

NATIONAL COUNCIL FOR  
CURRICULUM & ASSESSMENT  
(MINISTRY OF EDUCATION)



**MATHEMATICS  
COMMON CORE PROGRAMME (CCP)  
CURRICULUM FOR JHS1 (B7) - JHS3 (B9)**

SEPTEMBER, 2020



MINISTRY OF EDUCATION  
REPUBLIC OF GHANA

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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 9 (JHS 1 – SHS 3) 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 10 to Basic 12 (SHS1 - 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.

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## INTRODUCTION

In the first three 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 ready 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 9.

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 in relation to 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:

- learning and teaching approaches – the core competencies, 4Rs and pedagogical approaches
- 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.

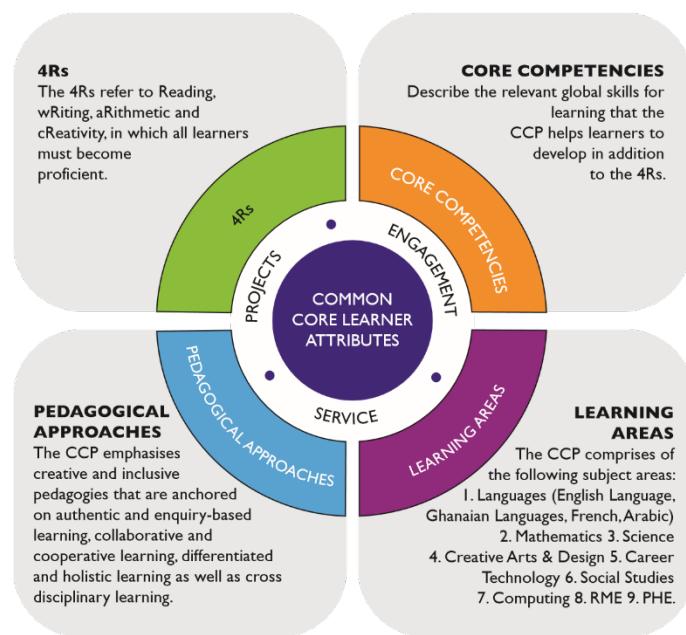


Figure 1 CCP Learner Attributes

These are elaborated subsequently:

## LEARNING AND TEACHING APPROACHES

- *The core competences:* 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 places emphasis on engagement of learners in the classroom activities, projects (in and outside classroom). These projects can involve individual or group tasks which all learners are required to complete by the end of Basic 9. The CCP project provides learners with contexts to demonstrate creativity and inventiveness in various areas of human endeavour. Community service offers opportunity for learners to nurture, love and care for, and solve problems in their community.

### Learning Areas

The CCP comprises the following subjects:

1. Languages (English, Ghanaian Languages, French, Arabic)
2. Mathematics
3. Science
4. Creative Arts and Design
5. Career Technology
6. Social Studies
7. Computing
8. Religious and Moral Education (RME)
9. Physical and Health Education

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 – B9) 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 ready 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 because 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 causes and origin of phenomena in our environment. The mathematics curriculum has considered the desired outcomes of education for learners at the basic level. 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 the ways in which 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 rather than they acquiring new ones. Learners are information constructors who operate as researchers. Teachers serve as facilitators by providing the enabling environment that promotes the construction of learners' own 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, good problem solvers, have the ability to think creatively and possess the confidence and competence to participate fully in the affairs of the Ghanaian society as responsible local and global citizens.

### **Subject Aims**

The mathematics curriculum is designed to help 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 in real-life situations
7. develop the knowledge, skills and attitudes necessary to pursue further studies in mathematics
8. 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 profile of learning behaviour dimensions that should be the basis for instruction and assessment.

A learner may acquire knowledge through some learning experience. They may also show understanding of concepts by comparing, summarising, re-writing in their own words and constructing meaning from instructions.

### **Profile of learning behaviour dimensions**

The learner may also learn to apply the knowledge acquired in some new context. At a higher level of learning behaviour, the learner may be required to analyse an issue or problem. At a much higher level, the pupil may be required to synthesise knowledge by integrating a number of ideas to formulate a plan, solve a problem, pose a problem or compose a story problem. Further, the learner 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, construct and design. These six learning behaviours ("knowing", "understanding", "analysis", "synthesis", "evaluation" and "creation") described are referred to as dimensions of learning. "Knowing" is a dimension, "applying knowledge" is also a dimension. More than one dimension forms a profile of learning behaviour dimensions.

In this curriculum, learning indicators are stated with action verbs to show what the learner should know and be able to do (e.g. "describe the numbers 1-5 in multiple ways, using objects ..." etc.). The learner being able to "describe" the activity after obtaining several experiences in it means that they have acquired "knowledge". Being able to explain, summarise, and give examples, etc., means that the learner has understood the concepts taught.

Similarly, being able to develop, defend, etc., means that the learner can "apply" the knowledge acquired in some new context. Each of the indicators in the curriculum contains an "action verb" that describes behaviour the learners are expected to demonstrate after a period of teaching and learning. "Knowing", "applying knowledge" etc., are dimensions that should be the prime focus of teaching and learning in schools. Teaching, in most cases tends to stress on knowledge acquisition to the detriment of other higher-level behaviours such as application of knowledge.

Each action verb in any indicator shows the underlying learning outcome or standard. It is therefore necessary for teachers to carefully read and comprehend<sup>1</sup> the standards they plan developing in their learners each week, and identify the group of indicators learners have to demonstrate in achieving these standards. Teachers must ensure the group of indicators selected for the week reflect the whole range of the profile of learning behaviour dimensions, that is, from the low level ("knowing", "understanding, etc.) to the high level (solve or pose a problem, create a pattern, etc.). The focus is to move 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 the real world (surface learning) to a new position called deep learning. Learners are expected to deepen their learning through knowledge application to develop critical thinking skills, explain reasoning, and generate creative ideas that solve real life problems in their school lives, and later in their adult lives. This is the point at which learning becomes beneficial to the learner.

### **Weighting of profile of learning behaviour dimensions**

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<sup>1</sup> This can only happen if teachers learn to work together, in school-based in-service education (INSET), as colleagues within and across disciplines and grade levels to develop communities of STEM learners. STEM Education is an approach to teaching and learning that integrates the content and skills of the STEM disciplines (i.e. Science, Technology, Engineering and Mathematics) and other disciplines, to answer complex questions, investigate global issues, solve real-world problems and challenges, and in the process, address the development of a set of personal attributes and transversal competencies needed for success in the 21st century. In addition to working scientifically, STEM involves learners working mathematically, digitally (or technologically), and working like an engineers.

As already stated, it is important to consider the underlying behaviours for teaching, learning and assessment. In basic level school mathematics, the three profiles of learning behaviour dimensions that have been specified for teaching, learning and assessment are:

- Knowledge and Understanding      30%
- Application of Knowledge      40%
- Attitudes, Values and Process Skills 30%

Each of the learning behaviour dimensions has been given a percentage weight that should be considered in teaching, learning and assessment. The weights indicated on the right of the dimensions show the relative emphasis that the teacher should give in the teaching, learning and assessment processes.

Emphasising the three domains of learning (cognitive, affective and psychomotor) in your teaching will ensure that mathematics will not only be taught and studied at the cognitive level, but will also lead learners to the acquisition of positive attitudes and skills that will enable them to deal effectively with life in general.

The explanation of the keywords involved in each profile of learning behaviour dimensions are as follows:

### **Knowledge and Understanding (KU)**

Knowing refers to 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 learnt and this constitutes the lowest level of learning.

Understanding is the ability to explain, outline, 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 material or concept that may be verbal, pictorial, or symbolic.

### **Applying Knowledge (AK)**

This dimension is also referred to as “Use of Knowledge”. It refers to the 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.

Applying knowledge as used in this curriculum has a number of learning behaviour levels. These include analysis, synthesis, evaluation and creation. These may be considered and taught separately, paying attention to each of them equally in your teaching. The dimension “Applying Knowledge”, is a summary dimension for all four learning sub-levels.

Details of each of the four sub-levels are as follows:

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

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

**Evaluating:** The ability to appraise, compare features of different things and make comments or judgement, compare, contrast, criticise, justify, argue, support, discuss, prove, conclude, prioritise, theorise, 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, combine ideas or elements to create, form, produce, manufacture, invent, discover, design, or construct, formulate other (new) products. Creation is the highest form of thinking and learning skill and is therefore a very critical behaviour. This, unfortunately, is the area where most learners perform poorly. It is therefore necessary to help learners develop a high level of thinking right from the Basic level. 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.

## ATTITUDES, VALUES AND PROCESS SKILLS

At the heart of the curriculum is the belief in nurturing honest, creative and responsible citizens with the requisite skills for national development. Learners therefore need to acquire positive attitudes, values and psychosocial skills that will enable them participate actively in lessons and take a stand on issues affecting them and others. The Mathematics curriculum thus focuses on the development of attitudes, values and skills.

**Values:** As such, every part of this curriculum, including the related pedagogy is consistent with the following set of values:

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

**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:** 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. Learners are from diverse backgrounds, which require the provision of equal opportunities to all, and that all strive to care for each other both personally and professionally.

**Commitment to achieving excellence:** Learners must be taught to appreciate the opportunities provided through the curriculum and persist in doing their best in whatever fields of endeavour as global citizens. The curriculum encourages innovativeness through creative and critical thinking, and the use of contemporary technology. Ghana will instil the value of excellent service above self.

**Teamwork/Collaboration:** Schools are to be dedicated to a constructive and team-oriented working and learning environment. This also means that learners should live peacefully with all persons with an attitude of tolerance and collaboration.

**Truth and Integrity:** The curriculum aims to develop learners into individuals who will consistently tell the truth irrespective of the consequences, be morally upright and have the attitude of doing the right thing even when no one is watching, be true to themselves and lawful beliefs, and be willing to live the values of honesty and compassion. Equally important, the ethos of the workplace, including integrity and grit, must underpin the learning processes to allow learners see and apply academic skills and competencies in the world of work.

## **ASSESSMENT IN THE CCP**

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 student 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 and William, 1998)<sup>2</sup>. 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 of Learning (AoL)**

Assessment of learning provides a picture of the achieved standards of the teacher and performance of students 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 students have attained expected learning outcomes at the end of their grade or programme.

### **Assessment as Learning (AaL)**

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

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<sup>2</sup>Paul Black & Dylan William (1998) Assessment and Classroom Learning, *Assessment in Education: Principles, Policy & Practice*, 5:1, 7-74, DOI: [10.1080/0969595980050102](https://doi.org/10.1080/0969595980050102)

## **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 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.

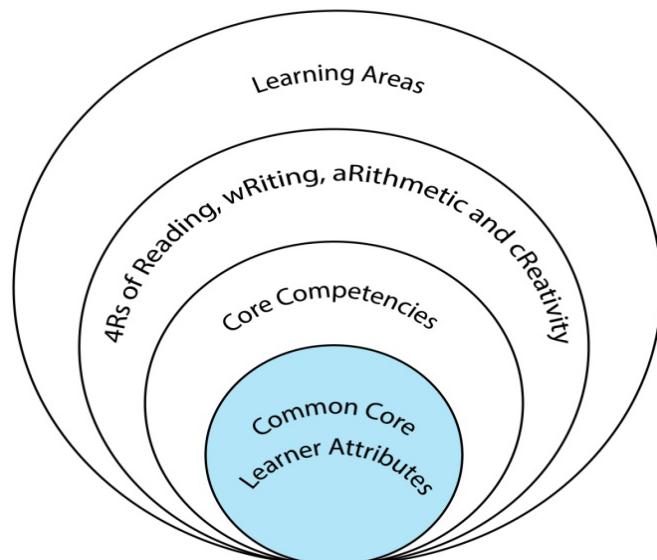


Figure 2. Essential Assessment Features

## **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, head teacher) 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**

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

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

- 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)<sup>3</sup> and *the School-Based Assessment Guidelines* (Ministry of Education, 2020b)<sup>4</sup>.

## **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.

<sup>3</sup>Ministry of Education (2020a). National Pre-tertiary Learning Assessment Framework (NPLAF). Accra: Ministry of Education.

<sup>4</sup>Ministry of Education (2020b). School-Based Assessment Guidelines. Accra: Ministry of Education.

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

<b>Level of Proficiency</b>	<b>Benchmark</b>	<b>Grade Level Descriptor</b>
1: Highly proficient (HP)	80% +	Learner shows a 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 and 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 a 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.

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
- 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. The 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 aim of the learning-centred classroom approach is 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
- Learners responsibly define their learning experience and draw up a plan to solve the problem in question.
- Learners collaborate whilst learning.
- Demonstrate the results of their learning through a product or performance.

It is more productive for learners to find answers to their own 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 take these differences into consideration.

The curriculum therefore promotes:

- learning that is linked to the learners' backgrounds and to 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 own 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 as a way of ensuring each learner benefits adequately from the delivery of the curriculum can be achieved in the classroom through:

- Task
- One-on-one support
- Outcome

*Differentiation by task* involves teachers setting different tasks for learners of different ability e.g. in sketching the plan and shape of their classroom some leaners could be made to sketch with free hand while others would be made to trace the outline of the plan of the classroom.

*Differentiation by support* involves the teacher providing a targeted support to learners who are seen as performing below expected standards or at risk of not reaching the expected level of learning outcome. 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 Communications Technology**

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 large quantities 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 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

The competencies for mathematics describe a body of skills that educators in mathematics at all levels should seek to develop in their learners. They are ways in which practitioners and learners in the mathematics discipline engage with the subject matter as they learn the subject throughout the various phases in their education. The competencies presented here describe a connected body of core skills that are acquired throughout the processes (explore, explain, extend/elaborate, and evaluate) of teaching and learning.

### **Critical Thinking and Problem Solving (CP)**

Developing learners' cognitive and reasoning abilities to enable them analyse issues and situations leading to the resolution of problems. This skill enables learners to draw on and demonstrate what they have learned, and from their own experiences analyse situations and choose the most appropriate out of a number of possible solutions. It requires that learners embrace the problem at hand, persevere and take responsibility for their own 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 problems at hand. It requires ingenuity of ideas, arts, technology and enterprise. Learners who possess this competency are able to 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)**

Developing 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)**

Improving self-awareness, self-knowledge, skills, building and renewing self-esteem, identifying and developing talents, fulfilling dreams and aspirations, learning from the mistakes and failures of the past and developing other people or meeting 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)**

Developing 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 own 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 competences.
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 situations 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

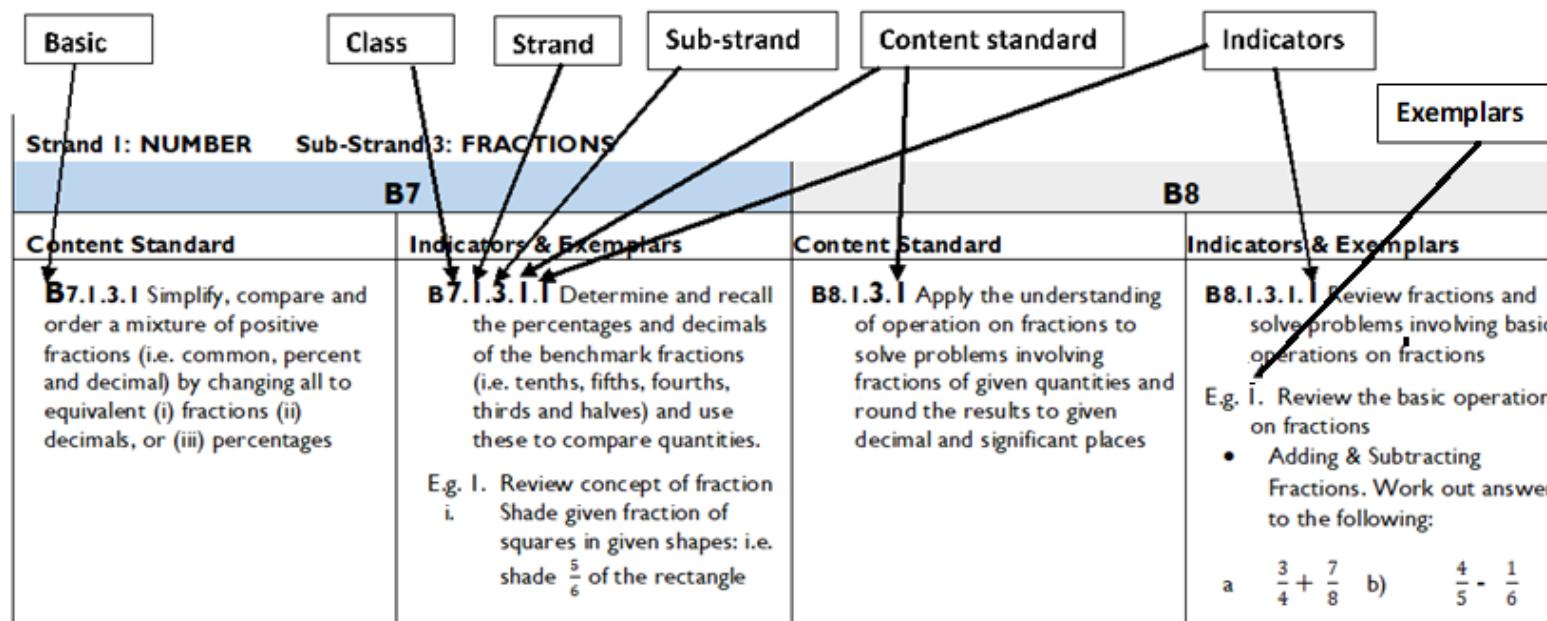
The curriculum is organised under key headings and annotations.

**Strands** are the broad areas/sections of the mathematics content to be studied.

**Sub-strands** are the topics within each strand under which the content is organised.

**Content standard** refers to the pre-determined level of knowledge, skill and/or attitude that a learner attains by a set stage of education.

**Indicator** is a clear outcome or milestone that learners have to exhibit in each year to meet the content standard expectation. The indicators represent the minimum expected standard in a year.



**Exemplar** – support and guidance which clearly explains the expected outcomes of an indicator and suggests what teaching and learning activities could take to support the facilitators/teachers in the delivery of the curriculum.

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 illustrated in Figure 3 and the coverage of the curriculum in terms of strands, sub-strands and total number of content standards from B7 – B9 is shown in Table 3.:

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

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

Table 3 shows the coverage of the curriculum in terms of strands, sub-strands and total number of content standards from B7 – B9.

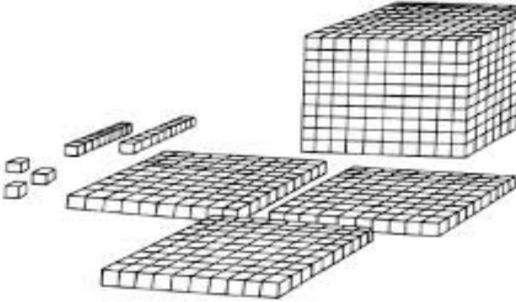
**Table 3** *Coverage of the curriculum in terms of strands, sub-strands and total number of content standards*

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

# **BASIC 7**

## STRAND 1: NUMBER

### *Sub-strand 1: Number and Numeration Systems*

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p><b>B7.1.1.1 Model number quantities more than 1,000,000,000 using graph sheets, isometric papers and multi-base blocks</b></p> <p>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.</p>  <p>i. Determine how many blocks will make a billion.</p> <p>E.g.2. Use multiples of 10s, 50s, 100s and 200s to represent numbers in multiples of ways (make sure each figure is used)</p> <p>i. <math>5,560 = 20 \times 200 + 10 \times 100 + 11 \times 50 + 1 \times 10</math>; or  <math>= 15 \times 200 + 20 \times 100 + 10 \times 50 + 6 \times 10</math>; etc.</p>	<p>Critical Thinking and Problem Solving (CP)</p> <p>Communication and Collaboration (CC)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p>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.</p> <ul style="list-style-type: none"> <li>i. Workout how many GH₵200 will make GH₵185, 000,000, GH₵1,890,750,000, etc.</li> <li>ii. Determine combinations of GH₵50, GH₵100 or GH₵200 notes that make GH₵1,000,000 (make sure each denomination is used);</li> </ul>	Critical Thinking and Problem Solving ( <b>CP</b> )
	<p><b>B7.1.1.2 Compare and order whole numbers more than 1,000,000,000 and represent the comparison using "&gt;, &lt;, or ="</b></p> <p>E.g.1. Skip count forwards and backwards in 25s, 50s and 250s beginning from 1000.</p> <p>E.g.2. Identify numbers which are for instance, 500,000 more than or less than a given 8-digit or 9-digit number.</p> <ul style="list-style-type: none"> <li>i. 1,295,800,000 is 500,000 more than 1,295,300,000 and 1,295,300,000 is 500,000 less than 1,295,800,000</li> </ul> <p>E.g.3. Use phrases such as "is equal to", "is greater than" and "is less than" as well as their symbols such as "&gt;", "&lt;" and "=" to compare any two numbers.</p> <ul style="list-style-type: none"> <li>i      1,300,850,700 .... 1,300,850,700</li> <li>ii.     5,223,487,637 .... 5,113,487,637 etc.</li> </ul>	Critical Thinking and Problem Solving ( <b>CP</b> )  Communication and Collaboration ( <b>CC</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																
	<p>E.g.4. Identify, read and write numbers in given positions in a number chart.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <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><b>3,187,500</b></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> <p>For instance, which number is on the right of 3,187,500? Write the number in words.</p>	187,500	687,500	1,187,500	1,687,500	2,187,500	2,687,500	<b>3,187,500</b>	3,687,500	4,187,500	4,687,500	5,187,500	5,687,500					
187,500	687,500	1,187,500	1,687,500															
2,187,500	2,687,500	<b>3,187,500</b>	3,687,500															
4,187,500	4,687,500	5,187,500	5,687,500															
<b>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.</b>	<p><b>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</b></p> <p>E.g. 1. Round off whole numbers up to over 1,000,000,000 to the nearest hundred-thousands, ten-thousands, thousands, hundreds, etc.</p> <p>i. 1,879,653 is 1,900,000 to the nearest hundred thousand and 1,880,000 to the nearest ten thousand</p> <p>E.g. 2. Explain the differences between the “round up” and “round down” concepts.</p> <p>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.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>2,846,655</th> <th>Round up</th> <th>Round down</th> <th>Round off</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>E.g.3. Express whole numbers to significant figures (i) 857386321</p> <ul style="list-style-type: none"> <li>▪ five significant figures</li> <li>▪ four significant figures</li> <li>▪ three significant figures, etc.</li> </ul>	2,846,655	Round up	Round down	Round off	To the nearest thousand	2,847,000	2,846,000	2,847,000	To the nearest ten thousand	2,850,000	2,840,000	2,850,000	To the nearest hundred thousand	2,900,000	2,800,000	2,800,000	Personal Development and Leadership (PL)  Creativity and Innovation (CI)
2,846,655	Round up	Round down	Round off															
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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.	<p><b>B7.1.1.4 Round decimals to the nearest tenth, hundredth, thousandths, etc.</b></p> <p>E.g. i. Round (off, up and down) decimals to the nearest tenths, hundredths, thousandths.....</p> <p>i. Round 486.3685 as indicated in the table below</p> <table border="1"> <thead> <tr> <th>Number</th><th>Round to the nearest tenths</th><th>Round to the nearest hundredths</th><th>Round to the nearest thousandths</th></tr> </thead> <tbody> <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> </tbody> </table> <p>ii. Round 78.4604783 as indicated in the table below</p> <table> <thead> <tr> <th></th><th>Round up</th><th>Round off</th><th>Round down</th></tr> </thead> <tbody> <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> </tbody> </table>	Number	Round to the nearest tenths	Round to the nearest hundredths	Round to the nearest thousandths	486.3685	486.4	486.37	486.369	0.0605368	0.1	0.06	0.061		Round up	Round off	Round down	nearest tenths	78.5	78.5	78.4	nearest hundredths	78.47	78.46	78.46	nearest thousandths	78.461	78.460	78.460	Critical Thinking and Problem Solving (CP)
Number	Round to the nearest tenths	Round to the nearest hundredths	Round to the nearest thousandths																											
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CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p><b>B7.1.1.1.5 Express decimal numerals to given significant and decimal places</b></p> <p>E.g.1 Explain when zero (0) is significant in a decimal numeral            i. 0.360 (3sf)   ii. 7.021 (4sf)</p> <p>E.g.2. Round the following numbers to            0.00234567 and 84.40995000            i. 3sf            ii. 4sf            iii. 6sf</p> <p>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            iii. 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.            iv. Investigate similar problems on significant figures.</p>	<p>Critical Thinking and Problem Solving (<b>CP</b>)</p> <p>Communication and Collaboration (<b>CC</b>)</p> <p>Creativity and Innovation (<b>CI</b>)</p>

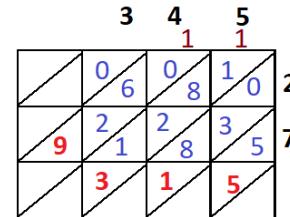
**STRAND 1: NUMBER**  
***Sub-strand 2: Number Operations***

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.1.2.1 Apply mental mathematics strategies and number properties used to solve problems</b>	<p><b>B7.1.2.1.1 Multiply and divide given numbers by powers of 10 including decimals and benchmark fractions</b></p> <p>E.g.1. Recall multiplication facts up to 144 and related division facts.</p> <p>E.g.2. Recall decimal names of given benchmark fractions converted to decimals or percentages (and vice versa)</p> <p>E.g. 3. Find the product of a given decimal number when it is multiplied by 10, 100, 1000, <math>\frac{1}{10}</math>, <math>\frac{1}{100}</math>, <math>\frac{1}{1000}</math>, etc.</p> <ul style="list-style-type: none"> <li>i. <math>105.25 \times 1000</math></li> <li>ii. <math>105.25 \times \frac{1}{100}</math></li> </ul>	<p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p>
	<p><b>B7.1.2.1.2 Apply mental mathematics strategies and number properties used to perform calculations.</b></p> <p>E.g. 1. Apply the halving and doubling techniques to determine the product of two given numbers.</p> <ul style="list-style-type: none"> <li>i. <math>28 \times 5</math>, think <math>14 \times 10 = 140</math></li> <li>ii. <math>125 \times 4</math>, think <math>(125 \times 2) \times 2 = 250 \times 2 = 500</math></li> </ul> <p>E.g. 2. Apply the distributive property to determine the product of two given numbers</p> <ul style="list-style-type: none"> <li>i. <math>7 \times 15</math>, think <math>7 \times (10 + 5) = 70 + 35 = 105</math></li> <li>ii. <math>18 \times 6</math>, think <math>(20 - 2) \times 6 = (20 \times 6) - (6 \times 2) = 120 - 12 = 108</math></li> </ul>	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem Solving (CP)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.1.2.1 Apply mental mathematics strategies and number properties used to solve problems</b>	<p><b>B7.1.2.1.3 Apply mental mathematics strategies to solve word problems.</b></p> <p>E.g. 1. Play mental mathematics games: - learners use mental strategies to perform the following;</p> <ul style="list-style-type: none"> <li>i. addition using words like plus, <i>add, calculate the sum, increase a number by</i>, and find the total;</li> <li>ii. subtraction using words like minus, <i>from a number take, , find the difference, and what must be added to make</i>;</li> <li>iii. multiplication using words like times, <i>multiply, find the product, square, and what must be divided by ... to give ...</i>;</li> <li>iv. division using words like <i>divide, share, how many times does it go into? and what must be multiplied by ... to give ...</i></li> </ul> <p>E.g.2. Play mental mathematics games:</p> <p>Find the cost of three 5 kg bags of rice at ₦2 per kg.</p> <ul style="list-style-type: none"> <li>i. What is the cost of 1 dozen of eggs at 80 pesewas each?</li> <li>ii. <math>8 \times 99</math>.</li> <li>iii. <math>28 \times 25</math>.</li> <li>iv. How many 21cm pieces can I cut off a string one metre long?</li> <li>v. What fraction of a litre is 250ml?</li> <li>vi. The area of a square board is <math>81 \text{ cm}^2</math>. What is its perimeter?</li> <li>vii. Two angles of a triangle add up to <math>98^\circ</math>. What is the size of the third angle?</li> <li>viii. How many minutes are there from 10.15 a.m. to noon?</li> <li>ix. What is 60 pesewas as a decimal of ₦2.40?</li> </ul>	<p>Creativity and Innovation (CI)</p> <p>Critical thinking and problem solving (CP)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p><b>B7.1.2.2.1 Add and subtract up to four-digit numbers.</b></p> <p>E.g.1. Use partitioning (or expanded form) and place value system to add and subtract whole and decimal numbers.</p> <p>i) Add 785 and 9,342</p> $  \begin{array}{r}  785 = 700+80+5 \\  + = 9000+300+40+2 \\  9,342 \\  \hline  10,127 = 9000+1000+120+7  \end{array}  $ <p>ii) Add 327.6 and 54.13</p> $  \begin{array}{r}  327.60 = 300 + 20 + 7 + \frac{6}{10} + \frac{0}{100} \\  + 54.13 = 50 + 4 + \frac{1}{10} + \frac{3}{100} \\  \hline  381.73 = 300 + 70 + 11 + \frac{7}{10} + \frac{3}{100}  \end{array}  $ <p>iii) Subtract 7.85 from 93.6</p> $  \begin{array}{r}  93.60 = 90 + 3 + \frac{6}{10} + \frac{0}{100} \\  - 7.85 = 7 + \frac{8}{10} + \frac{5}{100} \\  \hline  85.75 = 80 + 5 + \frac{75}{100}  \end{array}  $	<p>Critical thinking and problem solving (<b>CP</b>)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p><b>B71.2.2.2 Multiply or divide multi-digit numbers by 1- and 2- digit numbers</b></p> <p>E.g.1 Use partitioning/expanded form to multiply and divide efficiently</p> <p>i) Multiply 584 by 8</p> $  \begin{array}{r}  584 = (500+ 80+4) \\  \times 8 = x8 \\  \hline  4,000+640+32 \\  \hline  4,672 = 4,672  \end{array}  $ <p>E.g.2. Multiply whole numbers using the vertical place value method or lattice method:</p> <p>i. Place value method:  <math>345 \times 27 =</math></p> $  \begin{array}{r}  345 \\  \times 27 \\  \hline  2,415 \\  + 6,900 \\  \hline  9,315  \end{array}  $ <p>Lattice method:</p> <p>Draw a 2 by 3 lattice for solving <math>345 \times 27</math>.</p>	<p>Critical thinking and problem solving (<b>CP</b>)</p> <p>Personal Development and Leadership (<b>PL</b>)</p>



CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p>E.g.3 Use the distributive property to multiply 325 by 15.</p> $=325 \times (10 + 5) = (325 \times 10) + (325 \times 5)$ $=3,250 + 1,625$ $=4,875$ <p>E.g.4 Investigate and determine basic division facts including divisibility test.</p> <p>(i) determine how a given number is divisible by 2,3, 4, 5, 6, 7 8, 9,10, etc.</p> <p>For example, a number is divisible by 3 if the sum of its digits is divisible by 3.</p> <p>So, 72 is divisible by 3 because <math>7+2 = 9</math>. Hence since 9 is divisible by 3, then 72 is divisible by 3.</p> <p>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.</p> <p>So, 595 is divisible by 7 because <math>5 \times 2 =10</math>. <math>59 - 10 = 49</math>. Therefore, 595 is divisible by 7.</p>	<p>Critical thinking and problem solving (<b>CP</b>)</p> <p>Personal Development and Leadership (<b>PL</b>)</p>
<b>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.</b>	<p><b>B7.1.2.2.3. Create and solve story problems involving decimals on the four basic operations.</b></p> <p>E.g. 1. Solve word problems.</p> <p>(i) A group of two hundred and fifteen men and seven hundred and eighty-four women went to watch a musical concert. An amount of GH₵25 was collected at the gate from each person. How much money was collected all together?</p>	<p>Critical thinking and problem solving (<b>CP</b>)</p> <p>Personal Development and Leadership (<b>PL</b>)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES												
<b>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.</b>	<p>(ii) Mrs Adamu bought 13.6kg of meat. Mrs Anderson bought 2.4kg of meat less than Mrs Adamu. How many kilograms of meat did they buy all together?</p> <p>(iii) Ebo weighs 28.6kg. His father weighs four times as heavy. What is the total weight of Ebo and his father?</p> <p>(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?</p>	<p>Critical thinking and problem solving (<b>CP</b>)</p> <p>Personal Development and Leadership (<b>PL</b>)</p>												
	<p>E.g.2 Solve word problems on data presented in a table</p> <p>(i) In preparation towards an open day anniversary, a school's Management Committee approved the following budget on some projects.</p> <table border="1"> <thead> <tr> <th>Activity</th><th>Cost (GH₵)</th></tr> </thead> <tbody> <tr> <td>Painting school building</td><td>4,580</td></tr> <tr> <td>Mending cracks on the basketball pitch</td><td>3,050</td></tr> <tr> <td>Restock the library with new books</td><td>2,690</td></tr> <tr> <td>Buying of choir robes</td><td>5,340</td></tr> <tr> <td>Buying prizes for awards</td><td>4,270</td></tr> </tbody> </table> <p>(a) How much was approved for painting the school building and buying choir robes?</p> <p>(b) How much more was to be spent on mending the cracks on the basketball pitch than restocking the library with new books?</p> <p>(c) How much was spent on buying prizes for awards if twice the amount approved was spent on this activity?</p>	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	
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CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving problems.</b>	<p><b>B7.1.2.3.1 Illustrate with examples the meaning of repeated factors using counting objects such as bottle tops or bundle sticks.</b></p> <p><b>E.g.1:</b> Model repeated factors using counters or bottle tops. i. <math>3 \times 3 \times 3</math>, is repeated factors, and each factor is 3.</p> <p><b>E.g.2</b> Explain what is meant by a power of a number.</p> <p>i. <math>2 \times 2 \times 2 \times 2 \times 2 = 2^5 = 32</math></p> <p><b>E.g.3</b> Explain the features of the power <math>2^3</math> The 2 in <math>2^3</math> is the base, while the 3 in <math>2^3</math> is the exponent or index</p>	<p>Creativity and Innovation (CI)</p> <p>Critical thinking and Problem Solving (CP)</p>
	<p><b>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</b></p> <p><b>E.g. 1</b> i. <math>32 = 2 \times 2 \times 2 \times 2 \times 2 = 2^5</math> ii. <math>81 = 3 \times 3 \times 3 \times 3 = 3^4</math> iii. <math>49 = 7 \times 7 = 7^2</math> iv. <math>16 \times 27 = 2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 3 = 2^4 \times 3^3</math></p>	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving problems.	<p><b>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.</b></p> <p><b>E.g.1</b> Verify why the value of any natural number with exponent zero is 1.  <i>Verification:</i></p> <p><math>\frac{x}{x} = 1</math>, but from indices, <math>\frac{x}{x} = x^0</math>, hence <math>x^0 = 1</math> for any natural number</p> <p>Thus: if we have <math>\frac{4}{4}</math>, the result is 1. This can also be done using powers of numbers. That is, <math>\frac{4}{4} = 2^2 \div 2^2 = 2^{2-2} = 2^0 = 1</math>. Therefore, any natural number with an exponent of 0 is 1.</p> <p>Also, if we have <math>\frac{27}{27}</math>, the result is 1. This can also be done using powers of numbers. That is, <math>\frac{27}{27} = 3^3 \div 3^3 = 3^{3-3} = 3^0 = 1</math>. Therefore, any natural number with an exponent of 0 is 1.</p>	Creativity and Innovation (CI)
	<p><b>B7.1.2.3.4 Find the value of a number written in index form.</b></p> <p><b>E.g.1i.</b> <math>5^3 = 5 \times 5 \times 5 = 25 \times 5 = 125</math></p> <p><b>ii.</b> <math>3^4 = 3 \times 3 \times 3 \times 3 = 9 \times 9 = 81</math></p> <p><b>iii.</b> <math>6^3 = 6 \times 6 \times 6 = 36 \times 6 = 216</math></p> <p><b>iv.</b> <math>\frac{1}{2^5} = \frac{1}{2 \times 2 \times 2 \times 2 \times 2} = \frac{1}{32}</math></p>	Creativity and Innovation (CI)

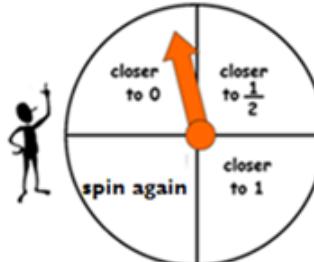
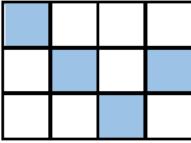
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving problems.	<p><b>B7.1.2.3.5 Apply the concept of powers of numbers (product of prime) to find Highest Common Factor (HCF).</b></p> <p><b>E.g.1</b> Expand a given number using product of prime concept.</p> <div style="border: 1px solid red; padding: 5px;"> <p>Find the Highest Common Factor (HCF) of 36 and 72</p> </div> <p>1. Find the prime factors of both numbers</p> $36 = 2 \times 2 \times 3 \times 3$ $72 = 2 \times 2 \times 2 \times 3 \times 3$ <p>2. Use one of each of the numbers that are in both lists</p> $\text{HCF} = 2 \times 2 \times 3 \times 3$ $\text{HCF} = 36$ <p><b>E.g. 2 HCF Real life example:</b>  Akweley has two pieces of paper. One piece is 24 cm wide and the other piece is 30 cm wide. She wants to cut both pieces into strips of equal width that are as wide as possible. How wide should she cut the strips?</p> <p><b>Answer:</b>  This problem can be solved using H.C.F. because we are cutting or “dividing” the strips of cloth into smaller pieces (Factor) of 24 and 30 (Common) and we are looking for the widest possible strips (Highest).  So,  H.C.F. of 24 and 30 is 6  So we can say that Akweley should cut each piece to be 18 cm wide.</p>	Creativity and Innovation (CI) Critical Thinking and Problem Solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.1.2.3 Demonstrate understanding and the use of powers of natural numbers in solving problems.</b>	<p><b>E.g. 3. LCM Real life example</b></p> <p>Baba exercises every 12 days and Serwa every 8 days. Baba and Serwa both exercised today. How many days will it be until they exercise together again?</p> <p><b>Answer:</b></p> <p>This problem can be solved using Least Common Multiple because we are trying to figure out when the soonest (Least) time will be that as the event of exercising continues (Multiple), it will occur at the same time (Common).</p> <p>So, L.C.M. of 12 and 8 is 24.</p> <p>So, they will exercise together again in 24 day</p>	Creativity and Innovation (CI) Critical Thinking and Problem Solving (CP)

## STRAND 1: NUMBER

### *Sub-strand 3: Fractions, Decimals and Percentages*

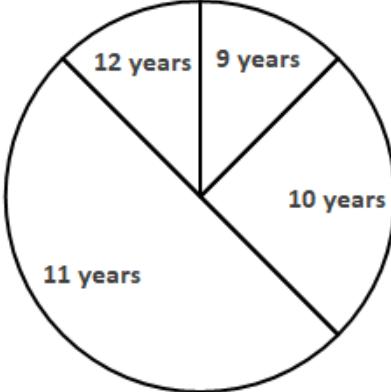
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																								
<p><b>B7.1.3.1 Simplify, compare and order a mixture of positive fractions (i.e. common, percent and decimal) by changing all to equivalent (i) fractions (ii) decimals, or (iii) percentages.</b></p>	<p><b>B7.1.3.1.1 Determine and recall the percentages and decimals of given benchmark fractions (i.e. tenths, fifths, fourths, thirds and halves) and use these to compare quantities.</b></p> <p>E.g. 1. Review the concept of fractions.</p> <ul style="list-style-type: none"> <li>i. Shade given fraction of squares in given shapes: i.e. shade <math>\frac{5}{6}</math> of the rectangle.</li> <li>ii. Write down 3 fractions equivalent to <math>\frac{2}{3}</math></li> <li>iii. Express the fraction <math>\frac{6}{10}</math> in its simplest form: <math>\frac{6}{10} = \frac{3}{5}</math></li> <li>iv. Convert to mixed numbers: <math>\frac{12}{5}</math></li> <li>v. Convert to improper fractions: <math>2\frac{5}{9}</math></li> </ul> <p>E.g. 2. Work out common, and decimal fractions and percent equivalences of given benchmark fractions to complete a table.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Common</td> <td><math>\frac{1}{10}</math></td> <td style="background-color: #ffcc99;"><b>A</b></td> <td><math>\frac{1}{4}</math></td> <td><math>\frac{1}{3}</math></td> <td style="background-color: #ffcc99;"><b>B</b></td> <td style="background-color: #ffcc99;"><b>C</b></td> <td><math>\frac{2}{3}</math></td> </tr> <tr> <td>Percent</td> <td>10%</td> <td>20%</td> <td style="background-color: #ffcc99;"><b>D</b></td> <td style="background-color: #ffcc99;"><b>E</b></td> <td>50%</td> <td style="background-color: #ffcc99;"><b>F</b></td> <td style="background-color: #ffcc99;"><b>G</b></td> </tr> <tr> <td>Decimal</td> <td>0.1</td> <td style="background-color: #ffcc99;"><b>H</b></td> <td style="background-color: #ffcc99;"><b>I</b></td> <td style="background-color: #ffcc99;"><b>J</b></td> <td style="background-color: #ffcc99;"><b>K</b></td> <td>0.4</td> <td style="background-color: #ffcc99;"><b>L</b></td> </tr> </table>	Common	$\frac{1}{10}$	<b>A</b>	$\frac{1}{4}$	$\frac{1}{3}$	<b>B</b>	<b>C</b>	$\frac{2}{3}$	Percent	10%	20%	<b>D</b>	<b>E</b>	50%	<b>F</b>	<b>G</b>	Decimal	0.1	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	0.4	<b>L</b>	<p>Critical thinking and Problem Solving (<b>CP</b>)</p> <p>Creativity and Innovation (<b>CI</b>)</p>
Common	$\frac{1}{10}$	<b>A</b>	$\frac{1}{4}$	$\frac{1}{3}$	<b>B</b>	<b>C</b>	$\frac{2}{3}$																			
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Decimal	0.1	<b>H</b>	<b>I</b>	<b>J</b>	<b>K</b>	0.4	<b>L</b>																			

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p>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.</p> <p>Spin the fraction wheel and pick the right fraction to win a fraction card. [Note cards picked should not be replaced].</p>   <p>E.g. 4. Simplify, compare and order common fractions.</p> <p>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?</p>  <p><math>\frac{4}{10}, \frac{4}{12}, \frac{7}{8}, \frac{1}{3}</math> and <math>\frac{1}{4}</math>.</p> <p>ii. Which symbol (&lt;, = or &gt;) makes the sentence <math>\frac{3}{5} \dots \frac{2}{3}</math> true?</p> <p>iii. Find which fraction is greater: <math>\frac{7}{12}</math> and <math>\frac{8}{10}</math>.</p>	<p>Critical thinking and Problem Solving (CP)</p> <p>Creativity and Innovation (CI)</p>

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.	<p><b>B7.1.3.1.2 Compare and order fractions (i.e. common, percent and decimal fractions up to thousandths) limit to the benchmark fractions.</b></p> <p>E.g. 1. Arrange in descending order, the following fractions <math>\frac{5}{6}</math>, <math>\frac{3}{4}</math> and <math>\frac{7}{8}</math>.</p> <p>E.g. 2. Find which decimal fractions is greater: 0.99 is greater than 0.977</p> <p>E.g. 3. Order the decimal numbers 0.098, 0.985 and 0.123 from least to greatest.</p> <p>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, <math>\frac{3}{8}</math> and 38% from least to largest; we have</p> $0.832 = \frac{832}{1000} = 83.2\%,$ $\rightarrow \frac{3}{8} = \frac{375}{1000} = 37.5\%,$ $38\% = \frac{38}{100} = 0.38\%,$ <p>Hence the order from least to the largest is <math>\frac{3}{8}</math>, 38% and 0.832.</p>	Communication and Collaboration (CC)  Critical thinking and problem solving (CP)
B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems	<p><b>B7.1.3.2.1 Explain the process of addition and subtraction of two or three unlike and mixed fractions.</b></p> <p>E.g. 1. To add mixed fractions, i.e. <math>2\frac{2}{5}</math> and <math>1\frac{2}{3}</math>, we first add the whole numbers and then add the fractions; i.e. <math>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}</math></p>	Communication and Collaboration (CC)  Critical thinking and problem solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>E.g. 2. To subtract mixed fractions, i.e. <math>2\frac{4}{5} - 1\frac{2}{3}</math>, we first subtract the whole numbers and then subtract the fractions; i.e. <math>(2 - 1) + \frac{4}{5} - \frac{2}{3} = 1\frac{12 - 10}{15} = 1\frac{2}{15}</math>.</p> <p>Alternatively, we may change the mixed fractions to improper fractions first.</p>	
<b>B7.1.3.2 Demonstrate an understanding of the process of addition and/or subtraction of fractions and apply this in solving problems</b>	<p><b>B7.1.3.2.2 Solve problems involving addition or subtraction of fractions.</b></p> <p>E.g. 1. Solve word problems involving addition or subtraction of fractions.</p> <ul style="list-style-type: none"> <li>i. <math>3\frac{1}{3}</math> feet are cut off a board that is <math>12\frac{1}{4}</math> feet long. How long is the remaining part of the board?</li> <li>ii. The Musa family decided to hike to a waterfall, approximately <math>8\frac{5}{8}</math> kilometres away. After an hour the lake was still <math>5\frac{1}{3}</math> kilometres away. How far did the group hike so far?</li> <li>iii. If you add 2 fractions and the sum is greater than <math>\frac{1}{2}</math>, what can you say about the fractions.</li> </ul>	<p>Critical thinking and problem solving (<b>CP</b>)</p> <p>Digital Literacy (<b>DL</b>)</p>
<b>B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems</b>	<p><b>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.</b></p> <p>E.g. 1. To multiply a whole number by a fraction, the multiplication is read as 'times'. For instance, <math>3 \times 2\frac{2}{3}</math> means 3 times <math>2\frac{2}{3}</math> or 3 groups of <math>2\frac{2}{3}</math>; i.e. <math>3 \times (2 + \frac{2}{3})</math> or <math>3 \times \frac{8}{3}</math>. The product can be obtained by (i) changing all into common fraction; (ii) multiplying all numerators and denominators; (iii) simplifying the results.</p> <p>Find    1. <math>15 \times \frac{2}{3}</math>        2. <math>12 \times \frac{3}{8}</math>.</p>	Critical thinking and problem solving ( <b>CP</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>E.g. 2. To multiply a fraction by a whole number, the multiplication is read as 'of'. for instance, <math>\frac{2}{3} \times 5</math> means <math>\frac{2}{3}</math> of 5 or i.e. <math>\frac{2}{3} \times \frac{5}{1} = \frac{2 \times 5}{3 \times 1} = \frac{10}{3} = 3\frac{1}{3}</math>. 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]</p> <p>Find (i) <math>\frac{2}{3} \times 240</math> (ii). <math>\frac{3}{8} \times 480</math></p>	
	<p>E.g. 3. Calculate the following (when necessary, round your answer to the nearest tenth): a. 28% of 40 b. 234% of 8 c. <math>3\frac{1}{2}\%</math> of 50 d. 0.2% of 15000 e. 8.25% of 62</p> <p>E.g. 4. To multiply a fraction by a fraction, the multiplication is read as 'of'. For instance, <math>\frac{2}{3} \times \frac{1}{2}</math> means <math>\frac{2}{3}</math> of <math>\frac{1}{2}</math> or i.e. <math>\frac{2}{3} \times \frac{1}{2} = \frac{2 \times 1}{3 \times 2} = \frac{2}{6} = \frac{1}{3}</math>. 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]</p> <p>Find (i) <math>\frac{2}{3} \times \frac{3}{5}</math>(ii) <math>\frac{3}{8} \times \frac{5}{6}</math></p>	
<b>B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems</b>	<p><b>B7.1.3.3.2 Find a fraction of given quantity (i.e. money or given quantity of objects)</b></p> <p>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, <math>\frac{2}{3} \times \text{GH₵}60</math> means <math>\frac{2}{3}</math> of GH₵60, i.e. <math>\frac{2}{3} \times \frac{60}{1} = \frac{2 \times 60}{3 \times 1} = \text{GH₵}40</math>.</p> <p>E.g. 2. There are 132 learners in a class. If <math>\frac{2}{3}</math> of the learners are girls, how many boys are in the class?</p>	Critical thinking and problem solving ( <b>CP</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>E.g. 3. The graph shows the ages of learners in a Primary 5 class.</p> <p>(i) Approximately, what fraction of the learners are 10 years old?</p> <p>(ii) How many learners are 11 years old if there are 32 learners in the class?</p> 	
<b>B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems</b>	<p><b>B7.1.3.3 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.</b></p> <p>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, <math>3 \div \frac{1}{4}</math> means how many <math>\frac{1}{4}</math>s can be obtained in 3, or</p> $3 = \frac{1}{4} \times \text{what?}$ <p>The quotient can be obtained by multiplying both dividend by divisor the reciprocal of the divisor. For <math>3 \div \frac{1}{4}</math>, the reciprocal of the divisor is <math>\frac{4}{1}</math>, hence <math>3 \div \frac{1}{4} \rightarrow (3 \times \frac{4}{1}) \div (\frac{1}{4} \times \frac{4}{1}) = 12</math>, and for <math>\frac{1}{4} \div 3</math>, the reciprocal of the divisor is <math>\frac{1}{3}</math>, hence <math>\frac{1}{4} \div 3 \rightarrow (\frac{1}{3} \times \frac{1}{4}) \div (3 \times \frac{1}{3}) = \frac{1}{12}</math></p> <p>Divide:</p> <ol style="list-style-type: none"> <li>1. <math>5 \div 1\frac{2}{3}</math></li> <li>2. <math>\frac{5}{8} \div \frac{1}{2}</math></li> </ol>	Critical thinking and problem solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.3.3 Demonstrate an understanding of the process of multiplying and dividing positive fractions and apply this in solving problems	<p><b>B7.1.3.3.4 Determine the result of dividing a quantity (i.e. money or objects) or a fraction by a fraction</b></p> <p>E.g. 1. A set of stacked plates for serving snacks at a party weighs 10 kg. If each plate in the stack weighs <math>\frac{1}{4}</math>kg, how many plates are in the stack?</p> <p>To divide by a fraction, multiply both dividend by divisor the reciprocal of the divisor, hence</p> $10 \div \frac{1}{4} \rightarrow (10 \times \frac{4}{1}) \div (\frac{1}{4} \times \frac{4}{1}) = 40$ $(10 \times \frac{4}{1}) \div (1) = (10 \times \frac{4}{1}) = 40$	Critical thinking and problem solving (CP)
	<p>E.g. 2. A class was given <math>9\frac{1}{2}</math>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?</p> <p>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?</p>	

## STRAND 1: NUMBER

### *Sub-strand 4: Number: Ratios and Proportion*

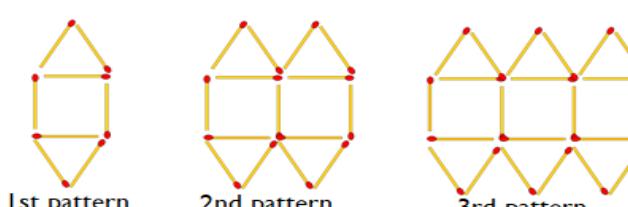
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B7.1.4.1 Demonstrate an understanding of the concept of ratios and its relationship to fractions and use it to solve problems that involve rates, ratios, and proportional reasoning	<p><b>B7.1.4.1.1 Find ratio and use ratio language to describe relationship between two quantities.</b></p> <p><b>E.g. 1</b> Determine ratio of given quantities.</p> <p>i. There are 60 boys and 120 girls in a school. So the ratio of boys to girls in the school is <math>\frac{60}{120} = \frac{1}{2} = 1:2</math></p> <p><b>E.g.2</b> Express two quantities as a ratio.</p> <p>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.</p> <p><b>E.g.3</b> Describe quantities with ratio language.</p> <p>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</p> <ul style="list-style-type: none"> <li>• Alhasan is twice as old as his son.</li> <li>• Musa is half the age of his father.</li> </ul>	<p>Critical Thinking and Problem solving (<b>CP</b>)</p> <p>Communication and Collaboration (<b>CC</b>)</p>
	<p><b>B7.1.4.1.2 Use the concept of a unit rate <math>\frac{a}{b}</math> associated with a ratio <math>a:b</math> with <math>b \neq 0</math>, and use rate language in the context of a ratio relationship.</b></p> <p><b>E.g.1</b> Write given ratios as unit rate <math>\frac{a}{b}</math>.</p> <p>i. This recipe has a ratio of 3 cups of flour to 4 cups of sugar, so there is <math>\frac{3}{4}</math> cups of flour for each cup of sugar.</p> <p>ii. Aisha polishes 8 square yards of floor tiles every 7 minutes, so there are <math>\frac{8}{7}</math> square yards per minute.</p>	Critical Thinking and Problem solving ( <b>CP</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																				
	<p><b>E.g.2</b> Work out rates and use them in solving problems.</p> <p>i. If 2 litres of coca cola cost GH₵18, find the cost of (a) 1. 5 litres (b) 3 litres (c) 7 litres</p> <p><b>E.g.3</b> Use tables/diagrams to explain the concept of rate that compares two different quantities measured in different units.</p> <p>i. The table shows the weight and cost of meat at Salaga Market. If 3kg of meat costs GH₵ 60, use the information to complete the table.</p> <table border="1"> <thead> <tr> <th>Meat (kg)</th><th>2</th><th>3</th><th>5</th><th>12</th></tr> <tr> <th>Cost (GH₵)</th><td></td><td>60</td><td></td><td></td></tr> </thead> </table>	Meat (kg)	2	3	5	12	Cost (GH₵)		60													
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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	<p><b>B7.1.4.1.3 Make tables of equivalent ratios (written as common fractions) relating quantities that are proportional.</b></p> <p><b>E.g.1</b> 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, how much money did they share?</p> <p>Solution</p> <table border="1"> <thead> <tr> <th>Names</th><th colspan="4">Equivalent Ratios</th></tr> </thead> <tbody> <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> </tbody> </table> <p><b>Hint:</b> Any of these ratios can be used for the calculation.</p> $2 \rightarrow 24000$ $9 \rightarrow x$ $9 \times 24000 = 2x$ $9 \times 12000 = x$ $x = 108,000, \text{ Hence, the amount of money shared} = \text{GH₵}108,000$	Names	Equivalent Ratios				Kafui	36	18	9	3	Adoley	48	24	12	4	Jantuah	24	12	6	2	Critical Thinking and Problem solving ( <b>CP</b> )
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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	<p><b>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.</b></p> <p><b>E.g. 2</b> Find the missing value marked x in a table of equivalent ratios.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <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> $\frac{x}{6} = \frac{10}{3} \text{ means the value of } x = \frac{10}{3} \times 6 = \frac{60}{3} = 20$	3	10	6	x	9	30	y	40	Critical Thinking and Problem solving ( <b>CP</b> )
3	10									
6	x									
9	30									
y	40									
	<p><b>B7.1.4.1.5Find a percent of a quantity as a rate per 100 (e.g. 30% of a quantity means <math>\frac{30}{100}</math>times the quantity).</b></p> <ul style="list-style-type: none"> <li>i. A salesman gets paid 35% commissions. How much commission does he make on sales of GH₵700?</li> <li>ii. Yaw paid GH₵80 for a shirt that was on sale at a discount of 20%. What was the original price?</li> <li>iii. A cell phone which regularly sells for GH₵450 is on sale for 40% off. How much would you pay for the phone?</li> <li>iv. A woman put GH₵520 into a savings account for one year. The rate of interest on the account was 6%. How much was the interest for the year?</li> </ul>	Critical Thinking and Problem solving ( <b>CP</b> )								

## STRAND 2: ALGEBRA

### *Sub-strand 1: Patterns and Relations*

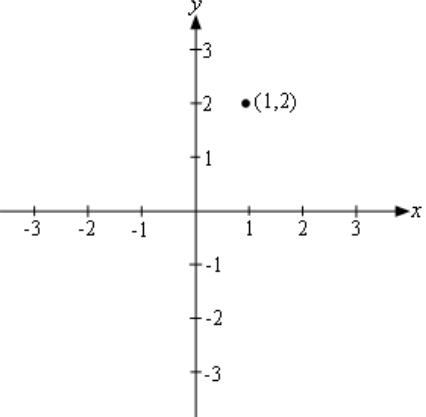
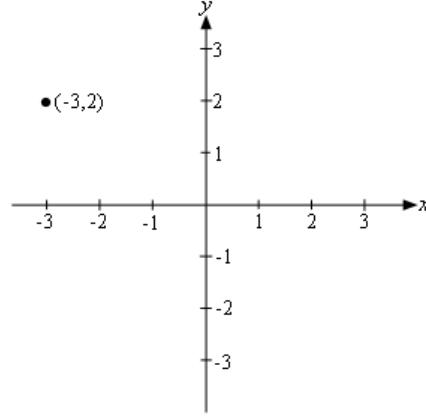
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																
<p><b>B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.</b></p>	<p><b>B7.2.1.1.1 Extend a given relation presented with and without symbolic materials and explain how each element differs from the preceding one.</b></p> <p><b>E.g.1</b> Extend a given symbolic relation.</p>  <p>i. Study the pattern made with match sticks below 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.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Pattern No.</td> <td style="padding: 2px; text-align: center;">1</td> <td style="padding: 2px; text-align: center;">2</td> <td style="padding: 2px; text-align: center;">3</td> <td style="padding: 2px; text-align: center;">4</td> <td style="padding: 2px; text-align: center;">5</td> <td style="padding: 2px; text-align: center;">6</td> <td style="padding: 2px; text-align: center;">7</td> </tr> <tr> <td style="padding: 2px;">Number of sticks</td> <td style="padding: 2px; text-align: center;">8</td> <td style="padding: 2px; text-align: center;">15</td> <td style="padding: 2px;"></td> </tr> </table> <p><b>E.g.2</b> Study the pattern of numbers below and complete table.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px;">Domain</td> <td style="padding: 2px; text-align: center;">1</td> <td style="padding: 2px; text-align: center;">2</td> <td style="padding: 2px; text-align: center;">3</td> <td style="padding: 2px; text-align: center;">4</td> <td style="padding: 2px; text-align: center;">5</td> <td style="padding: 2px; text-align: center;">6</td> <td style="padding: 2px; text-align: center;">7</td> </tr> <tr> <td style="padding: 2px;">Co-domain</td> <td style="padding: 2px; text-align: center;">4</td> <td style="padding: 2px; text-align: center;">7</td> <td style="padding: 2px; text-align: center;">10</td> <td style="padding: 2px;"></td> <td style="padding: 2px; text-align: center;">16</td> <td style="padding: 2px;"></td> <td style="padding: 2px;"></td> </tr> </table> <p>i. What are the missing numbers in the co-domain?</p>	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			<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>
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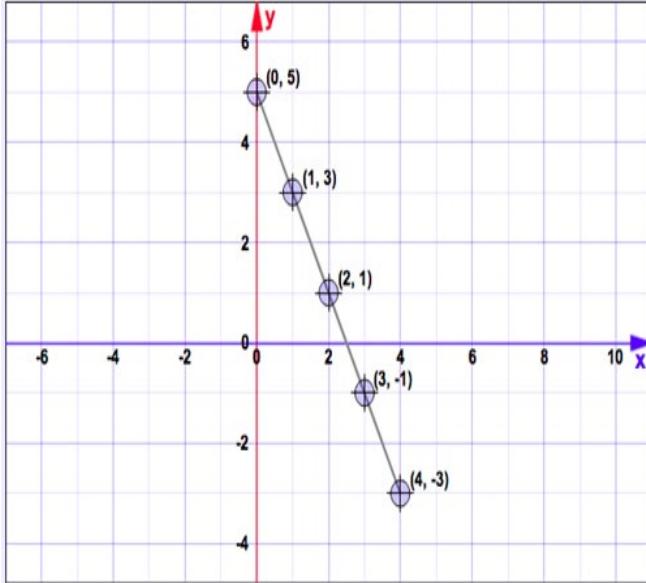
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<p><b>B7.2.1.1 Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.</b></p>	<p>E.g.3 Extend a given number relation.</p> <p>i. If the next number in the domain is 9, what will be the corresponding number in the co-domain?</p> <table border="1"> <thead> <tr> <th>Domain</th> <th>Co-domain</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>9</td> </tr> <tr> <td>4</td> <td>16</td> </tr> <tr> <td>5</td> <td>25</td> </tr> <tr> <td>6</td> <td>36</td> </tr> </tbody> </table>	Domain	Co-domain	2	4	3	9	4	16	5	25	6	36	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>												
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	<p><b>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.</b></p> <p>E.g.1 Describe given relations</p> <p>"Is the square of"</p> <table border="1"> <thead> <tr> <th>Domain</th> <th>Co-domain</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>9</td> </tr> <tr> <td>4</td> <td>16</td> </tr> <tr> <td>5</td> <td>25</td> </tr> <tr> <td>6</td> <td>36</td> </tr> </tbody> </table> <p>"is a double of"</p> <table border="1"> <thead> <tr> <th>Domain</th> <th>Co-domain</th> </tr> </thead> <tbody> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>6</td> </tr> <tr> <td>4</td> <td>8</td> </tr> <tr> <td>5</td> <td>10</td> </tr> <tr> <td>6</td> <td>12</td> </tr> </tbody> </table>	Domain	Co-domain	2	4	3	9	4	16	5	25	6	36	Domain	Co-domain	2	4	3	6	4	8	5	10	6	12	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>
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<p><b>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.</b></p>	<p><b>E.g.2</b> 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.</p> <table border="1"> <tr> <td>Number of workers</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>?</td> </tr> <tr> <td>Cost of breakfast</td> <td>3</td> <td>6</td> <td>9</td> <td>12</td> <td>15</td> <td>18</td> <td>120</td> </tr> </table> <p>(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.</p> <p><b>E.g.3</b> State the rules in words to represent a given relation.</p> <table border="1"> <thead> <tr> <th>Term/Input (<math>x</math>)</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th><math>x</math></th> <th>Rule for <math>n</math> in words</th> </tr> </thead> <tbody> <tr> <td>Result/Output A</td> <td>5</td> <td>10</td> <td>15</td> <td>20</td> <td></td> <td></td> <td><math>x \rightarrow 5</math> times <math>x</math></td> </tr> <tr> <td>Result/Output B</td> <td>0</td> <td>4</td> <td>8</td> <td>12</td> <td></td> <td></td> <td><math>x \rightarrow 4</math> times one less <math>x</math></td> </tr> <tr> <td>Result/Output C</td> <td>4</td> <td>7</td> <td>10</td> <td>13</td> <td></td> <td></td> <td><math>x \rightarrow 1</math> more than thrice <math>x</math></td> </tr> <tr> <td>Result/Output D</td> <td>2</td> <td>6</td> <td>8</td> <td>10</td> <td></td> <td></td> <td><math>x \rightarrow</math> twice 1more than <math>x</math></td> </tr> <tr> <td>Result/Output E</td> <td>5</td> <td>11</td> <td>17</td> <td></td> <td></td> <td></td> <td><math>x \rightarrow</math></td> </tr> </tbody> </table>	Number of workers	1	2	3	4	5	6	?	Cost of breakfast	3	6	9	12	15	18	120	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				$x \rightarrow$	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>
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Result/Output E	5	11	17				$x \rightarrow$																																																											

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																																												
<p><b>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.</b></p>	<p><b>B7.2.1.1.3 Identify the relation or rule in a pattern/mapping presented numerically or symbolically and predict subsequent elements</b></p> <p><b>E.g.1</b> Determine the rule for a given symbolic pattern.</p>  <table border="1"> <thead> <tr> <th>Shape number</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>50</th></tr> </thead> <tbody> <tr> <td>Number of matchsticks</td><td>3</td><td>5</td><td>7</td><td>9</td><td>11</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table> <p>Rule for the pattern      Number of matchsticks = Shape number × _____ + _____</p> <p><b>E.g.2</b> Determine the rule for a given numerical pattern.</p> <p>i. Find the rule</p> <table style="margin-left: 200px;"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> <tr> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> </tr> <tr> <td>y</td> <td>0</td> <td>1</td> <td>4</td> <td>9</td> <td>16</td> </tr> </table> <p>ii. Find the rule and determine the value of n</p> <table style="margin-left: 200px;"> <tr> <td>0</td> <td>3</td> <td>6</td> <td>9</td> <td>12</td> <td>15</td> </tr> <tr> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> <td>↓</td> </tr> <tr> <td>-1</td> <td>5</td> <td>11</td> <td>17</td> <td>23</td> <td>n</td> </tr> </table>	Shape number	1	2	3	4	5	6	7	8	9	10	50	Number of matchsticks	3	5	7	9	11							x	0	1	2	3	4	↓	↓	↓	↓	↓	↓	y	0	1	4	9	16	0	3	6	9	12	15	↓	↓	↓	↓	↓	↓	-1	5	11	17	23	n	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>
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CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																				
	<p><b>E.g.3</b>Determine an element when given the rule</p> <ol style="list-style-type: none"> <li>The result of <math>x</math> in the mapping <math>x \rightarrow 2x + 3</math> is 3. Find the value of <math>x</math>.</li> <li>The result of <math>x</math> in the mapping <math>x \rightarrow -2x + 5</math> is 45. Find the value of <math>x</math>.</li> <li>Copy the table and use the rule to find the missing values of <math>n</math>.</li> </ol>  <table border="1"> <tr> <td>Shape number (x)</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> <td>8</td> <td>9</td> <td>10</td> <td>50</td> </tr> <tr> <td>Number of matchsticks</td> <td>5</td> <td>8</td> <td>11</td> <td>14</td> <td>17</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>n</td> </tr> <tr> <td>Rule for the pattern</td> <td colspan="11">the rule is <math>3x + 2</math></td></tr> </table>	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 $3x + 2$											Communication and Collaboration (CC)
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Rule for the pattern	the rule is $3x + 2$																																					
<b>B7.2.1.1</b> 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.	<p><b>B7.2.1.1.4</b> 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.</p> <p><b>E.g.1</b> Make a table of values for a given rule:</p> <ol style="list-style-type: none"> <li>Draw a table for the mapping defined by the rule on the domain <math>\{-2, -1, 0, 1, 2, 3\}</math>  <b>Rule:</b> <math>x \rightarrow 2x + 1</math></li> </ol> <table border="1"> <tr> <td>x</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>y</td> <td>-3</td> <td></td> <td></td> <td>5</td> <td></td> <td></td> </tr> </table> <ol style="list-style-type: none"> <li>Draw a table for the mapping defined by the rule on the domain <math>\{-2, -1, 0, 1, 2, 3\}</math>  <b>Rule:</b> <math>x \rightarrow x^2 + 2</math></li> </ol> <table border="1"> <tr> <td>x</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td>y</td> <td>6</td> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> </table>	x	-2	-1	0	1	2	3	y	-3			5			x	-2	-1	0	1	2	3	y	6			3			Creativity and Innovation (CI)  Critical Thinking and Problem solving (CP)								
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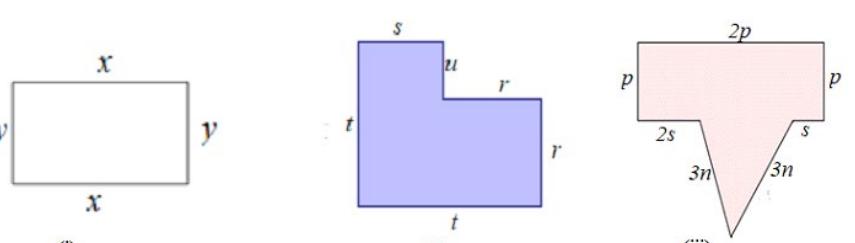
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.1.1</b> Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.</p>	<p>E.g.2 Locate points on the number plane – (1, 2) and (-3, 2)</p>  	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>

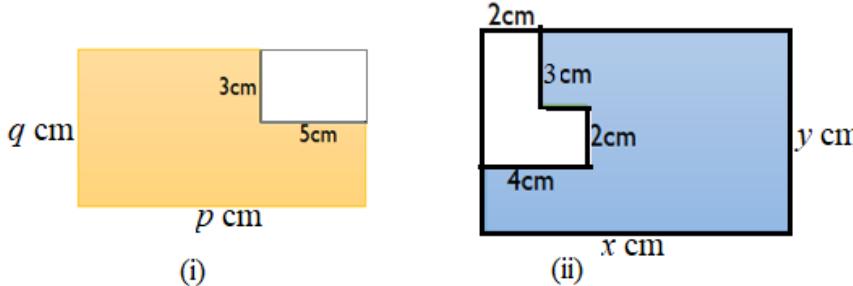
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES												
<p><b>B7.2.1.1</b> Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.</p>	<p><b>E.g.3</b> Draw graphs for given relations</p> <p>i. Plot the table of values on a number plane</p> <table border="1"> <thead> <tr> <th>x</th> <th>y</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>5</td> </tr> <tr> <td>1</td> <td>3</td> </tr> <tr> <td>2</td> <td>1</td> </tr> <tr> <td>3</td> <td>-1</td> </tr> <tr> <td>4</td> <td>-3</td> </tr> </tbody> </table> 	x	y	0	5	1	3	2	1	3	-1	4	-3	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>
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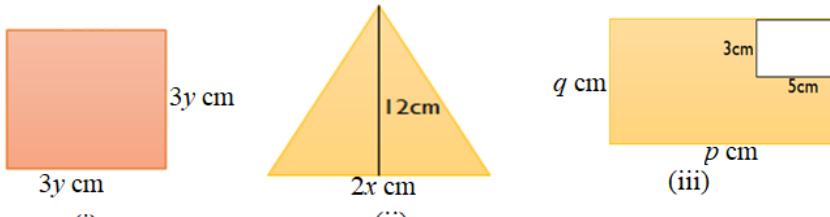
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.1.1</b> Derive the rule for a set of points of a relation, draw a table of values to graph the relation in a number plane and make predictions about subsequent elements of the relation.</p>	<p><b>E.g.4</b> Use knowledge of identifying and plotting points in a number plane to solve problems. The number plane shows the location of animals.</p> <p>Use the plane to answer the questions that follow.</p> <ol style="list-style-type: none"> <li>If Faako walks 7 units west and 8 units south, which animal does he see?</li> <li>Which animal is closest to Faako?</li> <li>Which animal is located at the point <math>(2, 7)</math>?</li> <li>What is point at which the giraffe is located?</li> </ol>	<p>Creativity and Innovation (CI)</p> <p>Communication and Collaboration (CC)</p> <p>Critical Thinking and Problem solving (CP)</p>

**STRAND 2: ALGEBRA**  
***Sub-strand 2: Algebraic Expressions***

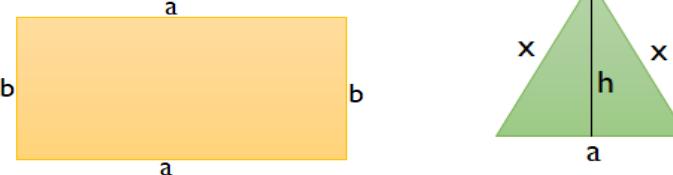
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b>	<p><b>B7.2.2.1.1 Create simple algebraic expressions using simple logic to translate a set of instructions into an algebraic expression.</b></p> <p><b>E.g.1</b> Form algebraic expressions for given mathematical statements.</p> <p>If <math>x</math> represents an unknown number, then</p> <ul style="list-style-type: none"> <li>i. 10 more than a number <math>x \rightarrow x + 10</math></li> <li>ii. 5 less than a certain number <math>x \rightarrow x - 5</math></li> <li>iii. 3 times a number <math>x \rightarrow 3x</math></li> <li>iv. Half of a certain number <math>x \rightarrow \frac{1}{2}x</math> or <math>\frac{x}{2}</math></li> <li>v. 2 more than 5 times a certain number <math>x \rightarrow 5x + 2</math></li> <li>vi. When 8 times a certain number <math>x</math> is subtracted from 5 and the result is multiplied by 2 <math>\rightarrow 2(5 - 8x)</math></li> </ul> <p><b>E.g.2</b> Form algebraic expressions from real life situations.</p> <ul style="list-style-type: none"> <li>i. Afrako is 3 years older than Maako. If Maako is now <math>x</math> years old, what is Afrako's age?</li> <li>ii. Agbolosu and Tetteh were given GH₵400.00 to share. Tetteh had GH₵35.00 more than Agbolosu. If Agbolosu's share is <math>x</math>, write an expression for Tetteh's share.</li> <li>iii. Find the profit a woman makes if she buys a basket of oranges for <math>x</math> cedi and sells it for <math>y</math> cedes.</li> <li>iv. Find the area of a rectangle which is <math>t</math> metres long and <math>q</math> metres wide.</li> <li>v. Find the perimeter of a rectangle which is <math>x</math> metres long and <math>y</math> metres wide.</li> </ul>	Communication and Collaboration ( <b>CC</b> ) Critical Thinking and Problem solving ( <b>CP</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b></p>	<p><b>B7.2.2.1.2 Perform addition and subtraction of algebraic expressions with rational coefficients.</b></p> <p><b>E.g.1 Add algebraic expressions</b></p> <p>i. Write each of these expressions in its simplest form:</p> <ol style="list-style-type: none"> <li>1. <math>x + x</math></li> <li>2. <math>y + y + y + y</math></li> <li>3. <math>s + s + s + t + t + k + k + k</math></li> </ol> <p>ii. Simplify the following expressions:</p> <ol style="list-style-type: none"> <li>1. <math>4x + 3x + x</math></li> <li>2. <math>5x + 4x + 2x + 3x</math></li> <li>3. <math>3abc + 4abc + 2abc</math></li> </ol> <p>iii. Write an expression for the perimeter of the following shapes:</p>  <p>(i) (ii) (iii)</p> <p><b>E.g.2 Subtract algebraic expressions.</b></p> <p>i. Write each of these expressions in its simplest form.</p> <ol style="list-style-type: none"> <li>1. <math>5x - 2x</math></li> <li>2. <math>3x - 4x - 2x</math></li> <li>3. <math>7x - 4x - x</math></li> </ol>	<p>Critical Thinking and Problem solving (<b>CP</b>)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b>	<p><b>E.g.3</b> Adding and subtracting algebraic expressions.</p> <p>i. Simplify the following expressions:</p> <ol style="list-style-type: none"> <li>1. <math>5x + 4 - 9y + 3x + 2y - 7</math></li> <li>2. <math>2p - 3q + 3p + 5q</math></li> <li>3. <math>4x + 7 - 2x - 4</math></li> <li>4. <math>7xy + 5x - 4x + 2xy - 3</math></li> </ol> <p>ii. Write an expression for the perimeter of the shaded region</p>  <p>(i)</p> <p>(ii)</p>	Critical Thinking and Problem solving ( <b>CP</b> )

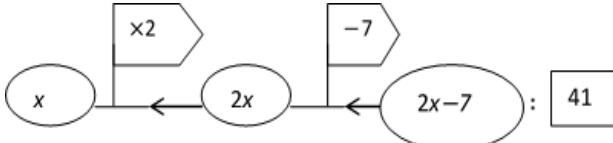
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b></p>	<p><b>B7.2.2.1.3 Perform multiplication and division of algebraic expressions with rational coefficients.</b></p> <p><b>E.g.1</b> Solve multiplication of algebraic expressions.</p> <p>i. Simplify the following expressions</p> <ol style="list-style-type: none"> <li>1. <math>4p \times 8p^2</math></li> <li>2. <math>5xy^2 \times 4x^4y^3</math></li> <li>3. <math>-2a \times 4c \times 5b</math></li> <li>4. <math>-3xy \times 5y</math></li> </ol>  <p>(i)</p> <p>(ii)</p> <p>(iii)</p> <p>ii. Write an expression for the area of the following shapes:</p>	<p>Communication and Collaboration (CC) Critical Thinking and Problem solving (CP)</p>
	<p><b>E.g.1</b> Solve division of algebraic expressions.</p> <p>Simplify the following expression:</p> <p>I. <math>\frac{12x^3y^2}{16xy^4}</math></p> <p>II. <math>\frac{-30abc}{6ab^3c^{-2}}</math></p> <p>III. <math>\frac{18x^5y^2}{24x^7y^2}</math></p>	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b>	<p><b>B7.2.2.1.4 Substitute values to evaluate algebraic expressions.</b></p> <p><b>E.g.1</b> Simplify the following expressions and substitute the values to evaluate them, if  <math>x = 2, y = 4, p = 3</math> and <math>z = -1</math>.</p> <p>I. <math>3xy \times 5y</math>      II. <math>7xy + 5x - 4x + 2xy - 3</math>      III. <math>4p \times 8z^2</math>      IV. <math>5x + 4 - 9y + 3x + 2y - 7</math></p> <p><b>E.g.2</b> Simplify the following expressions and substitute the values to evaluate them, if  <math>x = 2, y = 4, a = 3, b = 2, z = 1</math> and <math>c = -1</math>,</p> <p>i. <math>\frac{12x^3y^2}{16xy^4}</math>      ii. <math>\frac{-30abc}{6ab^3c^2}</math>      iii. <math>\frac{18x^5y^2}{24x^3y^2}</math>      iv. <math>\frac{8xyz}{16xy}</math>      v. <math>\frac{5ab^2}{ab}</math>      vi. <math>\frac{21x^7}{3x^4}</math></p>	Communication and Collaboration (CC) Critical Thinking and Problem solving (CP)

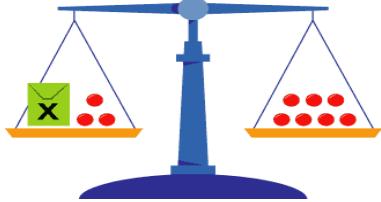
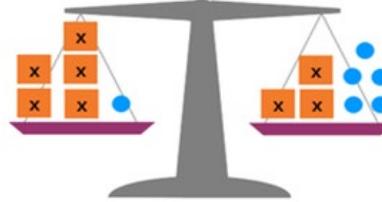
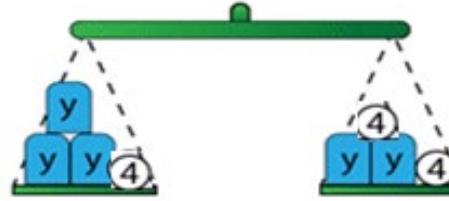
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.2.1 Simplify algebraic expressions involving the four basic operations and substituting values to evaluate algebraic expressions.</b></p>	<p>i. If <math>x = 5, a = 8, b = 3, h = 6</math>, find the perimeter and area of the following: ii. shapes.</p>  <p><b>B7.2.2.1.5 Use properties of the four operations to simplify algebraic expressions with rational coefficients.</b></p> <p><b>E.g.1</b> Simplify algebraic expressions involving the four operations.</p> <p>i. <math>3xy \times 2 + \frac{6x^2y^3}{2y^2}</math>  ii. <math>\frac{7x+4x-2x}{3x}</math>  iii. <math>3x^2y + 2xy^2 - 4x^2y - 6xy^2</math></p>	<p>Communication and Collaboration (CC) Critical Thinking and Problem solving (CP)</p>

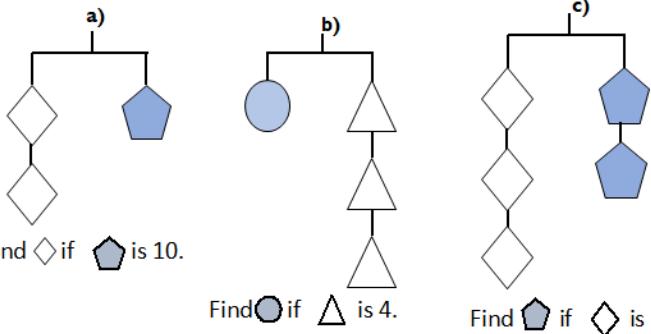
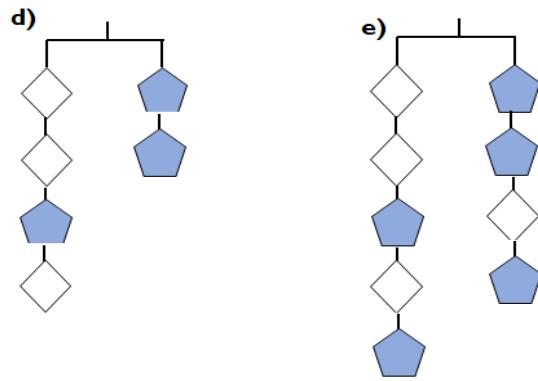
## STRAND 2: ALGEBRA

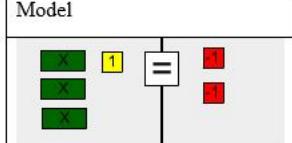
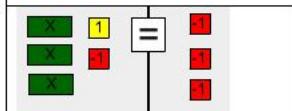
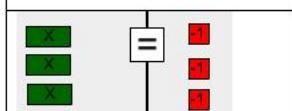
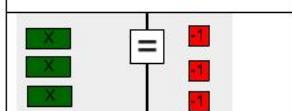
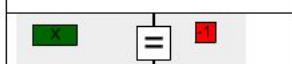
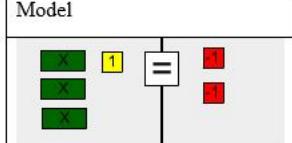
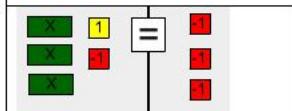
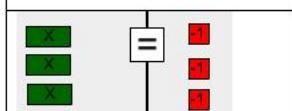
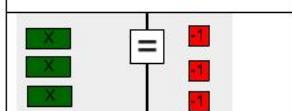
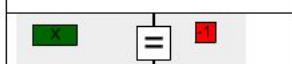
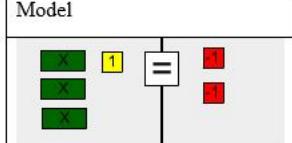
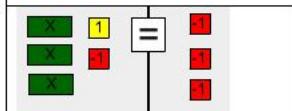
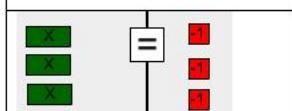
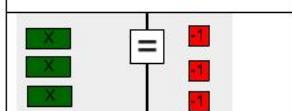
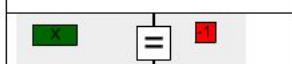
### *Sub-strand 3: Variables and Equations*

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.3.1 Demonstrate an understanding of linear equations of the form <math>x + a = b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.</b></p>	<p><b>B7.2.3.1.1 Translate word problems to linear equations in one variable and vice versa</b></p> <p>E.g.1: Use a flag diagram for equations and their inverses to solve equations.</p> <p>i. Think of a number, double it and subtract 7. The result is 41. What was the original number?  The flag diagram is:</p>  <p>i.e. <math>2x - 7 = 41</math></p> <p>To solve the equation, move in the opposite direction and do the inverse of the operations.</p> <p style="text-align: center;"> <math>\begin{array}{ccc} \div 2 &amp; &amp; +7 \\ 24 &amp; \leftarrow &amp; 48 &amp; \leftarrow &amp; 41 \end{array}</math> </p> <p style="text-align: center;"> <math display="block">\begin{array}{l} 2x - 7 = 41 \\ \quad +7 \quad +7 \\ 2x = 48 \\ \div 2 \quad \div 2 \\ x = 24 \end{array}</math> </p>	<p>Communication and Collaboration (<b>CC</b>)</p> <p>Critical Thinking and Problem solving (<b>CP</b>)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.2.3.1 Demonstrate an understanding of linear equations of the form <math>x + a = b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.</b>	<p><b>E.g.2:</b> Translate word problems to linear equations.</p> <p>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 <math>x</math> ∴ the age of older one = <math>4x</math>  <math display="block">4x + x = 25</math></p> <p>ii. Adaako and Afrakoma shared 40 oranges. Afrakoma had 6 more than Adaako. Write a mathematical sentence for this word problem.  i.e. let <math>x</math> represent Adaako's share. ∴ Afrakoma's share is <math>x + 6</math> and their share put together gives 40.  <math display="block">\therefore x + (6 + x) = 40</math></p>	Communication and Collaboration ( <b>CC</b> ) Critical Thinking and Problem solving ( <b>CP</b> )
	<p><b>E.g. 3</b> Write word problems for given linear equations</p> <p>i. <math>x + x = 15</math>  i.e. the sum of two equal numbers is 15</p> <p>ii. <math>2x - 4 = 12</math>  i.e. when 4 is taken away from 2times a certain number, the result is 12.</p> <p>iii. <math>\frac{2}{3}x = 4</math>  i.e. two-thirds of a certain number is 4.</p>	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.3.1 Demonstrate an understanding of linear equations of the form <math>x + a = b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.</b></p>	<p><b>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.</b></p> <p><b>E.g. 1</b> Model and solve linear equations set with objects on a balance</p> <p>i. <b>Solution:</b></p> $\begin{array}{rcl} x + 3 & = & 7 \\ -3 & & -3 \\ x & = & 4 \end{array}$  <p>ii. <b>Solution:</b></p> $\begin{array}{rcl} 3x + 1 & = & 3x + 5 \\ -3x & & -3x \\ 2x + 1 & = & 5 \\ -1 & & -1 \\ 2x & = & 4 \\ x & = & 2 \end{array}$  <p>iii. <b>Solution:</b></p> $\begin{array}{rcl} 3y + 4 & = & 2y + 8 \\ -2y & & -2y \\ y + 4 & = & 4 + 4 \\ -4 & & -4 \\ y & = & 4 \end{array}$ 	<p>Communication and Collaboration (<b>CC</b>)</p> <p>Critical Thinking and Problem solving (<b>CP</b>)</p>

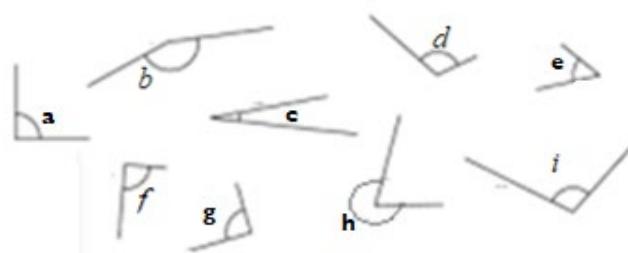
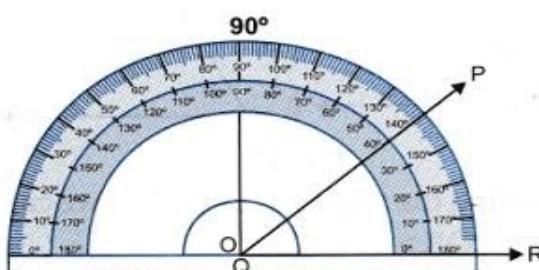
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.2.3.1 Demonstrate an understanding of linear equations of the form <math>x + a = b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.</b></p>	<p><b>E.g. 2. Model and solve linear equations set with shapes on a balance</b></p> <p>i. In each balance the mass of one shape is given in grams. Find the mass of the other shape.</p>  <p>Find <math>\diamond</math> if <math>\text{pentagon} = 10</math>.</p> <p>Find <math>\circ</math> if <math>\triangle = 4</math>.</p> <p>Find <math>\text{pentagon}</math> if <math>\diamond = 10</math>.</p>	<p>Communication and Collaboration (<b>CC</b>)</p> <p>Critical Thinking and Problem solving (<b>CP</b>)</p>
	<p>ii. In each balance the mass of one rhombus is 12 grams. Find the mass of the pentagon.</p> 	

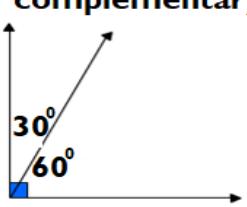
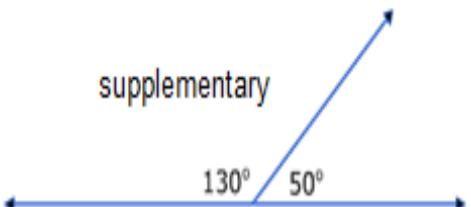
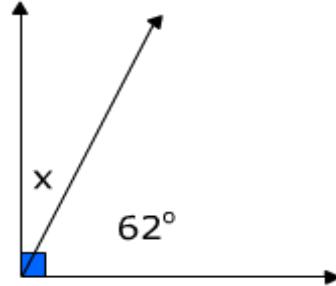
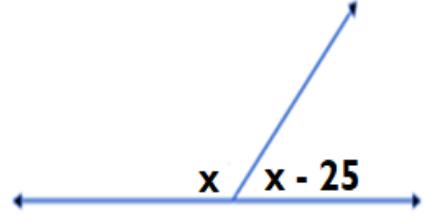
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<p><b>B7.2.3.1 Demonstrate an understanding of linear equations of the form <math>x + a = b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear equation and solving the problems concretely, pictorially, and symbolically.</b></p>	<p> <math>\bullet + \diamond \times \triangle</math>  <math>\bullet + \bullet + \bullet = 60</math>  <math>\bullet + \diamond + \diamond = 40</math>  <math>\diamond + \triangle + \triangle = 20</math> </p> <p>iii. Use the three equations below to find the value of</p> <p><b>B7.2.3.1.3 Model linear equations, then write mathematical expressions and describe the process of solving the equation using algebraic tiles.</b></p> <p><b>E.g.1</b></p> <table border="1"> <thead> <tr> <th>Model</th> <th>Algebraic</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td></td> <td><math>3x + 1 = -2</math></td> <td>3 times a number plus 1 equals -2.</td> </tr> <tr> <td></td> <td><math>3x + 1 = -2</math> <math>-1 = -1</math></td> <td>Subtract 1 from both sides.</td> </tr> <tr> <td></td> <td><math>3x = -3</math></td> <td>3 times a number equals -3.</td> </tr> <tr> <td></td> <td><math>\frac{3x}{3} = \frac{-3}{3}</math></td> <td>Divide both sides by 3.</td> </tr> <tr> <td></td> <td><math>x = -1</math></td> <td><math>x = -1</math></td> </tr> </tbody> </table>	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.		$x = -1$	$x = -1$	<p>Communication and Collaboration (<b>CC</b>)</p> <p>Critical Thinking and Problem solving (<b>CP</b>)</p>
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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.	<p><b>E.g.2</b></p> <p><math>3x - 2 = 4</math></p> <p>The tiles model the equation. A green tile represents <math>x</math>.</p> <p><math>3x - 2 + 2 = 4 + 2</math></p> <p>Add 2 to each side.</p> <p><math>3x = 6</math></p> <p>Simplify by removing zero pairs.</p> <p><math>\frac{3x}{3} = \frac{6}{3}</math></p> <p>Divide each side into three equal groups.</p> <p><math>x = 2</math></p> <p>Each green tile equals two yellow tiles, so <math>x = 2</math>.</p>	Communication and Collaboration (CC) Critical Thinking and Problem solving (CP)
<b>B7.2.3.1.4 Solve linear equations in one variable</b>		
	<p>E.g. 1 Using the idea of balance solve simple linear equations.</p> $3x + 5 = 20$ $3x + 5 - 5 = 20 - 5$ $3x = 15$ $x = 5$	<p>Solve the following simple linear equations</p> <ol style="list-style-type: none"> <li><math>4x + 1 = 3x + 7</math></li> <li><math>7w + 3 = 2w + 18</math></li> <li><math>5r - 3 = r - 1</math></li> <li><math>20 - 3k = k + 12</math></li> <li><math>6z + 4 = 28</math></li> </ol>

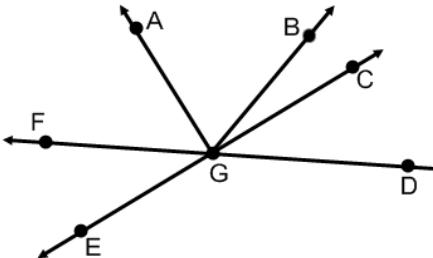
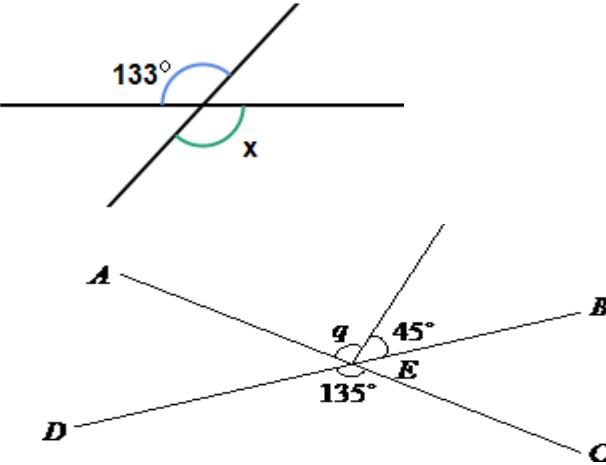
### STRAND 3: GEOMETRY AND MEASUREMENT

#### *Sub-strand 1: Shape and Space*

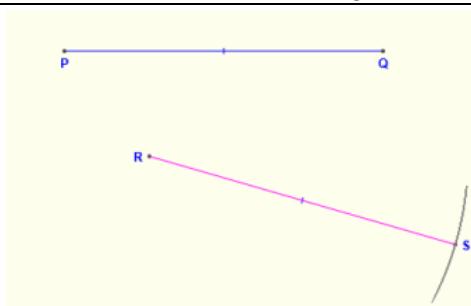
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.3.1.1 Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems.</b></p>	<p><b>B7.3.1.1.1 Measure and classify angles according to their measured sizes – right, acute, obtuse and reflex.</b></p> <p>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)</p>  <p>E.g. 2 Use a protractor to draw angles such as <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math>, <math>90^\circ</math>, <math>120^\circ</math>, <math>150^\circ</math>, <math>270^\circ</math>, <math>300^\circ</math>, etc.</p> 	<p>Creativity and Innovation (CI)</p>

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.	<p><b>B7.3.1.1.2</b> Apply the fact that (i) complementary angles are two angles that have a sum of <math>90^\circ</math>, and (ii) supplementary angles are two angles that have a sum of <math>180^\circ</math> to solve problems.</p> <p><b>complementary</b></p>  <p><b>supplementary</b></p>  <p>E.g.1 Determine the missing angle marked x.</p>  <p>E.g.2 Determine the missing angle marked x.</p> 	Creativity and Innovation (CI)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.1.1 Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems.</b>	<p><b>B7.3.1.1.3 Use adjacent, supplementary and vertically opposite angles to solve problems</b></p> <p>E.g. 1 Determine the angle(s) marked with letters in the adjacent and/or supplementary angles below.</p> <p>E.g.2 Identify each pair of angles as adjacent, vertically opposite, complementary or supplementary.</p>	Creativity and Innovation (CI)

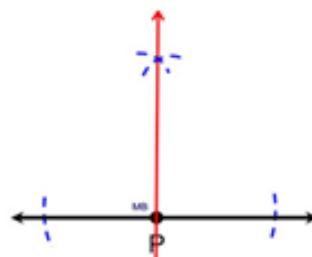
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.1.1 Demonstrate understanding of angles including adjacent, vertically opposite, complementary, supplementary and use them to solve problems.</b>	<p>E.g.3 Use the figure at the right to identify and label the following angles</p> <ol style="list-style-type: none"> <li>two acute vertical angles.</li> <li>two obtuse vertical angles.</li> <li>a pair of adjacent angles</li> <li>a pair of complementary angles.</li> <li>an angle supplementary to <math>\angle FGE</math></li> </ol> 	Creativity and Innovation (CI)
	<p>E.g. 4 Use adjacent, vertically opposite, complementary or supplementary to solve problems. Determine the angle(s) marked with letters.</p> 	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b></p>	<p><b>B7.3.1.2.1 Construct a line segment perpendicular to another line segment.</b></p> <p>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.</p>	<p>Critical Thinking and Problem solving (CP)</p>

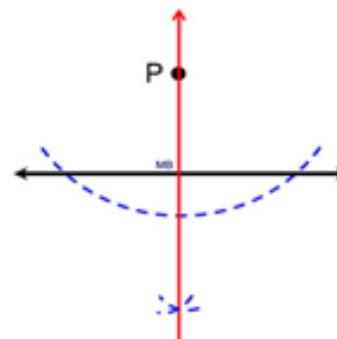


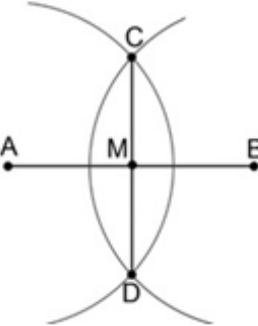
E.g.2: Use a pair of compasses and ruler to construct a perpendicular at a point on a line segment, and drop a perpendicular from a given point outside a line segment.

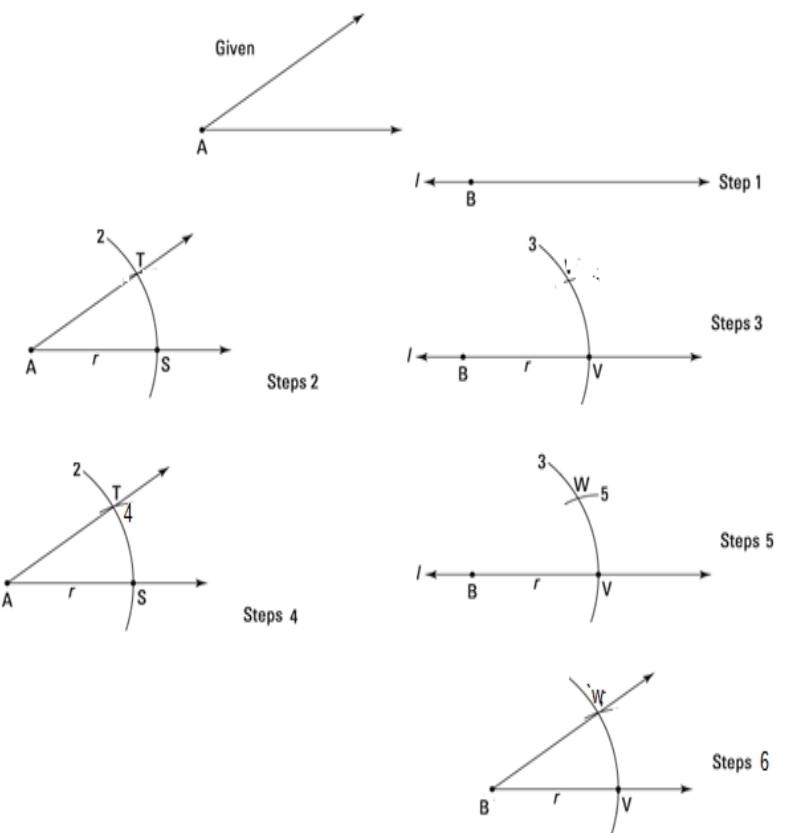
(i) A perpendicular at a point on a line segment:

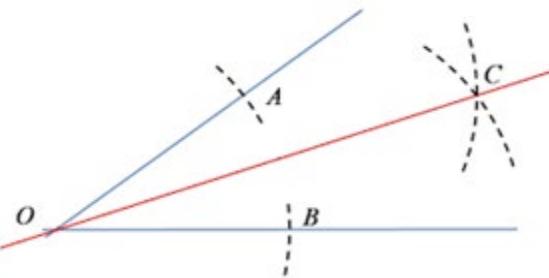
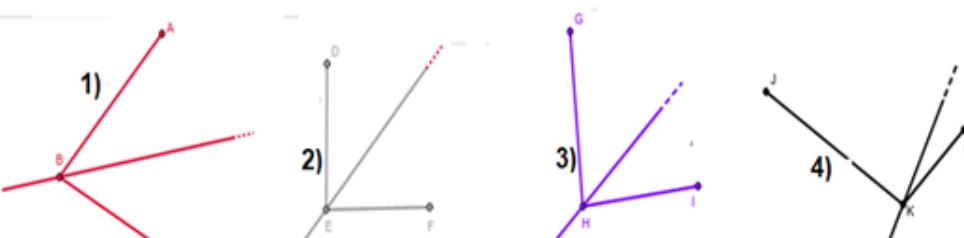


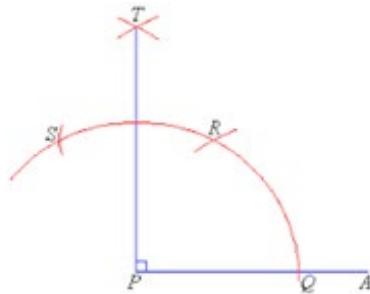
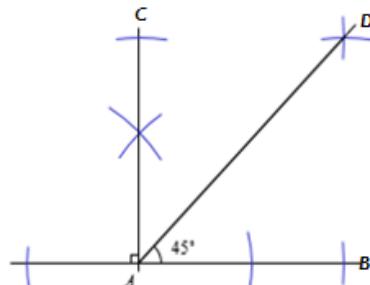
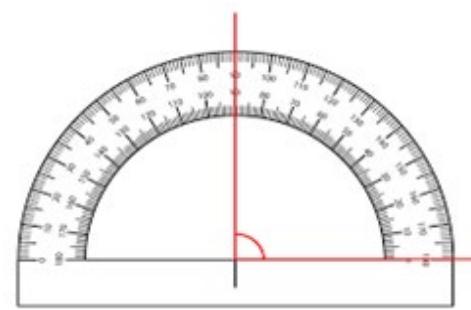
(ii) A perpendicular from a given point outside a line segment:

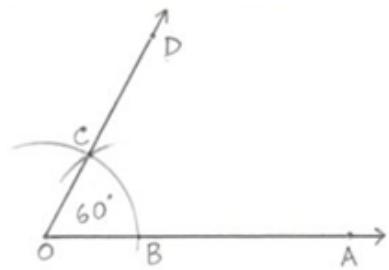
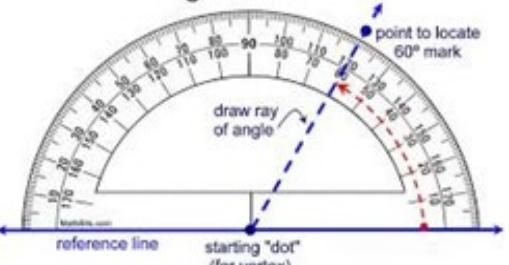
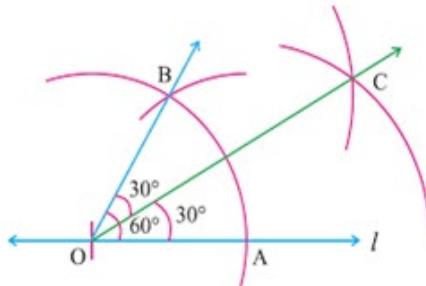
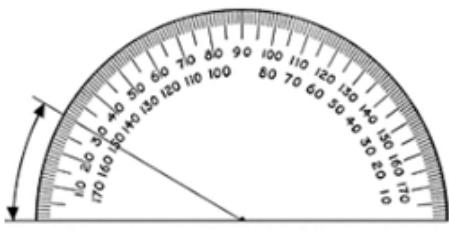


CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b>	<p><b>B7.3.1.2.2: Construct the perpendicular bisector of a line segment</b></p> <p>E.g.1: Use a pair of compasses and a ruler to construct a perpendicular bisector of a given line segment. (The line segment <math>CD</math> is a perpendicular bisector of <math>AB</math>)</p> <p>The point of intersection between <math>\overline{AB}</math> and <math>\overline{CD}</math>, M, is the midpoint of <math>\overline{AB}</math>.</p>  <p>E.g. 2: Draw and bisect the following lines</p> <p>(i) <math>\overrightarrow{AB} = 8\text{cm}</math></p> <p>(ii) <math>\overrightarrow{AB} = 5.5\text{cm}</math></p>	Critical Thinking and Problem solving ( <b>CP</b> )

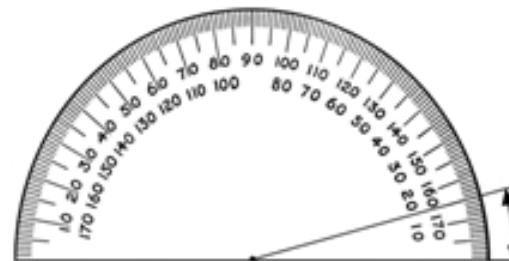
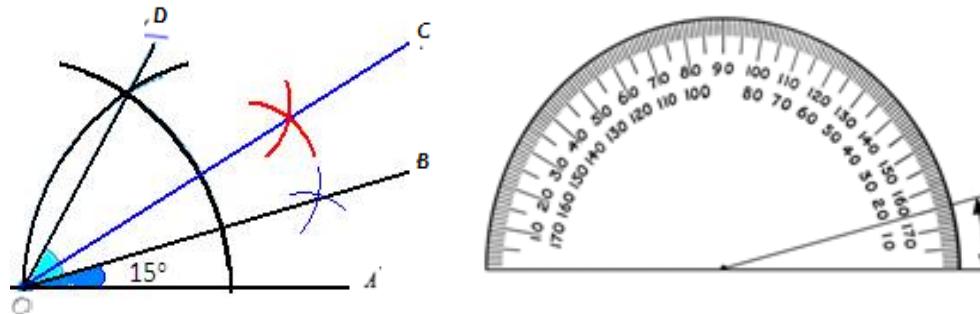
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<p><b>B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b></p>	<p><b>B7.3.1.2.3: Copy and bisect angles</b></p> <p>E.g.1: Use a pair of compasses and a ruler to copy a given angle <math>A</math>, (i.e. draw a line and locate point <math>B</math>; copy the arc <math>ST</math> and transfer using <math>B</math> as the centre to obtain <math>VW</math>; join <math>B</math> and <math>W</math> to obtain the copied angle.</p>  <p>The diagram shows the construction of a copy of angle <math>A</math> at point <math>B</math>. Step 1: A horizontal line <math>l</math> passes through <math>B</math>. Step 2: An arc with center <math>A</math> intersects ray <math>AT</math> at <math>S</math>. Step 3: An arc with center <math>B</math> and radius <math>BS</math> intersects ray <math>l</math> at <math>V</math>. Step 4: An arc with center <math>A</math> and radius <math>ST</math> intersects ray <math>AT</math> at <math>T</math>. Step 5: An arc with center <math>B</math> and radius <math>BT</math> intersects ray <math>l</math> at <math>W</math>. Step 6: Line segment <math>BW</math> is drawn, forming the copied angle <math>WBV</math>.</p>	<p>Critical Thinking and Problem solving (<b>CP</b>)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b>	<p>E.g.2 Perform geometric construction to bisect a given angle (<math>\angle BOA</math>) to obtain the two equal angles <math>\angle BOC</math> and <math>\angle COA</math>.</p>  <p>(i) Sketch any acute angle and label it <math>ABC</math>.  (ii) Copy the angle, measure and record its value.  (iii) Sketch any angle and ask a colleague to copy the angle.</p> <p>E.g. 3 Which of the angles has a correct angle bisector?</p> 	Critical Thinking and Problem solving (CP)
		Critical Thinking and Problem solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b></p>	<p><b>7.3.1.2.4: Construct angles of <math>90^\circ</math> and <math>45^\circ</math></b></p> <p>E.g.1: Use a pair of compasses and a ruler to construct an angle of <math>90^\circ</math> (raise a perpendicular at a point) on a given line segment and verify using the protractor. (The line segment <math>PT</math> is perpendicular to <math>PA</math> therefore <math>\angle APT = 90^\circ</math>)</p>   	<p>Critical Thinking and Problem solving (<b>CP</b>)</p>
	<p>E.g.2: Construct an angle of <math>45^\circ</math> by bisecting an angle of <math>90^\circ</math> (i.e. bisect <math>\angle BAC = 90^\circ</math> to obtain <math>\angle BAD = 45^\circ</math>: line <math> AD </math> is the angle bisector of the right angle).</p> <p>(i) Construct <math>\angle ABC = 45^\circ</math> such that <math> AB  = 5\text{cm}</math> and <math> BC  = 6\text{cm}</math>: bisect <math>\angle ABC = 45^\circ</math></p> <p>(ii) Construct <math>\angle ABC = 90^\circ</math> and bisect it.</p>	

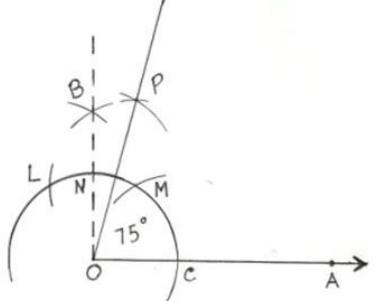
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<b>B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b>	<p><b>7.3.1.2.5: Construct angles of <math>60^\circ</math> and <math>30^\circ</math></b></p> <p>E.g.1: Use a pair of compasses and a ruler to:</p> <p>a) Construct an angle of <math>60^\circ</math> at a point on a given line segment (<math>\angle AOD = 60^\circ</math>) and verify with the protractor:</p>  <p>Draw a <math>60^\circ</math> angle.</p> 	Critical Thinking and Problem solving (CP)
	<p>E.g.2 Construct an angle of <math>30^\circ</math> by bisecting an angle whose measure is <math>60^\circ</math>(i.e. bisect <math>\angle AOB = 60^\circ</math> to obtain <math>\angle AOC = \angle COB = 30^\circ</math>: line <math> OC </math> is the angle bisector)</p>  	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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°</b></p>	<p><b>7.3.1.2.6: Construct angles whose measures are 15° and 75°.</b></p> <p>E.g.1: Construct an angle of 15° by bisecting an angle of 30° (i.e. bisect <math>\angle AOD = 60^\circ</math> to obtain <math>\angle AOC = 30^\circ</math> and then bisect <math>\angle AOC = 30^\circ</math> to obtain <math>\angle AOB = 15^\circ</math>)</p>	<p>Critical Thinking and Problem solving (<b>CP</b>)</p> <p>Communication and Collaboration (<b>CC</b>)</p>



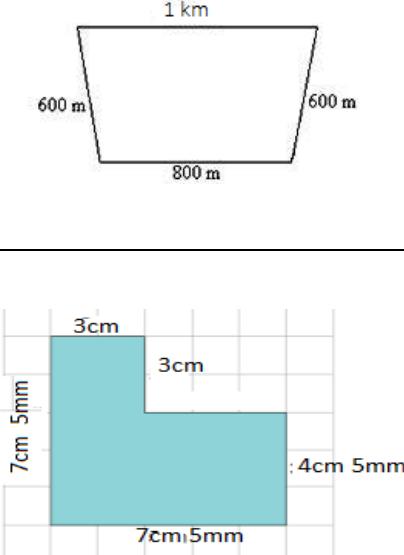
E.g..2 Construct the following:

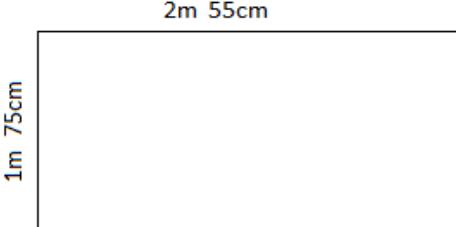
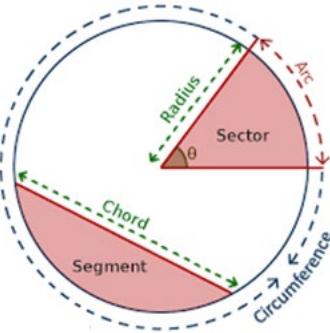
- (i)  $\angle PQR = 7\frac{1}{2}^\circ$
- (ii)  $\angle ABC = 60^\circ$
- (iii)  $\angle KLM = 30^\circ$
- (iv)  $\angle RST = 15^\circ$

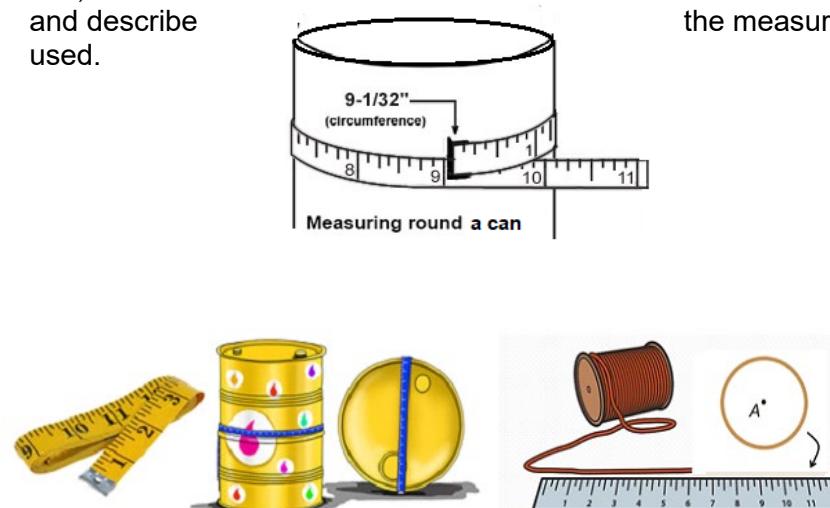
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.3.1.2 Demonstrate how to construct a perpendicular to a line from a given point, bisect a line, bisect angles, and construct angles of the following sizes: <math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>75^\circ</math> and <math>90^\circ</math></b></p>	<p>E.g.3: Use a pair of compasses and a ruler to construct an angle of <math>75^\circ</math> at a point on a given line segment [i.e. construct a right angle <math>\angle AOB = 90^\circ</math>); bisect the arc <math>MN</math> and join <math>O</math> through <math>P</math> to obtain <math>\angle AOP 75^\circ</math>]</p>  <p>E.g.4: Construct and bisect <math>\angle PQR = 75^\circ</math></p> <p><b>B7.3.1.2.7: Describe examples of perpendicular line segments, perpendicular bisectors and angle bisectors in the environment.</b></p> <p>E.g.1: Identify angle bisectors and perpendicular bisectors in structures and artefacts such as buildings, water tanks, boxes, etc. in the environment</p> <p>E.g.2 Estimate the measure of the size of angles in artefacts, tools, and structures.</p>	<p>Communication and Collaboration (CC)</p>

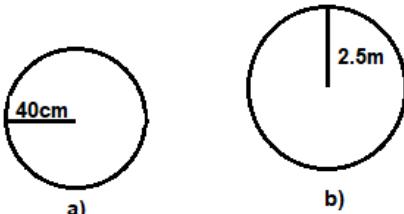
## STRAND 3: GEOMETRY AND MEASUREMENT

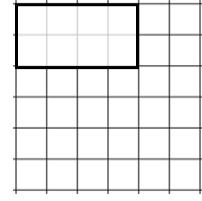
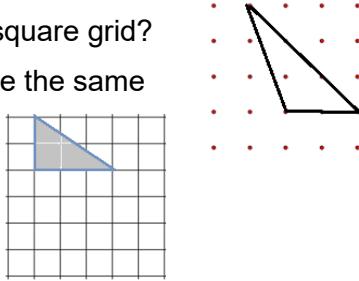
### *Sub-strand 2: Measurement*

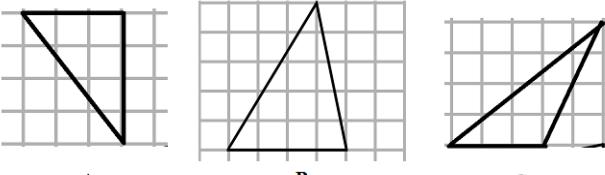
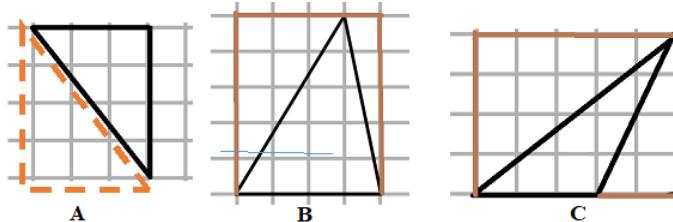
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (<math>\pi</math>) to find the circumference of a circle.</b>	<p><b>B.7.3.2.1.1 Calculate the perimeter of given shapes whose dimensions are in two units (i.e. cm and mm, m and cm, or km and m)</b></p> <p>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.</p>	Communication and Collaboration (CC) Critical Thinking and Problem solving (CP)
	<p>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).</p> 	

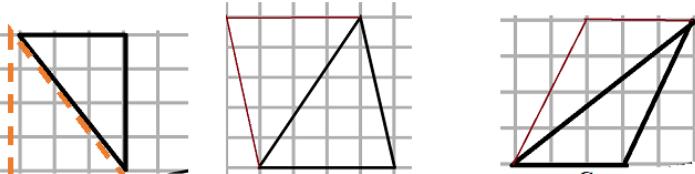
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (<math>\pi</math>) to find the circumference of a circle.</b>	<p>E.g. 3 Calculate the perimeter of a shape with dimensions given in m and cm by converting to decimal fractions in the larger unit (i.e. 1m 75cm = 1.75m).</p>  <p style="text-align: center;">2m 55cm 1m 75cm</p>	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>
	<p><b>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.</b></p> <p>E.g.1: Identify the name the parts of a circle – radius, diameter, circumference, arc, sector, etc.</p>	

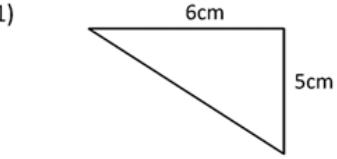
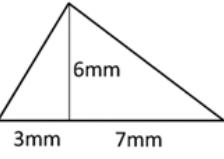
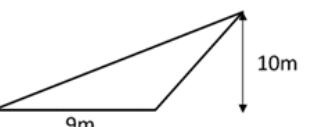
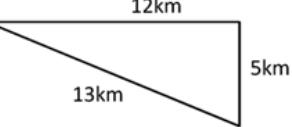
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (<math>\pi</math>) to find the circumference of a circle.</b></p>	<p>E.g.2: Measure the radius, diameter and circumference of circular objects like base or cross section of cylindrical objects like cans, tyres, bowls, roundabouts, etc. and describe the measuring tools used.</p> 	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																												
B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi ( $\pi$ ) to find the circumference of a circle.	<p>E.g.3: Explain the relationship between the diameter and circumference of a circle by:</p> <ul style="list-style-type: none"> <li>i. Recording the measured diameter and circumference of various circles;</li> <li>ii. Completing the table for the measured values; and</li> <li>iii. Observing the results of <math>c \div d</math>.</li> </ul> <table border="1"> <thead> <tr> <th>Circle</th><th>Circumference(c)</th><th>Diameter(d)</th><th><math>c \div d</math></th></tr> </thead> <tbody> <tr> <td>Tin A</td><td>13</td><td>4</td><td><math>13 \div 4 =</math></td></tr> <tr> <td>Tin B</td><td>38</td><td>12</td><td><math>38 \div 12 =</math></td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table> <p>iv. Conclude that the result of <math>c \div d</math> or the ratio of the circumference of a circle to its diameter is named <math>\pi</math> (and pronounced pi). The ratio itself is approximately <math>\frac{22}{7}</math> or 3.141592+. [Read more on the internet about the pi – who discovered it, and its value].</p>	Circle	Circumference(c)	Diameter(d)	$c \div d$	Tin A	13	4	$13 \div 4 =$	Tin B	38	12	$38 \div 12 =$																	Creativity and Innovation (CI)  Critical Thinking and Problem solving (CP)
Circle	Circumference(c)	Diameter(d)	$c \div d$																											
Tin A	13	4	$13 \div 4 =$																											
Tin B	38	12	$38 \div 12 =$																											
	<p>E.g.4: Use the relationship between the diameter and circumference of a circle (i.e. <math>\pi = \frac{c}{d} = \frac{c}{2r}</math>) to solve problems.</p> <ul style="list-style-type: none"> <li>i. The radius of a circle is 140 cm. What is the (a) diameter (b) circumference? [Take <math>\pi = \frac{22}{7}</math>]</li> <li>ii. Find the circumference of the circles below whose radii are given and round your answer to the nearest tenth [take <math>\pi = 3.142</math>]:</li> </ul> 																													

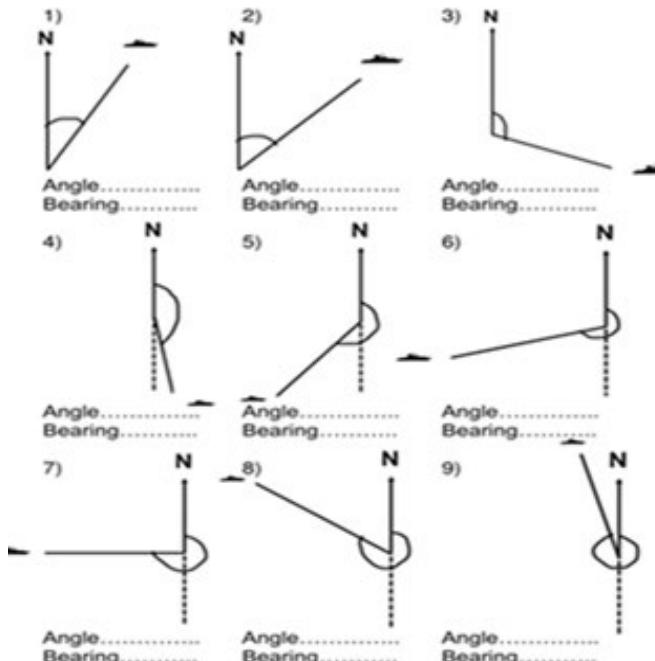
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B.7.3.2.1 Demonstrate the ability to find the perimeter of plane shapes including circles using the concept of pi (<math>\pi</math>) to find the circumference of a circle.</b></p>	<p><b>B7.3.2.1.3 Draw in a square grid rectangles and triangles with given dimensions.</b></p> <p>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.</p>	 <p>Creativity and Innovation (CI)  Critical Thinking and Problem solving (CP)  Communication and Collaboration (CC)</p>
	<p>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?</p>	

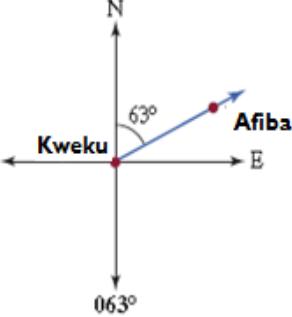
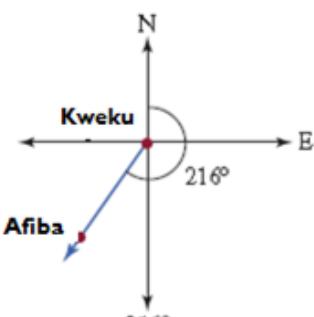
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B.7.3.2.2 Derive the formula for determining the area of a triangle and use it to solve problems</b></p>	<p><b>B7.3.2.2.1 Use the relationships between a triangle and a rectangle (or parallelogram) to deduce the formula for determining the area of a triangle.</b></p> <p>E.g.1: Determine the number of unit squares enclosed by the triangles below.</p> <ul style="list-style-type: none"> <li>i. What is the perpendicular height of each triangle?</li> <li>ii. What is the area of each of the triangles?</li> <li>iii. How does the perpendicular heights of each triangle help you in calculating its area?</li> </ul>  <p>A                    B                    C</p>	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>
	<p>E.g.2: Spot the <i>RECTANGLE</i> enclosing the triangles to find the unit squares in each triangle. Notice the base and height of the triangle.</p>  <p>Area of a triangle = <math>\frac{1}{2}</math> (Area of the rectangle = <math>\frac{1}{2}</math> base <math>\times</math> perpendicular height)</p>	

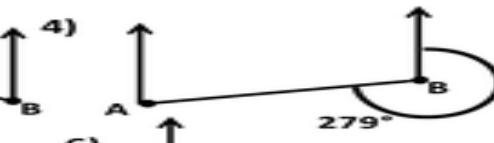
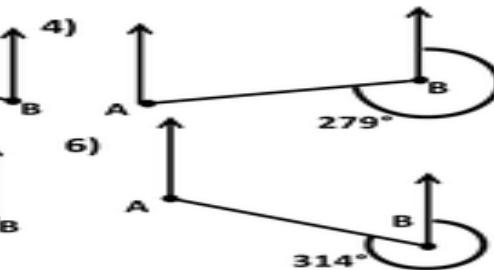
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B.7.3.2.2 Derive the formula for determining the area of a triangle and use it to solve problems</b>	<p>E.g.3: Spot the Parallelogram from which the triangle was formed.</p>  <p>Area of the triangle = <math>\frac{1}{2}</math>(Area of the parallelogram)= <math>\frac{1}{2}</math> (base of parallelogram) <math>\times</math> height = <math>\frac{1}{2}b \times h</math></p>	<p>Creativity and Innovation (CI)</p> <p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B.7.3.2.2 Derive the formula for determining the area of a triangle and use it to solve problems.</b>	<p><b>B7.3.2.2.2 Determine the area of a triangle.</b></p> <p>E.g. 1. Calculate the area of the triangles:</p> <p>1) </p> <p>2) </p>	Communication and Collaboration ( <b>CC</b> )
	<p>3) </p> <p>4) </p>	Critical Thinking and Problem solving ( <b>CP</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases.</b>	<p><b>B7.3.2.3.1 Describe the bearing of a point from another point</b></p> <p>E.g.1 use protractor to find the marked angles. For each diagram write the three-digit bearing.</p>	Critical Thinking and Problem solving ( <b>CP</b> )



CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases.</b>	<p>E.g.2 Recognise true bearings as the angle measured in the clockwise direction from the North.</p> <p>E.g.3 Express the following vectors graphically (i) <math>\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}</math> (ii) <math>\overrightarrow{BC} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}</math> and measure each angle.</p> <p>E.g.4 Draw the following vectors (i) <math>\overrightarrow{AB} = (3\text{km}, 060)</math> (ii) <math>\overrightarrow{QR} = (5\text{km}, 120)</math> and measure each angle.</p>	Critical Thinking and Problem solving (CP)
	<p>The bearing of Afiba from Kweku is <math>060^\circ</math></p>  <p>The bearing of Kweku from Yaw is <math>216^\circ</math></p> 	

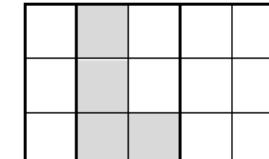
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases.</b></p>	<p><b>B7.3.2.3.2 Explain how to find the back bearing when the direction of travel has a bearing which is less than <math>180^\circ</math> and/ or greater than <math>180^\circ</math>.</b></p> <p>E.g.1</p> <p>A. For each question below find:</p> <ul style="list-style-type: none"> <li>i. The bearing of B from A</li> <li>ii. The bearing of A from B</li> </ul> <p>1) </p> <p>2) </p> <p>3) </p> <p>4) </p> <p>5) </p> <p>6) </p>	<p>Critical Thinking and Problem solving (CP)</p>

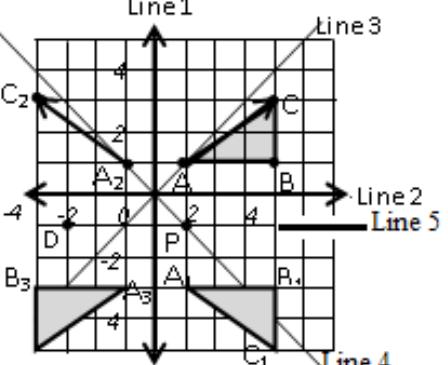
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	E.g.2 The bearing of P from Q is $060^\circ$ .What is the bearing of Q from P E.g.3 The bearing of P from Q is $145^\circ$ .What is the bearing of Q from P	
<b>B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases.</b>	<b>B7.3.2.3.3 Distinguish between scalar and vector quantities</b> 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... E.g.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. $\vec{TS} = .(6\text{km}, 245^\circ)$ . 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.	Critical Thinking and Problem solving ( <b>CP</b> )  Communication and Collaboration ( <b>CC</b> )
	<b>B7.3.2.3.4 Represent vector in the column (component) form <math>\begin{pmatrix} x \\ y \end{pmatrix}</math> and determine its magnitude and direction.</b>	Critical Thinking and Problem solving ( <b>CP</b> )  Communication and Collaboration ( <b>CC</b> )
	E.g.1 Write each of the following as column vectors using graph. (i) $\vec{AB} = (5\text{km}, 030^\circ)$ , $\vec{CD} = (25\text{km}, 150^\circ)$ E.g.2 Use any other method apart from graph to write the following as column vectors (i) $\vec{XY} = (10\text{km}, 270^\circ)$ (ii) $\vec{ST} = (70\text{km}, 090^\circ)$ and find its magnitude and direction.	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B7.3.2.3 Demonstrate understanding of bearings, vector and its components using real life cases.</b>	<b>B7.3.2.3.5 Convert vectors in the column (component) form <math>\begin{pmatrix} x \\ y \end{pmatrix}</math> to the Magnitude–Bearing form <math>(k, \theta)</math> and vice versa</b>	Critical Thinking and Problem solving (CP) Communication and Collaboration (CC)
	<p>E.g.1 Use the Pythagorean theorem to find the length or the magnitude of a vector.</p> $ \overrightarrow{AB}  = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ <p>Eg.2 Find the magnitude and the direction of the following vectors      (i) <math>\overrightarrow{AB} = \begin{pmatrix} 12 \\ 15 \end{pmatrix}</math>      (ii) <math>\overrightarrow{PQ} = \begin{pmatrix} 15 \\ 9 \end{pmatrix}</math></p>	

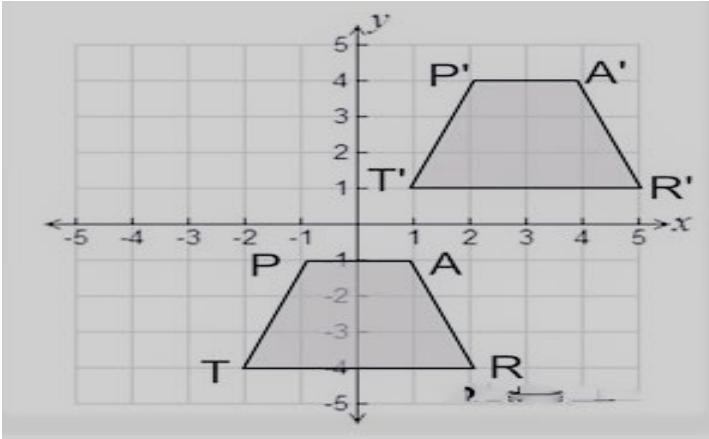
## STRAND 3: GEOMETRY AND MEASUREMENT

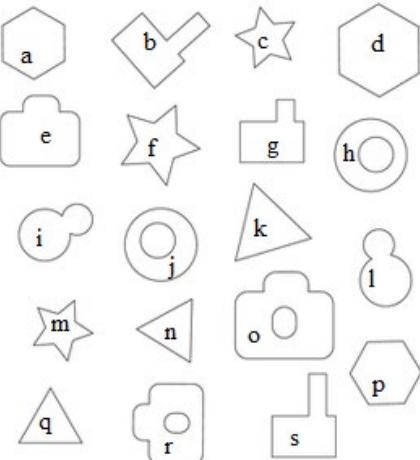
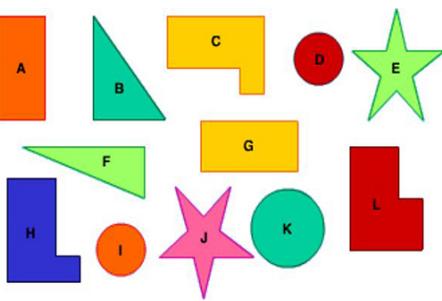
### *Sub-strand 3: Position and Transformation*

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.)	<p><b>B7.3.3.1.1 Determine shapes in real life that have reflectional (or fold) symmetries.</b></p> <p>E.g. 1: Identify examples of designs (or objects) in everyday life that have reflectional (or fold) symmetries (e.g. adinkra symbols).</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>Nyame Biribi</p> </div> <div style="text-align: center;">  <p>Sesa Wo Suban</p> </div> <div style="text-align: center;">  <p>Sankofa</p> </div> <div style="text-align: center;">  <p>Pempamsie</p> </div> <div style="text-align: center;">  <p>Tamfo Bebre</p> </div> <div style="text-align: center;">  <p>Woforo Dua Pa A</p> </div> <div style="text-align: center;">  <p>Wo Nsa Da Mu A</p> </div> <div style="text-align: center;">  <p>Wawa Aba</p> </div> <div style="text-align: center;">  <p>Mmere Dane</p> </div> </div> <p>E.g. 2: In how many different ways can one more square be shaded in this shape so that it can have a line of symmetry?</p> <div style="text-align: center;">  </div>	Critical Thinking and Problem solving ( <b>CP</b> )  Creativity and Innovation ( <b>CI</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.)</b></p>	<p><b>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</b></p> <p>E.g. 1: Plot points and shapes (i.e. plane figures) with given coordinates in the number plane.</p> <p>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).</p>	<p>Creativity and Innovation (CI)</p> <p>Digital Literacy (DL)</p>
	<p>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.</p> <p>Draw and label the axes of the coordinate plane and label the lines such as Line 1 is <math>y</math>-axis or <math>x=0</math>; Line 2 is <math>x</math>-axis or <math>y=0</math>; Line 3 is <math>y=x</math>; Line 5 is <math>y = -1</math>, etc.</p> 	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.)</b>	<p>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) <math>y=x</math></p> <ul style="list-style-type: none"> <li>i. (a) Draw point <math>A_2 (-1, 1)</math> as the image of point <math>A (1, 1)</math> under a reflection in the y axis (or line <math>x=0</math>)           <ul style="list-style-type: none"> <li>(b) Draw point <math>P (1, -1)</math> as the image of point <math>A (1, 1)</math> under a reflection in the x axis (or line <math>y=0</math>) and</li> <li>(c) Draw point <math>A_2 (-1, 1)</math> as the image of point <math>P (1, -1)</math> under a reflection in the line <math>y=x</math>.</li> </ul> </li> <li>ii. Draw triangle <math>A'B'C'</math> as the image of triangle <math>ABC</math> under the reflection <math>x=0, y=0, y=x</math> and any other line.</li> </ul> <p>Compare the images</p>	Digital Literacy ( <b>DL</b> )
	<p>E.g. 4: Derive the coordinate rules</p> <ul style="list-style-type: none"> <li>i. If <math>(a, b)</math> is reflected on the x-axis, its image is the point <math>(a, -b)</math></li> <li>ii. If <math>(a, b)</math> is reflected on the y-axis, its image is the point <math>(-a, b)</math></li> <li>iii. If <math>(a, b)</math> is reflected on the line <math>y = x</math>, its image is the point <math>(b, a)</math></li> <li>iv. If <math>(a, b)</math> is reflected on the line <math>y = -x</math>, its image is the point <math>(-b, -a)</math></li> </ul> <p><b>NB:</b> Reflection can occur over a line and/ or in a point.</p>	Digital Literacy ( <b>DL</b> )

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.)</b></p>	<p><b>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.</b></p> <p>E.g. 1: As people go down a slide, they undergo a translation.  </p> <p>E.g. 2: Plot point(s) and shapes (i.e. plane figures) in a coordinate plane using a translating vector and describe the changes in the vertices as well as the direction of the movement.</p>  <ul style="list-style-type: none"> <li>ii. Draw a shape and its image under a translation by a given vector.</li> <li>iii. Describe a single movement or transformation that takes the shape PART to the image P'A'R'T'</li> </ul>	Digital Literacy (DL) Creativity and Innovation (CI)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.)</b></p>	<p><b>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)</b></p> <p>E.g. 1: Verify which shapes are similar and which are congruent.</p> <p>E.g. 2. Which of the following shapes are congruent?</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>a b c d e f g h i j k l m n o p</p> </div> <div style="text-align: center;">  <p>A B C D E F G H I J K L</p> </div> </div>	<p>Creativity and Innovation (CI)</p>

## STRAND 4: HANDLING DATA

### *Sub-strand 1: Data*

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p><b>B7.4.1.1.1- Select and justify a method to collect data (quantitative and qualitative) to answer a given question.</b></p> <p>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’:</p> <ul style="list-style-type: none"> <li>(a) The type of drinks to buy for a class party.</li> <li>(b) The make of football boots to buy for the school team.</li> <li>(c) Do people who eat more fufu develop pot belly?</li> <li>(d) The number of desks in each classroom.</li> <li>(e) The amount of money B6 students spend on bus fare to school every month.</li> <li>(g) Buy a mobile phone from an online shop.</li> </ul> <p>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)</p> <ul style="list-style-type: none"> <li>▪ questionnaires,</li> <li>▪ interview,</li> <li>▪ observation,</li> <li>▪ experiments,</li> <li>▪ survey</li> <li>▪ databases,</li> <li>▪ electronic media or internet</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Digital Literacy (DL)</b></p>

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.	<p><b>B7.4.1.1.2- Design and administer a questionnaire for collecting data to answer questions and record the results.</b></p> <p>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.</p> <p style="text-align: center;"><b>Class Survey Question Form</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">1)</td> <td>Hello, What's your name? _____</td> </tr> <tr> <td>2)</td> <td>How old are you? _____</td> </tr> <tr> <td>3)</td> <td>What's your favourite school subject? _____</td> </tr> <tr> <td>4)</td> <td>What's your worst subject? _____</td> </tr> <tr> <td>5)</td> <td>What's the most important school subject? _____</td> </tr> <tr> <td>6)</td> <td>What is your favourite hobby _____</td> </tr> <tr> <td>7)</td> <td>What's your favourite day of the week? _____</td> </tr> <tr> <td>8)</td> <td>How much do you spend on bus fare to school every day? _____</td> </tr> </table> <p>E.g. 2. Use a table (like the one below) to organise the data obtained with the question form (or questionnaire).</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Name</th> <th>Age</th> <th>Favourite subject</th> <th>Worst subject</th> <th>Important subject</th> <th>Favourite hobby</th> <th>Favourite weekday</th> <th>Daily bus fare (cedes)</th> </tr> </thead> <tbody> <tr> <td> </td> </tr> <tr> <td> </td> </tr> <tr> <td> </td> </tr> <tr> <td> </td> </tr> </tbody> </table>	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? _____	Name	Age	Favourite subject	Worst subject	Important subject	Favourite hobby	Favourite weekday	Daily bus fare (cedes)																																	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>
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B7.4.1.2 Determine the measures of central tendency (mean, median, mode) for a given ungrouped data and use it to solve problems	<p><b>B7.4.1.2.1 Calculate the mean for a given ungrouped data and use it to solve problems</b></p> <p>E.g. 1 Find the <b>mean</b> for a data set by dividing the sum of all the items in the data set by the number of items.</p> <ul style="list-style-type: none"> <li>i. The mean for the data set {8, 9, 7, 6, 8, 10} is <math>\frac{8+9+7+6+8+10}{6} = 8</math></li> <li>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.</li> </ul> <table border="1" style="margin-left: auto; margin-right: auto;"> <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> <p>E.g. Find the <b>mean</b> for a data set (in a frequency table) by dividing the sum of all the items in the data set by the number of items.</p> <ul style="list-style-type: none"> <li>i. Find the mean for the marks obtained out of a total of 5 in a mathematics class test presented in the frequency table:</li> </ul> <table border="1" style="margin-left: auto; margin-right: auto;"> <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> <ul style="list-style-type: none"> <li>ii. Find the mean of the ages of children at a party presented in the frequency table:</li> </ul> <table border="1" style="margin-left: auto; margin-right: auto;"> <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>	3	4	2	4	3	2	2	5	4	3	4	1	2	6	3	5	5	2	4	1	Score	1	2	3	4	5	Frequency	2	6	4	5	3	Ages (x):	1	3	5	6	7	8	9	10	Frequency (f):	2	5	6	10	8	5	3	1	Critical Thinking and Problem solving (CP)
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CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>E.g. 3 Solve problems involving calculating the mean or average.</p> <ul style="list-style-type: none"> <li>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?</li> <li>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. <i>Set up the problem like this:</i> <math>(75 + 87 + 90 + 88 + 79 + \square) \div 6 = 85</math></li> </ul>	Critical Thinking and Problem solving (CP)
<b>B7.4.1.2 Determine the measures of central tendency (mean, median, mode) for a given ungrouped data and use it to solve problems</b>	<p><b>B7.4.1.2.2 Calculate the median for a given ungrouped data and use it to solve problems</b></p> <p>E.g. 1 Find the <b>median</b> for a data set by arranging the items in the set in an array and identifying the middle item.</p> <ul style="list-style-type: none"> <li>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)</li> <li>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</li> </ul>	Critical Thinking and Problem solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																												
B7.4.1.2 Determine the measures of central tendency (mean, median, mode) for a given ungrouped data and use it to solve problems	<p>E.g. 2 Find the <b>median</b> for a data set (in a frequency table).</p> <p>iii. Find the median mark obtained in a mathematics class test presented in the frequency table:</p> <table border="1"> <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> <p><i>NB. Since there are 20 values, the 10<sup>th</sup> and 11<sup>th</sup> scores are the middle numbers and they are both 3, so the median value is 3.</i></p> <p>iv. Find the median ages of children at a party presented in the frequency table:</p> <table border="1"> <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> </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> </tr> </table> <p><i>NB. Since there are 39 values, the 20<sup>th</sup> age is 6, so the median value is 6.</i></p>	Score	1	2	3	4	5	Frequency	2	6	4	5	3	Ages (x):	1	3	5	6	7	8	9	Frequency (f):	2	5	6	10	8	5	3	Critical Thinking and Problem solving ( <b>CP</b> )
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## STRAND: HANDLING DATA

### *Sub-strand 2: Chance or Probability*

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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</b></p>	<p><b>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.</b></p> <p>E.g. 1. Describe each outcome using words like: <i>impossible</i>, <i>possible</i>, or <i>certain</i>.</p> <ul style="list-style-type: none"> <li>i. The dog will fly tomorrow (impossible).</li> <li>ii. Someone in the class would be a teacher in the future (possible).</li> <li>iii. Ghana will still be an African country tomorrow (certain).</li> </ul> <p>E.g. 2. Ask learners to work in groups to discuss the outcome of the following events using words like: <i>impossible</i>, <i>possible</i>, or <i>certain</i></p> <ul style="list-style-type: none"> <li>A. A coin lands heads side up.</li> <li>B. The day after Monday will be Tuesday.</li> <li>C. A new-born baby will be a girl.</li> <li>D. It will rain in Winneba in the first week of January.</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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</b></p>	<p><b>B7.4.2.1.2 Classify the likelihood of a single outcome occurring in a probability experiment as impossible, possible, or certain</b></p>  <p>E.g. 1 Discuss the following outcomes of throwing a die using words like <i>impossible, possible, or certain.</i></p> <ul style="list-style-type: none"> <li>A. Obtaining the number 1</li> <li>B. Obtaining the number 7</li> <li>C. Obtaining the number 4</li> </ul> <p>E.g. 2 Discuss the following outcomes of throwing two dice using words like <i>impossible, possible, or certain.</i></p> <ul style="list-style-type: none"> <li>A. Obtaining a total of 12</li> <li>B. Obtaining a total of 2</li> <li>C. Obtaining a total of 13</li> </ul> 	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p>

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	<p><b>B7.4.2.1.3</b> Calculate the probability of the event and express the probability as fractions, decimals, percentages and/or ratios.</p> <p>E.g. 1 Calculate the probabilities and complete the table.</p> <table border="1"> <thead> <tr> <th>Name:</th> <th>Score:</th> </tr> </thead> <tbody> <tr> <td align="center" colspan="2">Probability with a single die </td> </tr> <tr> <th>The probability of rolling:</th> <th>Fractions</th> <th>Decimals</th> <th>Percentages</th> <th>Ratios</th> </tr> <tr> <td>1. factors of 60</td> <td>1</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2. a multiple of 3</td> <td><math>\frac{1}{3}</math></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3. factors of 2</td> <td><math>\frac{1}{3}</math></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4. divisors of 12</td> <td>—</td> <td>0.83</td> <td></td> <td></td> </tr> <tr> <td>5. a 3 or greater</td> <td><math>\frac{2}{3}</math></td> <td></td> <td></td> <td></td> </tr> <tr> <td>6. factors of 8</td> <td>—</td> <td></td> <td></td> <td>1:2</td> </tr> <tr> <td>7. factors of 6</td> <td><math>\frac{2}{3}</math></td> <td></td> <td></td> <td></td> </tr> <tr> <td>8. divisors of 30</td> <td><math>\frac{5}{6}</math></td> <td></td> <td></td> <td></td> </tr> <tr> <td>9. a 3 or smaller.</td> <td>—</td> <td></td> <td>50</td> <td></td> </tr> </tbody> </table>	Name:	Score:	Probability with a single die 		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	—	0.83			5. a 3 or greater	$\frac{2}{3}$				6. factors of 8	—			1:2	7. factors of 6	$\frac{2}{3}$				8. divisors of 30	$\frac{5}{6}$				9. a 3 or smaller.	—		50		Critical Thinking and Problem solving (CP)
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# **BASIC 8**

## STRAND 1: NUMBER

### *Sub-strand 1: Number and Numeration Systems*

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B8.1.1.1.1 Apply the understanding of place value to read and write in number quantities over 1,000,000,000.</b></p> <p>E.g.1. Read and write numbers in words and vice versa.</p> <ul style="list-style-type: none"> <li>(i) 2408321: Two million, four hundred and eight thousand, three hundred and twenty-one.</li> <li>(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.</li> </ul> <p><b>B8.1.1.1.2. Skip count forwards and backwards in 10,000s, 100,000s, 500,000s, etc.</b></p> <p>E.g.1 Count forward in 500000s up to the fifth number.</p> <ul style="list-style-type: none"> <li>(i) 200,000, 700,000, ...</li> </ul> <p>E.g. 2. Count backwards in 100,500s up to the fifth number.</p> <ul style="list-style-type: none"> <li>(I) 1,800,000, 1699500, 1599000, ...</li> </ul> <p><b>B8.1.1.1.3. Compare and order whole numbers using “&gt;, &lt;, and =”</b></p> <p>E.g. 1 Identify numbers which are 100,000, 1500,000, etc. more or less than given 8 to 9-digit number.</p>	Communication and Collaboration (CC)
		Critical Thinking and Problem solving (CP)

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B8.1.1.4 Express integers of any size into standard form</b></p> <p>E.g.1 Write integers as a power of 10:            (i) <math>1 = 10^0</math>  <math>10 = 10^1</math>  <math>100 = 10^2</math>  <math>1000 = 10^3</math></p>	<b>Critical Thinking and Problem solving (CP)</b>
	<p>E.g. 2. Write multiples of 10 in standard form:            (I) <math>10 = 1 \times 10</math>  <math>100 = 1 \times 10^2</math>  <math>1000 = 1 \times 10^3</math> etc.</p> <p>E.g.3. Write integers in standard form:            (i) <math>26 = 2.6 \times 10</math>            (ii) <math>375 = 3.75 \times 10^2</math>            (iii) <math>8,765,049 = 8.765049 \times 10^6</math></p>	
	<p><b>B8.1.1.5 Express integers in a given number of significant and decimal places</b></p> <p>E.g.1. Express any given integer to a given number of significant figures.            (i) Express 56734 correct to two significant figures as 57000.</p> <p>E.g. 2. Express 975.8674, correct to            (i) two decimal places;            (ii) three decimal places.</p>	<b>Critical Thinking and Problem solving (CP)</b>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p><b>B8.1.1.6 Create and solve word or real-life problems on place values</b></p> <p>E.g. 1 Solve word or story problems.</p> <p>(i) Adom earns Gh₵2500 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?</p>	<b>Creativity and Innovation (CI)</b>
<b>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</b>	<p><b>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</b></p> <p><b>E.g. 1.</b> Identify perfect squares or perfect numbers.</p> <p>(i) List sets of multiples of numbers and identify a set of perfect numbers among them</p> <p>5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, ...</p> <p>2, 4, 6, 9, 12, 16, 18, ...</p> <p>4, 8, 12, 16, 20, 24, ...</p> <p>Perfect squares</p> <p>4, 9, 16, 25, 36, .....</p> <p><b>E.g. 2.</b> Use the knowledge on odd numbers to determine the square root of perfect numbers.</p> <p>(i) Determine the square root of 49.</p> <p>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.</p>	<b>Critical Thinking and Problem solving (CP)</b>

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>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</b></p> <p><b>E.g. 1.</b> 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.</p>	<b>Critical Thinking and Problem solving (CP)</b>
	<p><b>E.g. 2.</b> Solve story and real-life problems involving union and intersection of sets</p> <p>(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 <math>x</math> of them grows both crops, write an equation in <math>x</math> and solve for it.</p>	

## STRAND 1: NUMBER

### *Sub-strand 2: Number Operations*

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



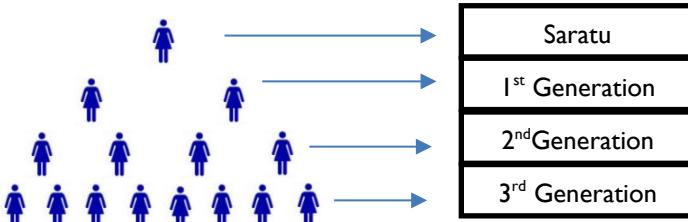
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES												
<p><b>B8.1.2.2 Apply the understanding of the addition, subtraction, multiplication and division of (i) whole numbers within 10,000, and (ii) decimals up to 1/1000, to solve problems and round answers to given decimal places</b></p>	<p><b>B8.1.2.2 Multiply or divide multi-digit numbers by 2- and 3-digit numbers.</b></p> <p>E.g.1 Use the area model (Expand and Box method) to multiply and divide efficiently.</p> $526 \times 54 =$ <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">500</td> <td style="text-align: center;">20</td> <td style="text-align: center;">6</td> <td></td> </tr> <tr> <td style="text-align: center;"><math>500 \times 50</math> = 25000</td> <td style="text-align: center;"><math>20 \times 50</math> = 1000</td> <td style="text-align: center;"><math>6 \times 50</math> = 300</td> <td style="text-align: center;">50</td> </tr> <tr> <td style="text-align: center;"><math>500 \times 4</math> = 2000</td> <td style="text-align: center;"><math>20 \times 4</math> = 80</td> <td style="text-align: center;"><math>6 \times 4</math> = 24</td> <td style="text-align: center;">4</td> </tr> </table> $\therefore 526 \times 54 = 25,000 + 2,000 + 1,000 + 300 + 80 + 24$ $= 28,404$ <p>E.g.2. Multiply whole numbers using the vertical place value method: (i.e. <math>657 \times 27 =</math>)</p> $  \begin{array}{r}  657 \\  \times 27 \\  \hline  4599 \\  + 1314 \\  \hline  17739  \end{array}  $	500	20	6		$500 \times 50$ = 25000	$20 \times 50$ = 1000	$6 \times 50$ = 300	50	$500 \times 4$ = 2000	$20 \times 4$ = 80	$6 \times 4$ = 24	4	<p>Critical Thinking and Problem solving (<b>CP</b>)</p>
500	20	6												
$500 \times 50$ = 25000	$20 \times 50$ = 1000	$6 \times 50$ = 300	50											
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CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p>E.g.3 Multiply whole numbers using the lattice method:</p> <p>That is to solve <math>382 \times 856</math>:</p> <p>Make a 3 by 3 lattice and set up the solution as follows:</p> <p style="text-align: center;"><math>382 \times 856 = 326,992</math></p>	Critical Thinking and Problem solving ( <b>CP</b> )
	<p>E.g.3 Use the distributive property to multiply <math>325 \times 15</math></p> $= 325 \times (10 + 5) = (325 \times 10) + (325 \times 5)$ $= 3,250 + 1,625$ $= 4,875$ <p>E.g.4 Investigate and determine basic division facts including divisibility test</p> <p>(i) Determine how a given number is divisible by 3,4,5, 6, 7, 8,9,10, etc.</p>	

CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B8.1.2.2.3. Create and solve story problems involving decimals on the four basic operations.</b></p> <p>E.g. 1. Solve word problems</p> <ul style="list-style-type: none"> <li>(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.</li> <li>(ii) A man gave an amount of GH₵ 2477.25 to be shared equally among his three children. How much did each receive?</li> <li>(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?</li> <li>(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?</li> </ul>	<b>Communication and Collaboration (CC)</b> <b>Creativity and Innovation (CI)</b>

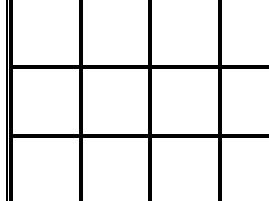
CONTENT STANDARD	INDICATORS AND EXEMPLARS	CORE COMPETENCIES												
<b>B8.1.2.2 Apply the understanding of the addition, subtraction, multiplication and division of (i) whole numbers within 10,000, and (ii) decimals up to 1/1000, to solve problems and round answers to given decimal places</b>	<p>E.g.2 Solve word problems on data presented in a table.</p> <p>(i) In preparation towards a speech day celebration, a school's Management Committee approved the following budget on some projects:</p> <table border="1"> <thead> <tr> <th>Activity</th> <th>Cost (GH₵)</th> </tr> </thead> <tbody> <tr> <td>Painting school building</td> <td>2,940</td> </tr> <tr> <td>Mending cracks on the netball pitch</td> <td>4,250</td> </tr> <tr> <td>Restock the computer laboratory with new computers</td> <td>9,990</td> </tr> <tr> <td>Buying of a new cadet uniform</td> <td>8,740</td> </tr> <tr> <td>Buying prizes for awards</td> <td>5,270</td> </tr> </tbody> </table> <p>(a) How much was approved for painting the school building and buying of new cadet uniforms?</p> <p>(b) How much less was to be spent on mending the cracks on the netball pitch than restocking the computer lab with new computers?</p> <p>(c) How much was spent on buying prizes for awards if twice the amount approved was spent on this activity?</p>	Activity	Cost (GH₵)	Painting school building	2,940	Mending cracks on the netball pitch	4,250	Restock the computer laboratory with new computers	9,990	Buying of a new cadet uniform	8,740	Buying prizes for awards	5,270	Communication and Collaboration (CC) Creativity and Innovation (CI)
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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</b></p>	<p><b>B8.1.2.3.1 Identify and explain the laws of indices</b></p> <p><b>E.g. I State the Laws of Indices.</b></p> <p>For real numbers <math>m</math>, <math>n</math> and valid bases <math>a</math>, <math>b</math>, the following basic laws hold</p> <ul style="list-style-type: none"> <li>i. Law 1: <math>a^m \times a^n = a^{(m+n)}</math></li> <li>ii. Law 2: <math>\frac{a^m}{a^n} = a^{(m-n)}</math></li> </ul> <p>For applying the above Law, if we choose both <math>m = 1</math> and <math>n = 1</math>, then we get:</p> $\frac{a^1}{a^1} = a^{(1-1)} = a^0 = 1$ <ul style="list-style-type: none"> <li>iii. Law 3: <math>(a^m)^n = a^{m \times n} = a^{mn}</math></li> <li>iv. Law 4: <math>(ab)^n = a^n b^n</math></li> </ul> <p><b>B8.1.2.3.2 Apply the laws of indices to simplify and evaluate numbers involving powers of numbers. (PEDMAS)</b></p>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p>
	<p><b>E.g. I Use the laws of indices to solve problems involving powers of number.</b></p> <ul style="list-style-type: none"> <li>i) Simplify <math>2^5 \times 16^2</math></li> <li>ii) Simplify <math>\frac{27}{3^2}</math></li> <li>iii) Simplify <math>y = x^{a-b} \times x^{b-c} \times x^{c-a} \times x^{-a-b}</math></li> <li>iv) Simplify and evaluate <math>(\frac{16}{81})^{-\frac{3}{4}}</math></li> <li>v) Evaluate <math>(5^2)^3</math></li> </ul>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B8.1.2.3.3 Solve exponential equations</b></p> <p>E.g.1 Solve these equations</p> <ul style="list-style-type: none"> <li>i. <math>25 = 5^{2x}</math></li> <li>ii. <math>2^{x+2} = 16</math></li> <li>iii. <math>\frac{2^5}{2^3} = 2^{2x}</math></li> <li>iv. <math>\frac{1}{27} = 3^x</math></li> </ul>	<b>Critical Thinking and Problem solving (CP)</b> <b>Communication and Collaboration (CC)</b> <b>Creativity and Innovation (CI)</b>
	<p><b>B8.1.2.3.4 Solve real life problems involving powers of natural numbers.</b></p> <p>E.g.1: Solve real-life problems on populations.</p> <p>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.</p>  <ul style="list-style-type: none"> <li>i. Make a table and a graph showing the number of ancestors in each of the 12 generations.</li> <li>ii. Write an equation for the number of ancestors in a given generation n.</li> </ul>	

## STRAND 1: NUMBER

### *Sub-strand 3: Fractions, Decimals and Percentages*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B8.1.3.1.1 Review fractions and solve problems involving basic operations on fractions</b></p> <p>E.g. 1. Review the concept of fractions.</p>  <p>i. Shade given fraction of squares in a shape or find the fraction shaded in the shape: i.e. shade <math>\frac{3}{4}</math> of the rectangle.</p> <p>ii. Write down 3 fractions equivalent to <math>\frac{2}{3}</math>.</p> <p>iii. Express the fraction <math>\frac{6}{10}</math> in its simplest form.</p> <p>iv. Express <math>\frac{12}{5}</math> as a mixed number.</p> <p>v. Express <math>2\frac{5}{9}</math> as an improper fraction.</p>	<b>Critical Thinking and Problem solving (CP)</b>
	<p>E.g. 2. Review the basic operations on fractions.</p> <p>i. Adding and subtracting fractions. Work out answers to the following:</p> <p>a) <math>\frac{3}{4} + \frac{7}{8}</math>   b) <math>\frac{4}{5} - \frac{1}{6}</math></p> <p>ii. Multiplying and dividing fractions. Work out answers to the following:</p> <p>a) <math>\frac{2}{3} \times \frac{3}{4}</math>   b) <math>\frac{5}{8} \div 2\frac{1}{2}</math></p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p><b>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.</b></p> <p>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).</p> <ul style="list-style-type: none"> <li>i. <math>21 \div 3 + (3 \times 9) \times 9 + 5</math></li> <li>ii. <math>18 \div 6 \times (4 - 3) + 6</math></li> <li>iii. <math>3^4 \div 9 + 40 - 2^3 \times 3^2 \div 9</math></li> </ul>	Critical Thinking and Problem solving (CP)
	<p>E.g. 2. Use the order of operations (BODMAS or PEDMAS) to simplify whole number expressions with more than two operations.</p> <ul style="list-style-type: none"> <li>a) <math>\frac{3}{4} + \frac{5}{8} \times \frac{4}{5} - \frac{1}{6}</math></li> <li>b) <math>\frac{3}{4} \div \frac{3}{8} + (\frac{4}{5} - \frac{1}{2})</math></li> <li>c) <math>(\frac{3}{4} + \frac{5}{8}) \times \frac{4}{11} - \frac{1}{2}</math></li> </ul>	
	<p><b>B8.1.3.1.3. Review word problems involving basic operations on fractions and related concepts.</b></p>	
	<p>E.g. 1. Solve word problems involving fractions.</p> <ul style="list-style-type: none"> <li>i. Determine the (i) perimeter and (ii) area of a rectangle whose sides measure <math>1\frac{1}{3}</math> cm by <math>3\frac{3}{4}</math> cm.</li> </ul>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<ul style="list-style-type: none"> <li>ii. Faako answers 42 out of 60 questions correctly. What percentage of her answers are correct?</li> <li>iii. In a school <math>\frac{2}{3}</math> of the students eat from the school feeding programme, <math>\frac{1}{4}</math> bring their packed lunch, and the rest go home to eat. What fraction of the students go home for lunch?</li> <li>iv. Esi and Fusena prepared an orange drink by mixing orange squash and water. Esi's drink was made of <math>\frac{2}{7}</math> orange squash and Fusena's was made up of <math>\frac{1}{4}</math> orange squash. Whose drink tastes stronger of orange?</li> </ul>	<b>Critical Thinking and Problem solving (CP)</b>

## STRAND 1: NUMBER

### *Sub-strand 4: Number: Ratios and Proportion*

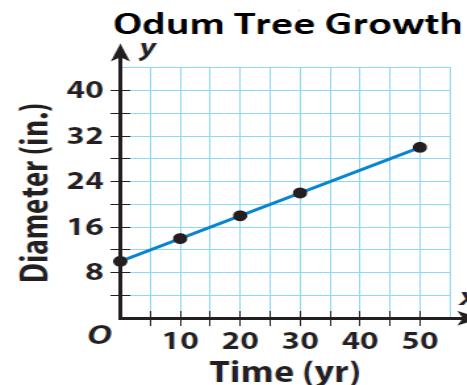
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.1.4.1 Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems	<p><b>B8.1.4.1.1</b> Use ratio reasoning to convert measurement units; manipulate and transform units appropriately when multiplying or dividing quantities.</p>	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b> <b>Personal Development and Leadership (PL)</b>
	<p><b>E.g.1</b> Convert (cm to m; km to m; ml to cm; etc.) one unit of measure to another using ratio reasoning.</p> <ul style="list-style-type: none"> <li>• 1m = 100cm is a conversion factor, and we can write from it the ratios <math>\frac{1\text{ m}}{100\text{ cm}}</math> and <math>\frac{100\text{ cm}}{1\text{ m}}</math>, with each being equivalent to 1. Then, to convert a measurement in metres into centimetres, we can multiply it by the ratio 1m/100cm.</li> </ul>	
	<p><b>E.g.2</b> Manipulate and use units appropriately to solve problems.</p> <ul style="list-style-type: none"> <li>• Agbo walks 4km to school every day. He uses 60minutes. Rukiya uses 45minutes to cover 4200m. Which of the two learners is faster?</li> </ul>	
	<p><b>B8.1.4.1.2</b> Solve unit rate problems including those involving unit pricing and constant speed; and speed translation.</p> <p><b>E.g.1</b> 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?</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES				
<p><b>B8.1.4.1 Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems.</b></p>	<ul style="list-style-type: none"> <li>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?</li> </ul> <p><b>Solution</b></p> <ul style="list-style-type: none"> <li>The ratio of calories burned to hours drumming is 756:3.</li> <li>Let's find an equivalent ratio that shows how many calories are burned in 1 hour.</li> <li>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.</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>				
	$\begin{array}{ccc} & \left\{ \begin{array}{c} 756 \\ ? \end{array} \right. & \xrightarrow{\quad} \\ \div 3 & & \xrightarrow{\quad} \left\{ \begin{array}{c} 3 \\ \div 3 \\ 1 \end{array} \right. \end{array}$ $756 \div 3 = 252$ <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Calories burned</td> <td style="text-align: center;">hours</td> </tr> <tr> <td style="text-align: center;"><math>\div 3</math></td> <td style="text-align: center;"><math>\left\{ \begin{array}{c} 756 \\ 252 \end{array} \right. \xrightarrow{\quad} \left\{ \begin{array}{c} 3 \\ 1 \end{array} \right. \div 3</math></td> </tr> </table> <p>Salamatu burns 252 calories per hour of drumming.</p>	Calories burned	hours	$\div 3$	$\left\{ \begin{array}{c} 756 \\ 252 \end{array} \right. \xrightarrow{\quad} \left\{ \begin{array}{c} 3 \\ 1 \end{array} \right. \div 3$	
Calories burned	hours					
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.1.4.1</b>Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems.</p>	<p><b>B8.1.4.1.3</b> Apply the knowledge of speed to draw and interpret travel graphs or distance-time graphs.</p> <p>E.g.1 Draw a graph for a passage on a distance time graph.</p> <p>i) A trader travels in a car from Buduata to Adawso. The distance between the two towns is 20miles. 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.</p>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>
<p>Notes: put a passage for the graph</p>	<p>Travel Graph</p> <p>Distance (Miles)</p> <p>Time</p> <p>(a) How long at Assin ? 36 mins or 0.6 hr</p> <p>(b) How far is it from Assin to Adawso? 12 miles</p> <p>(c) Average speed from Assin to Adawso? <math>S = d/t = 12/0.4</math> = 30 mph</p> <p>(d) Average speed on return journey? <math>S = d/t = 20/0.8</math> = 25 mph</p> <p>(e) Average speed for whole journey? <math>S = d/t = 40/3</math> = 13 1/3 mph</p>	

CONTENT STANDARDS	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.	<p><b>E.g.2 Interpret a given travel graph</b></p> <p><b>Travel Graphs(1)</b></p> <p>(a) Time of arrival at Winneba 10:30</p> <p>(b) Distance from Apam to Kasoa. 45 km</p> <p>(c) How long at Kasoa? 30 mins</p> <p>(d) Average speed: Apam to Kasoa  <math>s = d/t = 45/1 = 45 \text{ km/hr}</math></p> <p>(e) Average speed: return journey.  <math>s = d/t = 45/\frac{1}{2} = 90 \text{ km/hr}</math></p>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>

CONTENT STANDARDS	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.	<p><b>B8.1.4.1.4</b> 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).</p> <p><b>E.g.1</b> Use given tables to check proportional relationships.</p> <table border="1"> <thead> <tr> <th colspan="2">Proportional</th> <th colspan="2">Non-Proportional</th> </tr> <tr> <th>Time (min.)</th> <th>Distance (ft.)</th> <th>Time (min.)</th> <th>Distance (ft.)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>4</td> </tr> <tr> <td>2</td> <td>6</td> <td>2</td> <td>10</td> </tr> <tr> <td>4</td> <td>12</td> <td>4</td> <td>16</td> </tr> <tr> <td>6</td> <td>18</td> <td>6</td> <td>22</td> </tr> </tbody> </table> $\frac{2}{6} = \frac{6}{18}$ <p>Ratios are equivalent.</p> $\frac{1}{5} \frac{2}{10} = \frac{6}{22} \frac{3}{11}$ <p>Ratios are not equivalent.</p>	Proportional		Non-Proportional		Time (min.)	Distance (ft.)	Time (min.)	Distance (ft.)	0	0	0	4	2	6	2	10	4	12	4	16	6	18	6	22	<p>Critical Thinking and Problem solving (CP)</p> <p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p>
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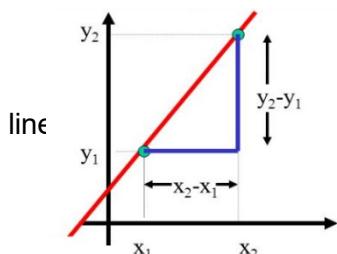
The graph shows a non-proportional relationship because the straight line does not go through the origin.

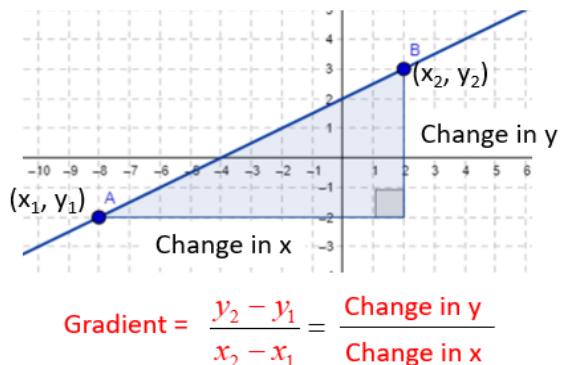
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																		
B8.1.4.1 Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems.	<p><b>B8.1.4.1.5 Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.</b></p> <p><b>E.g.1</b>  <i>We can find the constant of proportionality from a table of values, equation and a graph.</i>  <i>In a table, simplify any one of the ratios.</i></p> <table border="1"> <tr> <td>Chaperones</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>Students</td> <td>12</td> <td>24</td> <td>36</td> <td>48</td> <td>60</td> </tr> </table> $k = \frac{y}{x} = \frac{36}{3} = 12$	Chaperones	1	2	3	4	5	Students	12	24	36	48	60	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b>						
Chaperones	1	2	3	4	5															
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	<p><b>E.g.2</b> An ant travels <math>\frac{9}{8}</math> inches in 45 seconds and <math>\frac{27}{8}</math> inches in 2 minutes and 15 seconds.      What is the constant of proportionality?</p>																			
	<p><b>E.g.3</b></p> <p>Ratio is constant for all points on the graph 1:10, so the constant of proportionality (<math>k</math>)=10</p> <p>Create a table using the points from the graph:</p> <table border="1"> <thead> <tr> <th>cedis (y)</th> <th>20</th> <th>40</th> <th>60</th> <th>80</th> <th>100</th> </tr> </thead> <tbody> <tr> <td>Total pounds (x)</td> <td>2</td> <td>4</td> <td>6</td> <td>8</td> <td>10</td> </tr> <tr> <td>Divide total price by total pounds</td> <td>10</td> <td>10</td> <td>10</td> <td>10</td> <td>10</td> </tr> </tbody> </table>	cedis (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	
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<b>B8.1.4.1 Demonstrate an understanding of ratio, rate and proportions and use it these to solve real-world mathematical problems.</b>	<p>Ratio is constant for all points on the graph 1:10. so the constant of proportionality (<math>k</math>)=10</p>  <p>Create a table using the points from the graph:</p> <table border="1"> <thead> <tr> <th>Total price (y)</th> <th>20</th> <th>40</th> <th>60</th> <th>80</th> <th>100</th> </tr> </thead> <tbody> <tr> <th>Total pounds (x)</th> <td>2</td> <td>4</td> <td>6</td> <td>8</td> <td>10</td> </tr> <tr> <th>Divide total price by total pounds</th> <td>10</td> <td>10</td> <td>10</td> <td>10</td> <td>10</td> </tr> </tbody> </table>	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	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b>
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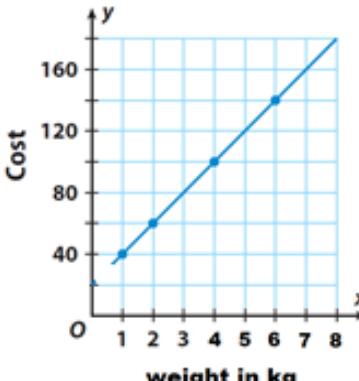
## STRAND 2: ALGEBRA

### Sub-strand 1: Patterns and Relations

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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 <math>y = mx + c</math>.</b></p>	<p><b>B8.2.1.1.1 Calculate the gradient of a line and use it to write equation of a line of the form <math>y = mx + c</math>.</b></p> <p><b>E.g.1</b> Explain the concept of gradient using real life examples and to discover the practical meaning of gradient.</p>   <p>The gradient is the measure of how steep the hill the rider is climbing is. The gradient is the slope (or steepness) of the roofing of the building.</p> <p><b>E.g.2</b> Determine the formula for calculating the gradient of a line.</p>  <p>The formula for calculating the gradient of a straight line</p> $\frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$	<p>Critical Thinking and Problem solving (CP)</p> <p>Personal Development and Leadership (PL)</p> <p>Creativity and Innovation (CI)</p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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 <math>y = mx + c</math>.</b>	<p><b>E.g.3</b> Determine the gradient when given two coordinates.</p> <p>Find the gradient of a line which passes through the point;</p> <ol style="list-style-type: none"> <li>A(1,1) and B(7,2)</li> <li>P(-2,4) and Q(3,5)</li> <li>C(3,-2) and D(-3,4)</li> </ol>	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b> <b>Creativity and Innovation (CI)</b>
	<p><b>E.g.4</b> Determine the gradient of a straight line when its equation is given.</p> <p>Find the gradient from the equation of the straight line below</p> <ol style="list-style-type: none"> <li><math>y = 5x + 13</math></li> <li><math>2x - 8y + 3 = 0</math></li> <li><math>y = -3x + 12</math></li> </ol>	
	<p><b>E.g.5</b> Determine the gradient from a graph.</p>  $\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{Change in } y}{\text{Change in } x}$	<p>Determine the gradient of the line in the graph.</p> <p>From the graph, the coordinates are A (-8,-2), B (2,3).</p> $m = \frac{-2-3}{-8-2} = \frac{-5}{-10} = \frac{1}{2}$ <p>The gradient of the line is <math>\frac{1}{2}</math></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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 <math>y = mx + c</math>.</b></p>	<p><b>E.g.6</b> Determine the slope-intercept form of the equation of a straight line  <b>Hint:</b> The equation of a straight line in slope-intercept form is <math>y = mx + c</math></p> <ul style="list-style-type: none"> <li>i. Find the equation of a line with slope 2 and y-intercept -3. Hence find the value of y when x is 4.</li> <li>ii. Find the equation of a line in slope-intercept form having y-intercept <math>\frac{7}{2}</math> and slope <math>-\frac{5}{2}</math>.</li> <li>iii. Find the equation of a line with slope <math>\frac{1}{2}</math> and y-intercept 4.</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b>  <b>Personal Development and Leadership (PL)</b>  <b>Creativity and Innovation (CI)</b></p>
	<p><b>E.g.7</b> Determine the point-slope form of the equation of a straight line  <b>Hint:</b> The point-slope form of the equation of a straight line is <math>y - y_1 = m(x - x_1)</math></p> <ul style="list-style-type: none"> <li>i. Find the equation of a line with slope <math>\frac{2}{3}</math> that passes through the point (3, -1).</li> <li>ii. Find the equation of a line that passes through the point (3, -7) and has the slope <math>m = \frac{5}{4}</math>.</li> <li>iii. Find the equation of a line which passes through the points (5, 4) and (-10, -2).</li> <li>iv. Write the equation <math>5x + 4y - 3 = 0</math> in the form <math>y = mx + c</math>. Hence state the gradient and the intercept.</li> </ul>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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 <math>y = mx + c</math>.</b></p>	<p><b>B8.2.1.1.2 Use graph of a linear relation to determine subsequent missing elements in the ordered pairs of the relation.</b></p> <p><b>E.g.1</b> Use information from a graph to find missing elements</p>  <p>The graph represents the relation <math>y = 20x</math>, where <math>y</math> is the cost (in Ghana cedis) of the weight (in kilograms) of meat sold in a market.</p> <p>Use the graph to find:</p> <ul style="list-style-type: none"> <li>i. the cost of 3.5kg of meat</li> <li>ii. the weight of meat that can be bought with GH₵80.</li> <li>iii. Using the relation from the graph, how many kilograms of meat can be bought at a cost of GH₵240.</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Creativity and Innovation (CI)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																						
<p><b>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 <math>y = mx + c</math>.</b></p>	<p><b>E.g.2</b> Use information from a graph to find missing elements:</p> <p><b>Growth of Wawa Tree</b></p> <table border="1"> <thead> <tr> <th>Time (yr)</th> <th>Diameter (in.)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>8</td> </tr> <tr> <td>10</td> <td>16</td> </tr> <tr> <td>20</td> <td>24</td> </tr> <tr> <td>30</td> <td>32</td> </tr> </tbody> </table> <p>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 <math>\frac{2}{5}</math> inch per year. The equation <math>y = \left(\frac{2}{5}\right)x + 10</math> gives you <math>y</math>, the diameter of the tree in inches, after <math>x</math> years.</p> <p>i. Use the graph to complete the table below.</p> <table border="1"> <thead> <tr> <th>X (years)</th> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>Y(diameter in inches)</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>ii. What will be the diameter of the tree in 100 years?</p>	Time (yr)	Diameter (in.)	0	8	10	16	20	24	30	32	X (years)	0	1	2	3	5	Y(diameter in inches)						<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Creativity and Innovation (CI)</b></p>
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	<p><b>B8.2.1.1.3 Use graphs of linear relations to solve real life problems.</b></p> <p><b>E.g.1</b> Draw graphs for real life problems.</p> <p>i. Every morning, you go for a walk. The distance you walk can be modelled by the equation <math>d = \frac{1}{3}h</math>, where <math>d</math> is the distance walked in kilometers and <math>h</math> 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.</p>																							

CONTENT STANDARDS	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 $y = mx + c$ .	<p>Copy and complete the table for the relation:</p> <table border="1"> <thead> <tr> <th>Distance</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr> </thead> <tbody> <tr> <td>Time</td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	Distance	1	2	3	4	5	Time						<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b> <b>Creativity and Innovation (CI)</b>
Distance	1	2	3	4	5									
Time														
	<p><b>E.g.2</b> 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.</p> <p>i. How much does she charge for a portrait that takes 3 hours to paint?  ii. If she charges GH₵175, how many hours did she use to paint the portrait?  iii. How many hours will she require to paint a portrait that cost GH₵300?</p>													

## STRAND 2: ALGEBRA

### *Sub-strand 2 Algebraic Expressions*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES								
<b>B8.2.2.1 Solve problems involving algebraic expressions (including multiplication of binomial expressions) factorise given expressions and substitute values to evaluate algebraic expressions.</b>	<p><b>B8.2.2.1.1 Use the distributive property to remove brackets and solve multiplication of binomial expression.</b></p> <p><b>E.g.1</b> Expand these expressions:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 10px; vertical-align: top;"> <ul style="list-style-type: none"> <li>• <math>6(x + 3)</math></li> <li>• <math>-5x(3x + 4)</math></li> <li>• <math>3(x + 4) - 2(x - 5)</math></li> </ul> </td><td style="padding: 10px; vertical-align: top;"> <ul style="list-style-type: none"> <li>• <math>2(6 - 5x) - 3(2 + 2x) - 4(3x - 1)</math></li> <li>• <math>8 - (4 - d) - (6 - d)</math></li> <li>• <math>(e + f - g) - (e - f + g)</math></li> </ul> </td></tr> </table> <p><b>E.g.2</b> Multiply binomial expressions</p> <p><b>Simplify</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 10px; vertical-align: top;"> i. <math>(a + 2)(a + 3)</math>  ii. <math>(2x + y)(2x - y)</math>  iii. multiply <math>(3x - 2y)</math> by <math>(3x + 2y)</math> </td><td style="padding: 10px; vertical-align: top;"> iv. <math>(2x + 3)^2</math>  v. <math>(x - 2x)^2</math>  vi. <math>(a + 2)^2</math> </td></tr> </table> <p><b>B8.2.2.1.2 Perform addition, subtraction, multiplication and division of algebraic expressions including fractions.</b></p> <p><b>E.g.1</b> Solve problems based on multiplication and division of algebraic fractions.</p> <p>Simplify:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 10px; vertical-align: top;"> a. <math>\frac{a}{7} \times \frac{b}{8}</math> </td><td style="padding: 10px; vertical-align: top;"> b. <math>\frac{p}{14} \times \frac{6}{p}</math> </td><td style="padding: 10px; vertical-align: top;"> c. <math>\frac{x-3}{8} \times \frac{12}{x-3}</math> </td><td style="padding: 10px; vertical-align: top;"> d. <math>\frac{5x^2}{x^2-2x} \times \frac{x^2-4}{x^2+2x}</math> </td></tr> </table>	<ul style="list-style-type: none"> <li>• <math>6(x + 3)</math></li> <li>• <math>-5x(3x + 4)</math></li> <li>• <math>3(x + 4) - 2(x - 5)</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>2(6 - 5x) - 3(2 + 2x) - 4(3x - 1)</math></li> <li>• <math>8 - (4 - d) - (6 - d)</math></li> <li>• <math>(e + f - g) - (e - f + g)</math></li> </ul>	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. $(a + 2)^2$	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. $\frac{5x^2}{x^2-2x} \times \frac{x^2-4}{x^2+2x}$	<b>Critical Thinking and Problem solving (CP)</b>  <b>Creativity and Innovation (CI)</b>  <b>Personal Development and Leadership (PL)</b>
<ul style="list-style-type: none"> <li>• <math>6(x + 3)</math></li> <li>• <math>-5x(3x + 4)</math></li> <li>• <math>3(x + 4) - 2(x - 5)</math></li> </ul>	<ul style="list-style-type: none"> <li>• <math>2(6 - 5x) - 3(2 + 2x) - 4(3x - 1)</math></li> <li>• <math>8 - (4 - d) - (6 - d)</math></li> <li>• <math>(e + f - g) - (e - f + g)</math></li> </ul>									
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. $(a + 2)^2$									
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. $\frac{5x^2}{x^2-2x} \times \frac{x^2-4}{x^2+2x}$							

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.2.2.1 Solve problems involving algebraic expressions (including multiplication of binomial expressions) factorise given expressions and substitute values to evaluate algebraic expressions.</b></p>	<p>Simplify:</p> <p>a. <math>\frac{3x-3}{4x-4}</math>   b. <math>\frac{4x-8}{6} \div \frac{x-2}{3}</math>   c. <math>\frac{x+1}{x+2}</math>   d. <math>\frac{2x}{3} \cdot \frac{y}{5}</math></p> <p><b>E.g.2</b> Solve problems based on addition and subtraction of algebraic fractions</p> <p>Simplify the following:</p> <p>i. <math>\frac{a-b}{3} + \frac{3a}{2}</math>   iv. <math>\frac{2x-1}{3} - \frac{x+3}{2}</math></p> <p>ii. <math>\frac{2a}{3} - \frac{a-b}{2}</math>   v. <math>\frac{3a+5b}{4} + \frac{a+b}{8}</math></p> <p>iii. <math>\frac{5}{6r} - \frac{3}{4r}</math>   vi. <math>\frac{2x}{6} + \frac{2x-3y}{3} - \frac{x+y}{2}</math></p> <p><b>B8.2.2.1.3 Substitute values to evaluate algebraic expressions including fractions and use these to solve problems.</b></p>	<p>Critical Thinking and Problem solving (CP)</p> <p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p>
	<p>if <math>x = 2, y = -2, z = 3, c = 1</math> and <math>d = -1</math>, simplify, then substitute in the value to evaluate the following expressions:</p> <p>i. <math>\frac{3}{x+1} - \frac{2}{x-1}</math> iv. <math>\frac{3ab}{15c^2d^2} \times \frac{10d}{9a^2}</math></p> <p>ii. <math>\frac{1}{x-1} + \frac{2}{x+1}</math> v. <math>\frac{6x^2+2xy}{5z} \times \frac{15z^2}{3x+y}</math></p> <p>iii. <math>\frac{12xy}{7} \times \frac{14x}{20}</math> vi. <math>5x + 7z^2 - 4d + 3y^2</math></p>	

CONTENT STANDARDS	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.	<p><b>B8.2.2.1.4 Factorise given expressions involving the four operations and use the experiences gained to solve problems.</b></p> <p><b>E.g.1</b> Factorise the following expressions</p> <p>i. Common factors</p> <ul style="list-style-type: none"> <li>• <math>3ax + 6ay</math></li> <li>• <math>54 - 81x</math></li> <li>• <math>100x - 25x^2</math></li> </ul> <p>ii. Method of grouping</p> <ul style="list-style-type: none"> <li>• <math>2ap + aq - bq - 2bp</math></li> <li>• <math>ab - by - ay + y^2</math></li> <li>• <math>3x^2 + 2xy - 12xy - 8yz</math></li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>

**STRAND 2: ALGEBRA**  
***Sub-strand 3 Variables and Equations***

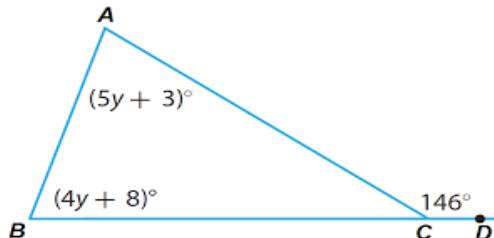
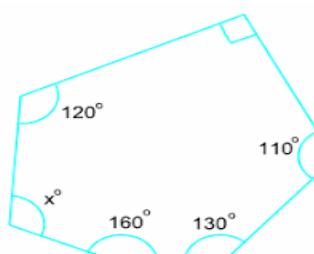
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES								
B8.2.3.1 Demonstrate an understanding of linear inequalities of the form $x + a \geq b$ (where $a$ and $b$ are integers) by modelling problems as a linear inequalities and solving the problems concretely, pictorially, and symbolically.	<p><b>B8.2.3.1.1 Translate word problems into linear inequalities in one variable and vice versa</b></p> <p><b>E.g.1</b> Make mathematical sentences involving linear inequalities from word problems.</p> <p>i. Think of a whole number less than 17 i.e. <math>x &lt; 17</math></p> <p>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. <math>-3x - 8 &gt; -26</math></p> <p>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.</p> $\text{GH₵}23 \geq -12 + p$ <p><b>B8.2.3.1.2 Solve simple linear inequalities</b></p> <p><b>E.g.1</b> Use the idea of balancing to solve simple linear inequalities.</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">i. <math>2x - 13 &gt; 29</math></td> <td style="width: 50%;">v. <math>x - 4 &gt; 1</math></td> </tr> <tr> <td>ii. <math>4x - 9 &gt; -5</math></td> <td>vi. <math>10 - x &lt; 12</math></td> </tr> <tr> <td>iii. <math>14 &lt; 8 - 2x</math></td> <td>vii. <math>x - 3 \geq 2</math></td> </tr> <tr> <td>iv. <math>3x \leq 8 + x</math></td> <td>viii. <math>2x - 5 \leq 35 - x</math></td> </tr> </table>	i. $2x - 13 > 29$	v. $x - 4 > 1$	ii. $4x - 9 > -5$	vi. $10 - x < 12$	iii. $14 < 8 - 2x$	vii. $x - 3 \geq 2$	iv. $3x \leq 8 + x$	viii. $2x - 5 \leq 35 - x$	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p>
i. $2x - 13 > 29$	v. $x - 4 > 1$									
ii. $4x - 9 > -5$	vi. $10 - x < 12$									
iii. $14 < 8 - 2x$	vii. $x - 3 \geq 2$									
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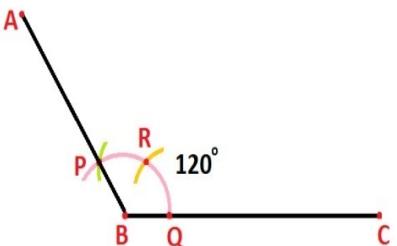
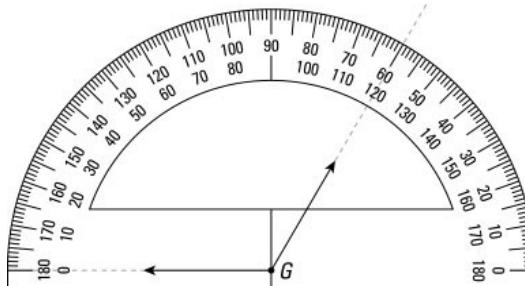
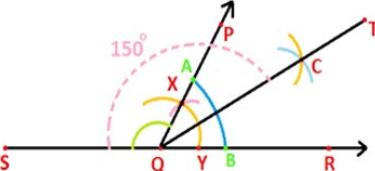
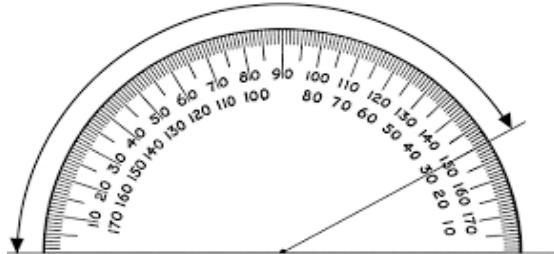
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.2.3.1 Demonstrate an understanding of linear inequalities of the form <math>x + a \geq b</math> (where <math>a</math> and <math>b</math> are integers) by modelling problems as a linear inequalities and solving the problems concretely, pictorially, and symbolically.</b></p>	<p><b>B8.2.3.1.3 Determine solution sets of simple linear inequalities in given domains</b></p> <p><b>E.g.1</b> Find solution sets for the following linear inequalities</p> <ul style="list-style-type: none"> <li>i. If <math>x &lt; 4</math> for whole numbers, then the domain is whole numbers and the solution set  <math>= \{0, 1, 2, 3\}</math></li> <li>ii. <math>2x &gt; 24</math></li> <li>iii. <math>x + 4 \leq 3x - 16</math></li> <li>iv. <math>9 - 5x &lt; 6</math></li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p>

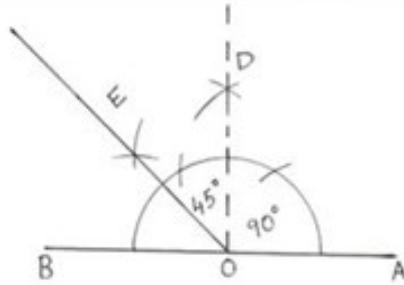
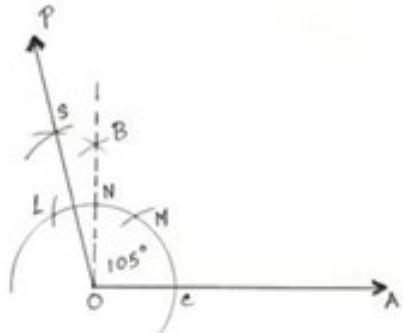
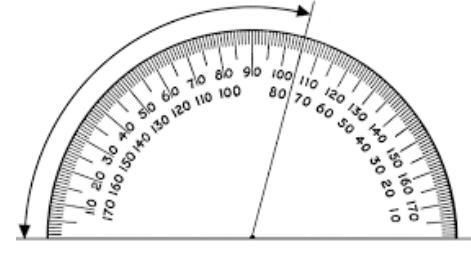
### STRAND 3: GEOMETRY AND MEASUREMENT

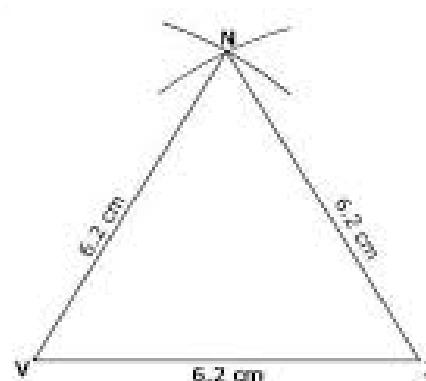
#### *Sub-strand 1: Shapes and Space*

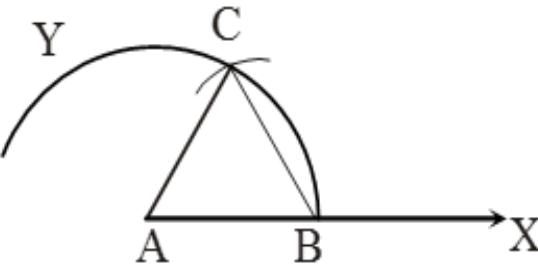
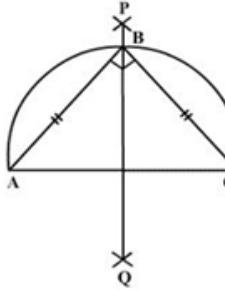
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.1.1 Demonstrate understanding and use of the relationship between parallel lines and alternate and corresponding angles and use the sum of angles in a triangle to deduce the angle sum in any polygon.</b>	<p><b>B8.3.1.1.1 Draw and determine the values of alternate and corresponding angles</b></p> <p>E.g.1. Draw the diagram and calculate the values of the angles marked 1, 3,4,5,6,7,8</p> <p>E.g. 2 Calculate the value of the angles a, b, c, and d</p>	<b>Creativity and Innovation (CI)</b>

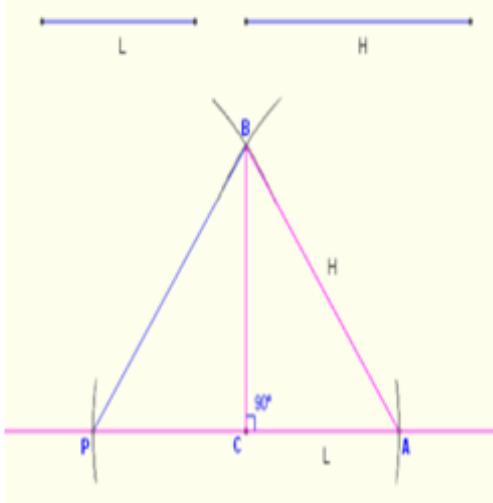
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B8.3.1.1 Demonstrate understanding and use of the relationship between parallel lines and alternate and corresponding angles and use the sum of angles in a triangle to deduce the angle sum in any polygon.	<p><b>B8.3.1.2 Determine the values of angles in a triangle using knowledge of the sum of interior angles in a triangle and other properties.</b></p> <p>E.g. 1 Calculate the values of <math>y</math> and the angles in the triangle</p>  <p>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.</p> <p>E.g. 3 Use the formula for finding the sum of interior angles in a polygon <math>(n-2)180</math> to determine the value of <math>x</math> in the hexagon.</p> 	Creativity and Innovation (CI)

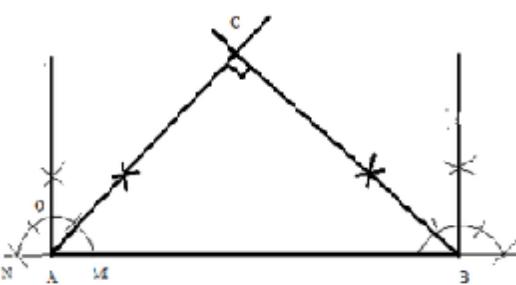
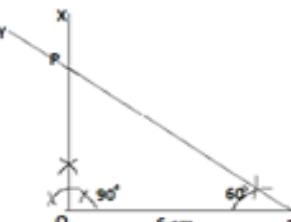
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (75°, 105°, 60°, 135° and 150°), and construct triangles and find locus of points under given conditions.</b></p>	<p><b>B8.3.1.2.1 Construct and bisect angles of 120°, 105°, 135° and 150°</b></p> <p><b>E.g.1:</b> Use a pair of compasses and a ruler to perform geometric construction of an angle (<math>\angle CBA</math>) = 120° [Draw a semi-circle over the point B to meet <math>BC</math> 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.</p>  	<p><b>Creativity and Innovation (CI)</b></p>
	<p><b>E.g.2:</b> Use a pair of compasses and a ruler to perform geometric construction of an angle of (<math>\angle SQC</math>) 150° and measure with a protractor to confirm.</p>  	

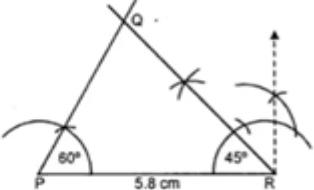
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b>	E.g.3: Use a pair of compasses and a ruler to perform the geometric construction of an angle ( $\angle AOE$ ) $135^\circ$ and measure with a protractor to confirm.   	<b>Creativity and Innovation (CI)</b>
	E.g.4: Use a pair of compasses and a ruler to perform geometric construction of an angle of $105^\circ$ and measure with a protractor to verify.   	<b>Creativity and Innovation (CI)</b>

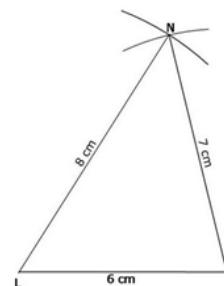
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p><b>B8.3.1.2.2:</b> Construct scalene triangles, isosceles triangles, equilateral triangles, obtuse-angled triangle, and acute-angled triangles in different orientations under given conditions.</p> <p>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 <math>VJ = 6.2\text{cm}</math> 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)</p> 	<p><b>Creativity and Innovation (CI)</b></p>

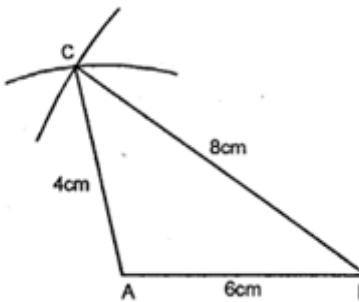
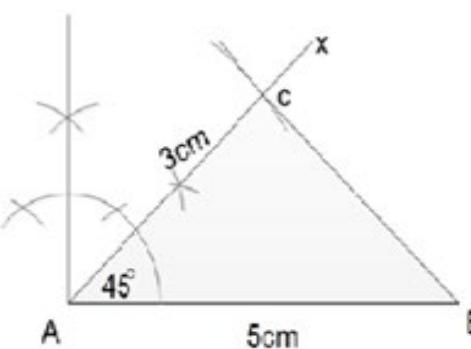
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (75°, 105°, 60°, 135° and 150°), and construct triangles and find locus of points under given conditions.</b>	<p>E.g.2 : Use a pair of compasses and a ruler to construct an equilateral triangle by using point A as a centre and constructing an arc to meet <math>\vec{AX}</math> in B, and then using the same radius to inscribe an arc (construct 60°angle) at point C and joining A to C and B to C.</p> 	<b>Creativity and Innovation (CI)</b>
	<p>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.</p> <p>In triangle ABC, PQ is a perpendicular bisector of AC = 7cm, ABC is a semi-circle and BC=BA</p> 	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p>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.</p> <p>i.e. construct Triangle PAB, such that CA=CP=L= 3.5cm. CB is a perpendicular bisector of PA. AB=PB=H=9cm. What can you say about <math>\angle BAP</math> and <math>\angle BPA</math>?</p> 	<b>Creativity and Innovation (CI)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>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.</p> <p>In triangle <math>ABC</math>, <math>\angle CAB = \angle CBA = 45^\circ</math>, <math>AB = 7\text{cm}</math>, find the length of <math>AC</math> and <math>BC</math></p> 	<p><b>Creativity and Innovation (CI)</b></p>
	<p>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.</p> <p>(In Triangle <math>PRQ</math>, <math>QR = 6\text{cm}</math>, <math>\angle PRQ = 60^\circ</math> and <math>\angle PQR = 90^\circ</math>; Triangle <math>PRQ</math> is a Right-angled triangle or a scalene triangle)</p> 	

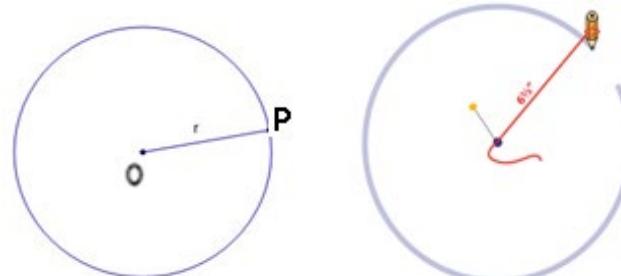
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b>	(In Triangle PRQ, $PQ = 5.8\text{cm}$ , $\angle QPR = 60^\circ$ and $\angle QRP = 45^\circ$ ; Triangle PRQ is an acute angled triangle or a scalene triangle.)  	<b>Creativity and Innovation (CI)</b>
	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.	

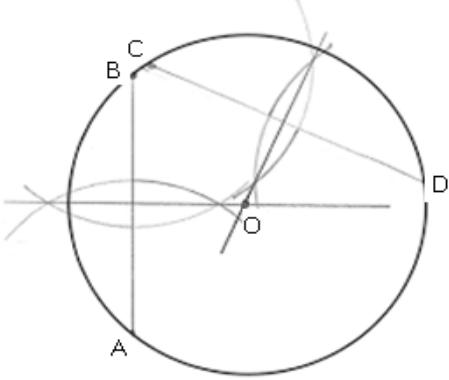


CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>In triangle ABC, AC = 4cm, AB = 6cm and BC = 8cm. Measure the value of the angles (what is the name of this triangle?)</p> 	<p><b>Creativity and Innovation (CI)</b></p>
	<p>E.g.8: Use a pair of compasses and a ruler to construct triangles when two sides and one angle are given</p> <p>In triangle ABC, <math>\angle CAB = 45^\circ</math>, AC = 3cm and AB = 5cm</p> 	

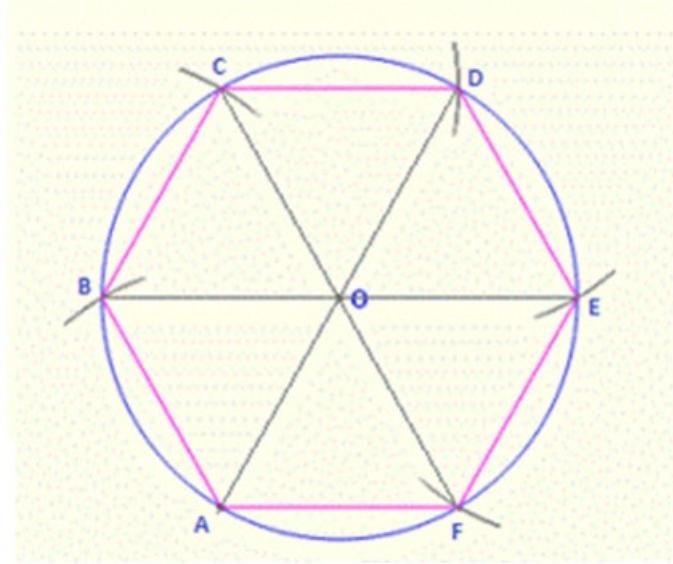
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p><b>B8.3.1.2.3: Construct loci under given conditions including:</b></p> <ul style="list-style-type: none"> <li>(i) the locus of sets of points from a fixed point;</li> <li>(ii) the locus of points equidistant from two fixed points;</li> <li>(iii) the locus of points equidistant from two intersecting straight lines, and</li> <li>(iv) the locus of points equidistant from two parallel lines.</li> </ul>	<p><b>Creativity and Innovation (CI)</b></p>

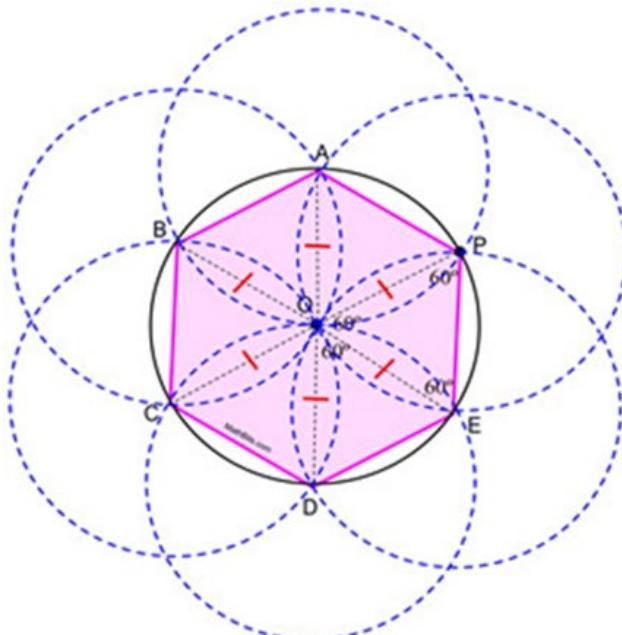
E.g.1: Describe the locus of a circle by tracing the path of a point P which moves in such a way that its distance from a fixed point, say O, is always the same to construct circles.

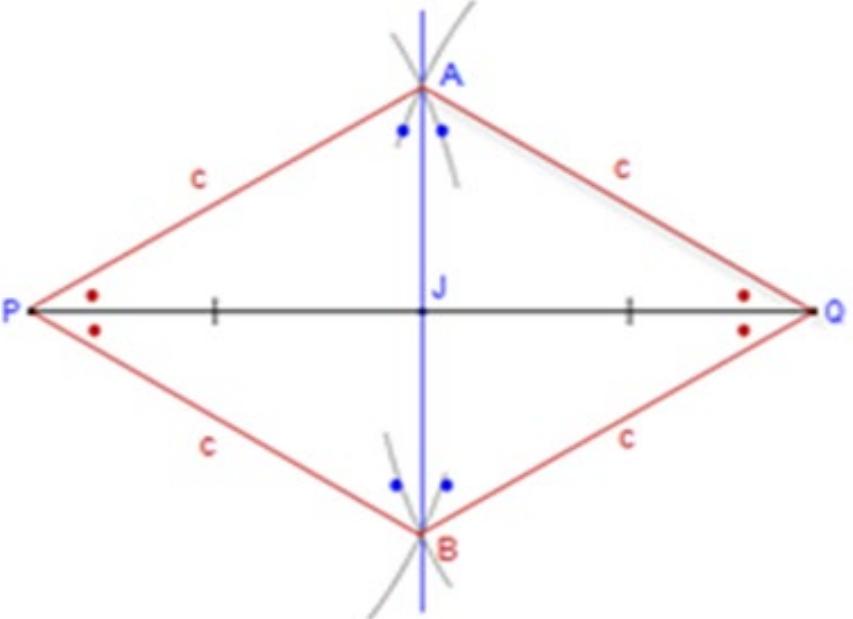


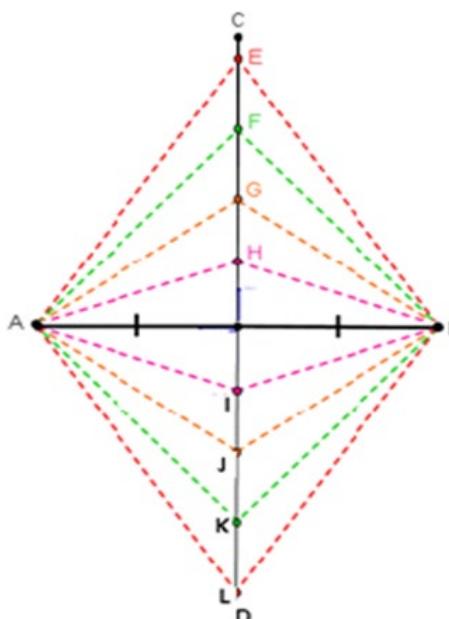
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>E.g.2: Perform geometric construction to locate the centre of a circle by locating the intersection of the perpendicular bisectors of any two chords on the circle.</p> <p>Find the centre of the circle</p> 	<p><b>Creativity and Innovation (CI)</b></p>

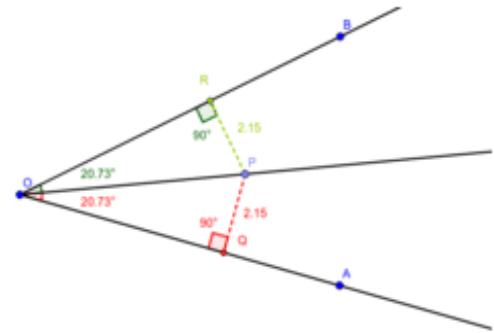
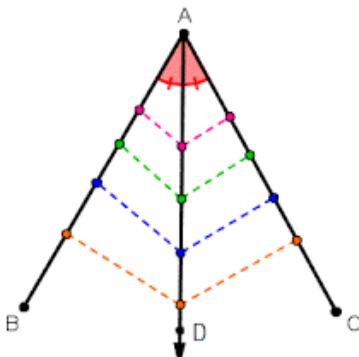
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>E.g.3: Draw circles of given radii at the points as centre and chord.</p>	<p><b>Creativity and Innovation (CI)</b></p>

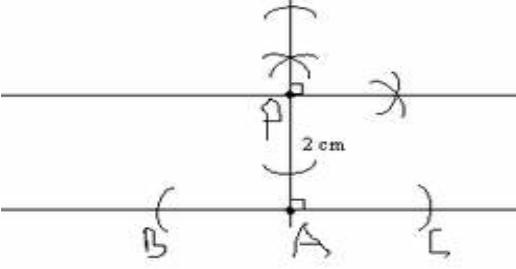
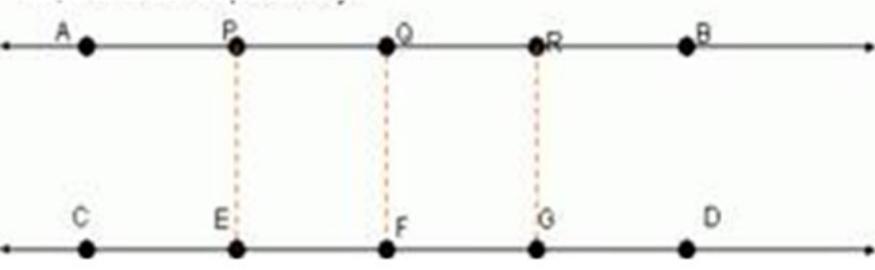
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b>	<p>E.g.4: Construct a regular hexagon within a circle given the length of a side</p> <p>Use a pair of compasses and a ruler to construct a hexagon ABCDEF such that <math> AB  = 6\text{cm}</math>. Find the measure of the angles AOB and compare to its value to <math>\angle AFG</math>, <math>\angle DOE</math>, <math>\angle DOC</math>, <math>\angle EOF</math> and <math>\angle BOC</math>. What is your observation?</p> 	<b>Creativity and Innovation (CI)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>E.g.5 Use intersecting circles to construct a regular hexagon and measure its sides.</p> <p>Perform geometric construction of hexagon ABCDEF using the method of intersecting circles. Take <math> OA  = 5\text{cm}</math>. Measure and compare the sides of the hexagon. Find the measure of the angles <math>\angle AOB</math> and compare to its value to <math>\angle AFG</math>, <math>\angle DOE</math>, <math>\angle DOC</math>, <math>\angle EOF</math> and <math>\angle BOC</math>. What is your observation?</p> 	<p><b>Creativity and Innovation (CI)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>E.g.6: Construct a perpendicular bisector (mediator) as a locus and explain why the perpendicular bisector is a locus.</p> <p>The line segment AB is a perpendicular bisector of PQ since line segments AP, AQ, PB, QB are all congruent.</p> 	<p><b>Creativity and Innovation (CI)</b></p>

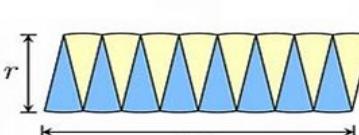
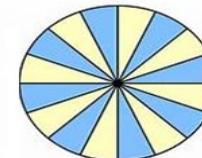
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<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>Any point on line CD is of equal distance from the two fixed points A and B.</p> 	<p><b>Creativity and Innovation (CI)</b></p>

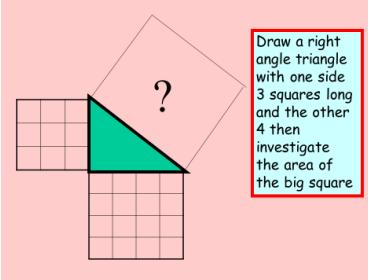
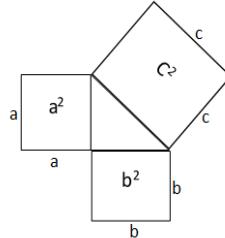
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<p><b>B8.3.1.2 Demonstrate the ability to perform geometric constructions of the angles (<math>75^\circ</math>, <math>105^\circ</math>, <math>60^\circ</math>, <math>135^\circ</math> and <math>150^\circ</math>), and construct triangles and find locus of points under given conditions.</b></p>	<p>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.</p> 	<p><b>Creativity and Innovation (CI)</b></p>
	<p>AD is a mediator (angle bisector) of the angle BAC</p> 	

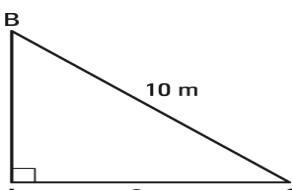
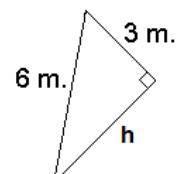
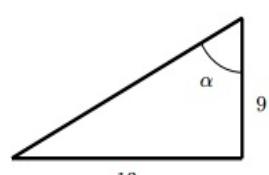
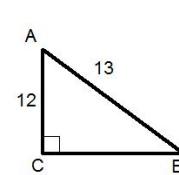
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	<p>E.g.9: Perform geometric constructions to prove that two given lines are parallel.</p> <p>Show that two given lines AB and CD are parallel (i.e. locate three points P, Q and R) draw perpendicular to AB at PQ and R to intersect CD at E, F and G respectively.</p>  <p>Measure the lengths of PE, QF, and RG. The perpendicular distance between two parallel lines is the same everywhere.</p>	

## STRAND 3 GEOMETRY AND MEASUREMENT

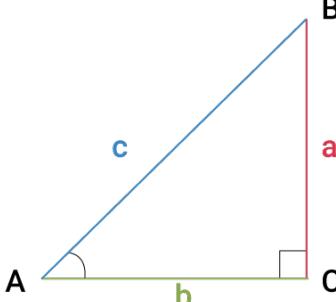
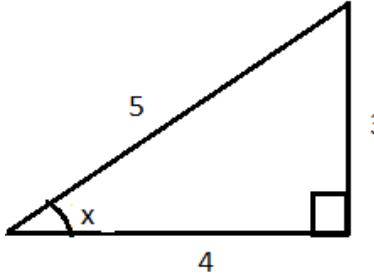
### *Sub-strand 2: Measurement*

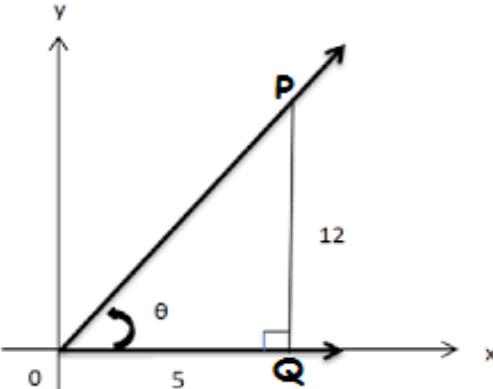
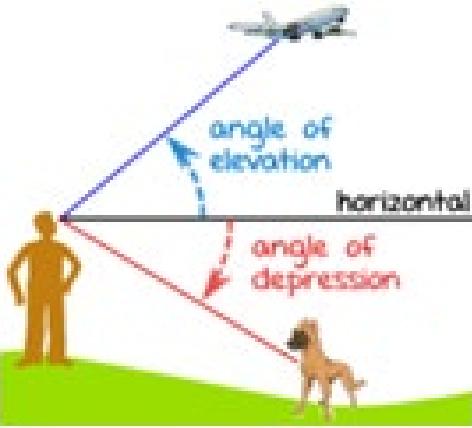
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.8.3.2.1 Apply the Pythagoras theorem, the primary trigonometric ratios and the formulas for determining the area of a circle to solve real problems.	<p><b>B8.3.2.1.1</b> Use the relationship between the diameter and circumference of a circle to deduce the formula for finding its area, and use this to solve problems.</p> <p>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 = <math>\pi r</math> width = <math>r</math></p> <div style="text-align: center;">  <math display="block">\therefore A = \pi r \times r = \pi r^2</math>  </div>	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b>
	<p>E.g. 2 Solve problems on area of a circle.</p> <p>(i) Find the area of a circle whose radius is 14cm (Take <math>\pi = 22/7</math>).</p> <p>(ii) Find the area of a semi-circle whose radius is 7cm (Take <math>\pi = 22/7</math>)</p> <p>(iii) Two circles have a common centre; the small circle has radius 7cm, the big circle has radius 14cm. Find the shaded area. (Take <math>\pi = 22/7</math>).</p>	

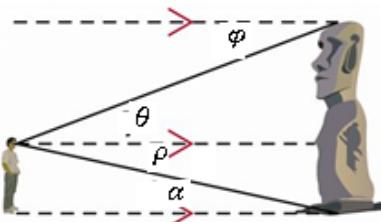
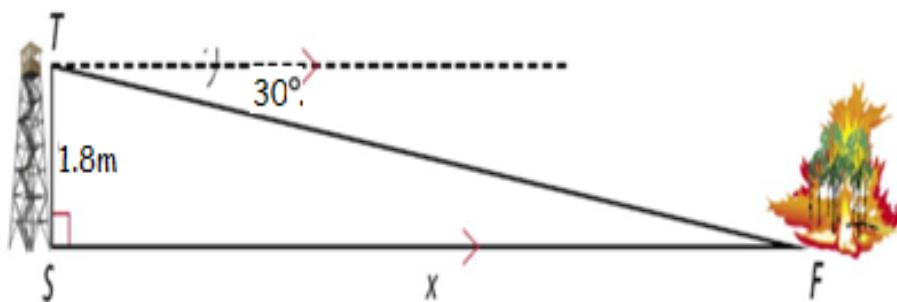
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.8.3.2.1 Apply the Pythagoras theorem, the primary trigonometric ratios and the formulas for determining the area of a circle to solve real problems.	<p><b>B8.3.2.1.2</b> Establish the relationship between the hypotenuse 'c' and the two other sides 'a' and 'b' of a right-angled triangle (i.e. <math>a^2 + b^2 = c^2</math>) and use it to solve problems.</p> <p>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 <b>sides</b> 'a' and 'b' of a right-angled triangle i.e. <math>a^2 + b^2 = c^2</math></p> 	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b>
	<p>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 <b>sides</b> 'a' and 'b' of a right-angled triangle i.e. <math>a^2 + b^2 = c^2</math>.</p> 	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p>E.g. 3 Solve problems involving the Pythagoras theorem.</p> <ul style="list-style-type: none"> <li>i. Determine the missing side marked <math>h</math> in the figure.</li> <li>ii. Find the height <math>AB</math>.</li> </ul>  	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b>
	<p><b>B8.3.2.1.3 Use the Pythagorean theorem to solve problems on right-angled triangle.</b></p> <p>E.g.1 An isosceles triangle has equal sides, 6cm long and a base of 4cm long. Find the altitude of the triangle.</p> <p>E.g.2 Find the length of each of the diagrams indicated below:</p>    <p>(i) the length <math>x</math>  (ii) the length <math>CB</math>  (iii) the longer length</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p><b>B8.3.2.1.4 Use the Pythagoras theorem to calculate the area of a triangle in real life problems.</b></p> <p>E.g.1 A boat travels 2m South and then 9m East. How far is the boat from its starting point?</p> <p>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.</p> <ul style="list-style-type: none"> <li>(i) Find the length of the wire used to hang the picture frame.</li> <li>(ii) Find the area of the triangle.</li> </ul> <p>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.</p> <p>E.g.4 The length of a side of an equilateral triangle is 12cm. Find</p> <ul style="list-style-type: none"> <li>i. the height of the triangle</li> <li>ii. the area of the triangle</li> <li>iii. the perimeter of the triangle</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>
	<p><b>B8.3.2.1.5 Establish the relationship between the basic trigonometric ratios and solve problems involving right-angled triangles.</b></p> <p>E.g.1 Identify and recognise the three primary trigonometric ratios.</p> <ul style="list-style-type: none"> <li>i. Establish the sine, cosine and tangent of an angle in a right-angled triangle</li> </ul>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B.8.3.2.1</b> Apply the Pythagoras theorem, the primary trigonometric ratios and the formulas for determining the area of a circle to solve real problems.</p>	<p><b>SOH – CAH - TOA</b></p>  <p>sine of <math>\angle A = \sin A = \frac{\text{Opposite}}{\text{Hypotenuse}} = \frac{a}{c}</math></p> <p>cosine of <math>\angle A = \cos A = \frac{\text{Adjacent}}{\text{Hypotenuse}} = \frac{b}{c}</math></p> <p>tangent of <math>\angle A = \tan A = \frac{\text{Opposite}}{\text{Adjacent}} = \frac{a}{b}</math></p>	<p>Critical Thinking and Problem solving (CP)</p> <p>Personal Development and Leadership (PL)</p>
	<p>i. Find <math>\sin X</math>, <math>\cos X</math> and <math>\tan X</math> in the diagram</p> 	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p>ii. Write two trig ratios of the angle marked <math>\theta</math> in the diagram below:</p> 	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>
	<p>E.g. 2 Explain the angles of elevation and depression in real life situations.</p> 	

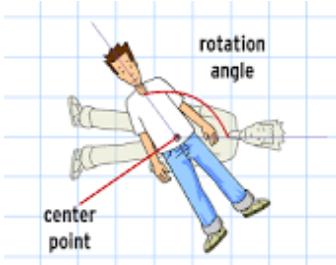
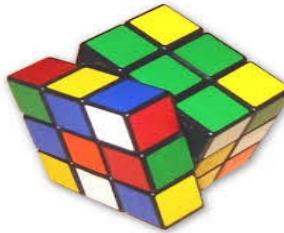
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B.8.3.2.1 Apply the Pythagoras theorem, the primary trigonometric ratios and the formulas for determining the area of a circle to solve real problems.	<p>ii. Identify angles of elevation and depression from the diagram</p> 	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b>
	<p>E.g.3 Use trig ratios and the Pythagoras theorem to solve problems involving angles of elevation and depression.</p> <p>i. A hunter, on top of a tower, sees a fire at an angle of depression of <math>30^\circ</math>. 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.</p> 	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.2.2 Demonstrate understanding of addition and subtraction of vectors and their applications in solving basic problems</b>	<p><b>B8.3.2.2.1 Add, subtract and find the scalar multiplication of vectors in the component form.</b></p> <p>E.g1 Add vectors using the graphical method.</p> <p>E.g.2 Add and subtract vectors in their corresponding components.</p> <p>If <math>\overrightarrow{AB} = \begin{pmatrix} a \\ b \end{pmatrix}</math> and <math>\overrightarrow{BC} = \begin{pmatrix} c \\ d \end{pmatrix}</math></p> <p>then <math>\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}</math></p> $= \begin{pmatrix} a \\ b \end{pmatrix} + \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a+c \\ b+d \end{pmatrix}$ <p>If <math>\overrightarrow{AB} = \begin{pmatrix} a \\ b \end{pmatrix}</math> and <math>\overrightarrow{BC} = \begin{pmatrix} c \\ d \end{pmatrix}</math></p> <p>then <math>\overrightarrow{AC} = \overrightarrow{AB} - \overrightarrow{BC}</math></p> $= \begin{pmatrix} a \\ b \end{pmatrix} - \begin{pmatrix} c \\ d \end{pmatrix} = \begin{pmatrix} a-c \\ b-d \end{pmatrix}$ <p>E.g3 Multiply a vector by a scalar <math>k\begin{pmatrix} x \\ y \end{pmatrix} = k\begin{pmatrix} kx \\ ky \end{pmatrix}</math></p> <p>E.g.4 If <math>p=\begin{pmatrix} -1 \\ 2 \end{pmatrix}</math>, <math>q=\begin{pmatrix} 4 \\ 3 \end{pmatrix}</math>, and <math>r=\begin{pmatrix} 3 \\ -2 \end{pmatrix}</math>, find (i) <math>3q-2p</math> (ii) <math>r-3p</math> (ii) <math>q-p+2r</math></p>	<b>Critical Thinking and Problem solving (CP)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.3.2.2 Demonstrate understanding of addition and subtraction of vectors and their applications in solving basic problems</b>	<p><b>B8.3.2.2 Demonstrate understanding of vector equality.</b></p> <p>E.g.1 Investigate the properties of equal vectors.</p> <ul style="list-style-type: none"> <li>i. If <math>a = \begin{pmatrix} 3 \\ 5 \end{pmatrix}</math>, <math>b = \begin{pmatrix} 7 \\ 2 \end{pmatrix}</math> and <math>c = \begin{pmatrix} -3 \\ -4 \end{pmatrix}</math>, Calculate <math> p </math>, if <math>p = a + \frac{1}{2}(b-c)</math></li> <li>ii. If <math>M = N</math>, find the value of <math>x</math> and <math>y</math> given that <math>M = \begin{pmatrix} x-2 \\ x-y \end{pmatrix}</math> and <math>N = \begin{pmatrix} 1 \\ 2x-1 \end{pmatrix}</math></li> </ul>	<b>Critical Thinking and Problem solving (CP)</b>

## STRAND 3: GEOMETRY AND MEASUREMENT

### *Sub-strand 3: Position and Transformation*

CONTENT STANDARDS	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)	<p><b>B8.3.3.1.1 Understand rotation and identify real-life situations involving rotation.</b></p> <p>E.g.1. Identify examples of rotation situations in everyday life and the nature of rotational movements as clockwise and anti-clockwise.</p>  	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b> <b>Digital Literacy (DL)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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)</b>	<p><b>B8.3.3.1.2 Draw rotation image in a coordinate plane and determine the angle of rotation.</b></p> <p>E.g. 1. Rotate a shape through a given centre of rotation and angle of rotation using rotation rules.</p> <ul style="list-style-type: none"> <li>i. State the object points and its corresponding image points under a given rotation.</li> <li>ii. Draw points of shapes under a clockwise or anti-clockwise rotation through a given angle about the origin (<math>90^\circ</math>, <math>180^\circ</math>, <math>270^\circ</math>).</li> </ul> <p>E.g. 2. Determine the angle of rotation using the points of an object, its images and centre.</p>	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b> <b>Digital Literacy (DL)</b>
	<p><b>B8.3.3.1.3 Investigate the concept of congruent shapes.</b></p> <p>E.g. 1. Use multiple and varied examples of rotation on coordinate planes to verify congruent shapes based on their properties.</p>	

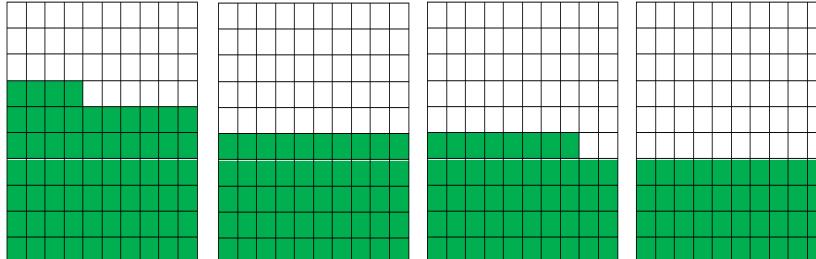
## STRAND 4: HANDLING DATA

### *Sub-strand 1: Data*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.4.1.1 Select, 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.</b>	<p><b>B8.4.1.1.1 Identify types of given data including numerical, categorical, ungrouped and grouped data</b></p> <p>E.g. 1 Discuss, in small groups, information collected in the process of investigation which may be numeric.</p> <ul style="list-style-type: none"> <li>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.</li> <li>ii. Numeric (and continuous): the weights of babies in a crèche (e.g. 4.5kg) which contains fractional values.</li> </ul> <p>E.g. 2 Discuss (in groups)information collected in the process of investigation which may be non-numeric.</p> <ul style="list-style-type: none"> <li>i. Non-numeric (cannot be quantified): sex (male or female); income group, movie type, age group, marital status, boxers' weight class, etc.</li> <li>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)</li> <li>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.</li> </ul>	<b>Critical Thinking and Problem solving (CP)</b> <b>Communication and Collaboration (CC)</b> <b>Personal Development and Leadership (PL)</b> <b>Digital Literacy (DL)</b>
	<p>E.g. 3</p> <ul style="list-style-type: none"> <li>i. The scores for 11 learners in a class test are 25, 30, 35, 40, 45, 26, 29, 50, 45, 37 and 47(these <b>individual</b> scores are <b>not grouped</b> in any way).</li> <li>ii. Find out those in the <b>group</b> 25 to 35 (i.e. 5) and those in the <b>group</b> 36 to 50 (i.e. 6)Data is now <b>grouped</b>.</li> </ul>	

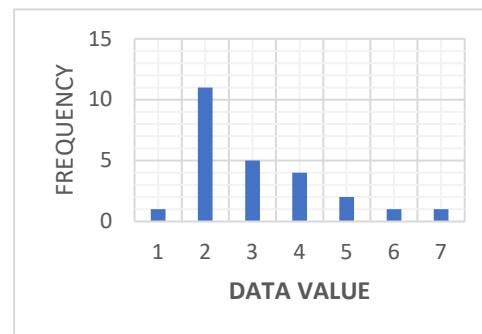
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.4.1.1 Select, justify, and use appropriate methods to collect data (quantitative and qualitative), use the data (grouped/ungrouped) to construct and interpret frequency tables, bar charts, pie charts, and pictograms to solve and/or pose problems.</b></p>	<p><b>B8.4.1.1.2 - Select and justify a method to collect data (quantitative and qualitative) to answer a given question.</b></p> <p>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 <b>B7.4.1.1.1</b>)</p> <ul style="list-style-type: none"> <li>i. Will eating twice a person's normal number of cream crackers increase their productivity?</li> <li>ii. Are people who eat more cream crackers more productive?</li> <li>iii. Does a group of students study better when cream crackers are present or absent?</li> </ul>	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Personal Development and Leadership (PL)</p> <p>Digital Literacy (DL)</p>
	<p>E.g. 2 -Select any study to be undertaken and design an appropriate form to be used in collecting data.</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																																																
<p><b>B8.4.1.1 Select, 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.</b></p>	<p><b>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.</b></p> <p>E.g. 1The 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.</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td>40</td><td>54</td><td>25</td><td>50</td><td>58</td><td>45</td><td>47</td><td>49</td><td>30</td><td>28</td></tr> <tr><td>52</td><td>31</td><td>52</td><td>41</td><td>47</td><td>44</td><td>46</td><td>39</td><td>51</td><td>59</td></tr> <tr><td>49</td><td>38</td><td>43</td><td>48</td><td>43</td><td>43</td><td>40</td><td>51</td><td>40</td><td>56</td></tr> <tr><td>31</td><td>53</td><td>44</td><td>37</td><td>35</td><td>37</td><td>33</td><td>38</td><td>46</td><td>36</td></tr> </table> <p>(i) Copy and complete the frequency distribution table below, using the data set above.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Lengths (mm)</th> <th>Tally</th> <th>Frequency</th> </tr> </thead> <tbody> <tr><td>25 – 29</td><td></td><td></td></tr> <tr><td>30 – 34</td><td></td><td></td></tr> <tr><td>35 - 39</td><td></td><td></td></tr> <tr><td>40 – 44</td><td></td><td></td></tr> <tr><td>45 – 49</td><td></td><td></td></tr> <tr><td>50 – 54</td><td></td><td></td></tr> <tr><td>55 - 59</td><td></td><td></td></tr> </tbody> </table>	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	Lengths (mm)	Tally	Frequency	25 – 29			30 – 34			35 - 39			40 – 44			45 – 49			50 – 54			55 - 59			<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Personal Development and Leadership (PL)</p> <p>Digital Literacy (DL)</p>
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B8.4.1.1 Select, 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.</b></p>	<p>E.g. -2 A cleaner of a small office spent GH₵120 of his salary on food; GH₵80 on rent; GH₵40 on clothing, GH₵110 on transport and saved GH₵50. Organise the data and draw (i) a bar chart and (b) a pie chart to represent the data.</p> <p>E.g. -3 – The waffle chart (i.e. a 10 X 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%.</p> <p>i. Read and record the average scores obtained by B8, B9 and B10.</p> <p style="text-align: center;">B 7                    B 8                    B 9                    B 10</p>  <p>ii. In a mathematics quiz Cordei scored <b>75%</b>, Kofi scored <b>80%</b>, Maama scored <b>35%</b>, Kpakpo scored <b>70%</b> and Adjoa scored <b>50%</b>. Draw a waffle chart to represent the data.</p>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES								
B8.4.1.1 Select, 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.	<p>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 visualizing the shape of a distribution and giving a great idea about the distribution of the data.)</p> <p>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.</p> <p>(Note that though there are no scores for 30s and 40s, 0s <b>should not</b> be put against stem 3 and stem 4. those spaces must be left blank. However, 0 <b>should</b> be put against 8 for 80)</p> <p>ii. From the plot, what can we say about the performance of the 14 B8 learners?</p> <p style="text-align: center;">Where:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: right;">stem</td> <td style="text-align: left;">leaf</td> </tr> <tr> <td style="text-align: right;">2</td> <td style="text-align: left;">3</td> <td style="text-align: left;">23</td> </tr> <tr> <td style="text-align: right;">7</td> <td style="text-align: left;">112</td> <td style="text-align: left;">71, 71, 72</td> </tr> </table>	stem	leaf	2	3	23	7	112	71, 71, 72	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>
stem	leaf									
2	3	23								
7	112	71, 71, 72								

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																
	<p>E.g. 5 – The stem and leaf plot shows the scores obtained by learners in a test. Use it to answer the following questions:</p> <ol style="list-style-type: none"> <li>What are the scores? Write them in ascending order.</li> <li>What is the mode of the scores?</li> <li>What is the median of the scores?</li> </ol> <table border="1"> <thead> <tr> <th>Stem</th> <th>Leaf</th> </tr> </thead> <tbody> <tr><td>1</td><td>5</td></tr> <tr><td>2</td><td>0</td></tr> <tr><td>3</td><td>5 5 5 5 7</td></tr> <tr><td>4</td><td>5</td></tr> <tr><td>5</td><td>5 5</td></tr> <tr><td>7</td><td>5 5</td></tr> <tr><td>9</td><td>0</td></tr> </tbody> </table>	Stem	Leaf	1	5	2	0	3	5 5 5 5 7	4	5	5	5 5	7	5 5	9	0	
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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.	<p><b>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.</b></p> <p>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).</p> <table border="1"> <caption>Sales Collected (GH₵)</caption> <thead> <tr> <th>Day</th> <th>Sales (GH₵)</th> </tr> </thead> <tbody> <tr><td>Mon</td><td>300</td></tr> <tr><td>Tue</td><td>300</td></tr> <tr><td>Wed</td><td>300</td></tr> <tr><td>Thu</td><td>300</td></tr> <tr><td>Fri</td><td>300</td></tr> </tbody> </table>	Day	Sales (GH₵)	Mon	300	Tue	300	Wed	300	Thu	300	Fri	300	<b>Critical Thinking and Problem solving (CP)</b> <b>Communication and Collaboration (CC)</b>				
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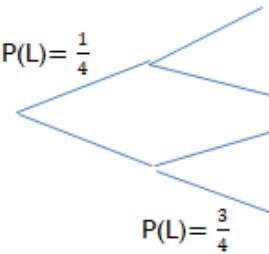
ONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																
<b>B8.4.1.2 Demonstrate an understanding of measures of central tendency (mean, median, mode) and range for grouped data and explain when it's most appropriate to use the mean, median, or mode.</b>	<p>E. g. 2 The table below shows the area of the sitting room floors of each of 7 real-estate houses (A, B C, ...) in Kwashiman</p> <table border="1"> <thead> <tr> <th>Houses</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th></tr> </thead> <tbody> <tr> <td>Area (m<sup>2</sup>)</td><td>22</td><td>24</td><td>26</td><td>30</td><td>48</td><td>30</td><td>30</td></tr> </tbody> </table> <ul style="list-style-type: none"> <li>i. In small groups, work out the mean, median, mode.</li> <li>ii. Draw a bar chart to represent the data collected, and</li> <li>iii. Explain why the values are the same.</li> </ul>	Houses	A	B	C	D	E	F	G	Area (m <sup>2</sup> )	22	24	26	30	48	30	30	<b>Critical Thinking and Problem solving (CP)</b> <b>Communication and Collaboration (CC)</b>
Houses	A	B	C	D	E	F	G											
Area (m <sup>2</sup> )	22	24	26	30	48	30	30											
	<p>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.</p> <table border="1"> <thead> <tr> <th>Data Value</th><th>Frequency</th></tr> </thead> <tbody> <tr> <td>1</td><td>1</td></tr> <tr> <td>2</td><td>11</td></tr> <tr> <td>3</td><td>5</td></tr> <tr> <td>4</td><td>4</td></tr> <tr> <td>5</td><td>2</td></tr> <tr> <td>6</td><td>1</td></tr> <tr> <td>7</td><td>1</td></tr> </tbody> </table>  <ul style="list-style-type: none"> <li>i. Calculate the mean, median, mode.</li> <li>ii. Locate them on the corresponding graph.</li> <li>iii. Explain why the values are different.</li> </ul>	Data Value	Frequency	1	1	2	11	3	5	4	4	5	2	6	1	7	1	
Data Value	Frequency																	
1	1																	
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES														
<p><b>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.</b></p>	<p><b>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.</b></p> <p>E.g.1 Kojo's says his taxi makes a number of trips each day as shown in the table below:</p> <table border="1"> <thead> <tr> <th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th><th>Saturday</th><th>Sunday</th></tr> </thead> <tbody> <tr> <td>8</td><td>6</td><td>10</td><td>10</td><td>9</td><td>10</td><td>3</td></tr> </tbody> </table> <ul style="list-style-type: none"> <li>i. Calculate the mean, median and mode for Kojo's trips for the week</li> <li>ii. Which measure of central tendency best represents or describes the number of trips that Kojo makes each day?</li> <li>iii. Justify the choice of central tendency in (ii).</li> </ul>	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	8	6	10	10	9	10	3	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p>
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday										
8	6	10	10	9	10	3										

## STRAND 4: HANDLING DATA

### *Sub-strand 2: Chance or Probability*

CONTENT STANDARDS	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.	<p><b>B8.4.2.1.1.</b> 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</p> <p>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.</p> <ul style="list-style-type: none"> <li>i. List the elements of the sample space of the events.</li> <li>ii. The sample space of the event of picking a red bottle top, R, with replacement is?</li> <li>iii. The probability of picking a red bottle top is .....</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Cultural Identity and Global Citizenship (CG)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>
	<p>E.g. 2 Consider the following two events: (a) throwing of a fair six-sided die and (b) tossing a fair coin</p> <ul style="list-style-type: none"> <li>i. What is the sample space for (a) and for (b)?</li> <li>ii. Does the occurrence of event (a) affect the occurrence of event (b)?</li> <li>iii. What is the probability of an even number showing up in (a)? What is the probability of a head showing up in (b)?</li> <li>iv. What is the relationship between the two events?</li> </ul>	
	<p>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.</p> <ul style="list-style-type: none"> <li>i. Does the event of Ampofo affect that of Serwa?</li> <li>ii. Can the two events occur together?</li> </ul>	

CONTENT STANDARDS	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.	<p><b>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.</b></p> <p>E.g. 1 The arrow on the spinner is spun twice and the number of wins recorded;</p> <ol style="list-style-type: none"> <li>identify the sample space.</li> <li>calculate the probability of a win <math>P(W)</math> and the probability of a lose, <math>P(L)</math>.</li> <li>copy and complete the probability tree diagram below that represents the events, i.e. the 1<sup>st</sup> and 2<sup>nd</sup> spins.</li> <li>express the probabilities stated on the branches in decimals, percentages and ratios.</li> </ol>  	<p>Critical Thinking and Problem solving (CP)</p> <p>Personal Development and Leadership (PL)</p>
	<p>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.</p> <ol style="list-style-type: none"> <li>What is the sample space of the 1<sup>st</sup> and the 2<sup>nd</sup> trials?</li> <li>Draw a probability tree diagram to represent the event.</li> </ol>	

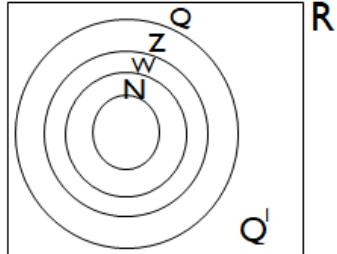
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B8.4.2.1 Identify the sample space for a probability experiment involving two independent events and express the probabilities of given events as fractions, decimals, percentages and/or ratios to solve problems.</b>	<p>E.g. 2 A die is thrown at most three times. If 6 is scored the game stops.</p> <p>i. Copy and complete the probability tree diagram. ii. Explain why some of the branches of the tree diagram have disappeared.</p>	<b>Critical Thinking and Problem solving (CP)</b>  <b>Cultural Identity and Global Citizenship (CG)</b>

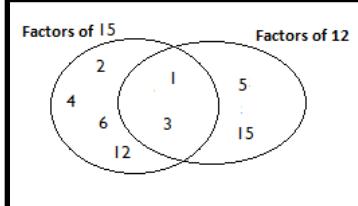
# BASIC 9

## STRAND 1: NUMBER

### *Sub-strand 1: Number and Numeration System*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
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	<p><b>B9.1.1.1.1 Express integers to a given number of significant and decimal places</b></p> <p>E.g.1. Express integers to a number of significant figures.</p> <p>(i) 857,386,321</p> <ul style="list-style-type: none"> <li>-five significant figures</li> <li>-four significant figures</li> <li>-three significant figures.</li> </ul> <p>E.g.2. Express decimal numbers to a given number of decimal places.</p> <p>(i) Write 98745.9674 correct to</p> <ul style="list-style-type: none"> <li>-three decimal places</li> <li>-two decimal places</li> <li>-one decimal place</li> </ul> <p><b>B9.1.1.1.2. Use knowledge and understanding of place value to solve real life problems</b></p> <p>E.g.1. Create and solve a real-life problem or a story problem and write the answer in standard form.</p> <p>(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?</p>	<p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>Think second digit: <math>3 \times 3 = 9</math></p> <p>fourth digit: <math>2 \times 3 = 6</math></p> <p>first digit: <math>9 - 2 = 7</math></p> <p>last digit: <math>7 - 5 = 2</math></p> <p>fifth digit: <math>6 - 1 = 5</math></p> <p>third digit: <math>6 \square \square \square</math></p> <p>So, the number is <math>793652 = 7.93652 \times 10^5</math></p> <p>E.g.2 Create similar real story problems and solve</p>	
<b>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</b>	<p><b>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.</b></p> <p>E.g. 1 Use sets diagrams to show the relationship among the Real numbers namely</p> <ul style="list-style-type: none"> <li>-Irrational numbers (<math>Q^I</math>)</li> <li>-Rational numbers (<math>Q</math>)</li> <li>- Integers (<math>Z</math>)</li> <li>-Whole numbers (<math>W</math>)</li> <li>-Natural or Counting numbers (<math>N</math>)</li> </ul> 	<b>Communication and Collaboration (CC)</b> <b>Creativity and Innovation (CI)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p>E.g. 2 Write the factors of 12 and 15 and represent them on a Venn diagram.</p> <p><math>12=\{1, 2, 3, 4, 6, 12\}</math></p> <p><math>15=\{1, 3, 5, 15\}</math></p> 	<b>Communication and Collaboration (CC)</b>
	<b>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</b>	
	<p>E.g.1 Create and solve real life problems to show the union and intersection of two sets.</p> <p>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:</p> <ol style="list-style-type: none"> <li>both crops.</li> <li>only one crop.</li> </ol>	

## STRAND 1: NUMBER

### *Sub-strand 2: Number Operations*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B.9.1.2.1 Apply mental mathematics and properties to determine answers for addition and subtraction of basic facts.</b>	<p><b>B9.1.2.1.1 Multiply and divide given numbers by powers of 10 including decimals and benchmark fractions</b></p> <p>E.g.1. Recall multiplication facts up to 144 and related division facts.</p> <p>E.g.2. Recall decimal names of given benchmark fractions converted to decimals or percentages (and vice versa)</p> <p>E.g. 3. Find the product of a given decimal number when it is multiplied by 10, 100, 1000, <math>\frac{1}{10}</math>, <math>\frac{1}{100}</math>, <math>\frac{1}{1000}</math>, etc.</p>	<b>Creativity and Innovation (CI)</b>
	<p><b>B.9.1.2.1.2 Demonstrate the ability to determine commutative properties of addition and multiplication.</b></p> <p>E.g1. Recognise that for any two numbers <b>a</b> and <b>b</b>;</p> <ul style="list-style-type: none"> <li>i. <math>a + b = b + a</math> i.e. <math>25 + 32 = 32 + 25 = 57</math></li> <li>ii. <math>a \times b = b \times a</math> i.e. <math>17 \times 8 = 8 \times 17 = 136</math></li> </ul> <p><b>B9.1.2.1.3 Use the associative property of addition and multiplication.</b></p>	
	<p>E.g1. Recognise that for any three numbers <b>a</b>, <b>b</b> and <b>c</b>;</p> <ul style="list-style-type: none"> <li>i. <math>a + (b + c) = (a + b) + c</math> or <math>a + (b + c) = (a + c) + b</math> i.e. <math>15 + (6 + 9) = (15 + 6) + 9 = 30</math></li> <li>ii. <math>(a \times b) \times c = a \times (b \times c)</math> i.e. <math>(12 \times 5) \times 4 = 12 \times (5 \times 4) = 240</math></li> </ul>	

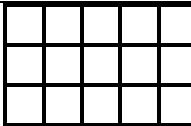
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p><b>B9.1.2.1.4 Use the distributive property in solving problems.</b></p> <p>E.g1. Recognise that for any three numbers <b>a</b>, <b>b</b> and <b>c</b>;</p> <ol style="list-style-type: none"> <li><math>a \times (b + c) = (a \times b) + (a \times c)</math> i.e. <math>5 \times (10 + 7) = (5 \times 10) + (5 \times 7) = 85</math></li> <li><math>a \times (b - c) = (a \times b) - (a \times c)</math> i.e. <math>5 \times (10 - 7) = (5 \times 10) - (5 \times 7) = 15</math></li> </ol>	
<b>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</b>	<p><b>B9.1.2.2.1 Solve operations involving addition, subtraction, multiplication and division using word problems.</b></p> <p>E.g. Create and solve story problems involving a combination of two or more of the basic operations. <math>(\times, \div, -, +)</math>.</p> <p>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?</p>	<b>Critical Thinking and Problem solving (CP)</b> <b>Communication and Collaboration (CC)</b>
	<p><b>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.</b></p> <p>ii) The price of a jacket is three times that of a shirt. The price of a jacket is GH₵560.65. 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:</p> <p>α) two decimal places β)three significant figures</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES		
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.	<p><b>B9.1.2.4.1 Identify simple and compound surds.</b></p> <p>E.g.</p> <p>i. <math>\sqrt{2}</math>,    ii. <math>7\sqrt{3}</math>,    iii. <math>2\sqrt{5}</math></p> <p>iv. <math>(\sqrt{3} + \sqrt{7} - \sqrt{5})</math></p> <p><b>B9.1.2.4.2 Explain the identities/rules of surds</b></p> <table border="0"> <tr> <td style="vertical-align: top;"> <b>Rule 1</b>  <math>\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}</math>    <b>Rule 2</b>  <math>\frac{\sqrt{a}}{\sqrt{b}} = \frac{\sqrt{a}}{\sqrt{b}}</math>    <b>Rule 3</b>  <math>\frac{b}{\sqrt{a}} = \frac{b}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = \frac{b\sqrt{a}}{a}</math> </td><td style="vertical-align: top;"> <b>Rule 4</b>  <math>a\sqrt{c} \pm b\sqrt{c} = (a \pm b)\sqrt{c}</math>    <b>Rule 5</b>  <math>\frac{c}{a + b\sqrt{n}} = \frac{c}{a + b\sqrt{n}} \times \frac{a - b\sqrt{n}}{a - b\sqrt{n}}</math>    <b>Rule 6</b>  <math>\frac{c}{a - b\sqrt{n}} = \frac{c}{a - b\sqrt{n}} \times \frac{a + b\sqrt{n}}{a + b\sqrt{n}}</math> </td></tr> </table>	<b>Rule 1</b> $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$  <b>Rule 2</b> $\frac{\sqrt{a}}{\sqrt{b}} = \frac{\sqrt{a}}{\sqrt{b}}$  <b>Rule 3</b> $\frac{b}{\sqrt{a}} = \frac{b}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = \frac{b\sqrt{a}}{a}$	<b>Rule 4</b> $a\sqrt{c} \pm b\sqrt{c} = (a \pm b)\sqrt{c}$  <b>Rule 5</b> $\frac{c}{a + b\sqrt{n}} = \frac{c}{a + b\sqrt{n}} \times \frac{a - b\sqrt{n}}{a - b\sqrt{n}}$  <b>Rule 6</b> $\frac{c}{a - b\sqrt{n}} = \frac{c}{a - b\sqrt{n}} \times \frac{a + b\sqrt{n}}{a + b\sqrt{n}}$	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p>
<b>Rule 1</b> $\sqrt{a \times b} = \sqrt{a} \times \sqrt{b}$  <b>Rule 2</b> $\frac{\sqrt{a}}{\sqrt{b}} = \frac{\sqrt{a}}{\sqrt{b}}$  <b>Rule 3</b> $\frac{b}{\sqrt{a}} = \frac{b}{\sqrt{a}} \times \frac{\sqrt{a}}{\sqrt{a}} = \frac{b\sqrt{a}}{a}$	<b>Rule 4</b> $a\sqrt{c} \pm b\sqrt{c} = (a \pm b)\sqrt{c}$  <b>Rule 5</b> $\frac{c}{a + b\sqrt{n}} = \frac{c}{a + b\sqrt{n}} \times \frac{a - b\sqrt{n}}{a - b\sqrt{n}}$  <b>Rule 6</b> $\frac{c}{a - b\sqrt{n}} = \frac{c}{a - b\sqrt{n}} \times \frac{a + b\sqrt{n}}{a + b\sqrt{n}}$			
	<b>B9.1.2.4.3 Simplify given surds</b>	)		
	<p>E.g. 1 Simplify:</p> <p>i. <math>\sqrt{27}</math></p> <p>ii. <math>\frac{\sqrt{8}}{16}</math></p> <p>iii. <math>\frac{\sqrt{12}}{121}</math></p> <p>iv. <math>(\sqrt{2})^2</math></p>			

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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.</b>	<p><b>B9.1.2.3.4 Approximate the square roots of non-perfect squares with calculators/tables.</b></p> <p>E.g.1 Square roots of non-perfect squares</p> <ul style="list-style-type: none"> <li>i. <math>\sqrt{2}</math></li> <li>ii. <math>\sqrt{5}</math></li> <li>iii. <math>\sqrt{12}</math></li> <li>iv. <math>\sqrt{30}</math></li> </ul>	<p><b>Personal Development and Leadership (PL)</b></p> <p><b>Cultural Identity and Global Citizenship (CG)</b></p>

## STRAND 1: NUMBER

### *Sub-strand 3: Fractions, Decimals and Percentages*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES								
<p><b>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</b></p>	<p><b>B9.1.3.1.1 Review fractions and solve problems involving basic operations on fractions</b></p> <p>E.g. 1. Review the concept of fraction.</p> <div style="display: flex; align-items: center; justify-content: space-around;">   </div> <ul style="list-style-type: none"> <li>i. Shade the fraction of squares in the rectangle that is equal to the shaded portion of the circle.</li> <li>ii. Write down 3 fractions equivalent to <math>\frac{2}{5}</math></li> <li>iii. Express the fraction <math>\frac{15}{10}</math> in its simplest form: <math>\frac{15}{10}</math></li> <li>iv. Express <math>\frac{12}{5}</math> as a mixed number: <math>2\frac{2}{5}</math></li> <li>v. Express <math>2\frac{5}{9}</math> as an improper fraction: <math>2\frac{5}{9}</math></li> </ul> <p>E.g. 2. Review the basic operations on fractions.</p> <ul style="list-style-type: none"> <li>i. Adding and subtracting fractions: Work out answers to the following:</li> </ul> <table style="margin-left: 100px;"> <tr> <td>a)</td> <td><math>\frac{3}{4} + \frac{7}{8}</math></td> <td>b)</td> <td><math>1\frac{1}{2} + \frac{4}{5} - \frac{5}{6}</math></td> </tr> </table> <ul style="list-style-type: none"> <li>ii. Multiplying and dividing fractions. Work out answers to the following:</li> </ul> <table style="margin-left: 100px;"> <tr> <td>a)</td> <td><math>\frac{2}{3} \times \frac{3}{4} - \frac{3}{8}</math></td> <td>b)</td> <td><math>\frac{5}{8} \div 2\frac{1}{2} + \frac{2}{3}</math></td> </tr> </table>	a)	$\frac{3}{4} + \frac{7}{8}$	b)	$1\frac{1}{2} + \frac{4}{5} - \frac{5}{6}$	a)	$\frac{2}{3} \times \frac{3}{4} - \frac{3}{8}$	b)	$\frac{5}{8} \div 2\frac{1}{2} + \frac{2}{3}$	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Personal Development and Leadership (PL)</p> <p>Creativity and Innovation (CI)</p>
a)	$\frac{3}{4} + \frac{7}{8}$	b)	$1\frac{1}{2} + \frac{4}{5} - \frac{5}{6}$							
a)	$\frac{2}{3} \times \frac{3}{4} - \frac{3}{8}$	b)	$\frac{5}{8} \div 2\frac{1}{2} + \frac{2}{3}$							

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.1.3.1</b> 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</p>	<p><b>B9.1.3.1.2</b> 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.</p> <p>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).</p> <ul style="list-style-type: none"> <li>i. <math>3^4 \div 3^2 + 40 - 2^3 \times 3^2 \div 9</math></li> <li>ii. <math>18 \div 6 \times (4 - 3) + 6</math></li> <li>iii. <math>18 \div 3^2 \times (4 - 3) \times 10</math></li> </ul> <p>E.g. 2. Use the order of operations (BODMAS or PEDMAS) to simplify fractions with more than two operations.</p> <ul style="list-style-type: none"> <li>a) <math>\frac{2}{3} \times \frac{3}{4} - \frac{5}{8} \div 2\frac{1}{2}</math></li> <li>b) <math>\frac{3}{4} \div \frac{3}{8} + (\frac{4}{5} - \frac{1}{2})</math></li> <li>c) <math>(\frac{3}{4} + \frac{5}{8}) \times \frac{4}{11} - \frac{1}{2}</math></li> </ul>	<p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>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</b>	<p><b>B9.1.3.1.3. Review word problems involving basic operations on fractions.</b></p> <p>E.g. 1. Solve word problems based on fractions.</p> <ul style="list-style-type: none"> <li>i. A test is made up of 20 questions, how many questions must you answer correctly to get a score of 80%?</li> <li>ii. By what percentage was a television set reduced if it was marked GH₵2,250 and sold for GH₵2,025?</li> <li>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?</li> <li>iv. Esi and Fusena prepared orange drink by mixing orange squash and water. Esi's drink was made of <math>\frac{3}{8}</math> orange squash and Fusena's was made up of <math>\frac{2}{5}</math> orange squash. Whose drink tasted stronger of orange?</li> </ul>	<b>Creativity and Innovation (CI)</b>  <b>Cultural Identity and Global Citizenship (CG)</b>

## STRAND 1: NUMBER

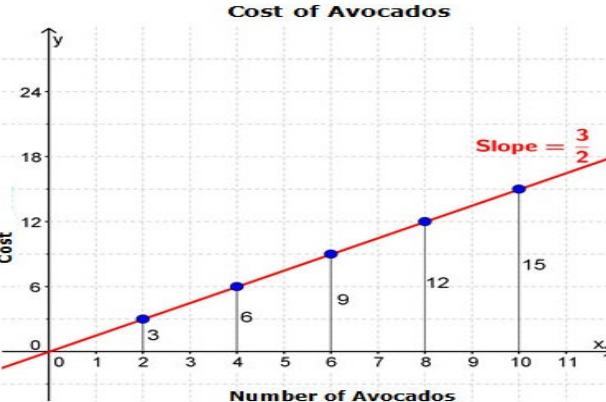
### *Sub-strand 4: Number: Ratios and Proportion*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.1.4.1</b> 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.	<p><b>B9.1.4.1.1</b> Represent proportional relationships by equations.</p> <p><b>E.g.1</b> If total cost (<math>t</math>) is proportional to the number of items (<math>n</math>) purchased at a constant price (<math>p</math>), the relationship between the total cost and the number of items can be expressed as <math>t = pn</math>.</p> <p><b>B9.1.4.1.2</b> Use proportional relationships to solve multistep ratio and percent problems, examples: simple interest, tax, discount and commissions, NHIL, depreciation, insurance, etc.</p> <p><b>E.g.1</b> Solve problems on simple interest.</p> <ul style="list-style-type: none"> <li>i. A girl deposited GH₵ 4500 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?</li> </ul> <p><b>E.g.2</b> Solve problems on tax (VAT).</p> <ul style="list-style-type: none"> <li>i. The VAT rate of Ghana is 12.5%. A man bought an item at GH₵ 4500.00, VAT inclusive. Calculate:           <ul style="list-style-type: none"> <li>b) the basic cost of the item.</li> <li>c) the VAT paid by the man.</li> </ul> </li> </ul>	<b>Critical Thinking and Problem solving (CP)</b> <b>Creativity and Innovation (CI)</b> <b>Personal Development and Leadership (PL)</b> <b>Digital Literacy (DL)</b>
	<p><b>E.g.3</b> Solve problems on discount.</p> <ul style="list-style-type: none"> <li>i. If a car costs GH₵ 80,500.00, what is its new value if there is a discount of 10%?</li> </ul> <p><b>E.g.4</b> Solve problems on commission.</p> <ul style="list-style-type: none"> <li>ii. A car agent's commission on the sale of a car is <math>3\frac{1}{2}\%</math>. Calculate the commission on a car sold for GH₵ 68,000.00.</li> </ul>	

CONTENT STANDARDS	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.	<p><b>E.g.5 solve problems involving depreciation.</b> The value of a mobile phone depreciates at the following rate:</p> <table border="1"> <thead> <tr> <th>Year of manufacture</th> <th>Depreciation on the original value</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>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.</p>	Year of manufacture	Depreciation on the original value	In the first year	5%	In the second year	10%	In the third year	15%	In the fourth year	22%	<p>Critical Thinking and Problem solving (CP)</p> <p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p> <p>Digital Literacy (DL)</p>
Year of manufacture	Depreciation on the original value											
In the first year	5%											
In the second year	10%											
In the third year	15%											
In the fourth year	22%											
	<p><b>E.g.6 Solve problems involving NHIL.</b></p> <ul style="list-style-type: none"> <li>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           <ul style="list-style-type: none"> <li>b) the cost of the television set (NHIL exclusive).</li> <li>c) the NHIL charged.</li> </ul> </li> </ul>											
	<p><b>E.g.7 Solve problems involving insurance.</b></p> <ul style="list-style-type: none"> <li>i. Kofi Mereku insured his house and paid a premium of GH₵ 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.</li> </ul>											
	<p><b>B9.1.4.1.3 Use knowledge of rates and proportional reasoning to solve problems involving SSNIT benefits and contributions.</b></p> <p><b>E.g.1</b> Describe the obligations of the employer/employee and the contribution rates.  <b>Act 766</b>                   <b>PNDC Law 247</b></p> <table> <tbody> <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><b>Total</b></td> <td>18.5% of basic salary</td> <td>17.5% of basic salary</td> </tr> </tbody> </table>	Employer	13.0% of basic salary	12.5 of basic salary	Worker	5.5% of basic salary	5.0% of basic salary	<b>Total</b>	18.5% of basic salary	17.5% of basic salary		
Employer	13.0% of basic salary	12.5 of basic salary										
Worker	5.5% of basic salary	5.0% of basic salary										
<b>Total</b>	18.5% of basic salary	17.5% of basic salary										

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																						
<b>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.</b>	<p><b>E.g.2</b> Calculate employee/employer contributions to SSNIT under Act 766.</p> <p>A worker's basic monthly salary is GH₵3,256.50.</p> <p>b. Calculate the SSNIT contributions under Act 766;</p> <ul style="list-style-type: none"> <li>i) by the employer</li> <li>ii) by the employee</li> </ul> <p>What is the total SSNIT contributions at the end of every month?</p>	<b>Critical Thinking and Problem solving (CP)</b>																						
	<p><b>E.g.3</b> Calculate employee/employer contributions to SSNIT under PNDCL 247.</p> <p>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.</p>																							
	<p><b>E.g.4</b> Calculate employee benefits from SSNIT under Act 766.</p> <p>The table shows the pension rights for SSNIT contributors under Act 766</p> <table border="1"> <thead> <tr> <th>Years of contributions</th><th>15</th><th>16</th><th>17</th><th>18</th><th>...</th><th>30</th><th>31</th><th>32</th><th>...</th><th>35</th></tr> </thead> <tbody> <tr> <td>Pension Rights (%)</td><td>37.500</td><td>38.625</td><td>39.750</td><td>40.875</td><td>...</td><td>54.375</td><td>55.500</td><td>56.625</td><td>...</td><td>60.000</td></tr> </tbody> </table> <p>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 (<b>36 months</b>) over the 20-year period was GH₵15,000.00, calculate his full pension under the National Pension Act 2008, (Act 766).</p> <p><b>Calculation for full pension</b>  Qualifying age = 60 years  Average best 3 years' salary = GH₵15,000  Pension right for 20 years = 43.13% (refer to the table on Pension Rights above)  Annual pension to Mr. Addai = <math>43.13/100 \times 15,000</math></p>	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	
Years of contributions	15	16	17	18	...	30	31	32	...	35														
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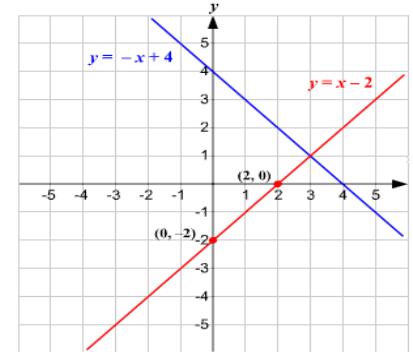
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																										
B9.1.4.1 Apply the understanding of ratio, rate and proportions to solve problems that involve rates, ratios, and proportional reasoning and use it to solve real-world mathematical problems.	<p style="text-align: right;">= GH₵6,469.50</p> <p>Monthly pension to Mr Addai = <math>\frac{\text{GH₵6,469.5}}{12}</math></p> <p><b>=GH₵ 539.13</b></p> <p>b. A worker contributed for <math>7\frac{1}{2}</math> years before being rendered incapacitated. If the best salary for over the 3-year (36 months) period was GH₵ 8,450.40, calculate the <b>invalidity benefit</b> for the worker.</p> <p>c. Mr Mensah's total SSNIT contribution stood at GH₵ 112,426.29 at the time of his demise. Calculate his <b>survivor's benefit</b> if the current interest rate is 15%.</p>	<b>Critical Thinking and Problem solving (CP)</b>																																										
	<p>E.g.5 Calculate employee benefits from SSNIT under PNDCL 247.</p> <p>The table shows the pension rights for SSNIT contributors under PNDCL 247.</p> <table> <thead> <tr> <th>Years of contributions</th> <th>20</th> <th>21</th> <th>22</th> <th>23</th> <th>24</th> <th>25</th> <th>26</th> <th>27</th> <th>28</th> <th>29</th> <th>30</th> <th>...</th> <th>40 &amp; above</th> </tr> </thead> <tbody> <tr> <th>Pension Rights (%)</th> <td>50.</td> <td>51.</td> <td>53.</td> <td>54.</td> <td>56.</td> <td>57.</td> <td>59.</td> <td>60.</td> <td>62.</td> <td>63.</td> <td>65.</td> <td>80.0</td> <td></td> </tr> <tr> <th>Pension Rights (%)</th> <td>0</td> <td>5</td> <td>0</td> <td>5</td> <td>0</td> <td>5</td> <td>0</td> <td>5</td> <td>0</td> <td>5</td> <td>0</td> <td></td> <td></td> </tr> </tbody> </table> <p>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 to calculate his annual pension using his best three years' salary of GH₵19,500.</p> <p><b>Calculation for full pension</b>  Qualifying age = 60years  Average best 3years' salary = GH₵19,500  Pension right for 25years = 57.5% (refer to the table on Pension Rights above)</p> <p>Annual pension to Mr. Bema = <math>\frac{57.5}{100} \times \text{GH₵19,500} = \frac{\text{GH₵11,212.5}}{12} = \text{GH₵934.38}</math></p>	Years of contributions	20	21	22	23	24	25	26	27	28	29	30	...	40 & above	Pension Rights (%)	50.	51.	53.	54.	56.	57.	59.	60.	62.	63.	65.	80.0		Pension Rights (%)	0	5	0	5	0	5	0	5	0	5	0			
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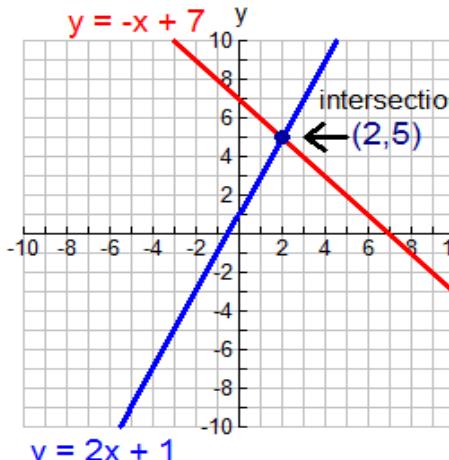
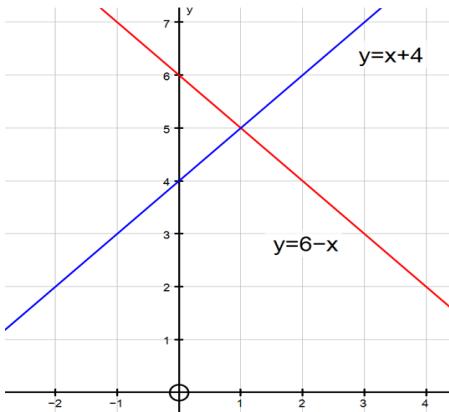
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p><b>B9.1.4.1.4</b> Recognise and graph proportional relationships, interpreting the unit rate as the slope of the graph and use these to solve problems.</p> <p><b>E.g.1</b>The graph below shows the cost of avocados.</p>  <p>The unit rate, from the data, is €1.50 per avocado, which is the same as the slope of the line connecting the data points (<math>\frac{3}{2}</math>).</p> <ul style="list-style-type: none"> <li>i. From the graph, how much does eight avocados cost?</li> <li>ii. Also, using the graph how much does 15 avocados cost?</li> </ul>	<p>Digital Literacy (DL)</p> <p>Creativity and Innovation (CI)</p>

**STRAND 2: ALGEBRA**  
***Sub-strand 1 Patterns and Relations***

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																								
<p><b>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.</b></p>	<p><b>B9.2.1.1.1 Construct a table of values for two linear relations and graph the relation</b></p> <p><b>E.g.1</b> Construct a table of values for two linear relations and draw the graphs of the relations</p> <p>Copy and complete the table of values for the relations <math>y_1 = -x + 5</math>; and <math>y_2 = \frac{1}{2}x - 3</math> for <math>x</math> from -4 to 3.</p> <table border="1"> <tr> <td><math>x</math></td> <td>-3</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> </tr> <tr> <td><math>y_1 = -x + 5</math></td> <td>8</td> <td></td> <td></td> <td></td> <td>4</td> <td></td> <td></td> </tr> <tr> <td><math>y_2 = \frac{1}{2}x - 3</math></td> <td></td> <td></td> <td>-4</td> <td></td> <td></td> <td></td> <td>-1.5</td> </tr> </table> <p><b>E.g.2</b> Draw graph for two linear relations.</p>	$x$	-3	-2	-1	0	1	2	3	$y_1 = -x + 5$	8				4			$y_2 = \frac{1}{2}x - 3$			-4				-1.5	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Cultural Identity and Global Citizenship (CG)</b></p>
$x$	-3	-2	-1	0	1	2	3																			
$y_1 = -x + 5$	8				4																					
$y_2 = \frac{1}{2}x - 3$			-4				-1.5																			
	<p><b>E.g.3</b> Construct a table of values for two linear relations.</p> <p>(i) Copy and complete the table of values for the relations <math>x - 2y = -2</math> and <math>x - 2y = 2</math> for <math>x</math> from -2 to 2.</p> <table border="1"> <tr> <td><math>x</math></td> <td>x</td> <td>-2</td> <td>-1</td> <td>0</td> <td>1</td> <td>2</td> </tr> <tr> <td><math>x - 2y = -2</math></td> <td><math>y = (x + 2)/2</math></td> <td>0</td> <td></td> <td></td> <td></td> <td>2</td> </tr> <tr> <td><math>x - 2y = 2</math></td> <td><math>y = (x - 2)/2</math></td> <td></td> <td><math>-1\frac{1}{2}</math></td> <td></td> <td></td> <td>0</td> </tr> </table> <p><b>E.g.4</b> Draw a graph for two linear relations.</p>	$x$	x	-2	-1	0	1	2	$x - 2y = -2$	$y = (x + 2)/2$	0				2	$x - 2y = 2$	$y = (x - 2)/2$		$-1\frac{1}{2}$			0				
$x$	x	-2	-1	0	1	2																				
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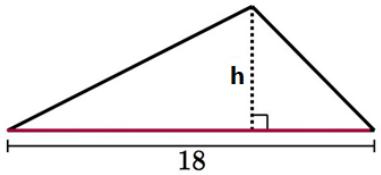
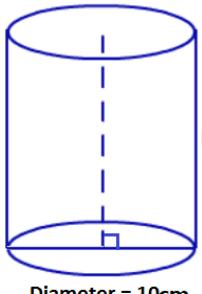
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																					
B9.2.1.1 Demonstrate the ability to construct tables of values for pairs of linear relations, graph the relations in a number plane and determine the intersection of the lines to solve simultaneous linear equations.	<p><b>B9.2.1.1.2 Use graphs of two linear relations to determine subsequent missing elements in ordered pairs of the relation.</b></p> <p><b>E.g.1 Find the missing elements of ordered pairs on graphs of two linear relations.</b></p> <p>The graph below is drawn from two linear relations:</p> $y = -x + 4$ $y = x - 2$ <p>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.</p> <table border="1"> <thead> <tr> <th>x</th> <th>6-3</th> <th>7-2</th> <th>8-1</th> <th>90</th> <th>1</th> <th>2</th> </tr> </thead> <tbody> <tr> <td>y = -x + 4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>y = x - 2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	x	6-3	7-2	8-1	90	1	2	y = -x + 4							y = x - 2							<b>Creativity and Innovation (CI)</b>
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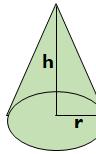


CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.1.1 Demonstrate the ability to construct tables of values for pairs of linear relations, graph the relations in a number plane and determine the intersection of the lines to solve simultaneous linear equations.</b></p>	<p><b>B9.2.1.1.3 Use graphs to solve equations involving two linear relations.</b></p> <p><b>E.g.1</b> Solve two linear equations simultaneously using the graph shown.</p> <p>i. Solve the following equations simultaneously using a graph.  <math>y = -x + 7</math>  <math>y = 2x + 1</math></p> <p><b>Hint:</b> Draw the graph and find the coordinates for the intersection of the two lines.</p> <p>In the graph shown the values of <math>(x, y) = (2, 5)</math></p>	
	<p><b>E.g.2</b> Solve two linear equations simultaneously using the graph.</p> <p>From the graph, determine the values of <math>x</math> and <math>y</math> that makes the linear equations true.</p> <p><math>y = x + 4</math>  <math>y = 6 - x</math></p>	

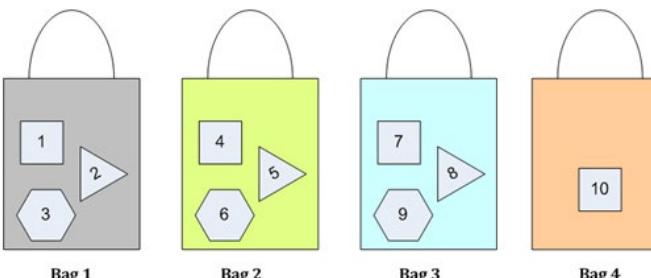
**STRAND 2: ALGEBRA**  
***Sub-strand 2 Algebraic Expressions***

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.2.1</b>Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.</p>	<p><b>B9.2.2.1.1</b> Perform change of subject of a given formula and use it to solve problems.</p> <p><b>E.g.1</b> Perform change of subject for given formulae  (i) Make <math>x</math> the subject of the following formulae</p> <p>1) <math>q = x + 7</math>      4) <math>\frac{3x+1}{2} = h</math></p> <p>2) <math>r = x - 3</math>      5) <math>3z = \frac{x}{4} + 1</math></p> <p>3) <math>5x = s</math></p>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Digital Literacy (DL)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.2.2.1 Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.</b>	<p>E.g.2 Use the concept of change of subject to solve problems involving formulae</p> <ul style="list-style-type: none"> <li>i. The area of a rectangle is <math>24\text{cm}^2</math>. If the length is 8cm, find the value of the width.</li> <li>ii. The formula for calculating the area of a circle is given as <math>\pi r^2</math>. If a circle has an area of <math>154\text{cm}^2</math>, what is its radius? [take <math>\pi = \frac{22}{7}</math>]</li> <li>iii. The triangle below has an area of <math>54\text{cm}^2</math>. Find the value of the height of the triangle.</li> <li>iv. The cylinder below has a volume of <math>330\text{cm}^3</math>. Find the value of the height of the cylinder. [take <math>\pi = \frac{22}{7}</math>]</li> </ul>  	<b>Creativity and Innovation (CI)</b>

CONTENT STANDARDS	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) factorize expressions that have simple binomial as a factor.	<p><b>B9.2.2.1.2 Substitute values into given formulae to evaluate it and use it to solve problems.</b></p> <p><b>E.g.1</b></p> <ul style="list-style-type: none"> <li>i. Find the value of <math>(x - b)^2 - 3(x - b)</math> if <math>x = 2</math> and <math>b = -5</math></li> <li>ii. Make <math>k</math> the subject of the formula:</li> </ul> $\frac{1}{n} = \sqrt{\left(\frac{k^2 + a^2}{hg}\right)}$ <p>If <math>n = \frac{8}{5}</math>, <math>a = 3</math>, <math>h = 2</math>, <math>g = 32</math>, find the value of <math>k</math>.</p> <ul style="list-style-type: none"> <li>iii. The formula for finding the volume of the shape below is given as <math>\frac{1}{3}\pi r^2 h</math>. Find the volume if <math>r = 7</math>, <math>h = 21</math>, a</li> </ul> 	Creativity and Innovation (CI)

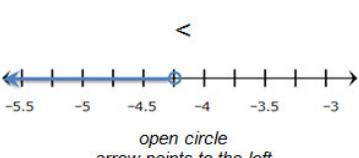
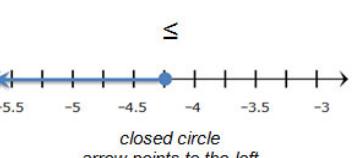
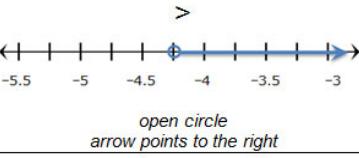
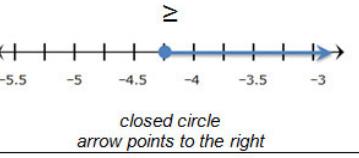
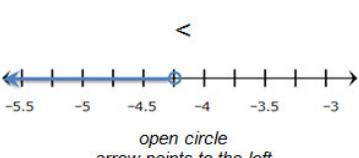
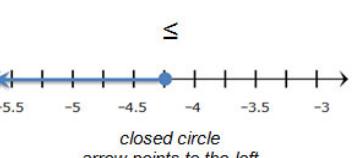
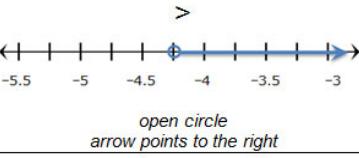
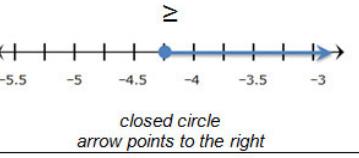
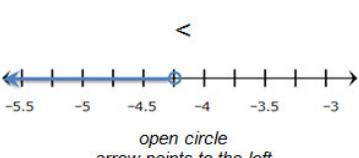
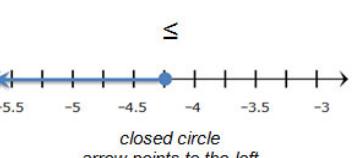
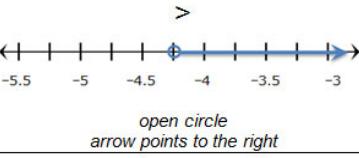
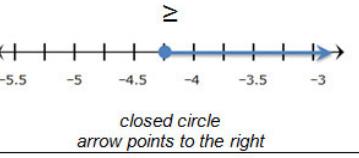
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.2.1</b>Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.</p>	<p><b>B9.2.2.1.3</b> Factorise expressions that have simple binomial.</p> <p>E.g. Factorise the following expressions.</p> <ul style="list-style-type: none"> <li>i. <math>3x + 4xy = x(3 + 4y)</math></li> <li>ii. <math>12ab + 16b = 4b(3a + 4)</math></li> <li>iii. <math>-13xy + 39x = -13x(y - 3)</math></li> <li>iv. <math>5y - 2y^2 + 3y = -3y + 3y</math></li> <li>v. <math>8y - 2y^2 = 2y(4 - y)</math></li> <li>vi. <math>-6x + 12 = -3(2x - 4)</math></li> </ul>	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p> <p>Digital Literacy (DL)</p>

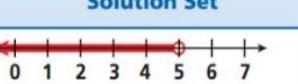
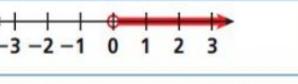
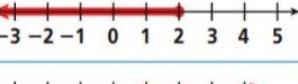
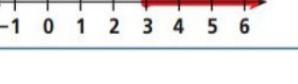
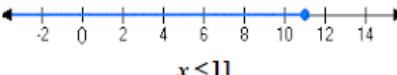
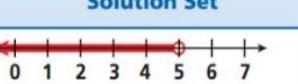
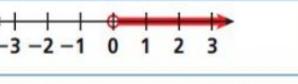
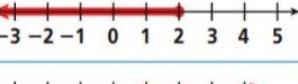
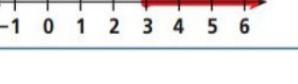
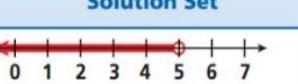
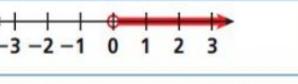
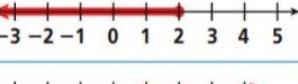
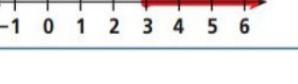
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.2.1</b>Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.</p>	<p><b>B9.2.2.1.4</b> Use the knowledge of simplifying and factorising expressions to solve real world problems.</p> <p><b>E.g.1</b> 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?</p> <p><b>Solution:</b> We use simple algebraic formula <math>\frac{x}{y}</math> to calculate the number of bags.</p> <p>x = Number of items purchased = 10</p> <p>y = Capacity of 1 bag = 3</p> <p>Hence,</p> $\frac{10}{3} = 3.333 \text{ bags}$ $= 4 \text{ bags}$ <p>So, we need 4 shopping bags to carry 10 items.</p> 	<p>Creativity and Innovation (CI)</p> <p>Digital Literacy (DL)</p>

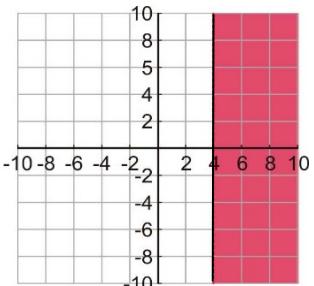
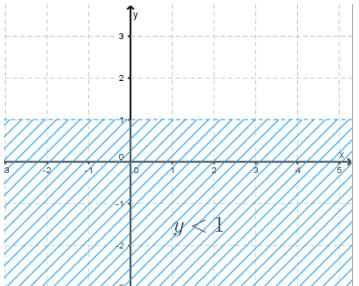
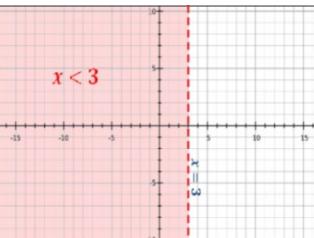
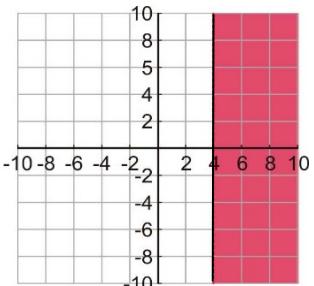
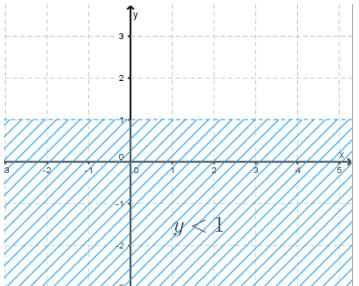
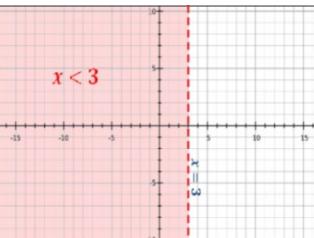
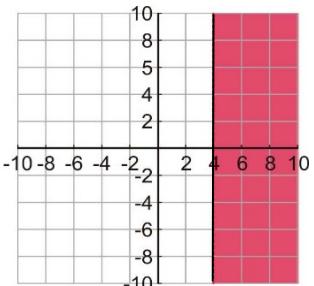
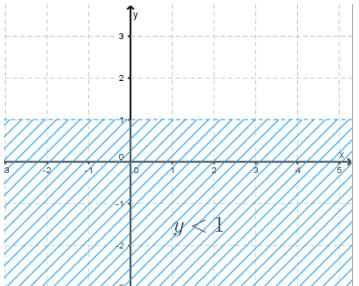
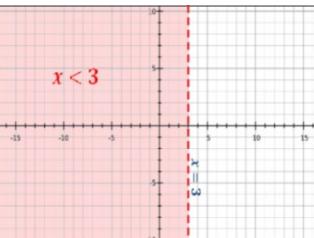
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.2.1 Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.</b></p>	<p><b>E.g.2</b> You have to buy two dozen of eggs priced at GH₵10, three loaves breads (each bread is GH₵5), and five bottles of juice (each bottle is GH₵8). How much money you will need to take to the grocery store?</p> <p>The prices are</p> <p>a = Price of two dozen eggs = GH₵10</p> <p>b = Price of one bread = GH₵5</p> <p>c = Price of one bottle of juice = GH₵8</p> <p>=&gt; Money needed = <math>a + 3b + 5c</math></p> <p>=&gt; Money needed = <math>GH₵10 + 3(GH₵5) + 5(GH₵8) = GH₵10 + GH₵15 + GH₵40 = GH₵65</math></p>	<p><b>Communication and Collaboration (CC)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.2.2.1</b> Demonstrate an understanding of (i) change of subject (ii) substituting values to evaluate expressions, and (iii) factorize expressions that have simple binomial as a factor.	<p><b>E.g.3</b> The area of a rectangle is <math>72 \text{ cm}^2</math>. The length is twice its width. What is the length and width of the rectangle?</p> <p>Let "x" be the width and "2x" be the length.</p> <p>Length <math>\times</math> Width = Area</p> $x \times (2x) = 2x^2 = \text{Area}$ $2x^2 = \text{Area}$ $2x^2 = 72$ $\frac{2x^2}{2} = \frac{72}{2}$ $x^2 = 36$ $x = 6$ <p>width = 6cm</p> $2x = 2 \times 6 = 12$ <p>So, the length is 12 cm</p>	<b>Critical Thinking and Problem solving (CP)</b>

**STRAND 2: ALGEBRA**  
***Sub-strand 3 Variables and Equations***

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES				
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• solving inequalities</li> <li>• verifying</li> <li>• comparing</li> <li>• graphing</li> </ul>	<p><b>B9.2.3.1.1 Solve single variable linear inequalities with rational coefficients.</b></p> <p>i. <math>2x + 7 &gt; \frac{5}{2}</math></p> <p>ii. <math>\frac{4}{5} - \frac{1}{5}x &gt; \frac{2}{7}</math></p> <p>iii. <math>\frac{3}{2}y - \frac{2}{5} &lt; \frac{4}{5}</math></p> <p>iv. <math>\frac{1}{2}(5x - 4) &lt; x + \frac{11}{24}</math></p> <p>v. <math>\frac{1}{3} &gt; x - \frac{4}{5}</math></p> <p>vi. <math>\frac{1}{2}(2x + 3) \leq x + 1</math></p> <p>vii. <math>x + \frac{1}{2} \geq -\frac{3}{2}</math></p> <p>viii. <math>-\frac{2}{3}x + 3 \geq 0</math></p> <p><b>B9.2.3.1.2 Illustrate solution sets of linear inequalities on the number line</b></p> <p>E.g.1 Illustrate and explain the inequality signs</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 10px;"> <b>Less Than</b>  <math>&lt;</math>              open circle            arrow points to the left         </td> <td style="text-align: center; padding: 10px;"> <b>Less Than or Equal To</b>  <math>\leq</math>              closed circle            arrow points to the left         </td> </tr> <tr> <td style="text-align: center; padding: 10px;"> <b>Greater Than</b>  <math>&gt;</math>              open circle            arrow points to the right         </td> <td style="text-align: center; padding: 10px;"> <b>Greater Than or Equal To</b>  <math>\geq</math>              closed circle            arrow points to the right         </td> </tr> </table>	<b>Less Than</b> $<$  open circle arrow points to the left	<b>Less Than or Equal To</b> $\leq$  closed circle arrow points to the left	<b>Greater Than</b> $>$  open circle arrow points to the right	<b>Greater Than or Equal To</b> $\geq$  closed circle arrow points to the right	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>
<b>Less Than</b> $<$  open circle arrow points to the left	<b>Less Than or Equal To</b> $\leq$  closed circle arrow points to the left					
<b>Greater Than</b> $>$  open circle arrow points to the right	<b>Greater Than or Equal To</b> $\geq$  closed circle arrow points to the right					

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES															
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• solving inequalities</li> <li>• verifying</li> <li>• comparing</li> <li>• graphing</li> </ul>	<p>E.g.2 Graph linear inequalities in one variable on a number line.</p> <table border="1"> <thead> <tr> <th>Word Phrase</th> <th>Inequality</th> <th>Solution Set</th> </tr> </thead> <tbody> <tr> <td><math>x</math> is less than 5</td> <td><math>x &lt; 5</math></td> <td></td> </tr> <tr> <td><math>a</math> is greater than 0 <math>a</math> is more than 0</td> <td><math>a &gt; 0</math></td> <td></td> </tr> <tr> <td><math>y</math> is less than or equal to 2 <math>y</math> is at most 2</td> <td><math>y \leq 2</math></td> <td></td> </tr> <tr> <td><math>m</math> is greater than or equal to 3 <math>m</math> is at least 3</td> <td><math>m \geq 3</math></td> <td></td> </tr> </tbody> </table> <p>E.g.3 Solve and graph linear inequalities on a number line.</p> <p>i. <math>-3x - 8 &gt; -26</math></p> $  \begin{array}{r}  -3x - 8 > -26 \\  +8 \quad +8 \\  \hline  -3x > -18 \\  \hline  -3 \quad -3 \\  \hline  x < 6  \end{array}  $  <p>ii. <math>2x - 3 \leq 19</math></p> $  \begin{array}{l}  2x \leq 22 \\  \frac{2x}{2} \leq \frac{22}{2} \\  x \leq 11  \end{array}  $ 	Word Phrase	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	$m \geq 3$		Digital Literacy (DL)
Word Phrase	Inequality	Solution Set															
$x$ is less than 5	$x < 5$																
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES			
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• solving inequalities</li> <li>• verifying</li> <li>• comparing</li> <li>• graphing</li> </ul>	<p>E.g.4 Solve and graph linear inequalities on a cartesian plane.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 5px;">           i. <math>2x \geq 8</math>  <math>\frac{2x}{2} \geq \frac{8}{2}</math>  <math>x \geq 4</math>   </td> <td style="width: 33%; padding: 5px;">           ii. <math>5y + 3 &lt; 6 + 2y</math>  <math>5y - 2y &lt; 6 - 3</math>  <math>3y &lt; 3</math>  <math>\therefore y &lt; 1</math>   </td> <td style="width: 33%; padding: 5px;">           iii. <math>\frac{7x}{3} &lt; 7 \rightarrow 3 \times \frac{7x}{3} &lt; 7 \times 3</math>  <math>\frac{7x}{7} &lt; \frac{21}{7}</math>  <math>x &lt; 3</math>   </td> </tr> </table>	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. $\frac{7x}{3} < 7 \rightarrow 3 \times \frac{7x}{3} < 7 \times 3$ $\frac{7x}{7} < \frac{21}{7}$ $x < 3$ 	<p><b>Digital Literacy (DL)</b></p>
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. $\frac{7x}{3} < 7 \rightarrow 3 \times \frac{7x}{3} < 7 \times 3$ $\frac{7x}{7} < \frac{21}{7}$ $x < 3$ 			

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• solving inequalities</li> <li>• verifying</li> <li>• comparing</li> <li>• graphing</li> </ul>	<p><b>B9.2.3.1.3 Solve real-life problems involving linear equations and inequalities.</b></p> <p><b>E.g.1</b> Solve real-life problems involving linear equations.</p> <p>i. A man has 260metres of fencing which he is going to put around a rectangular field which is 50metres wide. How long is the field?</p> <p><b>Solution:</b> Since we need to find the length of the field, let <math>x</math> metres be the length.</p>  $x + 50 + x + 50 \text{ or } 2(x + 50)$ <p>But this expression is given as 260m</p> $\therefore 2(x + 50) = 260$ $x + 50 = 130$ $x = 80\text{m}$	<p><b>Critical Thinking and Problem solving (CP)</b></p>

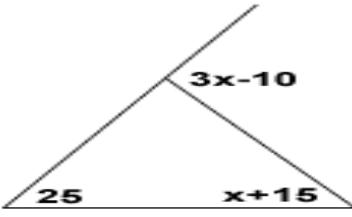
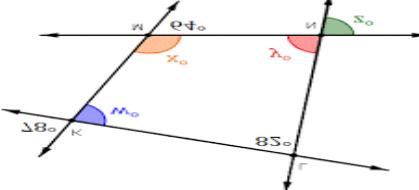
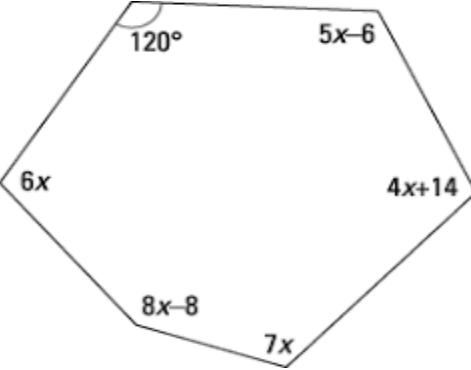
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• solving inequalities</li> <li>• verifying</li> <li>• comparing</li> <li>• graphing</li> </ul>	<p>ii. A man paid GH₵ 290 for 11 books. Some of the books were geography books, and the rest were history books. If each geography book cost GH₵ 30 and each history book cost GH₵ 20, how many geography books did he buy?</p> <p>Solution:</p> <p>i. Total cost of the books is GH₵ 290; total number of books is 11.</p> <p>ii. 1 geography book costs GH₵ 30; 1 history book costs GH₵ 20,</p> <p>Total cost of all the books is <math>30x + 20(11 - x) = 290</math></p> $\therefore 30x + 20(11 - x) = 290$ $30x + 220 - 20x = 290$ $10x + 220 = 290$ $x = 7$ <p>Hence the number of geography books bought is 7.</p>	<b>Critical Thinking and Problem solving (CP)</b>
	<p><b>E.g.2</b> Solve real-life problems involving linear inequalities.</p> <p>i. Two sides of a triangle have lengths 6 cm and 8 cm. What is the length of the third side?</p> <p><b>Note:</b> The sum of the lengths of the two sides of a triangle is greater than the length of the third side.</p>	

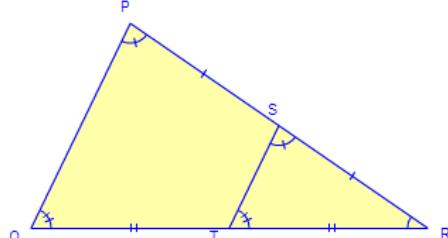
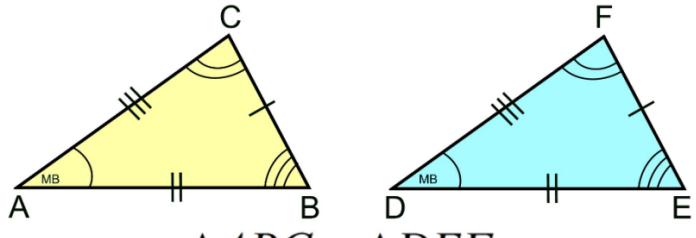
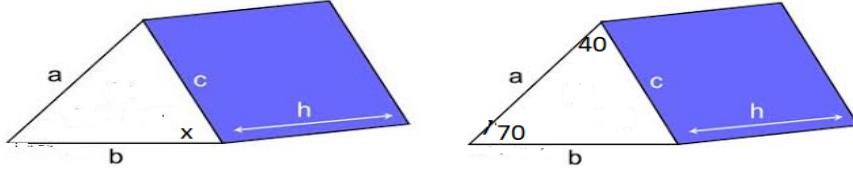
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.2.3.1 Demonstrate understanding of single variable linear inequalities with rational coefficients including:</b></p> <ul style="list-style-type: none"> <li>• <b>solving inequalities</b></li> <li>• <b>verifying</b></li> <li>• <b>comparing</b></li> <li>• <b>graphing</b></li> </ul>	<p>If the third side is <math>x</math> cm long then,  <math>6 + 8 &gt; x</math> giving <math>x &lt; 14</math>.  Also, <math>6 + x &lt; 8</math> giving <math>x &gt; 2</math>.  [Also, <math>8 + x &gt; 6</math> which gives <math>x &gt; -2</math>.  Hence, <math>2 &lt; x &lt; 14</math>. that is, the third side has length between 2cm and 14cm.</p> <p>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?</p>	<p><b>Critical Thinking and Problem solving (CP)</b></p>

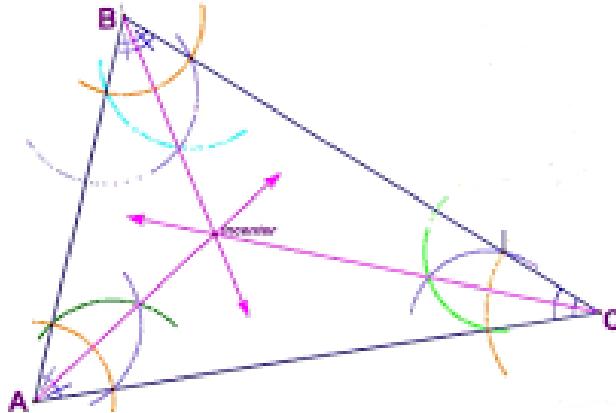
### STRAND 3: GEOMETRY AND MEASUREMENT

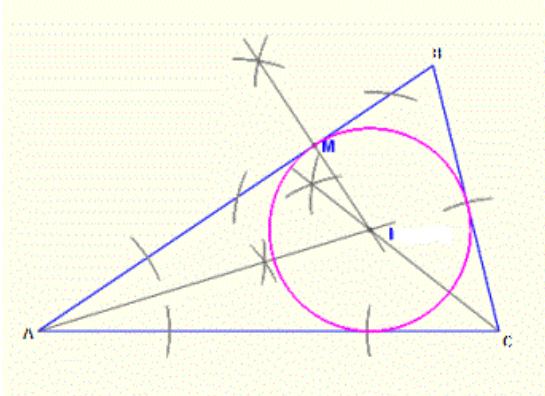
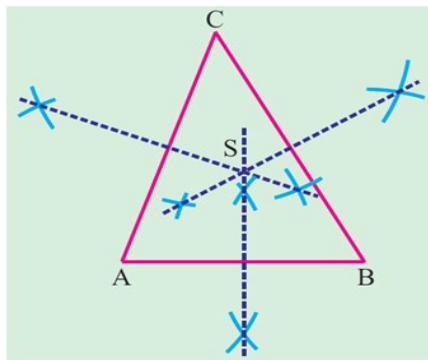
#### *Sub-strand 1 Shapes and Space*

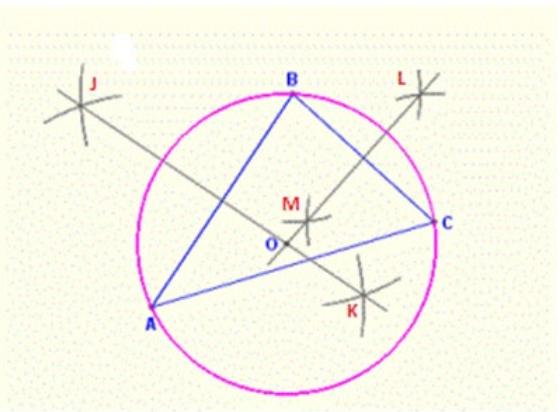
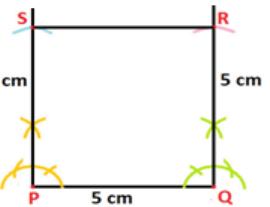
CONTENT STANDARDS	INDICATORS AND EXEMPLARS			CORE COMPETENCIES									
B9.3.1.1 Apply the properties of angles at a point, angles on a straight line, vertically opposite angles, corresponding, angles to solve problems.	<p><b>B9.3.1.1</b>Derive the formula for calculating the sum of angles in any polygon and use this to calculate the value of missing angles in polygons</p> <p><b>E.g.1.</b> Identify and name the various polygons such as a triangle, quadrilaterals, pentagons, and hexagons, etc.</p> <table style="width: 100%; text-align: center; border-collapse: collapse;"> <tr> <td style="width: 33.33%; padding: 10px;">   Equilateral Triangle 3 sides         </td> <td style="width: 33.33%; padding: 10px;">   Square 4 sides         </td> <td style="width: 33.33%; padding: 10px;">   Pentagon 5 sides         </td> </tr> <tr> <td style="width: 33.33%; padding: 10px;">   Hexagon 6 sides         </td> <td style="width: 33.33%; padding: 10px;">   Heptagon 7 sides         </td> <td style="width: 33.33%; padding: 10px;">   Octagon 8 sides         </td> </tr> <tr> <td style="width: 33.33%; padding: 10px;">   Nonagon 9 sides         </td> <td style="width: 33.33%; padding: 10px;">   Decagon 10 sides         </td> <td style="width: 33.33%; padding: 10px;">   Undecagon 11 sides         </td> </tr> </table>			 Equilateral Triangle 3 sides	 Square 4 sides	 Pentagon 5 sides	 Hexagon 6 sides	 Heptagon 7 sides	 Octagon 8 sides	 Nonagon 9 sides	 Decagon 10 sides	 Undecagon 11 sides	Communication and Collaboration (CC)
 Equilateral Triangle 3 sides	 Square 4 sides	 Pentagon 5 sides											
 Hexagon 6 sides	 Heptagon 7 sides	 Octagon 8 sides											
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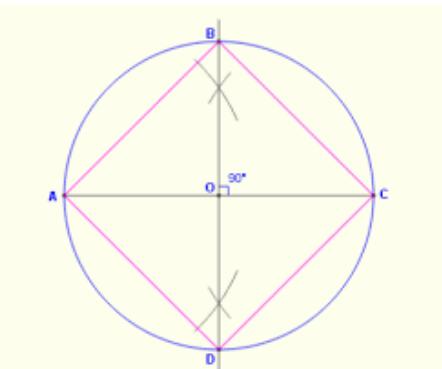
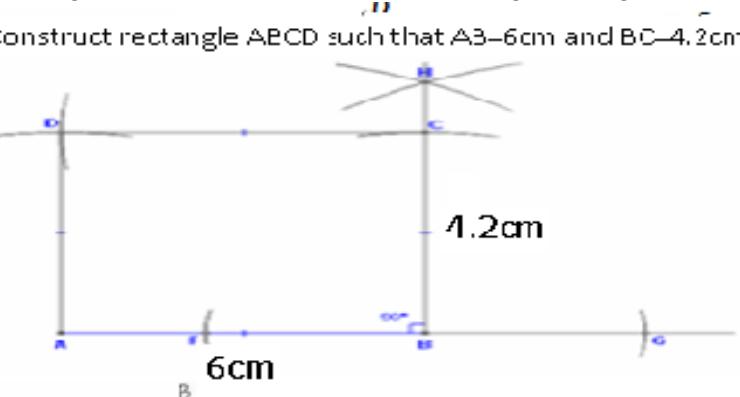
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.1 Apply the properties of angles at a point, angles on a straight line, vertically opposite angles, corresponding, angles to solve problems.</b>	<p>E.g.2. Derive and use the formula <math>(n - 2) \times 180^\circ</math> and calculate the value of <math>x</math> (interior and exterior angles of a triangle).</p>	 <p>Critical Thinking and Problem solving (CP) Communication and Collaboration (CC)</p>
	<p>E.g.3. Derive and use the formula <math>(n - 2) \times 180^\circ</math> and calculate the interior angles of a quadrilateral.</p>	
	<p>E.g.4. Derive and use the formula <math>(n - 2) \times 180^\circ</math> and calculate the interior angles of polygons, pentagons, hexagons, etc.</p> <p>(i) Find the value of <math>x</math> and the various angles in the hexagon.</p>	

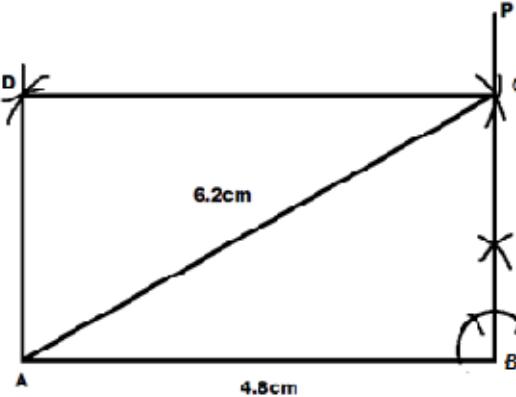
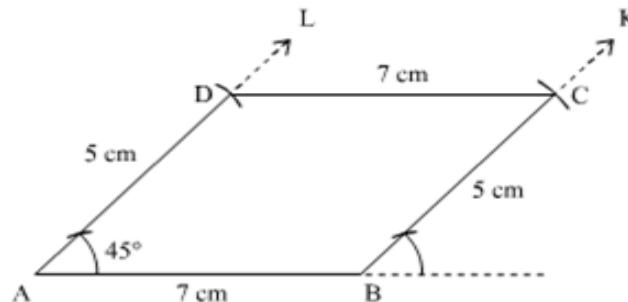
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.1.1 Apply the properties of angles at a point, angles on a straight line, vertically opposite angles, corresponding, angles to solve problems.	<p><b>B9.3.1.1.2 Identify similar and congruent triangles and use the knowledge to solve related problems</b></p> <p>E.g.1. Recognise similar triangles and solve for the values of the indicated angles in the diagram below:</p>  <p>E.g.2. Recognise congruent triangles and solve for the values of the indicated angles in the diagram below:</p>  $\Delta ABC \cong \Delta DEF$ <p>E.g. 3. Determine the value of <math>x</math> (using knowledge in similarity and congruency).</p> 	<p>Critical Thinking and Problem solving (CP)</p> <p>Creativity and Innovation (CI)</p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	<p><b>B9.3.1.2.1 Draw inscribed and circumscribed circles for triangles under given conditions</b></p> <p>E.g.1: Use a pair of compasses and a ruler to construct a triangle (say <math>\triangle ABC</math>) 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?</p> 	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	E.g..2: Use a pair of compasses and a ruler to construct a triangle (say ABC) under a given condition, bisect at least any two angles ( $\Delta BAC$ and $\Delta BCA$ ); 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.  	<b>Creativity and Innovation (CI)</b>  <b>Digital Literacy (DL)</b>
	E.g.3: Construct a triangle (say ABC); bisect all three sides (i.e. line segments $AB$ , $AC$ and $BC$ ); locate the intersection (circumcentre) of the three perpendicular bisectors (S); Measure the distance from the intersecting centre (S) to points A, B and C. What do you observe about the lengths?  	<b>Personal Development and Leadership (PL)</b>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	<p>E.g.4: Perform a geometric construction of a triangle (say <math>ABC</math>) under a given condition; bisect at least any two sides (<math>AB</math> and <math>BC</math>); locate the intersection of the two perpendicular bisectors (<math>O</math>) and draw a locus of points equidistant from the fixed point (<math>O</math>) to circumscribe the triangle.</p> 	<b>Creativity and Innovation (CI)</b>
	<p><b>B9.3.1.2.2 Construct parallelograms (i.e. square, rectangle, rhombus) under given conditions.</b></p> <p>E.g.1: Perform geometric construction of a square with a given side.</p> <p>PQRS is a geometric construction of a square with side 5cm</p> 	<b>Communication and Collaboration (CC)</b>

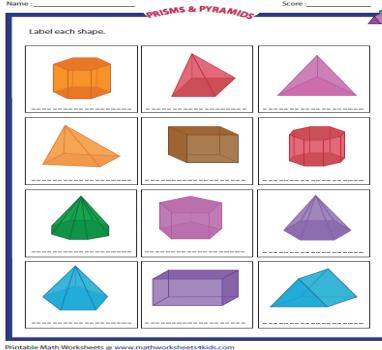
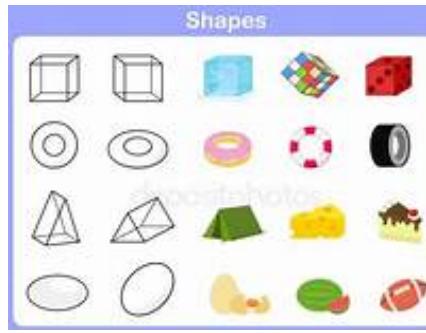
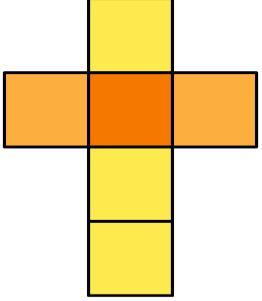
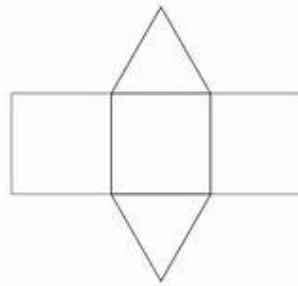
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	<p>E.g.2: Construct a square ABCD with <math>\overrightarrow{AB}=6.5\text{cm}</math>. Measure and record the diagonal of the square.</p> <p>E.g.3: Perform geometric construction of a square with a given diagonal. Construct the square ABCD with <math>AC=10\text{cm}</math>. What is the length of the sides?</p> 	<b>Critical Thinking and Problem solving (CP)</b>
	<p>E.g.4: Perform geometric construction of a rectangle with given side.</p> <p>Construct rectangle ABCD such that <math>AB=6\text{cm}</math> and <math>BC=4.2\text{cm}</math></p> 	

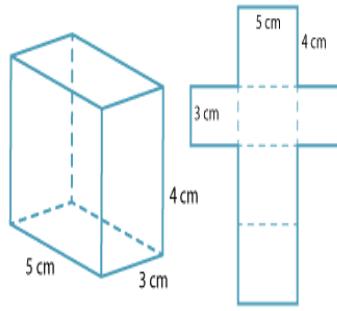
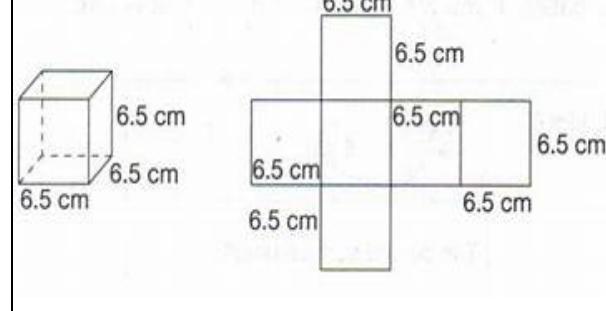
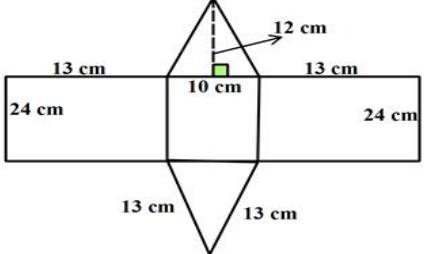
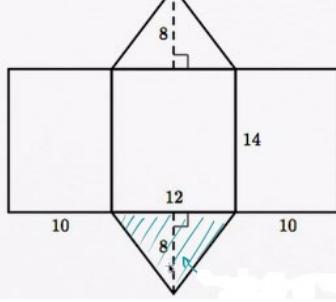
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	<p>E.g.5: Perform geometric construction of a rectangle with a given side and diagonal.</p> <p>Construct a rectangle ABCD with length AB = 4.8cm and diagonal AC= 6.2cm</p> 	<b>Critical Thinking and Problem solving (CP)</b>
	<p>E.g.6: Perform geometric construction of a parallelogram with given sides and given angle(s).</p> <p>Construct the parallelogram ABCD such that the line segments AB=7cm and AD=5cm, and <math>\angle DAB=45^\circ</math></p> 	<b>Creativity and Innovation (CI)</b>

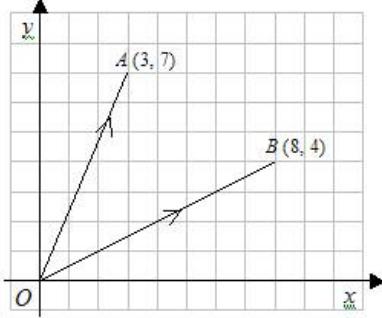
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.3.1.2 Construct inscribed and circumscribed triangles and parallelograms with given dimensions.</b>	<p>E.g.7: Perform geometric construction of regular compound plane shapes with given sides and angles.</p> <p>ABCD is a parallelogram such that <math>\angle DAB = 60^\circ</math>, <math>\angle CBA = 120^\circ</math>, AB=6cm. AEF is an isosceles triangle, such that AE=FE= 15cm, B is the midpoint of AF=12cm.</p>	<b>Digital Literacy (DL)</b>

## STRAND 3: GEOMETRY AND MEASUREMENT

### Sub-strand 2 Measurement

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B.9.3.2.1</b> Derive the formulas for determining the surface area of prisms (i.e. cuboid and triangular prism) and use to solve problems.</p>	<p><b>B9.3.2.1.1</b> Identify cuboids and triangular prisms; draw their nets to construct the 3-D shapes and use it to determine the surface area.</p> <p>E.g.1 Sort out shapes that are triangular prisms and cuboids.</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Printable Math Worksheets at <a href="http://www.mathworksheetskids.com">www.mathworksheetskids.com</a></p> </div> <div style="text-align: center;">  </div> </div> <p>E.g.2 Identify each of the nets below:</p> <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>A net of.....</p> </div> <div style="text-align: center;">  <p>A net of.....</p> </div> </div>	<p>Critical Thinking and Problem solving (CP)</p> <p>Creativity and Innovation (CI)</p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.</b></p>	<p>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.</p> <p><b>B9.3.2.1.2 Use the net of a cuboid to determine its surface area.</b></p> <p>E.g.1 Find the surface area of each of the cuboids</p>  	<p><b>Critical Thinking and Problem solving (CP)</b></p>
	<p><b>B9.3.2.1.3 Use the net of a triangular prism to determine its surface area.</b></p> <p>E.g.1Find the surface area of each of the triangular prisms.</p>  	

CONTENT STANDARDS	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.	<p><b>B9.3.2.1.4 Express points in the Cartesian plane as position vectors</b></p> <p>E.g.1 Identity the following using the diagram below:</p> <p>(i) the origin          (ii) the position vector</p> <p>If <math>a = \begin{pmatrix} 3 \\ 7 \end{pmatrix}</math>, then the coordinates of A will be (3, 7).</p> <p>Similarly, if <math>b = \begin{pmatrix} 8 \\ 4 \end{pmatrix}</math>, then coordinates of B will be (8, 4)</p> <p>E.g.2 Draw and write the position vectors of the following with 0 as the origin:</p> <p>(i) M(2,3) (ii) N(-1,2)</p> 	Creativity and Innovation (CI)

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
B9.3.2.2 Solve problems involving bearings and addition/subtraction of vectors	<p><b>B9.3.2.2.1 Show an understanding of parallel vectors and perpendicular vectors</b></p> <p>E.g.1 Investigate conditions for parallel vectors and perpendicular vectors.</p> <p>E.g.2 Use the result from the investigation to solve the following questions:</p> <p>(i) Find the value(s) of x, if the vectors <math>\begin{pmatrix} 3x \\ 2 \end{pmatrix}</math> and <math>\begin{pmatrix} 6 \\ x \end{pmatrix}</math> are parallel.</p> <p>(ii) Which of the vectors is perpendicular to <math>\begin{pmatrix} 3 \\ 4 \end{pmatrix}</math></p> <p>(a) <math>\begin{pmatrix} -3 \\ 4 \end{pmatrix}</math>   (b) <math>\begin{pmatrix} -3 \\ -4 \end{pmatrix}</math>   (c) <math>\begin{pmatrix} -4 \\ 3 \end{pmatrix}</math>   (d) <math>\begin{pmatrix} -4 \\ -3 \end{pmatrix}</math></p>	Digital Literacy (DL)
	<p><b>B9.3.2.2.2 Apply the triangular and parallelogram laws of addition to resolve vectors</b></p> <p>E.g.1 Deduce the triangle law of vector addition.  <math>\overrightarrow{AB} + \overrightarrow{BC} = \overrightarrow{AC}</math> Where ABC are points in the Oxy plane.</p> <p>E.g.2 The vertices of a triangle are P(1,-3), Q(7,5) and R(-3,5)</p> <p>(i) Express <math>\overrightarrow{PQ}</math>, <math>\overrightarrow{QR}</math>, and <math>\overrightarrow{PR}</math> as column vectors.</p> <p>(ii) Show that triangle PQR is an isosceles.</p> <p>(iii) Find the equation of the line <math>\overrightarrow{PR}</math>.</p> <p>Eg3 Investigate the parallelogram law of vector addition.</p> <p>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)</p> <p>(i) Find <math>\overrightarrow{PQ}</math>, and <math>\overrightarrow{SR}</math> hence find the values of x and y.</p>	Creativity and Innovation (CI)

## STRAND 3:GEOMETRY AND MEASUREMENT

### *Sub-strand 3 Position and Transformation*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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.)</b></p>	<p><b>B9.3.3.1.1 Know examples of situations in everyday life that depict enlargement situations in everyday life.</b></p> <p>E.g. 1. Know examples of situations that relate to enlargement situations in everyday life and the nature of movements – vertical and horizontal.</p> 	<p><b>Creativity and Innovation (CI)</b> <b>Digital Literacy (DL)</b></p>
	 	

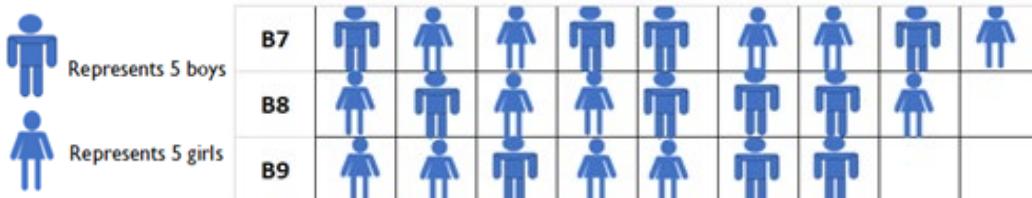
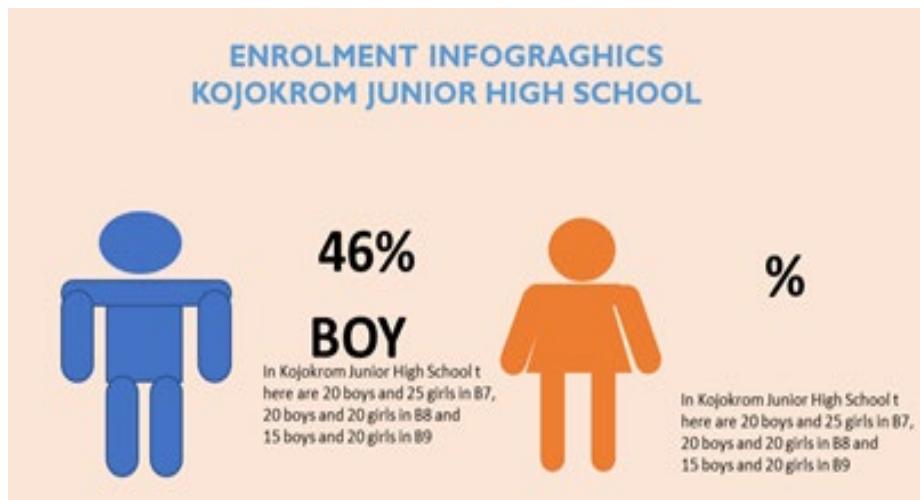
CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>B9.3.3.1 Demonstrate understanding of how to perform an enlargement on a geometrical shape given a scale factor and describe the properties of the image under the transformation (i.e. congruence, similarity, etc.)</b></p>	<p><b>B9.3.3.1.2 Understand enlargement and identify real-life situations involving enlargement.</b></p> <p>E.g. 1. Draw an enlargement of shapes using a given scale factor.</p> <ol style="list-style-type: none"> <li>State the single transformation that maps triangle P onto Q.</li> <li>State the single transformation that maps triangle P onto R.</li> </ol> <p>iii. Investigate the characteristics of enlargements under the following conditions of scale factor:</p> <ul style="list-style-type: none"> <li>if the scale factor (<math>K</math>) is negative</li> <li>if the scale factor (<math>K</math>) is greater than 1 or less than <math>-1</math></li> <li>if the scale factor (<math>K</math>) is between <math>-1</math> and <math>1</math> (i.e., fraction)</li> </ul> <p>E.g. 2. Using an object, and its image, determine the scale factor in a transformation?</p>	<p>Creativity and Innovation (CI)</p>
	<p><b>B9.3.3.1.3 Investigate the concept of congruent and similar shapes</b></p> <p>E.g. 1. Using multiple and varied examples of enlargement on a coordinate plane, verify congruent and similar shapes using their properties.</p>	

## STRAND 4: HANDLING DATA

### *Sub-strand 1: Data*

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.4.1.1Select, 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.</b>	<p><b>B9.4.1.1.1Select and justify a method to collect data (quantitative and qualitative) to answer a given question.</b></p> <p>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</p> <p>Areas of study are described as follows:</p> <ul style="list-style-type: none"> <li>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.</li> <li>b. Find the most common mode of travel by learners in Oyoko Junior and Senior High Schools.</li> </ul>	<b>Critical Thinking and Problem solving (CP)</b>  <b>Communication and Collaboration (CC)</b>  <b>Creativity and Innovation (CI)</b>
	<p><b>B9.4.1.1.2Organise data (grouped/ungrouped) present it in frequency tables, line graphs, 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.</b></p> <p>E.g. 1 -Thirty bulbs were life-tested and their lifespan to the nearest hour are as follows:</p> <p style="text-align: center;">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</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES															
<p><b>B9.4.1.1</b> 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.</p>	<p>i. Present the raw data in a frequency table by completing the table below:</p> <table border="1"> <thead> <tr> <th>Lifespan of Bulbs (hours)</th> <th>Tally</th> <th>Frequency</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>ii. What is the modal group? Justify your decision for that choice.</p> <p>iii. Complete the stem and leaf plots below to display the raw data.</p> <p>Use the plot to solve the following problems.</p> <ol style="list-style-type: none"> <li>Find the range of the lifespan of bulbs</li> <li>What is the mode lifespan?</li> <li>What is the median lifespan?</li> <li>What other problems can you pose?</li> </ol>	Lifespan of Bulbs (hours)	Tally	Frequency	164 - 167			168 – 171			172 - 175			176 – 179			<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Creativity and Innovation (CI)</b></p>
Lifespan of Bulbs (hours)	Tally	Frequency															
164 - 167																	
168 – 171																	
172 - 175																	
176 – 179																	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES												
<p><b>B9.4.1.1</b> 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.</p>	<p>E.g. 2 The pictograph below describes the number of boys and girls in each class in Kojokrom Junior High School</p>  <table border="1"> <thead> <tr> <th>Class</th> <th>Boys (Blue)</th> <th>Girls (Orange)</th> </tr> </thead> <tbody> <tr> <td>B7</td> <td>4</td> <td>3</td> </tr> <tr> <td>B8</td> <td>3</td> <td>4</td> </tr> <tr> <td>B9</td> <td>3</td> <td>2</td> </tr> </tbody> </table>  <p>ENROLMENT INFOGRAPHICS KOJOKROM JUNIOR HIGH SCHOOL</p> <p><b>46%</b> <b>BOY</b></p> <p>In Kojokrom Junior High School there are 20 boys and 25 girls in B7, 20 boys and 20 girls in B8 and 15 boys and 20 girls in B9</p> <p>%</p> <p>In Kojokrom Junior High School there are 20 boys and 25 girls in B7, 20 boys and 20 girls in B8 and 15 boys and 20 girls in B9</p>	Class	Boys (Blue)	Girls (Orange)	B7	4	3	B8	3	4	B9	3	2	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p>
Class	Boys (Blue)	Girls (Orange)												
B7	4	3												
B8	3	4												
B9	3	2												

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES																																																												
<p><b>B9.4.1.1</b>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.</p>	<p><b>B9.4.1.1.3</b> Use a histogram to determine the mode of a given data to solve and/or pose real life cases.</p> <p>E.g. 1- The waiting times, <math>x</math> minutes, for 60 patients at a certain clinic are as follows</p> <table style="margin-left: auto; margin-right: auto;"> <tr><td>25</td><td>12</td><td>53</td><td>8</td><td>26</td><td>5</td><td>19</td><td>73</td><td>67</td><td>18</td><td>87</td><td>42</td></tr> <tr><td>6</td><td>21</td><td>14</td><td>19</td><td>12</td><td>15</td><td>13</td><td>36</td><td>36</td><td>16</td><td>72</td><td>36</td></tr> <tr><td>13</td><td>37</td><td>11</td><td>51</td><td>39</td><td>32</td><td>30</td><td>47</td><td>6</td><td>22</td><td>68</td><td>25</td></tr> <tr><td>98</td><td>23</td><td>45</td><td>22</td><td>7</td><td>9</td><td>26</td><td>35</td><td>27</td><td>48</td><td>58</td><td>56</td></tr> <tr><td>29</td><td>20</td><td>32</td><td>62</td><td>80</td><td>41</td><td>58</td><td>17</td><td>54</td><td>15</td><td>14</td><td>74</td></tr> </table> <p>i. Construct a frequency table using class intervals <math>0 - 10.5</math>; <math>10.5 - 20.5</math>; <math>20.5 - 30.5</math>, and so on.  ii. Construct a frequency table using class intervals <math>0 &lt; x \leq 10</math>; <math>10 &lt; x \leq 20</math>; <math>20 &lt; x \leq 30</math>, and so on.  iv. Draw a histogram and find the modal class.</p>	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	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p>
25	12	53	8	26	5	19	73	67	18	87	42																																																			
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CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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).</b></p>	<p><b>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.</b></p> <p>E. g. 1 Suppose in a school survey form the following question was asked:</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p><b>Overall, don't you think the teaching of mathematics is very good?</b></p> </div> <p>The designer of the survey form has a <b>bias</b> for the methodology used in math lessons and the bias influences how the question was written.</p> <p>The <b>language</b> used in writing the question may lead people to just answer <b>yes</b> or <b>no</b>.</p> <p>A better question would be:</p> <p>Overall, how will you rate the teaching of mathematics?</p> <p> <input type="radio"/> <b>Very poor</b>            <input type="radio"/> <b>Poor</b>            <input type="radio"/> <b>Fair</b>            <input type="radio"/> <b>Good</b>            <input type="radio"/> <b>Very Good</b> </p>	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p> <p>Digital Literacy (DL)</p>
	<p>E.g. 2 Ama Mereku in B9 wants to write an article for their school magazine on <b>sport-related injuries</b>. The responses for the survey question stated below were <b>collected from only the schools' football team</b>.</p> <p>The influencing factors in this survey question are: <b>time</b> and <b>bias</b>.</p> <p>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.</p> <p>In order to report <b>accurately</b> on sport-related injuries Ama needs to ask <b>more</b> people (<b>time needed</b>) who participate in a <b>variety of sports</b>, including <b>contact and non-contact</b> sports (e.g. <b>athletics tennis, volleyball</b>, and so on).</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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).</b></p>	<p>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;</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"><b><i>What is your current body weight?</i></b></div> <p>Identify the influencing factor in the survey and provide a solution.</p> <p>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.</p> <div style="border: 1px solid black; padding: 5px; text-align: center;"><b><i>What is your worst subject?</i></b></div> <p>If you then use the information collected <b>to write an article for the school magazine</b> how would your actions be described and how would that influence future surveys you conduct?</p>	<p>Critical Thinking and Problem solving (CP)</p> <p>Communication and Collaboration (CC)</p> <p>Creativity and Innovation (CI)</p> <p>Personal Development and Leadership (PL)</p> <p>Digital Literacy (DL)</p>
	<p>E.g. 5 -Suppose in a survey questionnaire you wanted to know the favourite method of cooking pork and you asked:</p> <p>Please tick the box against your favourite method of cooking pork</p> <p><input type="checkbox"/> Boiling      <input type="checkbox"/> Grilling      <input type="checkbox"/> Frying</p> <p>Please tick the box against your favourite method of cooking pork (<b>Optional</b>)</p> <p><input type="checkbox"/> Boiling      <input type="checkbox"/> Grilling      <input type="checkbox"/> Frying</p> <p>This question does not apply to everyone because some people do not eat pork (i.e. the question is not culturally sensitive.)</p> <p>A better question would be</p> <p>If you eat pork please name the favourite method you cook it.</p> <p><input type="checkbox"/> Boiling      <input type="checkbox"/> Grilling      <input type="checkbox"/> Frying</p>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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).</b></p>	<p style="text-align: center;"><b>OR</b></p> <p>If you eat pork please name the favourite method you cook it.</p> <p style="text-align: center;"> <input type="checkbox"/> Boiling      <input type="checkbox"/> Grilling      <input type="checkbox"/> Frying     </p> <p><b>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.</b></p> <p>Refer to E.g. 1 of <b>B9.4.1.1.2</b> and find (minimum, maximum, measures of central tendency and range)</p> <ul style="list-style-type: none"> <li>i. The minimum lifespan, to the nearest hour, of the bulbs tested.</li> <li>ii. The maximum lifespan, to the nearest hour, of the bulbs tested.</li> <li>iii. The range of the data collected from the life-testing.</li> <li>iv. What is the mean lifespan of the bulbs?</li> <li>v. What is the median of the lifespan of the bulbs?</li> <li>vi. What is the mode of the lifespan of the bulbs?</li> <li>vii. When placing an order for the bulbs tested to sell in your shop, which of them will you consider buying?</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<p><b>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).</b></p>	<p><b>B9.4.1.2.3 Demonstrate the effect on the mean, median, and mode when extreme data is included in a data set</b></p> <p>E.g.1 Refer to E.g. 1 of B9.4.1.1.2.</p> <ul style="list-style-type: none"> <li>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</li> <li>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.</li> <li>iii. Continue to replace the values of the lifespan in the data <i>with extreme values</i> (small and large), calculate the mean, median, and mode and discuss the findings.</li> </ul>	<p><b>Critical Thinking and Problem solving (CP)</b></p> <p><b>Communication and Collaboration (CC)</b></p> <p><b>Creativity and Innovation (CI)</b></p> <p><b>Personal Development and Leadership (PL)</b></p> <p><b>Digital Literacy (DL)</b></p>

**STRAND 4: HANDLING DATA**  
***Sub-strand 2: Chance or Probability***

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
<b>B9.4.2.1</b> 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.	<p><b>B9.4.2.1.1.</b> Perform a probability experiment involving two dependent events e.g. drawing coloured bottle tops from a bag without replacement</p> <p>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 <b>without replacement</b>.</p> <ul style="list-style-type: none"> <li>i. List the elements of the sample space of the events.</li> <li>ii. Does the occurrence of the one trial affect the occurrence of the other trials?</li> </ul>	<b>Critical Thinking and Problem solving (CP)</b> <b>Personal Development and Leadership (PL)</b>
	<p><b>B9.4.2.1.2.</b> Express the probabilities of the events as fractions, decimals, percentages and/or ratios; e.g. using a tree diagram, table or another graphic organiser</p>	
	<p>E.g. 1 Draw a probability tree diagram for the experiment in B9.4.2.1.1,</p> <p>E.g. 1. Express the probabilities of the events (on their respective branches) as decimals, percentages and ratios.</p>	
	<p>E.g. 2:</p> <ul style="list-style-type: none"> <li>i. Consider the experiment of drawing two Aces (in two trials) in a standard deck of cards without replacement.</li> <li>ii. Calculate the probability of <b>each</b> trial and express the probabilities of the events as decimals, percentages and ratios.</li> </ul>	

CONTENT STANDARDS	INDICATORS AND EXEMPLARS	CORE COMPETENCIES
	<p>E.g. 3:</p> <ul style="list-style-type: none"> <li>i. Consider the experiment of drawing an Ace and a Jack (in two trials) in a standard deck of cards without replacement.</li> <li>ii. Calculate the probability of <b>each</b> trial and express the probabilities of the events as decimals, percentages and ratios.</li> </ul>	

## **APPENDIX: UNPACKING THE CORE COMPETENCES OF THE STANDARDS-BASE CURRICULUM**

**NATIONAL COUNCIL FOR CURRICULUM AND ASSESSMENT (NaCCA)**  
CORE COMPETENCIES AND SUBSKILLS OF THE COMMON CORE PROGRAM (CCP)

### **1. COMMUNICATION AND COLLABORATION (CC)**

B7-B10

<b>CC7: LISTENING</b>	<b>CC8: PRESENTING</b>	<b>CC9: TEAMWORK</b>
<b>CC7.1:</b> Identify words or sentences in context appropriately	<b>CC8.1:</b> Speak clearly and explain ideas. Share a narrative or extended answer while speaking to a group	<b>CC9.1:</b> Demonstrate behaviour and skills of working towards group goals
<b>CC7.2:</b> Interpret correctly and respond to non-verbal communication such as facial expressions, cues and gestures	<b>CC8.2:</b> Explain ideas in a clear order with relevant detail, using correct construction and structure of speech	<b>CC9.2:</b> Understand and use interpersonal skills
<b>CC7.3:</b> Provide feedback in areas of ideas, organisation, voice, word choice and sentence fluency in communication	<b>CC8.3:</b> Apply appropriate diction, and structure sentences correctly for narrative, persuasive, imaginative and expository purposes	<b>CC9.3:</b> Understand roles during group activities
<b>CC7.4:</b> Identify underlying themes, implications and issues when listening	<b>CC8.4:</b> Anticipate different responses from the audience and plan for them	<b>CC9.4:</b> Help group work on relevant activities
<b>CC7.5:</b> Identify and analyse different points of views of speaker	<b>CC8.5:</b> Vary the level of detail and the language used when presenting to make it appropriate to the audience	<b>CC9.5:</b> Appreciate the importance of including all team members in discussions and actively encourage contributions from them
		<b>CC9.6:</b> Ability to work with all group members to complete a task successfully
		<b>CC9.7:</b> Effectively perform multiple roles within the group
		<b>CC9.8:</b> 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	
<b>CP5: CRITICAL THINKING</b>	<b>CP6: PROBLEM SOLVING</b>
<b>CP 5.1:</b> Ability to combine Information and ideas from several sources to reach a conclusion	<b>CP 6.1:</b> Ability to effectively define goals towards solving a problem
<b>CP 5.2:</b> Analyse and make distinct judgement about viewpoints expressed in an argument	<b>CP 6.2:</b> Ability to explain plans for attaining goals
<b>CP 5.3:</b> Create simple logic trees to think through problems	<b>CP 6.3:</b> Identify important and appropriate alternatives
<b>CP 5.4:</b> Generate hypothesis to help answer complex problems	<b>CP 6.4:</b> Ability to identify important and appropriate criteria and use them to evaluate available alternatives
<b>CP 5.5:</b> Effectively evaluate the success of solutions used in an attempt to solve a complex problem	<b>CP 6.5:</b> Ability to select alternative(s) that adequately meet selected criteria
<b>CP 5.6:</b> Demonstrate a thorough understanding of a generalised concept and facts specific to task or situation	<b>CP 6.6:</b> Preparedness to recognise and explain results after implementation of plans
<b>CP 5.7:</b> Provide new insight into controversial situation or task	<b>CP 6.7:</b> Implement strategies with accuracy
<b>CP 5.8:</b> Identify and prove misconceptions about a generalised concept or fact specific to a task or situation	
<b>CP 5.9:</b> Identify and explain a confusion, uncertainty, or a contradiction surrounding an event	
<b>CP 5.10:</b> Develop and defend a logical plausible resolution to a confusion, uncertainty or contradiction surrounding an event	

## 3. PERSONAL DEVELOPMENT AND LEADERSHIP (PL)

B7-B10	
<b>PL5: PERSONAL DEVELOPMENT</b>	<b>PL6: LEADERSHIP</b>
<b>PL5.1:</b> Understanding oneself (strengths, weaknesses, goals and aspirations) in reacting and adjusting to novel situations	<b>PL6.1:</b> Ability to serve group members effectively
<b>PL5.2:</b> Demonstrate a sense of belongingness to a group	<b>PL6.2:</b> Division of tasks into solvable units and assigning group members to task units
<b>PL5.3:</b> Recognise one's emotional state and their preparedness to apply emotional intelligence	<b>PL6.3:</b> Ability to manage time effectively

<b>PL5.4:</b> Ability to understand one's personality traits	<b>PL6.4:</b> Ability to manage and resolve conflicts
<b>PL5.5:</b> Desire to accept one's true self and overcome weaknesses	<b>PL6.5:</b> Ability to monitor team members to ascertain progress
<b>PL5.6:</b> Ability to set and maintain personal standards and values	<b>PL6.6:</b> Ability to mentor peers
	<b>PL6.7:</b> 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
	<b>PL6.8:</b> 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	
<b>CG5: CULTURAL IDENTITY</b>	<b>CG6: GLOBAL CITIZENSHIP</b>
<b>CG5.1:</b> Show a strong sense of belongingness to one's culture	<b>CG6.1:</b> Understanding of influences of globalisation on traditions, languages and cultures
<b>CG5.2:</b> Develop and exhibit ability to defend one's cultural beliefs, practices and norms	<b>CG6.2:</b> Recognise resistance to global practices that are inimical to our culture
<b>CG5.3:</b> Develop and express respect, recognition and appreciation of others' cultures	<b>CG6.3:</b> Know the global discourse about the roles of males and females
<b>CG5.4:</b> Develop and exhibit a sense of cultural identity	<b>CG6.4:</b> Exhibit a sense of nationality and global identity
<b>CG5.5:</b> Adjust to the demands of customs, traditions, values and attitudes of society	

## 5. CREATIVITY AND INNOVATION (CI)

B7-B10

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

## 6. DIGITAL LITERACY (DL)

B7-B10

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

### Please note these inclusivity issues

The core competencies 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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