* 0s should not *be put against stem 3 and stem 4. Those spaces must left blank. However,* 0 should *be put against 8 for 80)*

Stem	Leaf
2	3
3	
4	
5	8
6	2 2 3 5 7
7	1 1 2
8	0 2 2 2

ii. From the plot, what can we say about the performance of the 14 B8 learners?

Where:

stem	leaf	
2	3	23
7	112	71, 71, 72

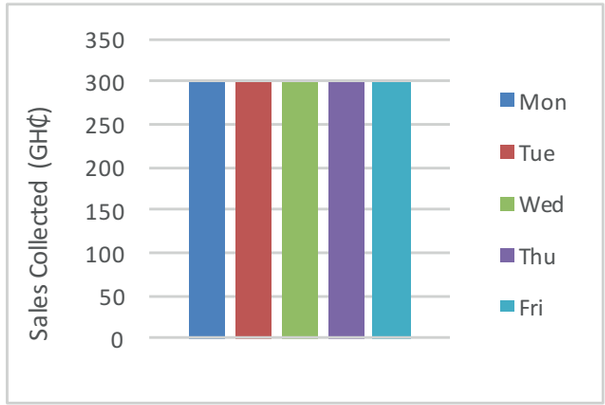
E.g. 5 The stem and leaf plot shows the scores obtained by learners in a test. Use it to answer the following questions:

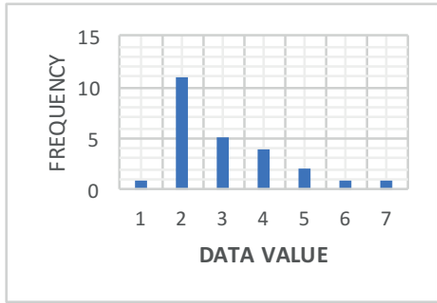
i. What are the scores? Write them in ascending order.

ii. What is the mode of the scores?

iii. What is the median of the scores?

Stem	Leaf
1	5
2	0
3	5 5 5 5 7
4	5
5	5 5
7	5 5
9	0

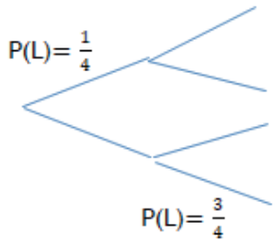
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.4.1.2 Demonstrate an understanding of measures of central tendency (mean, median, mode) and range for grouped data and explain when it's most appropriate to use the mean, median, or mode.	**B8.4.1.2.1 Calculate the mean, median and mode for a given set of ungrouped data, and explain why these values may be the same or different.** **E.g. 1.** The bar graph on the right shows the sales of a small business from Monday to Friday. Calculate the mean, median and mode for amounts collected during the period and explain your findings (i.e. why the values are the same).  E. g. 2 The table below shows the area of the sitting room floors of each of 7 real estates houses (A, B C, …) in KwashiKumaman | Houses	A	B	C	D	E	F	G
---	---	---	---	---	---	---	---
Area (m^2)	22	24	26	30	48	30	30 | i. In small groups, work out the mean, median, mode. ii. Draw a bar chart to represent the data collected, and iii. Explain why the values are the same.	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures **(CC7.2)** • Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication **(CC7.3)** • Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)**

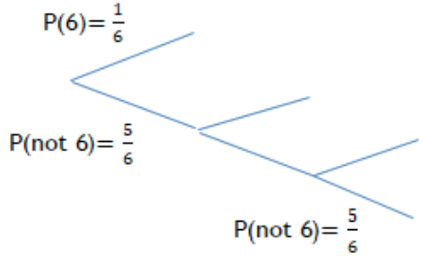
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3 The table below shows the occurrence of the data values from 1 to 7 and is represented by the corresponding bar graph. Data Value / Frequency 1 / 1 2 / 11 3 / 5 4 / 4 5 / 2 6 / 1 7 / 1  i. Calculate the mean, median, mode. ii. Locate them on the corresponding graph. iii. Explain why the values are different.	
	B8.4.1.2.2 Justify a context in which the mean, median or mode is the most appropriate measure of central tendency to use when reporting findings. **E.g. 1.** Kojo's taxi makes a number of trips each day as shown in the table below: Monday / Tuesday / Wednesday / Thursday / Friday / Saturday / Sunday 8 / 6 / 10 / 10 / 9 / 10 / 3 i. Calculate the mean, median and mode for Kojo's trips for the week ii. Which measure of central tendency best represents or describes the number of trips that Kojo makes each day? iii. Justify the choice of central tendency in (ii).	• Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures **(CC7.2)** • Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication **(CC7.3)** • Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)**

STRAND 4: HANDLING DATA

SUB-STRAND 2: CHANCE OR PROBABILITY

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.4.2.1 Identify the sample space for a probability experiment involving two independent events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems.	**B8.4.2.1.1.Perform a probability experiment involving two independent events such as drawing coloured bottle tops from a bag with replacement and list the elements of the sample space** **E.g. 1.** In an experiment, Emmanuel was asked to pick one bottle top from a bag, three times, which contains 3 red, 2 green and 1 pink bottle tops. i. List the elements of the sample space of the events. ii. The sample space of the event of picking a red bottle top, R, with replacement is? iii. The probability of picking a red bottle top is ……. **E.g. 2.** Consider the following two events: (a) throwing of a fair six-sided die and (b) tossing a fair coin i. What is the sample space for (a) and for (b)? ii. Does the occurrence of event (a) affect the occurrence of event (b)? iii. What is the probability of an even number showing up in (a)? What is the probability of a head showing up in (b)? iv. What is the relationship between the two events? **E.g. 3.** Ampofo and Serwa are two learners from a school. Ampofo walks to school daily and Serwa travels to school on a bus daily. i. Does the event of Ampofo affect that of Serwa? ii. Can the two events occur together?	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Cultural Identity and Global Citizenship (CG), Personal Development and Leadership (PL)** • Preparedness to recognise and explain results after implementation of plans **(CP6.6)** • Implement strategies with accuracy **(CP6.7)** • Can appreciate the importance of including all team members in discussions and actively encourage contributions from them **(CC9.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B8.4.2.1.2. Express the probabilities of the events as fractions, decimals, percentages and/or ratios. e.g. by using a tree diagram, table or other graphic organiser. **E.g. 1.** The arrow on the spinner if spun twice and the number of wins recorded; i. identify the sample space. ii. calculate the probability of a win P(W) and the probability of a lose, P(L). iii. copy and complete the probability tree diagram below that represents the events, i.e. the 1st and 2nd spins. iv. express the probabilities stated on the branches in decimals, percentages and ratios.   **E.g. 2.** A box contains 3 blue pens and 4 pink pens. A pen is taken from the box, its colour noted, and then replaced. Another pen is taken and its colour noted. i. What is the sample space of the 1st and the 2nd trials? ii. Draw a probability tree diagram to represent the event.	• Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event **(CP5.10)** • Actively assist group identify changes or modifications necessary in the group activities and work towards carrying out those changes **(PL6.8)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2 A die is thrown at most three times. If 6 is scored the game stops.  i. Copy and complete the probability tree diagram. ii. Explain why some of the branches of the tree diagram have disappeared.	• Develop and exhibit a sense of cultural identity **(CG5.4)** • Identify and explain a confusion, uncertainty, or a contradiction surrounding an event **(CP5.9)**

BASIC 9

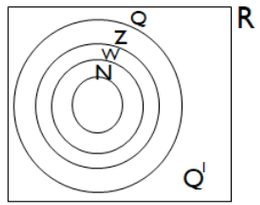
STRAND 1: NUMBER

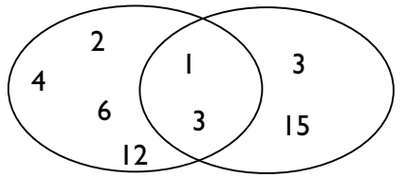
SUB-STRAND 1: NUMBER AND NUMERATION SYSTEM

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td rowspan="2">B9.1.1.1 Apply the understanding of place value in solving real life problems involving integers of any size, rounding this to given decimal places and significant figures</td>
<td>B9.1.1.1.1 Express integers to a given number of significant and decimal places
E.g. 1. Express integers to a number of significant figures.
(i) 857,386,321
- five significant figures
- four significant figures
- three significant figures.

E.g. 2. Express decimal numbers to a given number of decimal places.
(i) Write 98745.9674 correct to
- three decimal places
- two decimal places
- one decimal place</td>
<td rowspan="2">Communication and Collaboration (CC)
Creativity and Innovation (CI)
Personal Development and Leadership (PL)
• Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication (CC7.3)
• Division of tasks into solvable units and assigning group members to task units (PL6.2)
• Ability to select the most effective creative tools for work and give reasons for the choice (CI6.3)</td>
</tr>
<tr>
<td>B9.1.1.1.2. Use knowledge and understanding of place value to solve real life problems

E.g. 1. Create and solve a real-life problem or a story problem and write the answer in standard form.
(I) I am a 6-digit number. My first digit is 5 more than the last digit, but 2 less than my second digit. My second digit is the third multiple of 3, while my fourth digit is the second multiple of 3. My third digit is the quotient when the fourth digit is divided by my last digit. However, my fourth and fifth digits are consecutive numbers. What number am I?</td>
</tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	Think second digit: 3 × 3 = 9 fourth digit: 2 × 3 = 6 first digit: 9 – 2 = 7 last digit: 7 – 5 = 2 fifth digit: 6 – 1 = 5 third digit: 6 ÷ 2 = **3** So, the number is 793652 = 7.93652×10^5 **E.g. 2.** Create similar real story problems and solve	
B9.1.1.2 Demonstrate an understanding of the relationship between members of the rational number system and solve real life problems involving union and intersection of three sets	**B9.1.1.2.1 Solve problems on relationship between members of the rational number system using knowledge and understanding of the concept of union and intersection of two sets.** **E.g. 1.** Use sets diagrams to show the relationship among the Real numbers namely - Irrational numbers (Q^I) - Rational numbers (Q) - Integers (Z) - Whole numbers (W) - Natural or Counting numbers (N) 	**Communication and Collaboration (CC), Creativity and Innovation (CI)** • Recognise and generalise information and experience; search for trends and patterns **(CI6.8)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2 Write the factors of 12 and 15 and represent them on a Venn diagram. 12 = {1, 2, 3, 4, 6, 12} 15 = {1, 3, 5, 15} Factors of 15 Factors of 12  	• Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures **(CC7.2)**
	B9.1.1.2.2 Apply the concept of sets to solve problems on relationship between members of rational number system and solve real life problems involving union and intersection of two sets **E.g. 1** Create and solve real life problems to show the union and intersection of two sets. i. There are 80 farmers in a certain village who grow either maize or beans. Fifty of them grow beans while sixty grow maize. If each farmer grows at least one of the two crops, represent the information on a Venn diagram and hence find the number of farmers who grow: a. both crops. b. only one crop.	

STRAND 1: NUMBER

SUB-STRAND 2: NUMBER OPERATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.9.1.2.1 Apply mental mathematics and properties to determine answers for addition and subtraction of basic facts.	**B9.1.2.1.1 Multiply and divide given numbers by powers of 10 including decimals and benchmark fractions** **E.g. 1.** Recall multiplication facts up to 144 and related division facts. **E.g. 2.** Recall decimal names of given benchmark fractions converted to decimals or percentages (and vice versa) **E.g. 3.** Find the product of a given decimal number when it is multiplied by 10, 100, 1000, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1000}$ etc.	**Creativity and Innovation (CI)**
	B.9.1.2.1.2 Demonstrate the ability to determine commutative properties of addition and multiplication. **E.g. 1.** Recognise that for any two numbers **a** and **b**; i. $a + b = b + a$ i.e. $25 + 32 = 32 + 25 = 57$ ii. $a \times b = b \times a$ i.e. $17 \times 8 = 8 \times 17 = 136$	• Recognise and generalise information and experience; search for trends and patterns **(CI6.8)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.2.1.3 Use the associative property of addition and multiplication. **E.g. 1.** Recognise that for any three numbers **a**, **b** and **c**; (i.) a + (b + c) = (a + b) + c or a + (b + c) = (a + c) + b i.e. 15 + (6 + 9) = (15 + 6) + 9 = 30 (ii.) (a × b) × c = a × (b × c) i.e. (12 × 5) × 4 = 12 × (5 × 4) = 240	• Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)**
	B9.1.2.1.4 Use the distributive property in solving problems. **E.g. 1.** Recognise that for any three numbers **a**, **b** and **c**; (i.) a × (b + c) = (a × b) + (a × c) i.e. 5 × (10 + 7) = (5 × 10) + (5 × 7) = 85 (ii.) a × (b - c) = (a × b) - (a × c) i.e. 5 × (10 - 7) = (5 × 10) - (5 × 7) = 15	
B9.1.2.2 Apply the understanding of addition, subtraction, multiplication and division of decimal numbers to solve problems, and round answers to given decimal places and significant figures	**B9.1.2.2.1 Solve operations involving addition, subtraction, multiplication and division using word problems.** **E. g. 1**. Create and solve story problems involving a combination of two or more of the basic operations. (×, ÷, –, +). i) A trader sells oranges from two baskets, A and B. Basket A contained 85 oranges and she sold 48. She sold 59 oranges from basket B and was left with the same number of oranges as in Basket A. How many oranges were originally in Basket B?	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>B9.1.2.2.2 Solve word problems involving the four basic operations and round the answers to the nearest two decimal figures or to some significant figures.

ii) The price of a jacket is three times that of a shirt. The price of a jacket is GH. Mr Mensa bought two of the jackets and four shirts for his twin sons. Calculate the total amount Mr Mensa paid for the items, correct your answer to:
α) two decimal places
β) three significant figures</td><td>• Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures (CC7.2)

• Generate hypothesis to help answer complex problems (CP5.4)</td></tr>
<tr><td rowspan="2">B9.1.2.4 Demonstrate understanding of surds as real numbers, the process of adding and subtracting of surds as well as determining (using a calculator) the approximate square root of a number that is not a perfect square.</td><td>B9.1.2.4.1 Identify simple and compound surds.

E.g.
i. $\sqrt{2}$
ii. $7\sqrt{3}$,
iii. $2\sqrt{5}$
iv. $(\sqrt{3}+\sqrt{7}-\sqrt{5})$</td><td rowspan="2">Critical Thinking and Problem solving (CP)
Communication and Collaboration (CC)
Creativity and Innovation (CI)

• Recognise and generalise information and experience; search for trends and patterns (CI6.8)

• Identification of requirements of a given situation and justification of more than one creative tool that will be suitable (CI5.3)</td></tr>
<tr><td>B9.1.2.4.2 Explain the identities/rules of surds

Rule 1
$\sqrt{a\times b} = \sqrt{a}\times\sqrt{b}$

Rule 2
$\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

Rule 3
$\frac{b}{\sqrt{a}} = \frac{b}{\sqrt{a}}\times\frac{\sqrt{a}}{\sqrt{a}} = \frac{b\sqrt{a}}{a}$

Rule 4
$a\sqrt{c} \pm b\sqrt{c} = (a \pm b)\sqrt{c}$

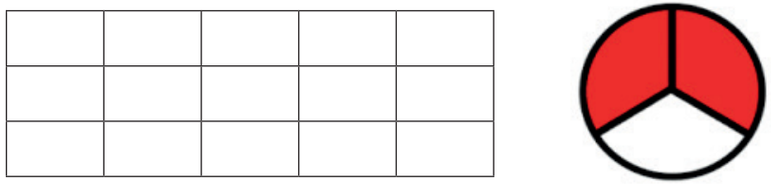
Rule 5
$\frac{c}{a+b\sqrt{n}} = \frac{c}{a+b\sqrt{n}}\times\frac{a-b\sqrt{n}}{a-b\sqrt{n}}$

Rule 6
$\frac{c}{a-b\sqrt{n}} = \frac{c}{a-b\sqrt{n}}\times\frac{a+b\sqrt{n}}{a+b\sqrt{n}}$</td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.2.4.3 Simplify given surds **E.g. 1.** Simplify: i. $\sqrt{72}$ ii. $\frac{\sqrt{8}}{16}$ iii. $\frac{\sqrt{12}}{121}$ iv. $(\sqrt{2})^2$	• Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures **(CC7.2)** • Generate hypothesis to help answer complex problems **(CP5.4)**
	B9.1.2.4.4 Approximate the square roots of non-perfect squares with calculators/ tables. **E.g. 1.** Square roots of non-perfect squares i. $\sqrt{2}$ ii. $\sqrt{5}$ iii. $\sqrt{12}$ iv. $\sqrt{30}$	• Demonstrate a sense belongingness to a group **(PL5.2)** • Develop and exhibit ability to defend one's cultural beliefs, practices and norms **(CG5.4)**

STRAND 1 NUMBER

SUB-STRAND 3: FRACTIONS, DECIMALS AND PERCENTAGES

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.1.3.1 Apply the understanding of operations on fractions to solve problems involving fractions of given quantities and round the results to given decimal and significant places	**B9.1.3.1.1 Review fractions and solve problems involving basic operations on fractions** **E.g. 1.** Review the concept of fraction.  i. Shade the fraction of squares in the rectangle that is equal to the shaded portion of the circle. ii. Write down 3 fractions equivalent to $\frac{2}{5}$ iii. Express the fraction $\frac{15}{10}$ in its simplest form. iv. Express $\frac{12}{5}$ as a mixed number. v. Express $2\frac{5}{9}$ as an improper fraction. **E.g. 2.** Review the basic operations on fractions. i. Adding and subtracting fractions: Work out answers to the following: a) $\frac{3}{4}+\frac{7}{8}$ b) $1\frac{1}{2}+\frac{4}{5}-\frac{5}{6}$ ii. Multiplying and dividing fractions. Work out answers to the following: a) $\frac{2}{3}\times\frac{3}{4}-\frac{3}{8}$ b) $\frac{5}{8}\div 2\frac{1}{2}+\frac{2}{3}$	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC) Personal Development and Leadership (PL), Innovation (CI)** • Understand and use interpersonal skills **(CC9.2)** • Generate hypothesis to help answer complex problems **(CP5.4)** • Understanding of one's self (strength, weaknesses, goals, aspiration, reaction and adjustment to novel situations) **(PL5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.3.1.2 Add and/or subtract, multiply and/or divide given fractions, using the principle of order of operations including the use of the BODMAS or PEMDAS rule, and apply the understanding of these to solve problems. **E.g. 1.** Use the order of operations (BODMAS or PEDMAS) to simplify whole number expressions with more than two operations. PEDMAS is Parenthesis, Exponents, Multiply/Divide (going from left to right)and Add/subtract (going from left to right). i. $3^4 \div 3^2 + 40 - 2^3 \times 3^2 \div 9$ ii. $18 \div 6 \times (4 - 3) + 6$ iii. $18 \div 3^2 \times (4 - 3) \times 10$ **E.g. 2.** Use the order of operations (BODMAS or PEDMAS) to simplify fractions with more than two operations. a) $\frac{2}{3} \times \frac{3}{4} - \frac{5}{8} \div 2\frac{1}{2}$ b) $\frac{3}{4} \div \frac{3}{8} + (\frac{4}{5} - \frac{1}{2})$ c) $(\frac{3}{4} + \frac{5}{8}) \times \frac{4}{11} - \frac{1}{2}$	• Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)** • Ability to set and maintain personal standards and values **(PL5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.3.1.3. Review word problems involving basic operations on fractions. **E.g. 1.** Solve word problems based on fractions. i. A test is made up of 20 questions, how many questions must you answer correctly to get a score of 80%? ii. By what percentage was a television set reduced if it was marked GH¢2,250 and sold for GH¢2,025? iii. In an election involving two contestants, one candidate claimed 52% of the votes, while the other candidate claimed 2,681 votes. If 5000 people voted, how do you know the election results are invalid?	• Ability to select the most effective creative tools for work and give reasons for the choice **(CI6.3)** • Adjust to the demands of customs, traditions, values and attitudes of society **(CG5.5)** • Identification of requirements of a given situation and justification of more than one creative tool that will be suitable **(CI5.3)**

B9 STRAND 1 NUMBER

SUB-STRAND 4: NUMBER: RATIOS AND PROPORTION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.1.4.1 **Apply the understanding of ratio, rate and proportions to solve problems that involve rates, ratios, and proportional reasoning and use it to solve real-world mathematical problems**	**B9.1.4.1.1 Represent proportional relationships by equations.** **E.g. 1.** If total cost **(t)** is proportional to the number of items **(n)** purchased at a constant price **(p),** the relationship between the total cost and the number of items can be expressed as **t = pn**. **B9.1.4.1.2 Use proportional relationships to solve multistep ratio and percent problems, examples: simple interest, tax, discount and commissions, NHIL, depreciation, insurance, etc.** **E.g. 1.** Solve problems on simple interest. i. A girl deposited GH¢ 4500.00 at the bank at a rate of 3% per annum for three years. Find the simple interest. What is the amount at the end of the fifth year? **E.g. 2.** Solve problems on tax (VAT). i. The VAT rate of Ghana is 12.5%. A man bought an item at GH¢ 4500.00, VAT inclusive. Calculate: a) the basic cost of the item. b) the VAT paid by the man. **E.g. 3.** Solve problems on discount. ii. If a car costs GH¢ 80,500.00, what is its new value if there is a discount of 10%? **E.g. 4.** Solve problems on commission. iii. A car agent's commission on the sale of a car is 13%. Calculate the commission on a car sold for GH¢68,000.00.	**Critical Thinking and Problem solving (CP), Creativity and Innovation (CI), Personal Development and Leadership (PL), Digital Literacy (DL)** • Anticipate and overcome difficulties relating to taking initiatives **(CI6.5)** • Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

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<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
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<td>
E.g. 5. Solve problems involving depreciation.
The value of a mobile phone depreciates at the following rate:
<table>
<tr><th>Year of manufacture</th><th>Depreciation on the original value</th></tr>
<tr><td>In the first year</td><td>5%</td></tr>
<tr><td>In the second year</td><td>10%</td></tr>
<tr><td>In the third year</td><td>15%</td></tr>
<tr><td>In the fourth year</td><td>22%</td></tr>
</table>
The original value of the mobile phone is GH¢ 1800.00. Find the value of the mobile phone at the end of each of the first four years.

E.g. 6. Solve problems involving NHIL.
i. The NHIL inclusive price of a television set is GH¢1200.00. If the NHIL is charged at a rate of 2.5%, find
a) the cost of the television set (NHIL exclusive).
b) the NHIL charged.

E.g. 7. Solve problems involving insurance.
i. Kofi Mereku insured his house and paid a premium ofGH¢ 30,000.00. If the insurance company fixed the rate at 5% of the value of the house, calculate the insured value of the house.
</td>
<td>
• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation (CP5.6)
</td>
</tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.4.1.3 Use knowledge of rates and proportional reasoning to solve problems involving SSNIT benefits and contributions. **E.g. 1.** Describe the obligations of the employer/employee and the contribution rates. **Act 766** — **PNDC Law 247** Employer — 13.0% of basic salary — 12.5 of basic salary Worker — 5.5% of basic salary — 5.0% of basic salary **Total** — 18.5% of basic salary — 17.5% of basic salary **E.g. 2.** Calculate employee/employer contributions to SSNIT under Act 766. A worker's basic monthly salary is GH¢3,256.50. a. Calculate the SSNIT contributions under Act 766; i) by the employer ii) by the employee What is the total SSNIT contributions at the end of every month? **E.g. 3.** Calculate employee/employer contributions to SSNIT under PNDCL 247. Mr Bediako's monthly SSNIT contribution under PNDCL 247 is GH¢440.54. How much does his employer contribute to SSNIT on his salary? Hence, calculate his basic salary per month.	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Calculate employee benefits from SSNIT under Act 766.	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

The table shows the pension rights for SSNIT contributors under Act 766

Years of contributions	15	16	17	18	…	30	31	32	…	35
Pension Rights (%)	37.500	38.625	39.750	40.875	…	54.375	55.500	56.625	…	60.000

a. Mr Addai retired at age 60 last year after working and contributing for 20 years. If the average of his best salary for 3 years (**36 months**) over the 20-year period was GH¢15,000.00, calculate his full pension under the National Pension Act 2008, (Act 766).

Calculation for full pension

Qualifying age = 60 years

Average best 3years' salary = GH¢15,000

Pension right for 20 years = 43.13% (refer to the table on Pension Rights above)

Annual pension to Mr. Addai = 43.13/100 × 15,000

= GH¢6,469.50

Monthly pension to Mr Addai = $\frac{\text{GH¢6,469.5}}{12}$

= GH¢ 539.13

b. A worker contributed for 7 years before being rendered incapacitated. If the best salary over the 3-year (36 months) period was GH¢8,450.40, calculate the **invalidity benefit** for the worker.

b. Mr Mensah's total SSNIT contribution stood at GH¢112,426.29 at the time of his demise. Calculate his **survivor's benefit** if the current interest rate is 15%.

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 5. Calculate employee benefits from SSNIT under PNDCL 247. The table shows the pension rights for SSNIT contributors under PNDCL 247.	• Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation **(CP5.6)**

Years of contributions	20	21	22	23	24	25	26	27	28	29	30	…	40 & above
Pension Rights (%)	50.0	51.5	53.0	54.5	56.0	57.5	59.0	60.5	62.0	63.5	65.0		80.0

Mr Bema, a history teacher at Academicals Senior High School, retired in 2009 after 25 years of service. Throughout this 25-year period he had been an active contributor to the SSNIT Pension Scheme. As the student who has learnt about social security, you are to help Mr Bema calculate his annual pension using his best three years' salary of GH¢19,500.

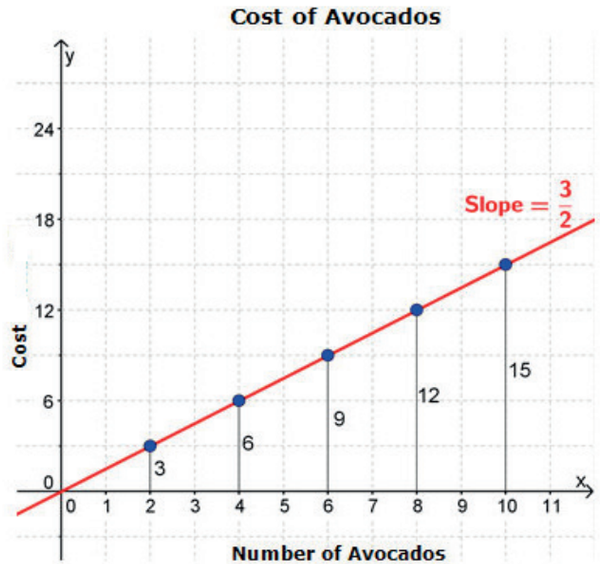
Calculation for full pension

Qualifying age = 60 years

Average best 3 years' salary = GH¢19,500

Pension right for 25 years = 57.5% (refer to the table on Pension Rights above)

$$\text{Annual pension to Mr. Bema} = \frac{57.5}{100} \times \text{GH¢19,500} = \frac{\text{GH¢11,212.5}}{12} = \text{GH¢934.38}$$

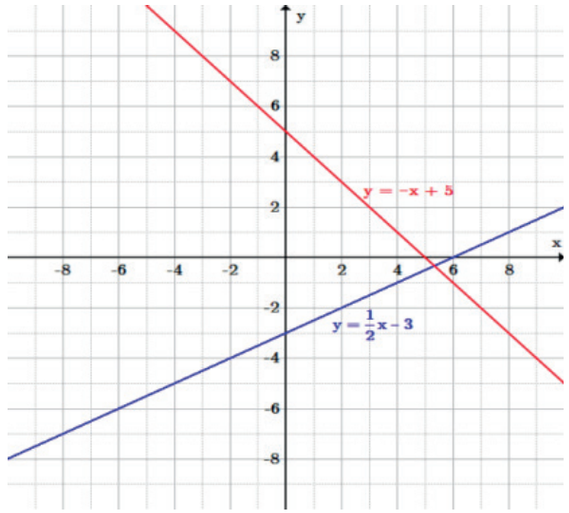
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.1.4.1.4 Recognise and graph proportional relationships, interpreting the unit rate as the slope of the graph and use these to solve problems. **E.g. 1.** The graph below shows the cost of avocados.  The unit rate, from the data, is GH¢1.50 per avocado, which is the same as the slope of the line connecting the data points ($\frac{3}{2}$). i. From the graph, how much does 8 avocados cost? ii. Also, using the graph how much does 15 avocados cost?	• Ability to find and utilise digital content **(DL5.3)** • Putting forward constructive comments, ideas, explanations and new ways of doing things **(CI5.7)**

STRAND 2: ALGEBRA

SUB-STRAND 1 PATTERNS AND RELATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.2.1.1 Demonstrate the ability to construct tables of values for pairs of linear relations, graph the relations in a number plane and determine the intersection of the lines to solve simultaneous linear equations.	**B9.2.1.1.1 Construct a table of values for two linear relations and graph the relation** **E.g. 1.** Construct a table of values for two linear relations and draw the graphs of the relations. Copy and complete the table of values for the relations $y_1 = -x + 5$; and $y_2 = \frac{1}{2}x - 3$ for from –4 to 3. **E.g. 2.** Draw graph for two linear relations.	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Creativity and Innovation (CI), Cultural Identity and Global Citizenship (CG)** • Understanding of influences of globalisation on traditions, languages and cultures **(CG6.1)** • Implement strategies with accuracy **(CP6.7)**

x	-3	-2	-1	0	1	2	3
$y_1 = -x + 5$	8				4		
$y_2 = \frac{1}{2}x - 3$		-4					-1.5



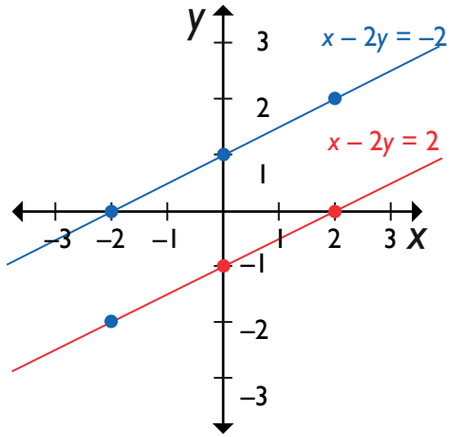
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 3. Construct a table of values for two linear relations.

(i) Copy and complete the table of values for the relations $x - 2y = -2$ and $x - 2y = -2$ for x from –2 to 2.

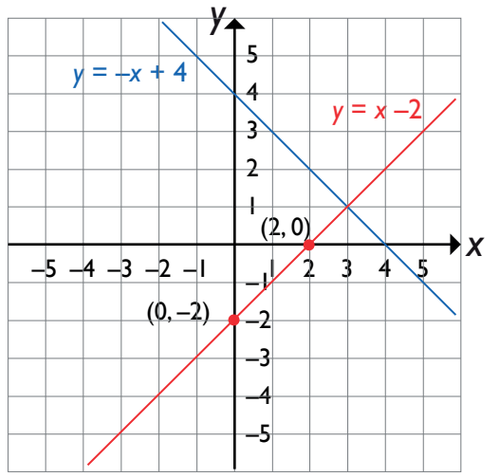
x	x	-2	-1	0	1	2
$x - 2y = -2$	$y = \frac{(x + 2)}{2}$	0				2
$x - 2y = -2$	$= \frac{(x - 2)}{2}$		-			0

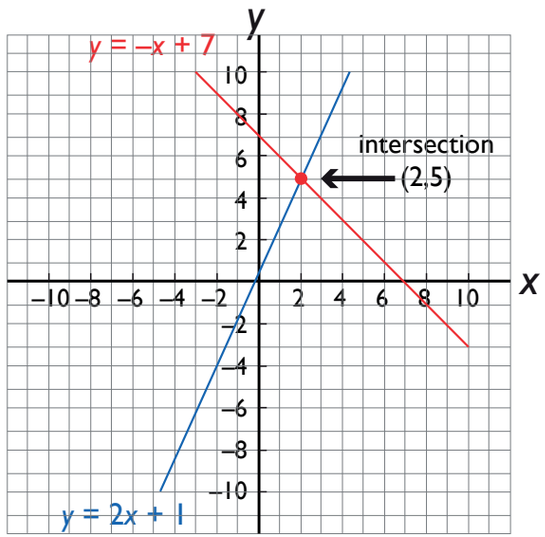
E.g. 4. Draw a graph for two linear relations.

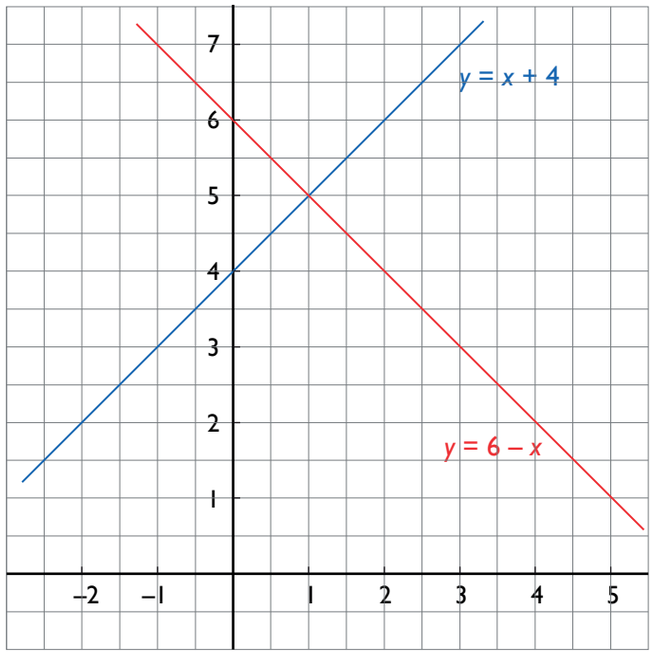


CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.2.1.1.2 Use graphs of two linear relations to determine subsequent missing elements in ordered pairs of the relation.	
	E.g. 1. Find the missing elements of ordered pairs on graphs of two linear relations. The graph below is drawn from a two linear relations: $y = -x + 4$ $y = x - 2$ i. Determine the coordinates for the intersection of the two lines. ii. Determine the corresponding values for y for both straight lines if $x = -1$. iii. Use the graph to find the values for y for the two relations.	• Putting forward constructive comments, ideas, explanations and new ways of doing things **(CI5.7)**

X	6-3	7-2	8-1	90	1	2
$y = -x + 4$						
$y = x - 2$						

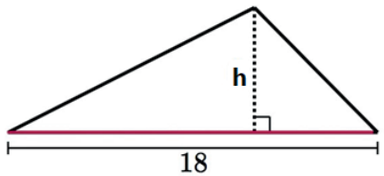
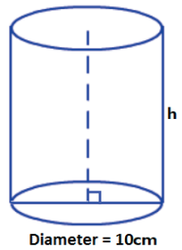


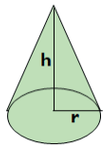
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.2.1.1.3 Use graphs to solve equations involving two linear relations. **E.g. 1.** Solve two linear equations simultaneously using the graph shown. i. Solve the following equations simultaneously using a graph. $y = -x + 7$ $y = 2x + 1$ **Hint:** Draw the graph and find the coordinates for the intersection of the two lines. In the graph shown the values of $(x, y) = (2, 5)$  	• Putting forward constructive comments, ideas, explanations and new ways of doing things **(CI5.7)**

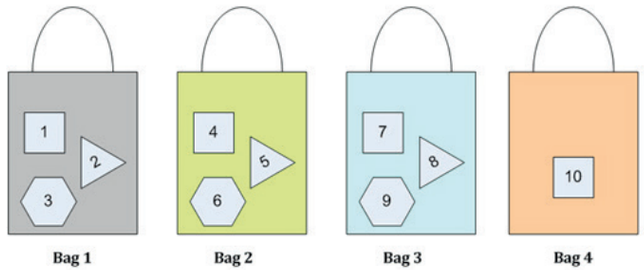
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Solve two linear equations simultaneously using the graph. From the graph, determine the values of x and y that makes the linear equations true. $y = x + 4$ $y = 6 - x$  	

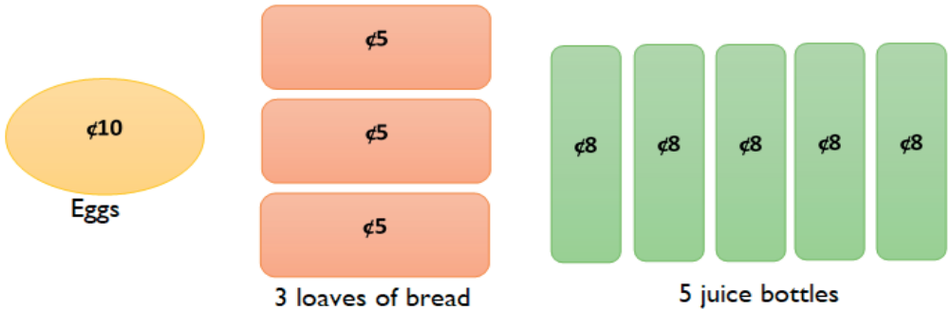
STRAND 2 ALGEBRA

SUB-STRAND 2 ALGEBRAIC EXPRESSIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.2.2.1 Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorise expressions that have simple binomial as a factor.	**B9.2.1.1.1 Perform change of subject of a given formula and use it to solve problems.** **E.g. 1.** Perform change of subject for given formulae (i) Make x the subject of the following formulae 1) $q = x + 7$ 4) $\frac{3x+1}{2} = h$ 2) $r = x - 3$ 5) $3z = \frac{x}{4} + 1$ 3) $5x = s$ **E.g. 2.** Use the concept of change of subject to solve problems involving formulae i. The area of a rectangle is 24cm^2. If the length is 8cm, find the value of the width. ii. The formula for calculating the area of a circle is given as . If a circle has an area of 154cm^2, what is its radius? [Take $\pi = \frac{22}{7}$] iii. The triangle below has an area of 54cm^2. Find the value of the height of the triangle. iv. The cylinder below has a volume of 330cm^3. Find the value of the height of the cylinder. [Take $\pi = \frac{22}{7}$]  	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** **Creativity and Innovation (CI) Digital Literacy (DL)** • Identify and explain a confusion, uncertainty, or a contradiction surrounding an event **(CP5.9)** • Ability to visualise alternatives, seepossibilities, identify problems and challenges **(CI5.4)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.2.2.1.2 Substitute values into given formulae to evaluate it and use it to solve problems. **E.g. 1.** i. Find the value of $(x- b)^2 -3(x-b)$ if $x = 2$ and $b = -5$ ii. Make ***k*** the subject of the formula: $\frac{1}{n} = \sqrt{\frac{k^2 + a^2}{hg}}$ If $n = \frac{8}{5}$, $a = 2$, $h = 2$, $g = 32$, find the value of k. iii. The formula for finding the volume of the shape below is given as $\frac{1}{3}\prod r^2 h$. Find the volume if $r = 7$, $h = 21$, and $\pi = \frac{22}{7}$  **B9.2.2.1.3 Factorise expressions that have simple binomial.** **E.g.** Factorise the following expressions. i. $3x + 4xy = x(3 + 4y)$ ii. $12ab + 16b = 4b(3a + 4)$ iii. $-13xy + 39x = -13x(y - 3)$ iv. $5y - 2y^2 + 3y = 2y(4 - y)$ v. $-6x + 12 = -3(2x - 4)$	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.2.2.1.4 Use the knowledge of simplifying and factorising expressions to solve real world problems. **E.g. 1.** You purchased 10 items from a shopping plaza, and now you need plastic bags to carry them home. If each bag can hold only 3 items, how many plastic bags will you need to accommodate the10 items? **Solution**: We use simple algebraic formula to calculate the number of bags. x = Number of items purchased = 10 y = Capacity of 1 bag = 3 Hence, $\frac{10}{3}$ = 3.333 bags = 4 bags So, we need 4 shopping bags to carry 10 items.  	• Ability to examine alternatives in creating new things **(CI5.1)** • Preparedness to make better decisions using information **(DL5.6)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. You have to buy two dozen of eggs priced at GH¢10.00 three loaves breads (each bread is GH¢5.00), and five bottles of juice (each bottle is GH¢8.00). How much money you will need to take to the grocery store? The prices are a = Price of two dozens of eggs = GH¢10.00 b = Price of one bread = GH¢5.00 c = Price of one bottle of juice = GH¢8.00 => Money needed = a + 3b + 5c => Money needed = GH¢10.00 + 3(GH¢5.00) + 5(GH¢8.00) = GH¢10.00 + GH¢15.00 + GH¢40.00 = GH¢65.00 	• Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication **(CC7.3)** • Identify and analyse different points of views of speaker **(CC7.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. The area of a rectangle is 72 cm^2. The length is twice its width. What is the length and width of the rectangle? Let "x" be the width and "$2x$" be the length. Length × Width = Area $x \times (2x) = 2x^2$ = Area $2x^2$ = Area $\frac{2x^2}{2} = \frac{72}{2}$ $x^2 = 36$ $x = 6$ width = 6cm $2x = 2 \times 6 = 12$ So, the length is 12 cm	• Generate hypothesis to help answer complex problems **(CP5.4)**

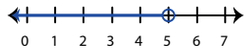
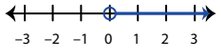
STRAND 2 ALGEBRA

SUB-STRAND 3 VARIABLES AND EQUATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.2.3.1 **Demonstrate understanding of single variable linear inequalities with rational coefficients including:** • **solving inequalities** • **verifying** • **comparing** • **graphing**	**B9.2.3.1.1 Solve single variable linear inequalities with rational coefficients.** I. $2x + 7 > \frac{5}{2}$ II. $\frac{4}{5} - \frac{1}{5}x > \frac{2}{7}$ III. $\frac{3}{2}y - \frac{2}{5} < \frac{4}{5}$ IV. $\frac{1}{2}(5x - 4) < x + \frac{11}{24}$ V. $\frac{1}{3} > x - \frac{4}{5}$ VI. $\frac{1}{2}(2x + 3) \leq x + 1$ VII. $x + \frac{1}{2} \geq -\frac{3}{2}$ VIII. $-\frac{2}{3}x + 3 \geq 0$	**Critical Thinking and Problem solving (CP), Personal Development and Leadership (PL)** **Digital Literacy (DL)** • Understanding of one's self (strength, weaknesses, goals, aspiration, reaction and adjustment to novel situations) **(PL5.1)** • Imagining and seeing things in a different way **(CI6.4)**
	B9.2.3.1.2 Illustrate solution sets of linear inequalities on the number line. **E.g. 1.** Illustrate and explain the inequality signs. **Less Than** <: open circle, arrow points to the left **Less Than or Equal To** ≤: closed circle, arrow points to the left **Greater Than** >: open circle, arrow points to the right **Greater Than or Equal To** ≥: closed circle, arrow points to the right	
	E.g. 2. Graph linear inequalities in one variable on a number line.	• Evaluate the quality and validity of information **(DL5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 3. Solve and graph linear inequalities on a number line.

Word Phase	Inequality	Solution Set
x is less than 5	$x < 5$	
a is greater than 0 a is more than 0	$a > 0$	
y is less than or equal to 2 y is at most 2	$y \leq 2$	
m is greater than or equal to 3 m is at least 3	$m \geq 3$	

i. $-3x - 8 > -26$

$-3x - 8 > -26$

$+8 \quad +8$

$-3x > -18$

$-3 \quad -3$

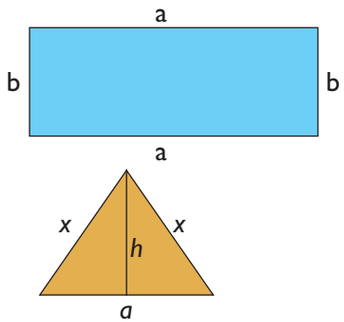
$x < 6$

ii. $2x - 3 \leq 19$

$2x \leq 22$

$\frac{2x}{2} \leq \frac{22}{2}$

$x \leq 11$

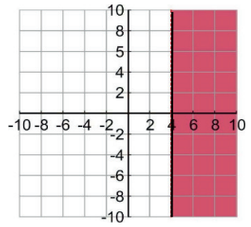


CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Solve and graph linear inequalities on a cartesian plane.	

i. $2x \geq 8$

$\frac{2x}{2} \geq \frac{8}{2}$

$x \geq 4$

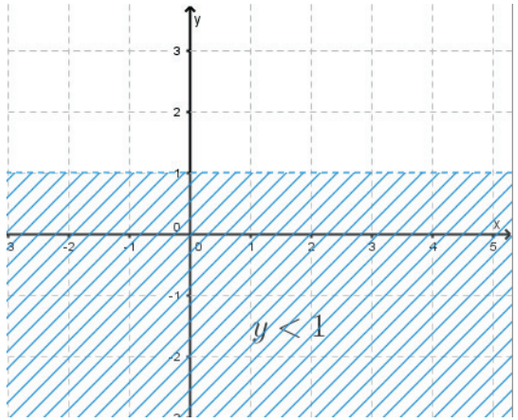


ii. $5y + 3 < 6 + 2y$

$5y - 2y < 6 - 3$

$3y < 3$

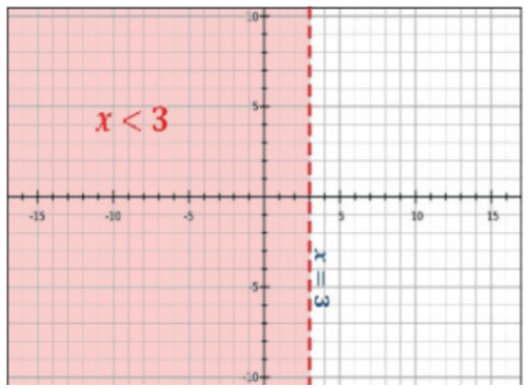
$\therefore y < 1$



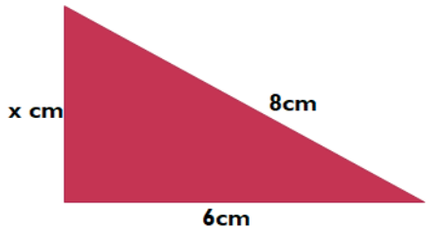
iii. $\frac{7x}{3} < 7 \quad \rightarrow 3 \times \frac{7x}{3} < 7 \times 3$

$\frac{7x}{7} < \frac{21}{7}$

$x < 3$

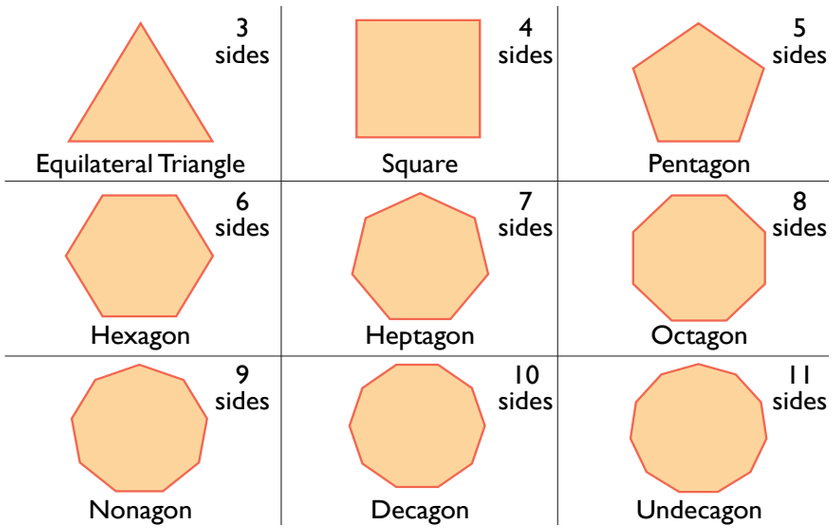
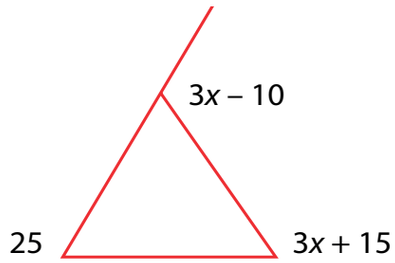


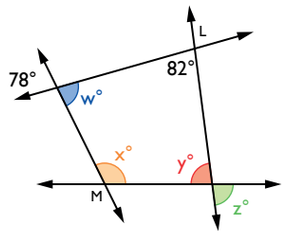
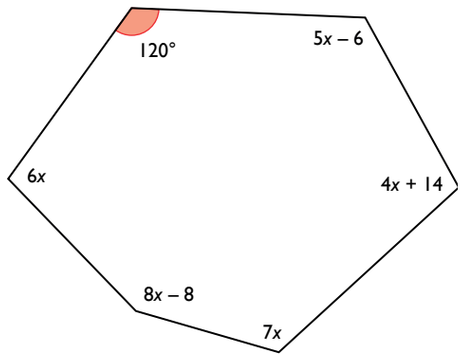
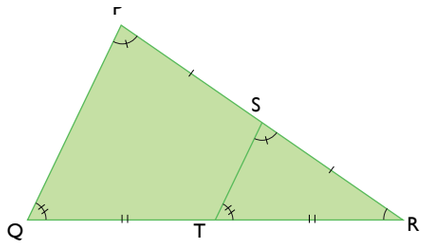
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.2.3.1.3 Solve real-life problems involving linear equations and inequalities. **E.g. 1.** Solve real-life problems involving linear equations. i. A man has 260 metres of fencing which he is going to put around a rectangular field which is 50 metres wide. How long is the field? **Solution**: Since we need to find the length of the field, let *x metres* be the length.  $x + 50 + x + 50$ *or* $2(x + 50)$ But this expression is given as 260m $\therefore \quad 2(x + 50) = 260$ $x + 50 = 130$ $x = 80$m	• Identify and prove misconceptions about a generalised concept or fact specific to a task or situation **(CP5.8)**

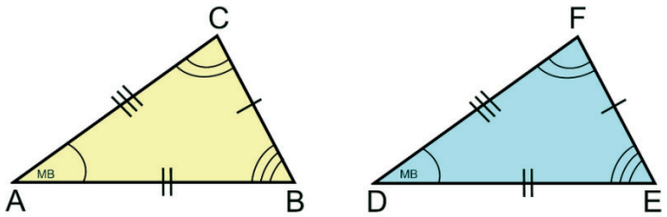
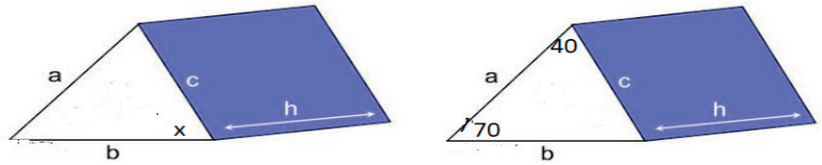
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	ii. A man paid GH¢ 290.00 for 11 books. Some of the books were geography books, and the rest were history books. If each geography book cost GH¢ 30.00 and each history book cost GH¢20.00, how many geography books did he buy? **Solution**: i. Total cost of the books is GH¢290.00; total number of books is 11. ii. 1 geography book costs GH¢30.00; 1 history book costs GH¢20.00, Total cost of all the books is $30x + 20(11 - x)$ = GH¢ 290 $\therefore\ 30x + 20(11-x)$= GH¢ 290 $30x + 220 - 20x$ = GH¢ 290 $10x + 220 = 290$ $x = 7$ books Hence the number of geography books bought is 7. **E.g. 2.** Solve real-life problems involving linear inequalities. i. Two sides of a triangle have lengths 6 cm and 8 cm. What is the length of the third side? **Note**: The sum of the lengths of the two sides of a triangle is greater than the length of the third side. If the third side is x *cm* long then, $6 + 8 > x$ giving $x < 14$. Also, $6 + x < 8$ *giving* $x > 2$. [Also, $8 + x > 6$ which gives $x > -2$.] Hence, $2 < x < 14$. That is, the third side has length between 2cm and 14cm.  ii. A student scores 70 and 76 marks in two tests. How many marks must she score in the third test to be put in Grade A if all students scoring an average of 80 or higher in three tests are put in grade A?	

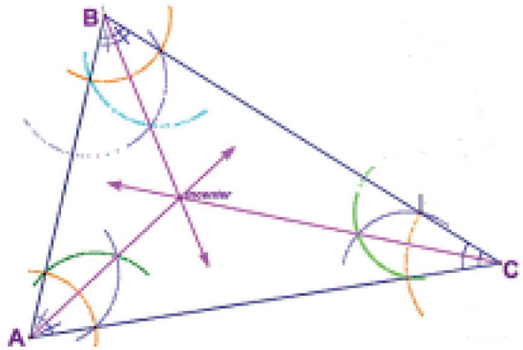
STRAND 3 GEOMETRY AND MEASUREMENT

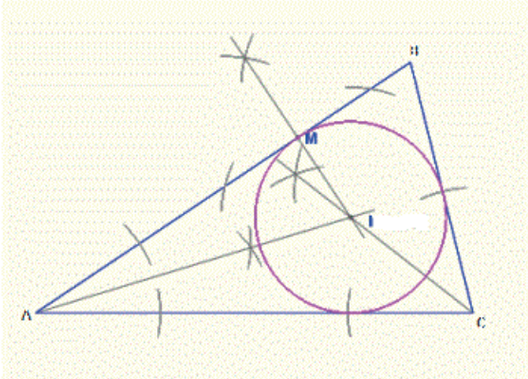
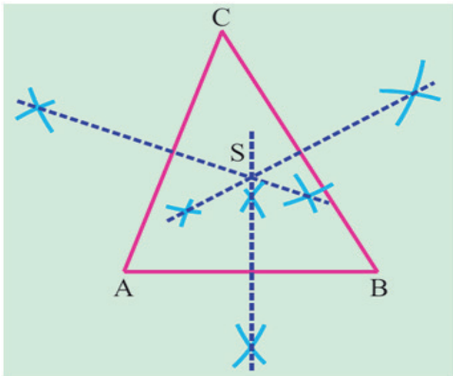
SUB-STRAND 1 SHAPES AND SPACE

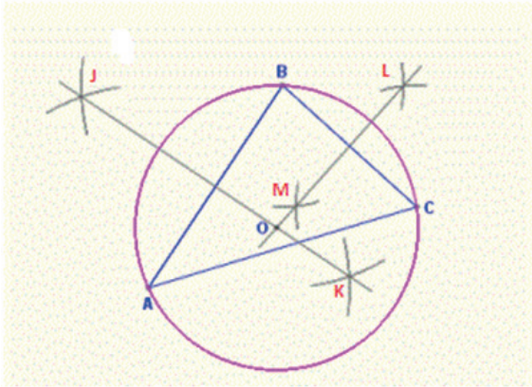
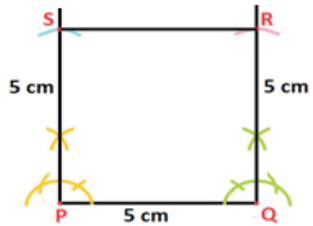
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.1.1 Apply the properties of angles at a point, angles on a straight line, vertically opposite angles, corresponding, angles to solve problems	**B9.3.1.1.1 Derive the formula for calculating the sum of angles in any polygon and use this to calculate the value of missing angles in polygons.** **E.g. 1. .** Identify and name the various polygons such as a triangle, quadrilaterals, pentagons, and hexagons, etc.  **E.g. 2.** Derive and use the formula (n - 2) × 180° and calculate the value of *x* (interior and angles of a triangle).  	**Communication and Collaboration (CC)** • Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication **(CC7.3)**

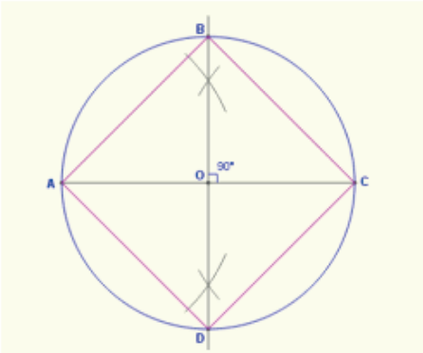
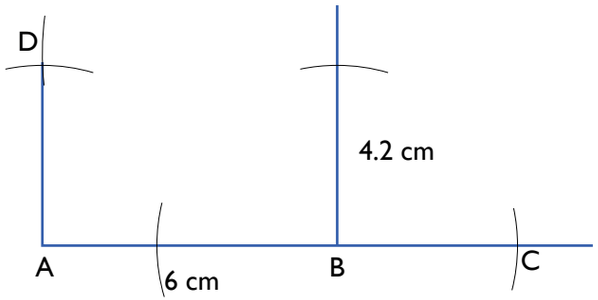
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Derive and use the formula (n - 2) × 180° and calculate the interior angles of a quadrilateral.  **E.g. 4.** Derive and use the formula (n - 2) × 180° and calculate the interior angles of polygons, pentagons, hexagons, etc. (i) Find the value of *x* and the various angles in the hexagon.  	
	B9.3.1.1.2 Identify similar and congruent triangles and use the knowledge to solve related problems **E.g. 1.** Recognise similar triangles and solve for the values of the indicated angles in the diagram below:  	

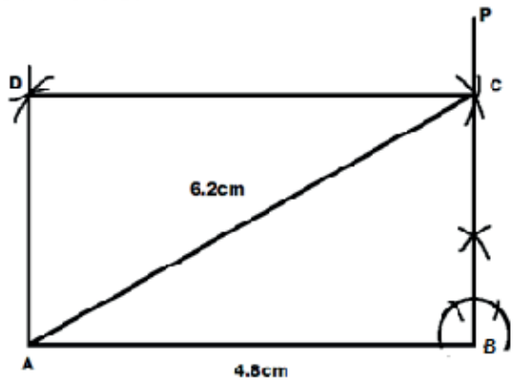
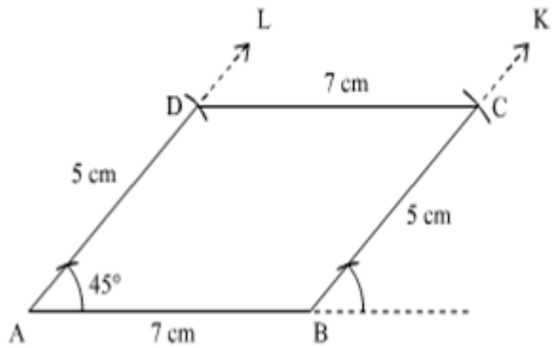
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Recognise congruent triangles and solve for the values of the indicated angles in the diagram below:  $\Delta ABC \cong \Delta DEF$ **E.g. 3.** Determine the value of *x* (using knowledge in similarity and congruency).  	

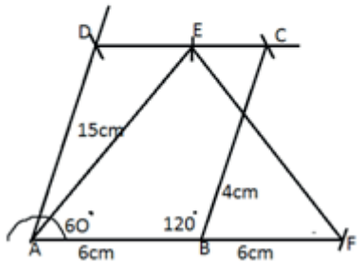
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions	**B9.3.1.2.1 Draw inscribed and circumscribed circles for triangles under given conditions** **E.g. 1.** Use a pair of compasses and a ruler to construct a triangle (say ΔABC) under a given condition and locate the incentre of the triangle (**the incentre is the point of concurrency of the three angle bisectors of a triangle**); measure the shortest distance from the incentre to the line segments AB, AC and BC. What do you observe about the lengths?  	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Creativity and Innovation (CI), Personal Development and Leadership (PL), Digital Literacy (DL)** • Actively promote effective group interaction and the expression of ideas and opinions in a way that is sensitive to the feelings and background of others **(PL6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Use a pair of compasses and a ruler to construct a triangle (say ΔABC) under a given condition, bisect at least any two angles (ΔBAC and ΔBCA); locate the intersection of the two angle bisectors (L) and draw a locus of points equidistant from the fixed point (L) to touch the edges of the triangle.  	• Ability to examine alternatives in creating new things **(CI5.1)** • Evaluate the quality and validity of information **(DL5.5)**
	E.g. 3. Construct a triangle (say *ΔABC*); bisect all three sides (i.e. line segments *AB, AC* and *BC*); locate the intersection (circumcentre) of the three perpendicular bisectors. Measure the distance from the intersecting centre (S) to points A, B and C. What do you observe about the lengths?  	• Desire to accept one's true self and overcome weakness **(PL5.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. : Perform a geometric construction of a triangle (say ΔABC) under a given condition; bisect at least any two sides (*AB* and *BC*)); locate the intersection of the two perpendicular bisectors *(O)* and draw a locus of points equidistant from the fixed point *(O)* to circumscribe the triangle.  	• Ability to reflect on approaches to creative task and evaluate the effectiveness of tools used **(CI6.2)**
	B9.3.1.2.2 Construct parallelograms (i.e. square, rectangle, rhombus) under given conditions. **E.g. 1.** Perform geometric construction of a square with a given side. PQRS is a geometric construction of a square with side 5 cm  	• Can vary the level of detail and the language use when presenting to make it appropriate to the audience **(CC8.5)**

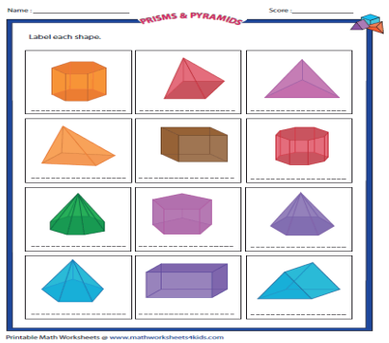
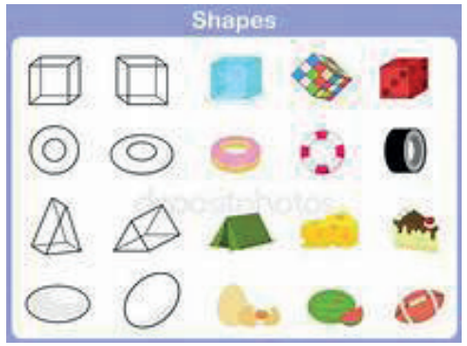
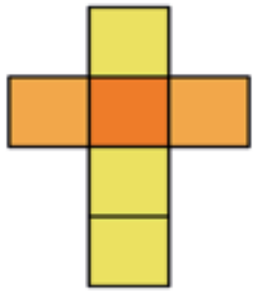
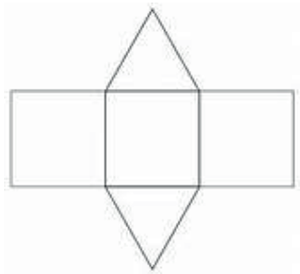
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Construct a square ABCD with =6.5cm. Measure and record the diagonal of the square. **E.g. 3.** Perform geometric construction of a square with a given diagonal. Construct the square ABCD with AC = 10 cm. What is the length of the sides?  **E.g. 4.** Perform geometric construction of a rectangle with given side. Construct rectangle ABCD such that AB = 6 cm and BC = 4.2 cm  	• Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**

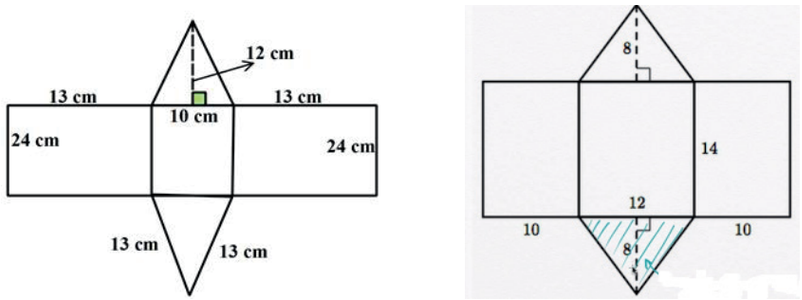
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 5. Perform geometric construction of a rectangle with a given side and diagonal. Construct a rectangle ABCD with length AB = 4.8cm and diagonal AC= 6.2cm  	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)**
	E.g. 6. Perform geometric construction of a parallelogram with given sides and given angle(s). Construct the parallelogram ABCD such that the line segments AB=7cm and AD=5cm, and ∠ DAB=45°  	• Being open-minded, adapting and modifying ideas to achieve creative results **(CI6.6)**

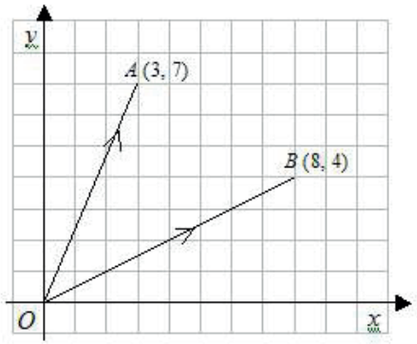
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 7 Perform geometric construction of regular compound plane shapes with given sides and angles. ABCD is a parallelogram such that <DAB=60°, <CBA = 120°, AB=6cm. AEF is an isosceles triangle, such that AE=FE= 15cm, B is the midpoint of AF=12cm.  	• Preparedness to make better decisions using information **(DL5.6)**

STRAND 3 GEOMETRY AND MEASUREMENT

SUB-STRAND 2 MEASUREMENT

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.9.3.2.1 Derive the formulas for determining the surface area of prisms (i.e. cuboid and triangular prism) and use to solve problems	**B9.3.2.1.1 Identify cuboids and triangular prisms; draw their nets to construct the 3-D shapes and use it to determine the surface area.** **E.g. 1.** Sort out shapes that are triangular prisms and cuboids.   **E.g. 2.** Identify each of the nets below:   A net of…….. A net of……..	**Critical Thinking and Problem solving (CP), Creativity and Innovation (CI)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Measure and find the area of each of the sections in the net and adding all together to give the surface area. **B9.3.2.1.2 Use the net of a cuboid to determine its surface area.** **E.g. 1.** Find the surface area of each of the cuboids 	• Preparedness to recognise and explain results after implementation of plans **(CP6.6)**
	B9.3.2.1.3 Use the net of a triangular prism to determine its surface area. **E.g. 1.** Find the surface area of each of the triangular prisms. Z 	

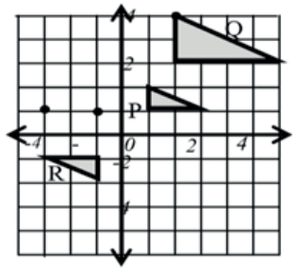
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.3.2.1.4 Express points in the Cartesian plane as position vectors **E.g. 1.** Identify the following using the diagram below: (i) the origin (ii) the position vector If $a = \begin{pmatrix} 3 \\ 7 \end{pmatrix}$, then the coordinates of A will be (3, 7). Similarly, if $b = \begin{pmatrix} 8 \\ 4 \end{pmatrix}$, then coordinates of B will be (8, 4)  **E.g. 2** Draw and write the position vectors of the following with 0 as the origin: (i) M(2,3) (ii) N(–1,2)	• Ability to merge simple/ complex ideas to create novel situations or things **(CI5.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.2.2 Solve problems involving bearings and addition/subtraction of vectors	**B9.3.2.2.1 Show an understanding of parallel vectors and perpendicular vectors.** **E.g. 1.** Investigate conditions for parallel vectors and perpendicular vectors. **E.g. 2.** Use the result from the investigation to solve the following questions: (i) Find the value(s) of x, if the vectors $\begin{pmatrix}3x\\2\end{pmatrix}$ and $\begin{pmatrix}6\\x\end{pmatrix}$ are parallel. (ii) Which of the vectors is perpendicular to $\begin{pmatrix}3\\4\end{pmatrix}$ (a) $\begin{pmatrix}-3\\4\end{pmatrix}$ (b) $\begin{pmatrix}-3\\-4\end{pmatrix}$ (c) $\begin{pmatrix}-4\\3\end{pmatrix}$ (d) $\begin{pmatrix}-4\\-3\end{pmatrix}$	• Preparedness to make better decisions using information **(DL5.6)**
	B9.3.2.2.2 Apply the triangular and parallelogram laws of addition to resolve vectors. **E.g. 1.** Deduce the triangle law of vector addition. $\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC}$ Where ABC are points in the 0xy plane. **E.g. 2.** The vertices of a triangle are P(1,-3), Q(7,5) and R(-3,5) i) Express $\overrightarrow{PQ}, \overrightarrow{QR}, \overrightarrow{PR}$,and as column vectors. ii) Show that triangle PQR is an isosceles. iii) Find the equation of the line $\overrightarrow{PR}$. **E.g. 3.** Investigate the parallelogram law of vector addition. **Eg .4**. P,Q,R,S is a parallelogram whose vertices are P(x ,y), Q(5,7), R(2,4) and S(1,3) i) Find $\overrightarrow{PQ}$ and $\overrightarrow{SR}$ hence find the values of x and y.	• Recognise and generalise information and experience; search for trends and patterns **(CI6.8)**

STRAND 3:GEOMETRY AND MEASUREMENT

SUB-STRAND 3: POSITION AND TRANSFORMATION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.3.1 Demonstrate understanding of how to perform an enlargement on a geometrical shape given a scale factor and describe the properties of the image under the transformation (i.e. congruence, similarity, etc.)	**B9.3.3.1.1 Know examples of situations in everyday life that depict enlargement situations in everyday life.** **E.g. 1.** Know examples of situations that relate to enlargement situations in everyday life and the nature of movements – vertical and horizontal.    	**Creativity and Innovation (CI), Digital Literacy (DL)** • Recognition of societal issues emanating from the useof digital technologies **(DL6.5)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.3.3.1.2 Understand enlargement and identify real-life situations involving enlargement. **E.g. 1.** Draw an enlargement of shapes using a given scale factor. i. State the single transformation that maps triangle P onto Q. ii. State the single transformation that maps triangle P onto R.  iii. Investigate the characteristics of enlargements under the following conditions of scale factor: • if the scale factor (K) is negative • if the scale factor (K) is greater than 1 or less than –1 • if the scale factor (K) is between –1 and 1 (i.e., fraction) **E.g. 2.** Using an object, and its image, determine the scale factor in a transformation?	• Putting forward constructive comments, ideas, explanations and new ways of doing **(CI5.7)** • Putting forward constructive comments, ideas, explanations and new ways of doing things **(CI5.7)**
	B9.3.3.1.3 Investigate the concept of congruent and similar shapes **E.g. 1.** Using multiple and varied examples of enlargement on a coordinate plane, verify congruent and similar shapes using their properties.	

STRAND 4 HANDLING DATA

SUB-STRAND: 1 DATA

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td rowspan="2">B9.4.1.1 Select, justify, and use appropriate methods of collecting data (grouped/ ungrouped), use the data to construct and interpret frequency tables and histogram and use it to determine the mode and to solve and/or pose problems.</td><td>B9.4.1.1.1 Select and justify a method to collect data (quantitative and qualitative) to answer a given question.
E. g. 1. Discuss and decide
i) from where/whom to collect data for the studies presented below;
ii) which data collection methods to use; and
iii) justify the choices for (i) and (ii) above
Areas of study are described as follows:
a. Musa has started a book club for Ayisha and her friends. He wants Ayisha to find out books that are most popular among her friends.
b. Find the most common mode of travel by learners in Oyoko Junior and Senior High Schools.</td><td>Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Creativity and Innovation (CI)</td></tr>
<tr><td>B9.4.1.1.2. Organise data (grouped/ungrouped) present it in frequency tables, linegraphs, pie graphs, bar graphs and/or pictographs (representations include infographics, waffle diagrams, box and whisker plots and stem and leaf plots) and analyse it to solve and/or pose problems.
E.g. 1. Thirty bulbs were life-tested and their lifespan to the nearest hour are as follows:
167 171 179 167 171 165 175 179 169 171
177 169 171 177 173 165 175 167 174 177
172 164 175 179 179 174 174 168 171 168
i. Present the raw data in a frequency table by completing the table below:
<table><tr><td>Lifespan of Bulbs (hours)</td><td>Tally</td><td>Frequency</td></tr><tr><td>164 – 167</td><td></td><td></td></tr><tr><td>168 – 171</td><td></td><td></td></tr><tr><td>172 – 175</td><td></td><td></td></tr><tr><td>176 – 179</td><td></td><td></td></tr></table></td><td>• Explain ideas in a clear order with relevant detail, using correct construction and structure of speech (CC8.2)
• Provide new insight into controversial situation or task (CP5.7)
• Ability to try new alternatives and different approaches (CI5.5)</td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

ii. What is the modal group? Justify your decision for that choice.

iii. Complete the stem and leaf plots below to display the raw data.

Use the plot to solve the following problems.

Stem	Leaf
16	4 5
17	1 1

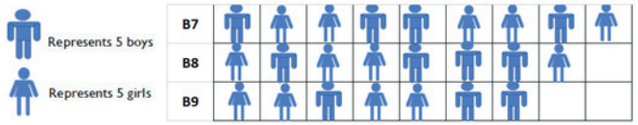
a. Find the range of the lifespan of bulbs

b. What is the mode lifespan?

c. What is the median lifespan?

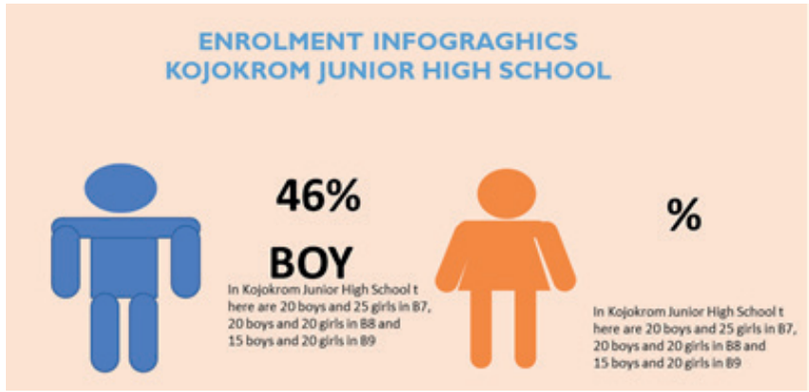
d. What other problems can you pose?

E.g. 2 The pictograph below describes the number of boys and girls in each class in Kojokrom Junior High School.



i. What is the percentage of boys and of girls in the school?

ii. Use your answers in (i) to represent the data by copying and completing the following infographic.



CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.4.1.1.3 Use a histogram to determine the mode of a given data to solve and/ or pose real life cases.	

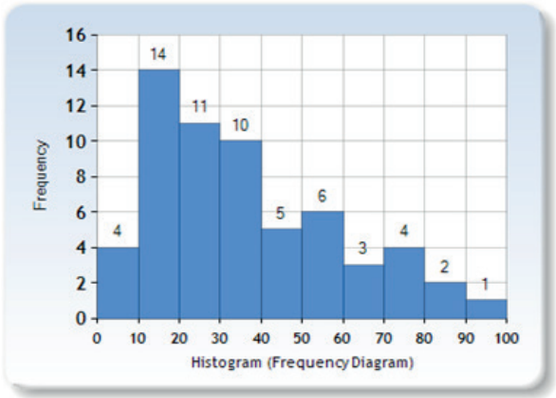
E.g. 1. The waiting times, x minutes, for 60 patients at a certain clinic are as follows:

25	12	53	8	26	5	19	73	67	18	87	42
6	21	14	19	12	15	13	36	36	16	72	36
13	37	11	51	39	32	30	47	6	22	68	25
98	23	45	22	7	9	26	35	27	48	58	56
29	20	32	62	80	41	58	17	54	15	14	74

i. Construct a frequency table using class intervals 0–10.5; 10.5–20.5; 20.5–30.5, and so on.

ii. Construct a frequency table using class intervals $0 < x \leq 10$; $10 < x \leq 20$; $20 < x \leq 30$, and so on.

iii. Draw a histogram and find the modal class.



CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.4.1.2 Select, justify, and use appropriate methods of collecting data (quantitative and qualitative), organise and analyse the data (grouped/ungrouped) to interpret the results using the descriptive statistics (measures of central tendency and range).	**B9.4.1.2.1 Select a method for collecting data (quantitative and qualitative), taking into consideration how bias (use of language, ethics, cost, time and timing, privacy or cultural sensitivity) may influence data.** **E.g. 1.** Suppose in a school survey form the following question was asked: **Overall, don't you think the teaching of mathematics is very good?** The designer of the survey form has a **bias** for the methodology used in maths lessons and the bias influences how the question was written. The **language** used in writing the question may lead people to just answer **yes** or **no**. A better question would be: Overall, how will you rate the teaching of mathematics? ◯ **Very poor** ◯ **Poor** ◯ **Fair** ◯ **Good** ◯ **Very good** **E.g. 2.** Ama Mereku in B9 wants to write an article for their school magazine on **sport-related injuries**. The responses for the survey question stated below were **collected** from **only the school's football team**. ***How many sport-related injuries have you had during your years of playing football?*** The influencing factors in this survey question are: **time** and **bias**. Football is a contact sport. The chances are that the answers from her targeted respondents will be high in favour of injuries and thus negatively affect the conclusion/report. In order to report **accurately** on sport-related injuries Ama needs to ask **more** people **(time needed)** who participate in a **variety of sports,** including **contact and non-contact** sports **(e.g. athletics tennis, volleyball,** and so on).	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC), Creativity and Innovation (CI), Personal Development and Leadership (PL), Digital Literacy (DL)** • Preparedness to make better decisions using information **(DL5.6)** • Look and think about things differently and from different perspectives **(CI6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Learners in B9 are asked by their physical education teacher to complete a survey related to "**Overall Physical Health**". One question on the survey form is; ***What is your current body weight?*** Identify the influencing factor in the survey and provide a solution. **E.g. 4** Suppose you tell your classmates that the response to the question in the Class Survey Question Form is to help you plan remedial classes. ***What is your worst subject?*** If you then use the information collected **to write an article for the school magazine** how would your actions be described and how would that influence future surveys you conduct? **E.g. 5.** Suppose in a survey questionnaire you wanted to know the favourite method of cooking chicken and you asked: ***Please tick the box against your favourite method of cooking chicken*** ☐ Boiling ☐ Grilling ☐ Frying ***Please tick the box against your favourite method of cooking pork (Optional)*** ☐ Boiling ☐ Grilling ☐ Frying This question does not apply to everyone because some people do not eat pork (i.e. the question is not culturally sensitive.) A better question would be ***If you eat pork please name the favourite method you cook it.*** ☐ Boiling ☐ Grilling ☐ Frying	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B9.4.1.2.2 Organise and analyse data and interpret the results using the descriptive statistics (i.e. minimum, maximum, measures of central tendency and range) to answer a given question. Refer to **E.g. 1** of **B9.4.1.1.2** and find (minimum, maximum, measures of central tendency and range): i. The minimum lifespan, to the nearest hour, of the bulbs tested. ii. The maximum lifespan, to the nearest hour, of the bulbs tested. iii. The range of the data collected from the life-testing. iv. What is the mean lifespan of the bulbs? v. What is the median of the lifespan of the bulbs? vi. What is the mode of the lifespan of the bulbs? vii. When placing an order for the bulbs tested to sell in your shop, which of them will you consider buying?	• Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use to solve a problem **(DL5.1)** • Look and think about things differently and from different perspectives **(CI6.7)**
	B9.4.1.2.3 Demonstrate the effect on the mean, median, and mode when extreme data is included in a data set **E.g. 1.** Refer to **E.g. 1** of **B9.4.1.1.2.** i. Find the mean of the data, if one of the bulbs is replaced with a new bulb with lifespan of 300 hours, find the new mean of the bulbs and compare it to the original mean ii. In small groups, find the mean of the data, if the lifespan of one of the bulbs tested was 70 hours, and compare it to the original mean. iii. Continue to replace the values of the lifespan in the data with extreme values (small and large), calculate the mean, median, and mode and discuss the findings.	• Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event **(CP5.10)** • Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures **(CC7.2)**

STRAND 4 HANDLING DATA

SUB-STRAND 1 CHANCE OR PROBABILITY

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.4.2.1 Identify the sample space for a probability experiment involving two dependent events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems.	**B9.4.2.1.1.Perform a probability experiment involving two dependent events e.g. drawing coloured bottle tops from a bag without replacement** **E.g. 1.** In an experiment, Anita was asked to pick one bottle top, in three trials, from a bag which contains 3 red, 2 green and 1 pink bottle tops **without replacement**. i. List the elements of the sample space of the events. ii. Does the occurrence of the one trial affect the occurrence of the other trials?	**Critical Thinking and Problem solving (CP), Personal Development and Leadership (PL)** • Demonstrate behaviour and skills of working towards group goals **(CC9.1)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Division of tasks into solvable units and assign group members to task units **(PL6.2)**
	B9.4.2.1.2. Express the probabilities of the events as fractions, decimals, percentages and/or ratios; e.g. using a tree diagram, table or another graphic organiser **E.g. 1.** Draw a probability tree diagram for the experiment in **B9.4.2.1.1**. **E.g. 2.** Express the probabilities of the events (on their respective branches) as decimals, percentages and ratios. **E.g. 3** i. Consider the experiment of drawing two Aces (in two trials) in a standard deck of cards without replacement. ii. Calculate the probability of **each** trial and express the probabilities of the events as decimals, percentages and ratios. **E.g. 4** i. Consider the experiment of drawing an Ace and a Jack (in two trials) in a standard deck of cards without replacement. ii. Calculate the probability of **each** trial and express the probabilities of the events as decimals, percentages and ratios.	

BASIC 10

STRAND 1: NUMBER

SUB-STRAND 1: NUMBER AND NUMERATION SYSTEM

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td>10.1.1.1. Apply the understanding of place value and standard form in solving real life problems involving integers of any size, rounding this to decimal places and significant figures</td>
<td>
10.1.1.1.1 Solve problems involving integers of any size and write answers in standard form, and round off to a given number of decimal places and significant figures

E.g. 1. Apply the understanding of place value to other sets of integers
(i) order these numbers in ascending and descending order: 804,356; 1478,942; 769,256; 306,984,721; 133,567,451; etc.

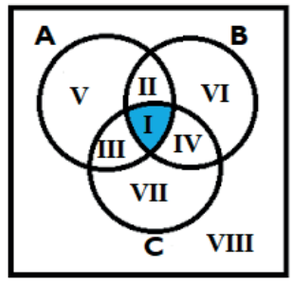
E.g. 2. Round numbers to given significant figures:
(i) Express these numbers, correct to four, three, and two significant figures.
<table>
<tr><td>number</td><td>4-sig. figures</td><td>3-sig. figures</td><td>2-sig. figures</td></tr>
<tr><td>187594</td><td>187600</td><td>188000</td><td>190000</td></tr>
</table>
E.g. 3. Approximate a decimal number to a given number of significant figures.

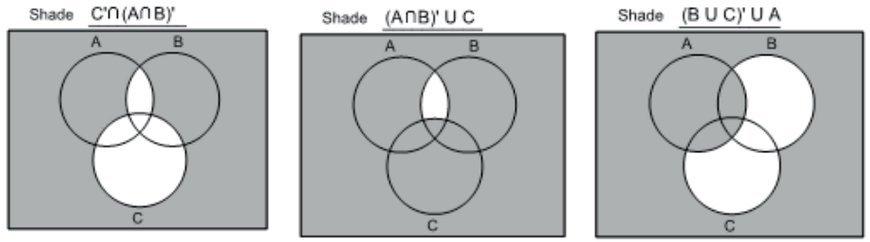
E.g. 4. Round decimal numbers to given decimal places.
<table>
<tr><td>Number</td><td>Three decimal places</td><td>Two decimal places</td><td>One decimal place</td></tr>
<tr><td>436.8437</td><td>436.844</td><td>436.84</td><td>436.8</td></tr>
<tr><td>98.9654</td><td>98.965</td><td>98.97</td><td>99.0</td></tr>
</table>
</td>
<td>
Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)

• Ability to help group work on relevant activities (CC9.4)

• Identify words or sentences in context appropriately (CC7.1)

• Explain ideas in a clear order with relevant detail, using correct construction and structure of speech (CC8.2)
</td>
</tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	10.1.1.1.2 Solve story or real-life problems and express answers in standard form **E.g. 1.** Create and solve real-life or story problems. (i) The length of a square field is 426m. Oko runs 8 times around the field. What is the total distance covered by Oko? Express the answer in standard form. (ii) A bus was hired from Monday to Wednesday. It travelled 1760.94km on Monday and travelled 204.2km more on Tuesday than on Monday. It travelled 96.32km less on Wednesday than on Tuesday. What was the total distance travelled by the bus on Wednesday? Write the answer in standard form.	• Ability to help group work on relevant activities **(CC9.4)** • Can effectively evaluate the success of solutions used in an attempt to solve a complex problem **(CP5.5)**
B10.1.1.2 Apply the understanding of the concepts and vocabulary of sets and the relationship between members of the real number system to solve real life problems involving union and intersection three sets.	**B10.1.1.2.1 Use Venn Diagrams to solve problems on relationship between sets of real number systems and solve real-life problems on relationship between sets of real number system.** **E.g. 1.** Identify the various sets or regions of the three intersecting sets. i. Draw three intersecting sets and identify the various regions or sets as: • All three sets • Exactly two sets • Two sets • Only one set.  	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Ability to help group work on relevant activities **(CC9.4)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	ii. Shade the regions labelled I, II, III, IV, V, VI and VII in terms of sets A, B and C. For example,  	• Ability to identify important and appropriate criteria and use them to evaluate available alternatives **(CP6.4)**
	E.g. 2. Create three-set real life or story problems on real number systems and solve. ***Think:*** A group of 22 travellers were each asked to acquire a passport, health certificate and foreign currency equivalent to $800. Only 7 of them obtained both health certificate and currency. 6 had both the passport and health certificate, and 6 had both the passport and currency. Each of the travellers had at least one of the three requirements. a. Represent this data on a Venn diagram if *x* of them had all the three requirements. b. Write an equation in *x* and solve. c. How many travellers obtained: i. Exactly 2 of the requirements ii. At most 2 of the requirements.	

STRAND 1: NUMBER

SUB-STRAND 2: NUMBER OPERATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.1.2.1 Demonstrate an understanding of the number properties to determine answers for addition, subtraction, multiplication, and division basic facts	**B10.1.2.1.1 Determine commutative properties of addition and multiplication.** **E. g. 1.** Recognise that for any two numbers **a** and **b**; i. a + b = b + a i.e. 56 + 45 = 45 + 56 = 101 ii. a × b = b × a i.e. 11 × 13 = 13 × 11 = 143 **B10.1.2.1.2 Use the associative property of addition and multiplication.** **E.g. 1.** Recognise that for any three numbers **a**, **b** and **c**; i. a + (b + c) = (a + b) + c or a + (b + c) = (a + c) + b i.e. 20 + (15 + 35) = (20 + 15) + 35 = 70 ii. (a × b) × c = a × (b × c) i.e. (20 × 4) × 5 = 20 × (4 × 5) = 200	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Ability to help group work on relevant activities **(CC9.4)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	B10.1.2.1.3 Use the distributive property in solving problems. **E.g. 1.** Recognise that for any three numbers **a**, **b** and **c**; i. a × (b + c) = (a × b) + (a × c) i.e. 20 × (8 + 12) = (20 × 8) + (20 × 12) = 400 ii. a × (b - c) = (a × b) - (a × c) i.e. 2 × (35 - 11) = (2 × 35) - (2 × 11) = 48	

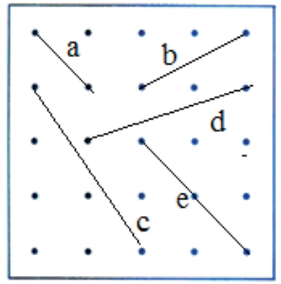
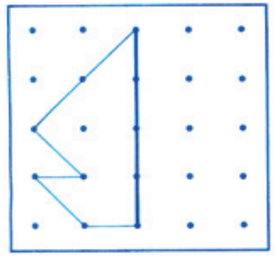
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.2.1.4 Use the closure property in solving problems. **E.g. 1.** Recognise that a set is **closed** with respect to that operation if the operation can always be completed with elements in the set.	
	B10.1.2.1.5 Use the identity property in solving problems. **E.g. 1.** Recognise that for any given set of numbers 1 is the multiplicative identity and 0 is the additive identity. i.e. $1 \times b = b \times 1 = b$ and $0 + a = a + 0 = a$, are the multiplicative and additive identities respectively.	
	B10.1.2.1.6 Use the inverse property in solving problems. **E.g. 1.** Recognise that the additive inverse of p *is* $= -p$ *i.e.* additive inverse of 3 *is* $= -3$ **E.g. 2.** Recognise that the multiplicative inverse of p is $= \frac{1}{p}$ i.e multiplicative inverse of = 3 *is* $= \frac{1}{3}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.1.2.2 Apply the understanding of the addition, subtraction, multiplication and division of decimal numbers to solve word problems and round answers to given decimal places or significant figures	**B10.1.2.2.1 Solve word problems involving the four basic operations and including problems that require rounding the answers to a given decimal or significant figures.** **E.g. 1.** Word problems involving the four basic operations. i. There were 42 mangoes in each crate. 12 such crates of mangoes were delivered to a factory. 4 mangoes were rotten and had to be thrown away. The remaining mangoes were packed into boxes of 10 mangoes each. How many boxes of mangoes were there? ii. There were 9,500 spectators at a football match. 6,375 of them were men. Of the remaining spectators, there were 4 times as many children as women. How many children were there? iii. Mikiru loves animals. She has three times as many goats as she has chickens. She has four more ducks than chickens. Altogether, she has 49 animals (just goats, ducks and chickens). How many more goats does she have than ducks? iv. At the school talent show, 1/3 of the students were boys, 3/6 were girls, and the rest were adults. If there were 50 more girls than adults, how many people were there in total?	**Critical Thinking and Problem solving (CP), Creativity and Innovation (CI)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Identification of requirements of a given situation and justification of more than one creative tool that will be suitable **(CI5.3)**

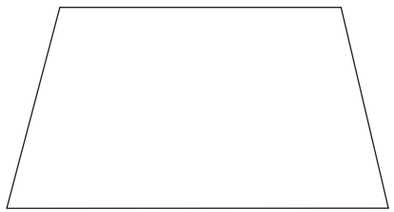
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Word problems involving rounding the answers to a given decimal or significant figure. i. At a musical show in Salaga, Adaku and Aliu bought 3 times more popcorn than they usually buy. A box of popcorn is GH¢2.65. If in their previous show they bought 3 boxes of popcorns, how much did they pay for their popcorn at the Salaga show? Leave your answer to the nearest whole number. ii. At a senior high school in the Bono Region, a teacher assigned a task to her students to calculate the density of some given items. Kwaakye had 12.134kg/m^3, Abebrese had 0.05632kg/m^3 and Rakia had 1,132.125kg/m^3. Correct each of their results to: a. 2dp b. 1dp c. 3sf d. 4sf	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

STRAND 1: NUMBER

SUB-STRAND 2: NUMBER OPERATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.1.2.3 Demonstrate understanding of the process of multiplying and rationalising surds as well as determining (using a calculator) the approximate square root of a non-perfect square and use these in solving real life problems.	**B10.1.2.3.1 Perform addition, subtraction and multiplication of surds.** **E.g. 1.** Use geodot activities on perimeter of shapes to develop and generate numbers in the form of surds. The lengths of the line segments in the diagram above are $\sqrt{2}, \sqrt{5}, \sqrt{13}, \sqrt{10}$ and $\sqrt{2}$ for **a**, **b**, **c**, **d**, and **e**, respectively.  The perimeter of the shape is $2\sqrt{2} + \sqrt{2} + 1 + \sqrt{2} + 1 + 4 = 6 + 4\sqrt{2}$ 	**Critical Thinking and Problem solving (CP)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td rowspan="3"></td><td>E.g. 2. Perform addition and subtraction of surds.
i. $5\sqrt{6}+4\sqrt{6}$
ii. $9\sqrt{3}-4\sqrt{3}$
iii. $\sqrt{12}+7\sqrt{3}$
iv. $\sqrt{7}-7-2\sqrt{7}$
v. $\sqrt{45}+\sqrt{125}-\sqrt{45}$
E.g. 3. Perform multiplication of surds.
i. $\sqrt{3}\times\sqrt{5}$
ii. $(\sqrt{3})^3$
iii. $(\sqrt{3})^2\times(\sqrt{5})^3$
iv. $(\sqrt{2})^6$</td><td></td></tr>
<tr><td>B10.1.2.3.2 Conjugate a given surd
E.g. 1.<table><tr><th>Surd</th><th>Conjugate</th></tr><tr><td>$\sqrt{a}+\sqrt{b}$</td><td>$\sqrt{a}-\sqrt{b}$</td></tr><tr><td>$xy\sqrt{z}-yz\sqrt{x}$</td><td>$xy\sqrt{z}+yz\sqrt{x}$</td></tr><tr><td>$\frac{1}{2}x+\frac{1}{2}\sqrt{y}$</td><td>$\frac{1}{2}x-\frac{1}{2}\sqrt{y}$</td></tr></table></td><td>Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)</td></tr>
<tr><td>B10.1.2.3.3 Rationalise a monomial denominator of a given surd
E.g. 1. Rationalise a surd with a monomial denominator.
i. $\frac{1}{\sqrt{5}}$
ii. $\frac{5}{\sqrt{7}}$
iii. $\frac{7\sqrt{3}}{2\sqrt{11}}$</td><td></td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.2.3.4 Rationalise a binomial denominator of a given surd **E.g. 1.** Rationalise a surd with a binomial denominator. i. $\frac{5}{2-\sqrt{3}}$ ii. $\frac{1}{\sqrt{7}+\sqrt{5}}$ iii. $-\frac{2}{3\sqrt{5}+4}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	B10.1.2.3.5 Use the knowledge of surds to solve problems. **E.g. 1.** i. The trapezium has an area of $(9 + 6\sqrt{3})$ cm^2. ii. What is the perpendicular height of the trapezium? $(\sqrt{2}+\sqrt{5})cm$  $(\sqrt{18}-\sqrt{5})cm$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

STRAND 1: NUMBER

SUB-STRAND 3: FRACTIONS, DECIMALS AND PERCENTAGES

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.1.3.1 Apply the understanding of operations on fractions to solve problems involving fractions of given quantities and round the results to given decimal and significant places	**B10.1.3.1.1 Add and/or subtract, multiply and/or divide given fractions, including the use of the BODMAS/PEDMAS rule, and apply the understanding to solve problems** **E.g. 1** Solve the following addition and subtraction of fractions: 1. $3\frac{1}{3}+1\frac{3}{4}-1\frac{2}{3}$ 4. $\frac{11}{2}-\left(\frac{2}{7}+\frac{3}{2}\right)$ 2. $\frac{17}{6}+\frac{5}{3}-3\frac{1}{2}$ 5. $1\frac{1}{5}+\frac{17}{2}-\frac{3}{2}$ 3. $\frac{1}{2}+\frac{13}{8}-\frac{11}{12}$ 6. $2\frac{5}{6}-\left(4\frac{1}{3}-\frac{3}{2}\right)$ **E.g. 2.** Solve the following multiplication and division of fractions i. $\frac{12}{17}\times\frac{34}{120}\div\frac{5}{6}$ iii. $\left(15\frac{1}{2}\times\frac{20}{62}\right)\div\left(3\frac{1}{5}\times3\frac{3}{4}\right)$ ii. $\left(\frac{7}{9}\div\frac{14}{21}\right)\times\left(\frac{3}{5}\div\frac{1}{4}\right)$ iv. $\frac{\frac{1}{3}\times\frac{1}{5}\div\frac{2}{3}\times\frac{1}{4}}{\frac{1}{4}\div\frac{1}{2}}$	**Critical Thinking and Problem solving (CP), Cultural Identity and Global Citizenship (CG)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.3.1.2 Add and/or subtract, multiply and/or divide given fractions, including the use of the BODMAS rule, and apply the understanding to solve problems **E.g. 3.** Find the value of each expression (involving the four operations) in the lowest term. i. $\frac{2}{3}+\frac{1}{5}-\frac{5}{8}\div\frac{1}{4}$ iii. $\frac{5\frac{2}{7}+\frac{1}{14}\times\frac{2}{3}-1\frac{1}{4}}{\frac{3}{8}\div\frac{1}{16}}$ ii. $7\frac{1}{9}\div\frac{8}{9}+\frac{3}{5}\times\frac{1}{4}$ iv. $3\frac{2}{5}\times1\frac{1}{2}\div\frac{20}{15}$	• Show a strong sense of belongingness to one's culture **(CG5.1)**
	B10.1.2.2.2 Express recurring decimals as common fractions. **E.g. 1.** Recognise that a recurring decimal has a digit or a block of digits which keep repeating. i. 2.555… or $2.5\dot{}$ ii. 0.323232… or $0.\dot{3}\dot{2}$ **E.g. 2.** Guide students to express recurring decimals as fractions of the form where b≠ 0 i. $0.\dot{7}$ = 0.7777777… = $\frac{7}{9}$ ii. $0.\dot{3}$ = 0.3333333… = $\frac{3}{9}$ iii. $0.\dot{6}\dot{3}$ = 0.63636363… $\frac{63}{99}=\frac{21}{33}=\frac{7}{11}$ iv. $0.\dot{2}0\dot{1}$ = 0.201201201… = $\frac{201}{999}=\frac{67}{333}$	
	B10.1.2.2.3 Apply knowledge of fractions and proportional relationships to solve multistep percent problems, examples: simple interest, tax, discount and commissions, NHIL, depreciation, insurance, etc. E.g. Refer to B9 for similar exemplars.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

STRAND 1: NUMBER

SUB-STRAND 4: NUMBER: RATIOS AND PROPORTION

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td>B10.1.4.1 Apply the understanding of ratio, rate and proportions solve problems that involve rates, ratios, and proportional reasoning and use it to solve real-world mathematical problems</td>
<td>
B10.1.4.1.1 Use ratio reasoning to convert foreign currencies into Ghana cedis and vice versa to solve problems.

E.g. 1. At a forex bureau, the rate of the cedi to the dollar is GH¢ 5.60: $1. How much (in cedis) will Kweku receive for $55?

E.g. 2. A daily interbank forex rates in Ghana are given in the table below.

<table>
<tr><th>Currency</th><th>Rate</th><th>Cedi (GH¢)</th></tr>
<tr><td>US Dollar</td><td>1</td><td>5.70</td></tr>
<tr><td>Pound Sterling</td><td>1</td><td>7.62</td></tr>
<tr><td>Swiss Franc</td><td>1</td><td>5.80</td></tr>
<tr><td>Euro</td><td>1</td><td>6.37</td></tr>
<tr><td>Naira</td><td>1</td><td>0.016</td></tr>
<tr><td>CFA franc</td><td>1</td><td>0.0097</td></tr>
</table>
Juhanah is travelling to Lagos. How much (in cedis) does he need to buy a plane ticket costing ₦50,800?
</td>
<td>
Critical Thinking and Problem solving (CP)
Communication and Collaboration (CC)
Cultural Identity and Global Citizenship (CG)

• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)

• Ability to help group work on relevant activities (CC9.4)
</td>
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</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.4.1.2 Explain and use rates such as kmh^{-1}, ms^{-1} and those used in utility bills to solve problems. **E.g. 1.** Calculate average speed in given situations. i. A boy cycles 6.5 kilometres to school in 30 minutes. Find the average speed in metres per second. ii. A woman covered a distance of 3 kilometres in 5 minutes on her motorbike. Find her average speed in kilometres per hour. iii. An aeroplane leaves Accra at 12:10 pm and reaches Lagos 464.22 km away at 1:25pm. Calculate, correct to the nearest whole number, the average speed of the air plane in km/h. **E.g. 2.** Calculate utility bills (water and light bills). (i) The monthly electricity charges in Ghana for a certain year were calculated as follows: First 100 units GH¢35.00 Remaining units 40p per unit How much did Mrs Anku pay for using 600 units in a month? (ii) In a company, the meter reading for water at the end of February 2020, was 8,786,000 litres. The meter reading at the end of March 2020 was 9,101,000 litres. The company was charged for the consumption at the following rates: The first 10,000 litres at 10p per litre The remaining litres at 15p per litre Calculate: a) the charge at the end of month. b) the total charge of the bill.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to help group work on relevant activities **(CC9.4)**

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>

B10.1.4.1.3 Use knowledge of rates and proportional reasoning to solve problems involving SSNIT benefits and contributions under Act 766 and PNDCL 247.

E.g. 1. Describe the obligations of the employer/employee and the contribution rates under Act 766 and PNDCL 247.

<table>
<tr><th></th><th>Act 766</th><th>PNDC Law 247</th></tr>
<tr><td>Employer</td><td>13.0% of basic salary</td><td>12.5 of basic salary</td></tr>
<tr><td>Worker</td><td>5.5% of basic salary</td><td>5.0% of basic salary</td></tr>
<tr><td>Total</td><td>18.5% of basic salary</td><td>17.5% of basic salary</td></tr>
</table>

E.g. 2. Calculate employee/employer contributions to SSNIT under Act 766.

(i) A worker's basic monthly salary is GH¢8,543.28.
Calculate the SSNIT contributions under Act 766;
a) by the employer
b) by the employee

(ii) What is the total SSNIT contribution at the end of every month?

E.g. 3. Calculate employee/employer contributions to SSNIT under PNDCL 247.

Mrs Sira's monthly SSNIT contribution under PNDCL 247 is GH¢860.60. How much does her employer contribute to SSNIT on her salary? Hence, calculate her basic salary per month.

</td><td></td></tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 4. Calculate employee benefits from SSNIT under Act 766.

The table below shows the pension rights for SSNIT contributors under Act 766

Years of contributions	15	16	17	18	19	…	33	34	35 & above
Pension Rights (%)	37.50	38.63	39.75	40.88	42.00		57.75	58.88	60

a. Mrs Nkrumah retired at age 60 last year after working for 34 years. If the average of her best salary for 3 years (36 months) over the 34-year period was GH¢24,000.00, calculate her full pension under the National Pension Act 2008, Act 766.

Calculation for full pension

Qualifying age = 60 years

Average best 3 years' salary = GH¢24,000.00

Pension right for 34 years = 58.88% (refer to the table on Pension Rights)

Annual pension to Mrs Nkrumah = 58.88/100 × 24,000

….. = GH¢14,131.20

Monthly pension to Mrs Nkrumah = $\frac{\text{Gh¢14,131.20}}{12}$

= GH¢1,177.60

b. A worker contributed for 4 years before being rendered incapacitated through an accident. If the best salary for 3 years (36 months) over the period was GH¢4,981.55, calculate the invalidity benefit for this worker.

c. Mr Nanjo's total SSNIT contribution stood at GH¢ 201,029.19 at the time of his demise. Calculate his survivor's benefit if the current interest rate is 15%.

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 5. Calculate employee benefits from SSNIT under PNDCL 247.

The table shows the pension rights for SSNIT contributors under PNDCL 247.

Years of contributions	20	21	22	23	24	25	26	27	28	29	30	…	40 & above
Pension Rights (%)	50.0	51.5	53.0	54.5	56.0	57.5	59.0	60.5	62.0	63.5	65.0		80.0

Mr Pogo, a French teacher at Adanso Senior High School, retired in 2018 after 29 years of service. Throughout this 29-year period he had been an active contributor to the SSNIT Pension Scheme. As the student who has learnt about social security, you are to help Mr Pogo to calculate his annual pension using his best three years' salary of GH¢ 23,108.44

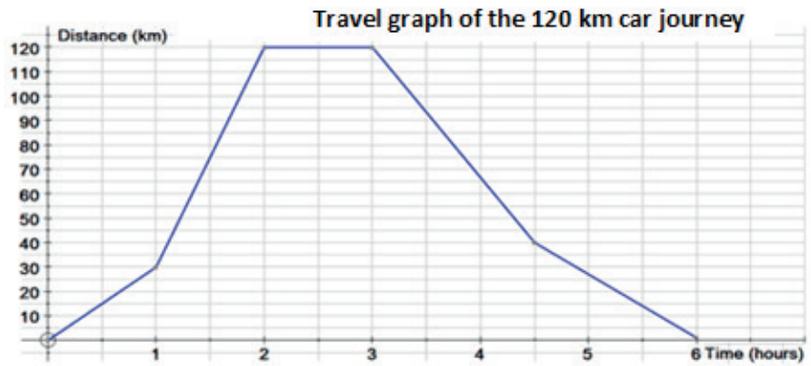
Calculation for full pension

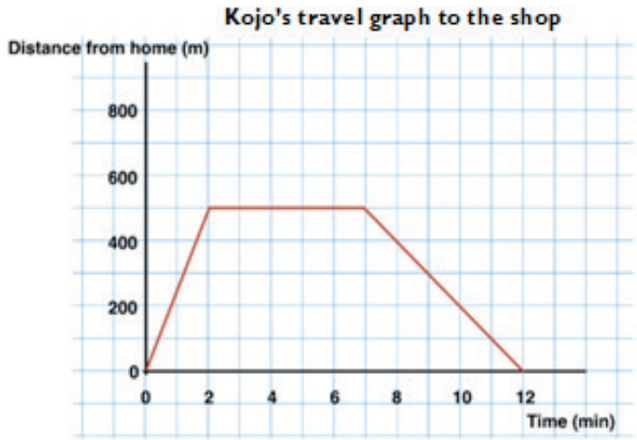
Qualifying age = 60 years

Average best 3 years' salary = GH¢23,108.44

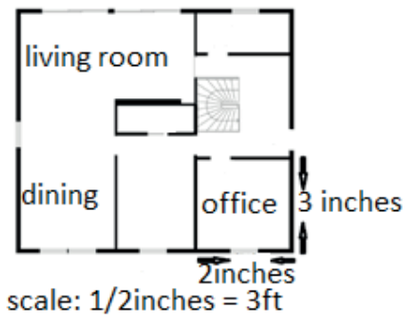
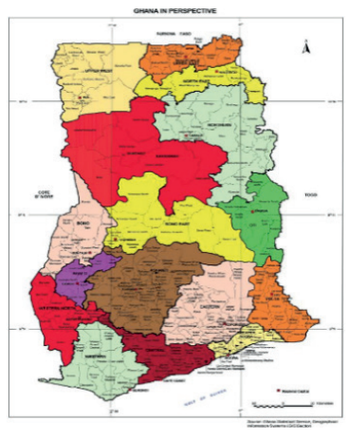
Pension right for 29 years = 63.5% (refer to the table on Pension Rights)

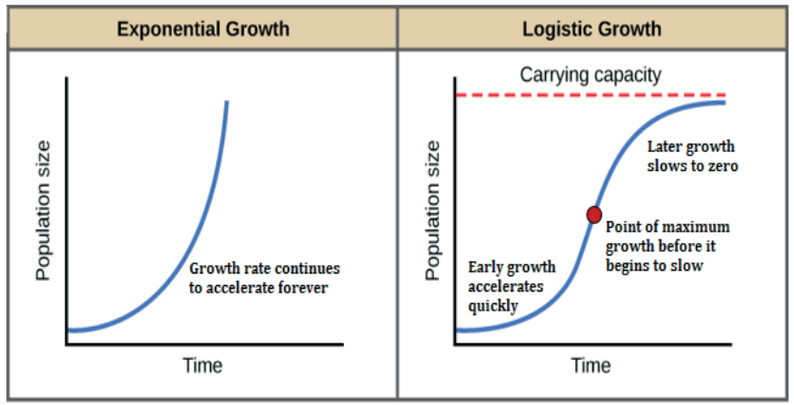
Annual pension to Mr Pogo $\frac{63.5}{100} \times$ GH¢23,108.44= $\frac{\text{GH¢}14,673.86}{12}$ = GH¢1,222.82

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.4.1.4 Draw and interpret travel graphs or distance-time graphs. **E.g. 1.** A head teacher travelled 120 km in a car to attend a meeting at the Regional Education Office. Below is the travel graph of the journey.  Use the line graph to answer the following questions: (i) How long did the whole journey take? (ii) How much time was spent at the destination? (iii) At which point in the journey was the car travelling its fastest? (iv) Why do you think the traveller changed the speed on the return journey?	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Ability to keep group working on relevant activities

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	The graph shows how Kojo ran to a shop, spent some time in the shop, and then walked back home.  Use the line graph to answer the following questions: a) How much time did Kojo spend in the shop? b) How far away from the house is the shop? c) At what speed did Kojo run to the shop? d) At what speed did Kojo walk home? e) What is the total distance covered by Kojo?	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.4.1.5 Interpret scales used in drawing plans and maps, use them to calculate distances between two points and to solve problems. **E.g. 1 Interpret scales** The Ghana map is drawn to a scale of 1cm representing 80km. **Hint:** 80km = 8,000,000cm. We therefore express the scale of this map as 1:8,000,000  **E.g. 2.** Use proportions to find measurements on scale drawings. The scale drawing of the tree is 1:500. If the height of the tree on paper is 20cm, what is the height of the tree in real life? 	• Ability to help group work on relevant activities **(CC9.4)** • Anticipate different responses from the audience and plan for them **(CC8.4)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Show a strong sense of belongingness to one's culture **(CG5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Set out a proportion to find actual measurement (actual length) The plan of the floor in the diagram shows several rooms. The length of the office space in the plan is 3inches. What is the actual length in feet of the office space? 	
	E.g. 4. Calculate actual distances between two places. The Ghana map shown is drawn to scale of 1cm representing 40km. **Hint:** 40km = 4,000,000cm. We therefore express the scale of this map as 1:4,000,000. What is the actual distance (km) from Kumasi to Tamale if the distance on the map is 8.2cm? 	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.1.4.1.6 Calculate and compare population growth rates and population densities. **E.g. 1.** Explain, with illustration, exponential and logistic population growth.  (a) (b)	• Analyse and make distinct judgment about viewpoints expressed in an argument **(CP5.2)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	E.g. 2. Calculate population growth rate. The table shows the annual population growth rate for countries A, B and C. Population increase in a year ÷ Population at the start of the year × 100 = Annual Population growth rate (%)	

Country	Population at the start of the year	Population at the end of the year	Population increase during the year	Annual Population growth rate (%)
A	28,000,000	28,530,000	530,000	1.9
B	450,000,000	470,000,000	20,000,000	4.4
C	7,900,000	8,100,000	200,000	2.5

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr><td></td><td>

E.g. 3. Calculate birth rates and death rates to find population growth rates

a) Birth rates (%) = $\frac{number\ of\ births}{population} \times 100$

b) Population growth rate (%) = birth rates – death rates

c) Death rates (%) = $\frac{number\ of\ deaths}{population} \times 100$

<table>
<tr><th>Country</th><th>Births</th><th>Deaths</th><th>Population</th><th>Birth rates (%)</th><th>Death rates (%)</th><th>Annual Population growth rate (%)</th></tr>
<tr><td>A</td><td>862,000</td><td>325,000</td><td>68,200,000</td><td>1.2%</td><td>0.5%</td><td>0.7%</td></tr>
<tr><td>B</td><td>490,000</td><td>185,000</td><td>32,000,000</td><td></td><td></td><td></td></tr>
<tr><td>C</td><td>315,300</td><td>199,000</td><td>8,150,000</td><td></td><td></td><td></td></tr>
</table>

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<tr><td></td><td>

E.g. 4. Calculate population densities.

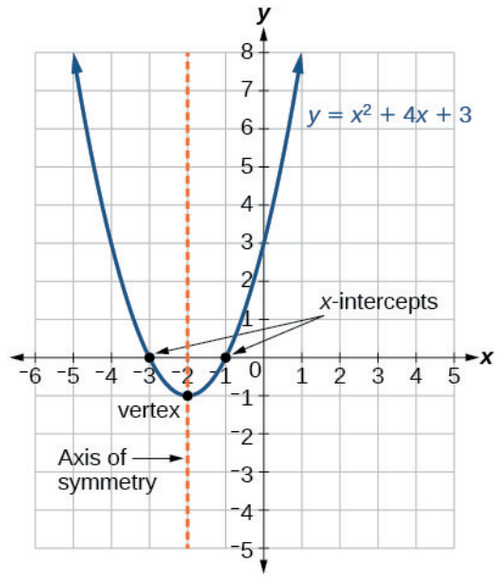
Population density= $\frac{number\ of\ people}{land\ area\ (km^2)}$

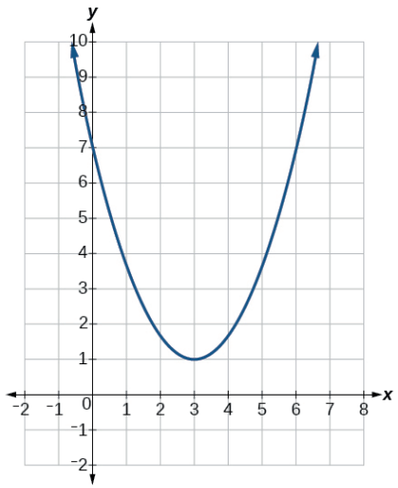
Ghana has a land area of 238,535km² and a population of 30,420,000. Calculate the population density.

</td><td></td></tr>
</table>

STRAND 2: ALGEBRA

SUB-STRAND 1: PATTERNS AND RELATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.2.1.1 Demonstrate the ability to construct a table of values for a linear relation and a quadratic relation, graph the relations in a number plane and determine the intersections to solve simultaneous equation involving one linear, and a quadratic, equation.	**B10.2.1.1.1 Construct a table of values of a given quadratic relation and graph the relation** E.g. 1 Identify the properties of quadratic graphs (Parabolas) The graph of a quadratic function is a U-shaped curve called a parabola. It has an extreme point, called the vertex. If the parabola opens up, the vertex represents the lowest point on the graph, or the minimum value of the quadratic function. If the parabola opens down, the vertex represents the highest point on the graph, or the maximum value. (In either case, the vertex is a turning point on the graph) The graph is also symmetric with a vertical line drawn through the vertex, called the axis of symmetry. The *y*-intercept is the point at which the parabola crosses the *y*-axis. The *x*-intercepts are the points at which the parabola crosses the *x*-axis. If they exist, the *x*-intercepts represent the zeros, or **roots**, of the quadratic function, the values of *x* at which *y*=0. **Graph of a parabola showing the x and y intercepts, vertex, and axis of symmetry** 	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	 • The vertex is at (3,1) • The axis of symmetry is x =3. • It has no zeros. • The y-intercept. (0,7)	
	E.g. 2. Determine the vertex, axis of symmetry, zeros, and y-intercept of the parabola shown in the graph.	• Anticipate different responses from the audience and plan for them (**CC8.4**).

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 2. Make tables for given quadratic relations.

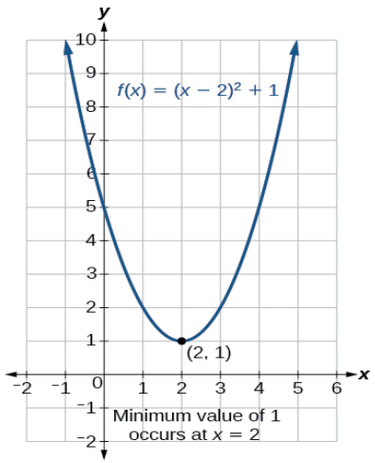
i. Make a table of values for the equation

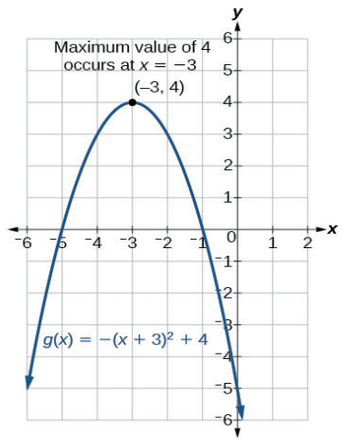
x	$y = 2x^2 - 3x + 1$
0	1
1	0
2	3
3	10
4	21
5	36
6	55

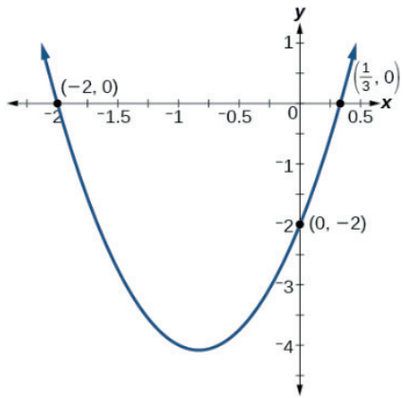
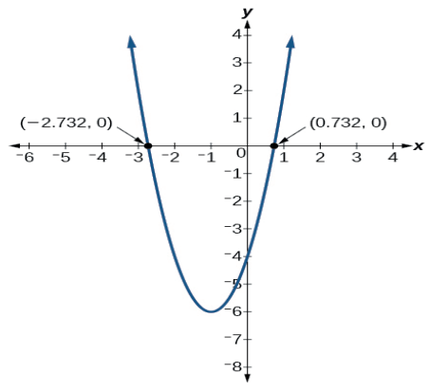
ii. Make a table of values for the equation

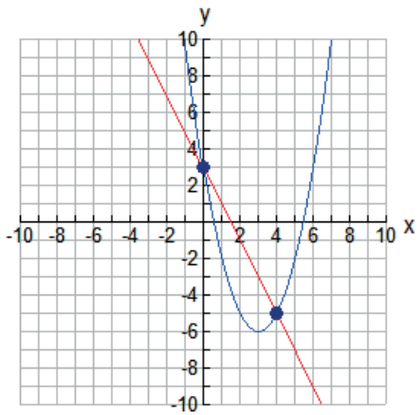
x	$y = x^2 + 3x - 1$
–3	–1
–2	–3
–1	
0	
1	
2	

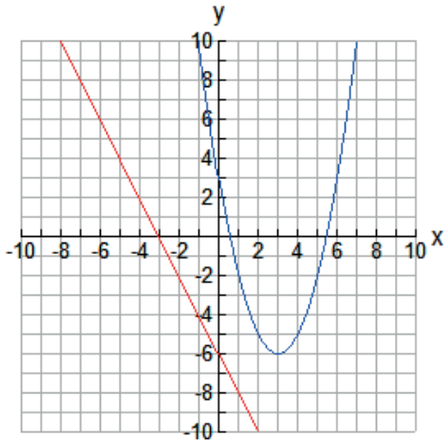
E.g. 3. Determine the minimum and maximum values of a quadratic graph.





CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Determine the intercept of a quadratic function. i. Find the intercept of the quadratic function $f(x) = x^2 - 2x - 8$. ii. Find the intercept of the quadratic function $f(x) = x^2 + 3x + 4$. **E.g. 5.** Determine the domain and range of a quadratic function. i. Find the domain and range of the function, $f(x) = x^2 - 3x - 4$, and determine the interval on which the function is increasing and decreasing. Find the domain and range of $f(x) = 5x^2 + 9x - 1$.	
	E.g. 6 Sketch/graph a quadratic function. i. Sketch the quadratic function $f(x) = 3x^2 + 5x - 2$.  ii. Sketch the quadratic function. $f(x) = 2x^2 + 4x - 4$.  	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.2.1.1.3 Use graphs to solve equations involving one linear and one quadratic relation. **E.g. 1.** Sketch the graph and determine the solution for a straight line and a quadratic graph i. Graph the solution for the straight line and the parabola intercept and state whether it has one or two solution(s).  • $y = -2x + 3$ • $y = x^2 - 6x + 3$ There are two solutions because the linear and the quadratic graph intercept at two points.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	ii. Graph the solution for the straight line and the parabola intercept and state whether it has one, two or no solution(s).  • $y = -2x - 6$ • $y = x^2 - 6x + 3$ There is no solution since the linear and the quadratic graphs do not intersect.	

STRAND 2: ALGEBRA

SUB-STRAND 2 ALGEBRAIC EXPRESSIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.2.2.1 Solve problems involving algebraic expressions or formulas (including difference of two squares) and substitute values to evaluate expressions	**B10.2.2.1.1 Express simple statements involving algebraic expressions in mathematical symbols and use it to solve problems involving the four operations.** **E.g. 1.** Translate statements involving algebraic expressions in mathematical symbols. i. Write an expression for "the sum of 6 and the product of 3 and d". ii. Daniel makes 100 cedis each week. He worked for x weeks this summer. iii. Sebastian has 12 more trophies than Megan. Megan has t trophies. iv. Write an expression for "8 less than the product of 7 and x". v. The sum of -7 and the quantity of 8 times x **E.g. 2.** Add and subtract algebraic expressions. Simplify the following expressions: a. $4x + 2y + 3x + 5y$ b. $4a + 5b - 3c$ c. $7x^3 - 3x^2y + xy^2 + x^2y - y^3$ d. Subtract $3x + y - 3z$ from $9x - 5y + z$. e. Add: $5x^2 + 7y - 8$, $4y + 7 - 2x^2$ and $6 - 5y + 4x^2$.	**Critical Thinking and Problem solving (CP)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 3. Multiply and divide algebraic expressions. Simplify the following expressions: I. $5z \times 8z^2$ II. $4xy^3 \times 4x^4y$ III. $32a^3 \div 4a^2$ IV. $\frac{3ab(4a^2b^5)}{8a^2b^3}$ V. $2a[a+3b+42a-b]$ **B10.2.2.1.2 Multiply two binomial expressions and simplify.** **E.g. 1.** Expand and simplify product of two binomial expressions. i. $(a+2)(a+3)$ ii. $(2x+3)^2$ iii. $(x-3)(x+2)$ iv. $(a-b)^2$	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.2.2.1.3 Factorise algebraic expressions (including quadratic trinomials). **E.g. 1.** Factorise given algebraic expressions with variable index not exceeding 2. i. Factorise completely a. $x^2 - ax + bx - ab$ b. $3a^2 + 2ab - 12ac - 8bc$ c. $y(3x - 1) - n(3x - 1)$ d. $ab - by - ay - y^2$ ii. Factorise completely a. $x^2 + 5x + 6$ b. $x^2 + x - 6$ c. $2x^2 - 3x + 1$ d. $3q^2 - 2x - 5$	
	B10.2.2.1.4 Apply difference of two squares to solve problems. **E.g. 1.** Develop the rule of difference of two squares. i.e. $a^2 - b^2 = (a + b)(a - b)$	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Apply the idea of difference of two squares to evaluate algebraic expressions. i. $4x^2 - y^2$ ii. $36k^2 - 49t^2$ iii. $27x^2 - 12y^2$ iv. $x^2 - y^2 = (x + y)(x - y)$, i.e. $6.42 - 3.62 = (6.4 + 3.6)(6.4 - 3.6)$ $= 10 \times 2.8 = 28$. v. $(4\frac{5}{8})^2 - (3\frac{3}{8})^2$ **B10.2.2.1.5 Perform operations on simple algebraic fractions including monomial and binomial denominators.** **E.g. 1.** Multiply and divide algebraic fractions Simplify the following: a) $(\frac{16xy}{3} \times \frac{12x}{8})$ b) $\frac{4a^2 + 8ab}{3} \div \frac{15ab + 10b^2}{9}$ c) $\frac{6x^2 + 2xy}{5z} \times \frac{15z^2}{3x + y}$	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Add and subtract algebraic fractions with monomial denominators. Simplify the following: a) $\frac{2}{5x^2}+\frac{1}{2x}$ b) $\frac{2}{3b^2}-\frac{5}{3b^2}+\frac{3}{4b}$ c) $\frac{1}{a^2}+\frac{3}{a}-\frac{1}{3a}$ d) $\frac{3}{4t^2}-\frac{5}{6t^2}+\frac{2}{3t}$ **E.g. 3.** Add and subtract algebraic fractions with binomial denominators. Simplify the following: i. $\frac{2}{x+3}+\frac{3}{x-3}$ ii. $\frac{5}{2x+1}-\frac{6}{3x-1}$ iii. $\frac{2x}{x+4}+\frac{8x-32}{x^2-16}$ iv. $\frac{10x^2+xy-24y^2}{4x^2-9y^2}-\frac{x+2y}{2x+3y}$	
	B10.2.2.1.5 Determine the condition under which an algebraic fraction is zero. **E.g. 1.** Identify the condition under which an algebraic expression is zero. $\frac{4y}{7d}$ is zero when $4y = 0$ i.e. when $y = 0$	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. Determine the condition under which an algebraic expression is undefined. Find the value(s) which make the fractions undefined. a) $\frac{1}{x+3}$ b) $\frac{x+2}{(x-2)(x+1)}$ c) $\frac{1}{x^2+3x+2}$	
	B10.2.2.1.7 Perform change of subjects and substitute values into formulae and use it to solve problems **E.g. 1.** Change subjects in given formulae i. Make ***m*** the subject of the relation $mt + n = mp + q$ ii. Make ***π*** the subject of the relation $l = 2r + \frac{1}{2}\pi r$ iii. Make ***g*** the subject ofthe relation T= $2\pi\sqrt{l/g}$ iv. Make x the subject of the relations v. $y = \frac{ax^3 - b}{3c}$, and **vi.** $y = a(c + \frac{1}{2})^3$ **E.g. 2.** Substitute values into formulae and evaluate: i. Given that R = 3, d = 2, and L =12, find the value of K, if $K = \frac{Rd^2}{L}$	

STRAND 2: ALGEBRA

SUB-STRAND 3: VARIABLES AND EQUATIONS

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.2.3.1 Demonstrate understanding of the multiplication and factoring of polynomial expressions (concretely, pictorially, and symbolically) including: • **multiplying of monomials, binomials, and trinomials** • **common factors** • **trinomial factoring** **relating multiplication and factoring of polynomials.**	**B10.2.3.1.1 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters** **E.g. 1.** Linear equation of the form $ax + b = c$, where a, b and c real numbers, and $a \neq 0$. 1. Solve for the variable indicated (a) $2x + 3 = 17$ (b) $3(2k - 4) = 9 - 3(k + 1)$ **E.g. 2.** If $\frac{a(b-2)}{c-3} = x$, solve for b **E.g. 3.** Linear inequality of the forms $ax + b < c$, $ax + b \leq c$, $ax + b > c$, $ax + b \geq c$ i). Find the solution set: (a) $5x + 3 < 17$ (b) $3(2 - x) \leq 5x - 2$ (c) $\frac{x+1}{3} - \frac{x-3}{2} < \frac{1}{6}$ ii) Solve $7x - 5 > 6x + 4a$ and graph the solution set on a number line. **E. g 4** Mumuni is delivering boxes of paper to each floor of the Cedi House. Each box weighs 34 kilograms and Mumuni weighs 80kg. If the maximum capacity of the elevator is 1,000 kilograms, how many boxes can Mumuni safely take on each elevator trip? Let x be the number of boxes Mumuni can carry on each trip. The total weight of boxes plus Mumuni's weight must be equal to or less than 1000 $80 + 32x \leq 1000$ $32x \leq 920$ $x \leq 28.75$ Since there cannot be fractional boxes, Mumuni cannot take more than 28 boxes	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.2.3.1.2 Use the method of completing squares to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. **E. g. 1.** If $x^2 + bx$ is a binomial, then $x^2 + bx + (\frac{b}{2})^2 = (x + \frac{b}{2})^2$ i) Solve $x^2 - 6x + 2 = 0$ by completing the square $(x - 3)^2 = 7$ $x = 3 - \sqrt{7}, x = 3 + \sqrt{7},$ E. g 2 Given $ax^2 + bx + c = 0$, where a> 0 $ax^2 + bx + c = 0$ $x^2 + \frac{b}{a}x + \frac{c}{a} = 0$ $x^2 + \frac{b}{a}x = -\frac{c}{a}$ $x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = -\frac{c}{a} + \frac{b^2}{4a^2}$ $\left(x + \frac{b}{2a}\right)^2 = -\frac{c}{a}\left(\frac{4a}{4a}\right) + \frac{b^2}{4a^2}$ $\left(x + \frac{b}{2a}\right)^2 = \frac{-4ac + b^2}{4a^2}$	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)** • Demonstrate behaviour and skills of working towards group goals **(CC9.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	$\left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}$ $\left(x+\frac{b}{2a}\right)=\pm\sqrt{\frac{b^2-4ac}{4a^2}}$ $x+\frac{b}{2a}=\pm\frac{\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b+\sqrt{b^2-4ac}}{2a}$ $x=\frac{-b-\sqrt{b^2-4ac}}{2a}$	
	B10.2.3.1.3 Recognise when the quadratic formula gives complex solutions and write them as *a* ± *bi* for real numbers *a* and *b*. **E.g. 1.** The discriminant and the nature of a quadratic equation's solution. The solution of a quadratic equation of the form $ax^2 + bx + c = 0$, where $a > 0$ is given by $x=\frac{-b+\sqrt{b^2-4ac}}{2a}$ where: $b^2 - 4ac$ determines the nature of the solutions to the quadratic equations. a) If $b^2 - 4ac$ is negative, the solutions are not real numbers. b) If $b^2 - 4ac$ is a positive perfect square, the solutions are rational numbers. c) If $b^2 - 4ac$ is a positive number that is not a perfect square, the solutions are irrational numbers.	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.2.3.1.4 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = mx + c$ and the curve $y = ax^2 + bx + c$.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)** • Demonstrate behaviour and skills of working towards group goals **(CC9.1)**

E.g. 1. . Find the solution of the line $y = 2x + 1$ and the curve $y = x^2 - 2$ on the interval $-4 < x < 4$

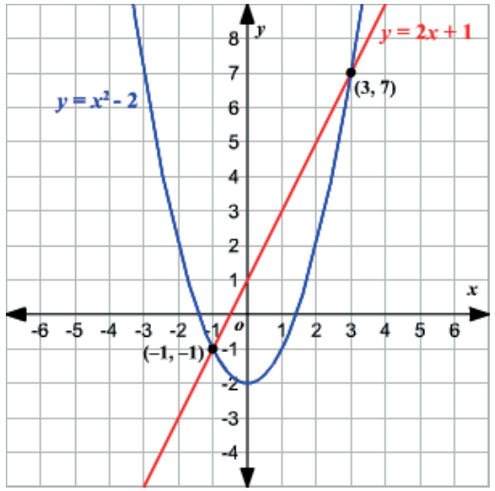
$2x + 1 = x^2 - 2$

$x^2 - 2x - 3 = 0$

$(x^2 - 3x) + (x - 3) = 0$

$(x - 3)(x + 1) = 0$

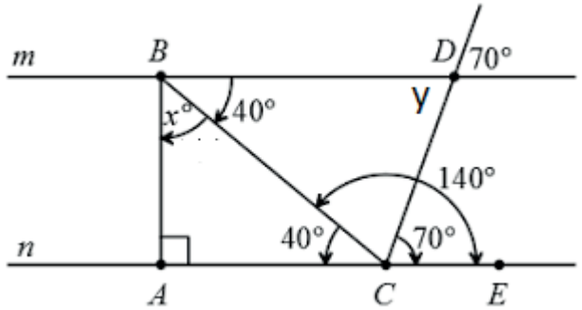
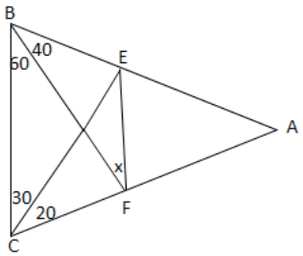
$x = 3, -1$

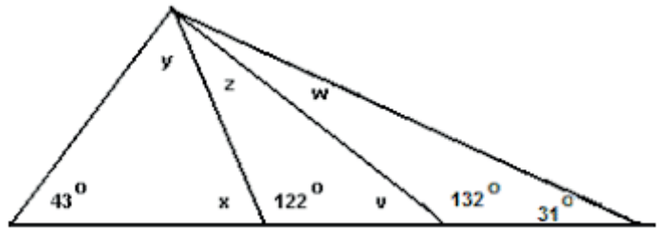
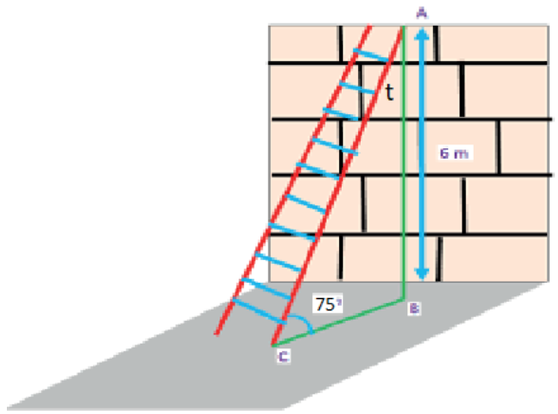


The line meets the curve at $x = 3, -1$

STRAND 3: GEOMETRY AND MEASUREMENT

SUB-STRAND 1: SHAPES AND SPACE

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.3.1.1 Apply the properties of angles and triangles to solve problems on the similar and special triangles	**B10.3.1.1.1 Use the knowledge and understanding of properties of angles to solve problems on similar angles** **E.g. 1** Calculate the value of *x* and *y* in the figure.  **E.g. 2.** Determine the value of *x* in the figure. **Note**: |BC| and |EF| are parallel.  	**Critical Thinking and Problem solving (CP)** **Communication and Collaboration (CC)** • Demonstrate behaviour and skills of working towards group goals **(CC9.1)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.3.1.1.2 Solve more problems on similar and special angles using the knowledge and understanding of properties of angles **E.g. 1.** Determine the values of angles v, w, *x*, *y* and z.  **E.g. 2.** Calculate the value of t (angle between the ladder and the wall)  	

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td>B10.3.1.2 Construct inscribed and circumscribed triangles and quadrilaterals with given dimensions</td>
<td>
B10.3.1.2.1 Construct inscribed and circumscribed circles for triangles under given conditions
E.g. 1. Use a pair of compasses and ruler to construct and circumscribe ΔABC with line segments AB = 5cm BC = 6.5cm and AC= 6cm.
i) Measure <<i>ACB</i> on the arc
ii) Construct a perpendicular bisectors of the sides opposite to ∠CAB and ∠CBA to to intersect at P.
iii) How is the inscribedangle at P related to its intercepted arc?
iv) Repeat parts (i), (ii) and (iii) several times for different triangles of different sides. Record your results in the following table. Write a conjecture about how an inscribed angle is related to its intercepted arc.
<table>
<tr><th>Measure of Inscribed Angle</th><th>Measure of Central Angle</th><th>Relationship</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>
E.g. 2. Construct and inscribe ΔXYZ, such that |XY| = 6 cm, |ZY|= 10 cm, |XZ|= 8 cm.
E.g. 3. Construct and circumscribe ΔXYZ, such that XY| = 6 cm, |ZY|= 10 cm, |XZ|= 8 cm.
</td>
<td>
Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)

• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)
• Understand and use interpersonal skills (CC9.2)
</td>
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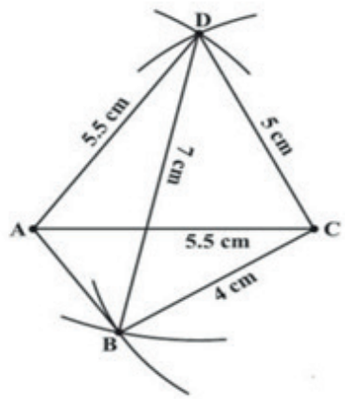
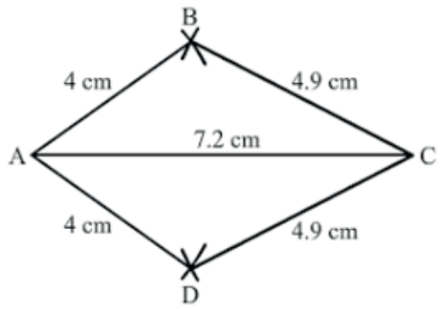
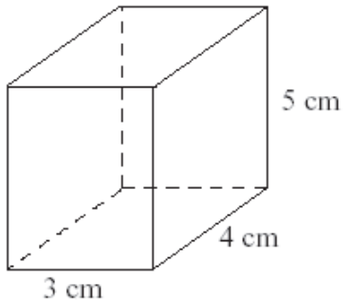
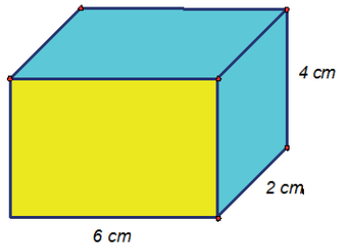
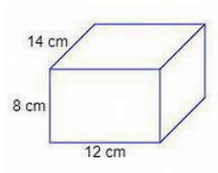
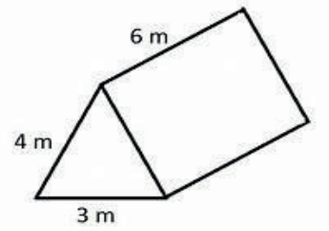
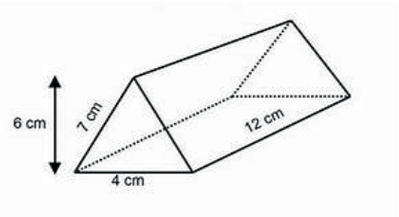
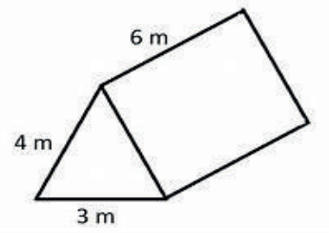
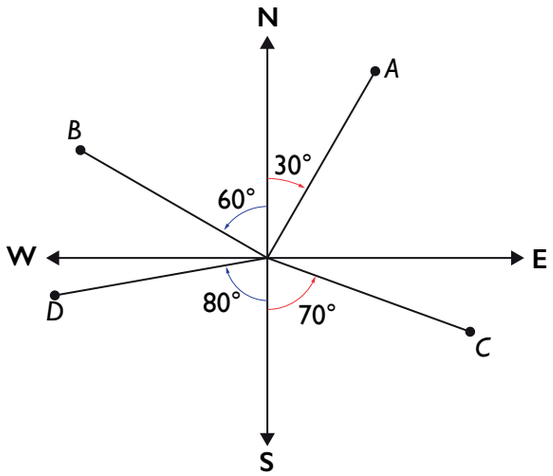
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.3.1.2.2 Draw kites, isosceles quadrilaterals, scalene trapezoids and right-trapezoids under given conditions. **E.g. 1.** Perform geometric construction of a quadrilateral with given sides and diagonal(s). i) Construct the quadrilateral ABCD such that AC = AD = 5 cm, CB= 4 cm, and DB = 7 cm. Complete the shape by joining BD. Measure the line segment AB ii) Construct a rhombus ABCD whose diagonals are 8 cm and 6 cm respectively. Measure the length of the side and the angles at the vertices.  **E.g. 2.** Use a pair of compasses and a ruler to construct a kite with given sides. (i) Construct a kite ABCD with sides AB = 4 cm and BC = 4.9 cm. Complete measure the diagonals of the kite.  	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**

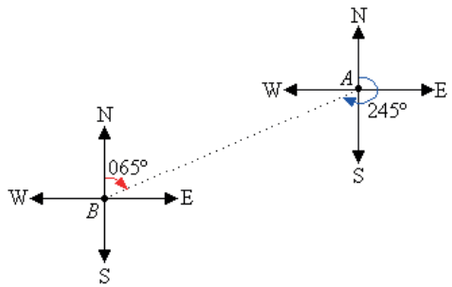
STRAND 3: GEOMETRY AND MEASUREMENT

SUB-STRAND 2: MEASUREMENT

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.3.2.1 Derive the formulas for determining the volumes of cuboid and triangular prisms and use these to solve problems	**B10.3.2.1.1Identify (length, width, height) of cuboids and triangular prisms and use it to determine the volume.**    E.g. Identify the length, the width and the height of the cuboids above. **E.g. 2.** Multiply the length, the width and the height for each of the volumes of the cuboids above. **E.g. 3.** Calculate the volume of a cuboid whose length is 3cm,width is 4cm and height is 5cm.	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

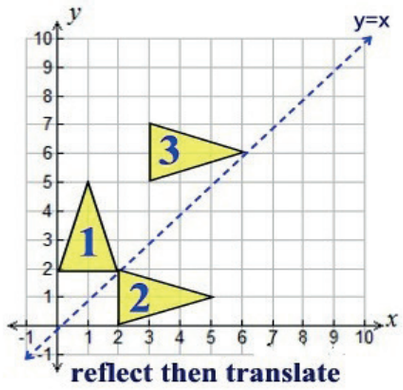
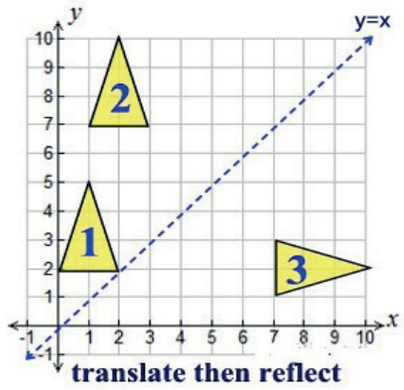
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.3.2.1.2 Identify triangles and rectangles in the triangular prisms. **E.g. 1** How many triangles and rectangles are in the triangular prisms?  **E.g. 2** Find the cross-sectional area and multiply it by the prism length to obtain length to obtain the volume (V = cross sectional area × prism length).  **E.g. 3** Find the volume of the triangular prisms.  	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.3.2.1.3 Solve real life problems on cuboids and triangular prisms **E.g. 1.** The volume of water in a rectangular tank is $30m^3$. The length of the tank is 5cm and its breadth is 2cm. Calculate the depth of water in the tank. **E.g. 2.** A rectangular box has length 20cm width 6cm and height 4cm. Find how many cubes of size 2cm that will fit into the box.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**
B10.3.3.2 Solve distance and bearing problems and problems involving application of vectors	**B10.3.3.2.1 Determine the bearing of objects in the various quadrants** **E.g. 1.** Investigate and identify bearings and the two kinds that exist. **E.g. 2.** Describe each of the following bearings as directions (i) 065° (ii) 080° (iii) 135°  E.g.Describe the position of A, C, and E as bearing from 0 in the figure above.	**Critical Thinking and Problem solving (CP)** • Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. Write the distance and the bearing of A from B from the figure given.  	
	B10.3.3.2.2 Solve distance and bearing problems involving application of vectors **E.g. 1.** The point B is 4km due east of the point C. If A is 3km due south of C, find: (i) The bearing of B from A. (ii) The distance of B from A. **E.g. 2.** A cyclist travels 5km south, then12 km east. Find the cyclist's bearing from the starting point to the nearest degree. **E.g. 3.** The bearing of B from A is 035° and the bearing of C from B is 125°. If $\|AB\|$= 50km and $\|BC\|$= 40km. Find the bearing and distance between A and C.	• Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Implement strategies with accuracy **(CP6.7)**

STRAND 3: GEOMETRY AND MEASUREMENT

SUB-STRAND 3: POSITION AND TRANSFORMATION

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.3.3.1 Describe changes and invariance achieved by performing a combination of successive transformations (reflection, translation, rotation) in 2D shape	**B10.3.3.1.1 Perform a combination of successive transformations and examine their properties (angles, lengths, shapes etc.) to determine congruent transformations and similar transformation** **E.g. 1.** Draw sequence of transformation and examine relationships, changes and invariance.  reflect then translate  translate then reflect	• Implement strategies with accuracy **(CP6.7)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.3.3.1.2 Understand and describe transformation in real-life including transformation used to create designs and patterns. **E.g. 1.** Describe the world around us with transformation language Describe the movement of the monkey using appropriate language for transformation such as below: The monkey started at the bottom of the tree, on the left, and then slid up the tree. The monkey flipped from the left-side to the right-side of the tree. The monkey then turned up and out onto the branch by rotating 90° clockwise. 	

STRAND 4: HANDLING DATA

SUB-STRAND 1: DATA

<table>
<tr><th>CONTENT STANDARD</th><th>INDICATORS AND EXEMPLARS</th><th>CORE COMPETENCIES</th></tr>
<tr>
<td>B10.4.1.1 Demonstrate an understanding of simple mathematical relationships between two variables (bivariate data) in observational and experimental contexts, illustrate using scatter graphs and use them to solve and/or pose problems.</td>
<td>
B10.4.1.1.1 Collect data from an observational study in which, for example, the interest is the relationship between weight and height of learners. Illustrate the data using scatter graphs and find the relationship between the weight and height if any.
E.g. 1. An observational study data (i.e. data collected are not due to manipulation or interference) is presented in the tables below.
i. Identify which table does not show bivariate data?
A
<table>
<tr><th>Litres</th><th>Kilometres Driven</th></tr>
<tr><td>68.2</td><td>482.8</td></tr>
<tr><td>90.9</td><td>643.7</td></tr>
<tr><td>113.7</td><td>804.7</td></tr>
</table>
B
<table>
<tr><th>Height (m)</th><th>Weight (kg)</th></tr>
<tr><td>0.96</td><td>22.67</td></tr>
<tr><td>1.22</td><td>31.75</td></tr>
<tr><td>1.52</td><td>40.82</td></tr>
</table>
C
<table>
<tr><th>Score</th><th>Frequency</th></tr>
<tr><td>10</td><td>2</td></tr>
<tr><td>20</td><td>6</td></tr>
<tr><td>35</td><td>4</td></tr>
<tr><td>50</td><td>3</td></tr>
</table>
ii. Identify the independent and dependent variables in the tables that show bivariate data.
iii. What effect has the number of litres of fuel used on number of kilometres driven? (learners should note the relationship between the two variables)
iv. Can any comparison be made between Score and Frequency in Table B? [Note: in this case though the frequencies are not the same, there is (i) one variable – univariate and (ii) no relationship between Score and Frequency]
</td>
<td>
Critical Thinking and Problem solving (CP)
Communication and Collaboration (CC)
• Ability to combine information and ideas from several sources to reach a conclusion (CP5.1)
• Understand and use interpersonal skills (CC9.2)
</td>
</tr>
</table>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 2. The bivariate data presented in the table below shows the hours studied and the percentage score (two variables — independent and dependent respectively) obtained in a statistics course by 9 learners.	

Learner	Hours Studied (h)	Test Score(s)
Ama	3	90
Koblah	1	86
Akua	5	84
Yaw	4	92
Efua	3	91
Kwami	5	100
Akosoa	0	76
Fiifi	1	82
Adjoa	2	85

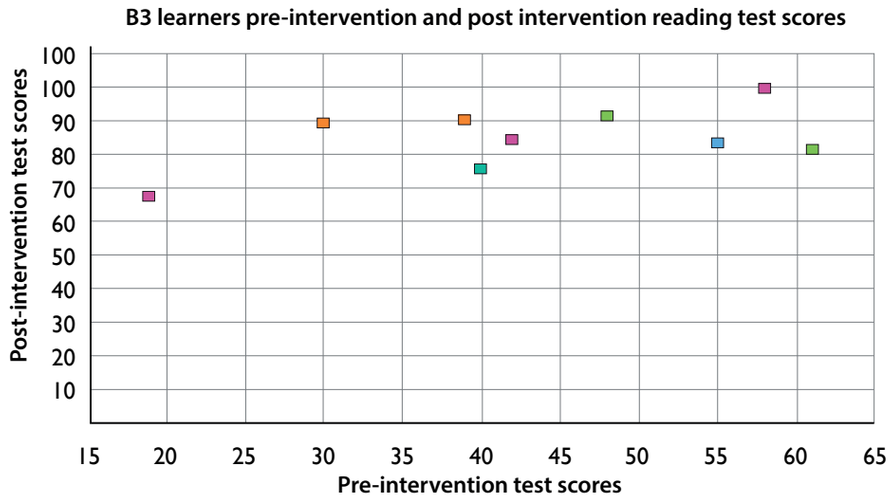
i. Place the information on a graph sheet (scatter plot) by plotting each learner as an ordered pair with Hours Studied on the *x*-axis and Test Score on the *y*-axis.

ii. Discuss the scatter plot, find the relationship between hours studied and test score, draw their conclusion and justify it

iii. Pose questions based on the analyses.

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.4.1.1.2 Collect data from an *experimental study* in which the interest is based on a treatment and non-treatment (control) groups. Illustrate the data using scatter graphs and find the relationship between the variables, if any	

E.g. 1. A reading test was given to 9 learners in B3. They then participated in an extensive reading programme. After participating in the programme (***group manipulated***), they were retested. The data collected was organised and plotted as a scatterplot (the ordered pair of scores for each learner) as follows:



In small groups, study the scatterplot, (using the skills for plotting and interpreting points on a graph sheet), find the relationship between Pre-reading test scores and Post-intervention Reading Test Scores, do a comparison, draw a conclusion and justify the conclusion.

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES

E.g. 2. The blood sugar level of 10 learners is tested before and after an exercise session. The bivariate (***i.e. two variables – independent and dependent***) data collected are organised and presented in the table below:

Age	Sex	Blood Sugar Level before the Exercise (mmol/L)	Blood Sugar Level after the Exercise (mmol/L)
12	F	9.0	8.1
11	M	8.5	7.5
13	M	10	8.7
12	F	7.2	6.6
12	F	9.5	8.1
11	M	12.0	10.8
13	F	8.0	6.9
12	M	16.0	14.3
14	F	7.5	6.7
11	M	9.0	7.5

i. Do a scatterplot of the bivariate data (you may round off the blood sugar levels to the nearest whole numbers).

ii. What is the relationship between the Blood Sugar Level before and after the Exercise sessions?

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.4.1.2 Demonstrate an understanding of the effect of contextual issues on the collection of data as well as develop and implement a survey/research to draw conclusions on issues/problems of interest.	**B10.4.1.2.1 Design a questionnaire for the collection of data for a survey taking into consideration contextual issues** (such as bias, use of language, ethics, cost, time and timing, privacy and cultural sensitivity). **E.g. 1.** Discuss and decide on a survey to undertake, what facts/contextual issues to take into consideration in designing the survey questionnaire, choose a suitable data collection method that includes the social considerations and how to collect the data. i. The introduction of the survey questionnaire should make clear the purpose of the survey, approximate time for completion of the questionnaire, assurance statement on how data collected would be handled (e.g. … your answers will remain confidential and they will be only used in finding …), and avoid all factors that would negatively influence responses, and so on. (reference: **B9.4.1.2.1**). ii. Develop the survey questionnaire.	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)**
	B10.4.1.2.2 Conduct the survey and draw conclusions. **E.g. 1.** Complete a survey according to the design/plan, analyse the data, draw conclusions and communicate findings to the class.	• Understand and use interpersonal skills **(CC9.2)**

STRAND 4: HANDLING DATA

SUB-STRAND 2: CHANCE OR PROBABILITY

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B10.4.2.1 Demonstrate an understanding of the role of probability in society and solve/pose problems involving single, two-independent and two-dependent events.	**B10.4.2.1.1. Provide an example from print and electronic media,** e.g., newspapers, television, the Internet, **where probability is used, and explain how the given probability influences individual decisions** (e.g. how we often cope with the uncertainties of life). **E.g. 1.** List and present with explanation at plenary some decisions that point to uncertainties/certainties of everyday life. *(for example, going out with or without an umbrella, the safety of crossing a road, getting married, the quantity of bread, koliko, akara a roadside seller prepares for sale for the day, chance of dying in an accident on a particular stretch of a road/highway, and so on)* **E.g. 2.** Before planning for picnic, you check the weather forecast and it says there is a 60% chance (probability) that rain may occur. Discuss and provide answers to the following questions: i. What does this probability mean? ii. How was the 60% determined? iii. What are the things taken for granted in determining the probability (assumptions) and/or anything that could change the forecast (limitations) if any? iv. How will it influence your decision on the planned picnic? **E.g. 3.** Discuss and provide answers to the following questions. (Interpret and explain the answers, indicating the assumptions and limitations involved, if any? (refer to **E.g. 2 above**) a. How may political analysts predict a certain political party to come into power? b. Flipping a coin is one of the most important events before the start of a football match. What is the chance or the probability of your team getting the desired outcome? c. As an active smoker, the chances (probability) of getting lungs disease are higher in you. Aware of this fact, which insurance scheme will you go for: health, vehicle or house insurance?	**Critical Thinking and Problem solving (CP), Communication and Collaboration (CC)** • Ability to combine information and ideas from several sources to reach a conclusion **(CP5.1)** • Understand and use interpersonal skills **(CC9.2)**

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g. 4. There is a probability of getting a desired card when we randomly pick one out of 52 deck of cards. i. What is the probability of picking up an ace in a 52 deck of cards? ii. What will be the odds of picking up any other card? Explain your answer. iii. How will the probabilities in (i) and (ii) influence the picking of cards at the start of the game?	
	B10.4.2.1.3.Solve real life cases involving the probability of two-independent events *(Refer to the examples in* **B8.4.2.1.1** *to set the processes of solving the following problems)* 1. A dresser drawer contains pairs of socks with the following colours: blue, brown, red, white and black. Each pair is folded together in a matching set. You reach into the drawer and choose a pair of socks without looking. You replace this pair and then choose another pair of socks. What is the probability that you will choose the red pair of socks both times? 2. A coin is tossed and a single 6-sided dice is rolled. Find the probability of landing on the head side of the coin and rolling a 3 on the dice. 3. A card is chosen at random from a deck of 52 cards. It is then replaced and a second card is chosen. What is the probability of choosing a jack and then an 8? 4. A nationwide survey showed that 65% of all children dislike eating vegetables. If 4 children are chosen at random, what is the probability that all 4 dislike eating vegetables? (Round your answer to the nearest percentage). ***(Note that the choice of any child does not affect the other three children)***	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	B10.4.2.1.4. Solve real life cases involving the probability of two events (independent and dependent combined) 1. A card is chosen at random from a standard deck of 52 playing cards. Without replacing it, a second card is chosen. What is the probability that the first card chosen is a queen and the second card chosen is a jack? 2. Mr. Mills needs two students to help him with a science demonstration for his class of 15 girls and 13 boys. He randomly chooses one student who comes to the front of the room. He then chooses a second student from those still seated. (*Note that the sample space of the dependent event will change)* What is the probability that both students chosen are girls? 3. In a shipment of 20 computers, 3 are defective. Three computers are randomly selected and tested. What is the probability that all three are defective if the first and second ones are not replaced after being tested?	

APPENDIX A

CORE COMPETENCIES AND SUBSKILLS OF THE COMMON CORE PROGRAMME (CCP)

1. Communication and Collaboration (CC)

B7-B10		
CC7: LISTENING	**CC8: PRESENTING**	**CC9: TEAMWORK**
CC7.1: Identify words or sentences in context appropriately	**CC8.1**: Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group	**CC9.1**: Demonstrate behaviour and skills of working towards group goals
CC7.2: Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures	**CC8.2**: Explain ideas in a clear order with relevant detail, using correct construction and structure of speech	**CC9.2**: Understand and use interpersonal skills
CC7.3: Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication	**CC8.3**: Apply appropriate diction, and structure sentences correctly for narrative, persuasive, imaginative and expository purposes	**CC9.3**: Understand roles during group activities
CC7.4: Identify underlying themes, implications and issues when listening	**CC8.4**: Anticipate different responses from the audience and plan for them	**CC9.4**: Help group work on relevant activities
CC7.5: Identify and analyse different points of views of speaker	**CC8.5**: Vary the level of detail and the language used when presenting to make it appropriate to the audience	**CC9.5**: Appreciate the importance of including all team members in discussions and actively encourage contributions from them
		CC9.6: Ability to work with all group members to complete a task successfully
		CC9.7: Effectively perform multiple roles within the group
		CC9.8: Demonstrate an awareness of the wider team dynamics and work to minimise conflicts in the team

2. Critical Thinking and Problem Solving (CP)

B7-B10	
CP5: CRITICAL THINKING	**CP6: PROBLEM SOLVING**
CP 5.1: Ability to combine information and ideas from several sources to reach a conclusion	**CP 6.1:** Ability to effectively define goals towards solving a problem
CP 5.2: Analyse and make distinct judgement about viewpoints expressed in an argument	**CP 6.2:** Ability to explain plans for attaining goals
CP 5.3: Create simple logic trees to think through problems	**CP 6.3:** Identify important and appropriate alternatives
CP 5.4: Generate hypothesis to help answer complex problems	**CP 6.4:** Ability to identify important and appropriate criteria and use them to evaluate available alternatives
CP 5.5: Effectively evaluate the success of solutions used in an attempt to solve a complex problem	**CP 6.5:** Ability to select alternative(s) that adequately meet selected criteria
CP 5.6: Demonstrate a thorough understanding of a generalised concept and facts specific to a task or situation	**CP 6.6:** Preparedness to recognise and explain results after implementation of plans
CP 5.7: Provide new insight into controversial situation or task	**CP 6.7:** Implement strategies with accuracy
CP 5.8: Identify and prove misconceptions about a generalised concept or fact specific to a task or situation	
CP 5.9: Identify and explain a confusion, uncertainty, or a contradiction surrounding an event	
CP 5.10: Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event	

3. Personal Development And Leadership (PI)

B7-B10	
PL5: PERSONAL DEVELOPMENT	**PL6: LEADERSHIP**
PL5.1: Understanding oneself (strengths,weaknesses, goals and aspirations), in reacting and adjusting to novel situations	**PL6.1:** Ability to serve group members effectively
PL5.2: Demonstrate a sense of belongingness to a group	**PL6.2:** Division of tasks into solvable units and assigning group members to task units
PL5.3: Recognise one's emotional state and their preparedness to apply emotional intelligence	**PL6.3:** Ability to manage time effectively
PL5.4: Ability to understand one's personality traits	**PL6.4:** Ability to manage and resolve conflicts
PL5.5: Desire to accept one's true self and overcome weaknesses	**PL6.5:** Ability to monitor team members to ascertain progress
PL5.6: Ability to set and maintain personal standards and values	**PL6.6:** Ability to mentor peers
	PL6.7: Actively promote effective group interaction and the expression of ideas and opinions in a way that is sensitive to the feelings and background of others
	PL6.8: Actively assist group identify changes or modifications necessary in the group activities and work towards carrying out those changes

4. Cultural Identity And Global Citizenship (CG)

B7-B10	
CG5: CULTURAL IDENTITY	**CG6: GLOBAL CITIZENSHIP**
CG5.1: Show a strong sense of belongingness to one's culture	**CG6.1:** Understanding of influences of globalisation on traditions, languages and cultures
CG5.2: Develop and exhibit ability to defend one's cultural beliefs, practices and norms	**CG6.2:** Recognise resistance to global practices that are inimical to our culture
CG5.3: Develop and express respect, recognition and appreciation of others' cultures	**CG6.3:**Know the global discourse about the roles of males and females
CG5.4: Develop and exhibit a sense of cultural identity	**CG6.4:** Exhibit a sense of nationality and global identity
CG5.5: Adjust to the demands of customs, traditions, values and attitudes of society	

5. Creativity and Innovation (CI)

B7-B10	
CI5: KNOWLEDGE, UNDERSTANDING, SKILLS AND STRATEGIES	**CI6: REFLECTION AND EVALUATION**
CI 5.1: Examine alternatives in creating new things	**CI 6.1:** Exhibit strong memory, intuitive thinking, and respond appropriately
CI 5.2: Ability to merge simple/complex ideas to create novel situations or things	**CI 6.2:** Ability to reflect on approaches to creative tasks and evaluate the effectiveness of tools used
CI 5.3: Identification of requirements of a given situation and justification of more than one creative tool that will be suitable	**CI 6.3:** Ability to select the most effective creative tools for work, and give reasons for the choice
CI 5.4: Ability to visualise alternatives, seepossibilities, and identify problems and challenges	**CI 6.4:** Imagining and seeing things in a different way
CI 5.5: Ability to try new alternatives and different approaches	**CI 6.5:** Anticipate and overcome difficulties relating to taking initiatives
CI 5.6: Understand and use analogies and metaphors	**CI 6.6:** Being open-minded, adapting and modifying ideas to achieve creative results
CI 5.7: Putting forward constructive comments, ideas, explanations and new ways of doing things	**CI 6.7:** Look and think about things differently and from different perspectives
	CI 6.8: Recognise and generalise information and experience; search for trends and patterns
	CI 6.9: Interpret and apply learning in new contexts
	CI 6.10: Reflect on work and explore the thinking behind thoughts and processes

6. Digital Literacy (DL)

B7-B10	
DL5: PHOTO-VISUAL AND INFORMATION LITERACY	**DL6: SOCIO-EMOTIONAL AND REPRODUCTION LITERACY**
DL5.1: Ability to ascertain when information is needed and be able to identify, locate, evaluate and effectively use it to solve a problem	**DL 6.1:** Understand the sociological and emotional aspects of cyberspace
DL5.2: Ability to recognise and avoid traps in cyberspace	**DL 6.2:** Create a meaningful and original piece of work, or its interpretation by integrating existing information
DL5.3: Ability to find and utilise digital content	**DL6.3:** Use digital tools to create novel things
DL5.4: Ability to construct knowledge from a non-linear hyper-textual navigation	**DL6.4:** Adhere to behavioural protocols that prevail in cyberspace
DL5.5: Evaluate the quality and validity of information	**DL6.5:** Recognition of societal issues emanating from the use of digital technologies
DL5.6: Preparedness to make better decisions using available information	**DL6.6:** Knowledge and recognition of ethical use of information

Please note these inclusivity issues

The core competences outlined in this document must be assessed taking into consideration people with special needs (physical disabilities, learning disabilities, etc.). Consider the use of realia for visual and visually challenged learners.

A system of creating alternatives for tasks must also be adopted.

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