REB | RWANDA BASIC EDUCATION BOARD

SAMPLE OF SCRIPTED LESSONS

MATHEMATICS

LOWER SECONDARY

(S1-S3)

FOREWORD

Dear teacher,

Rwanda Basic Education Board (REB) is honoured to present the book of Mathematics lessons sampled from scripted lessons of Lower Secondary. This book serves as a reference to competence-based teaching and learning that infuses the 5E Instructional Model to ensure consistency and coherence in the learning of the Mathematics and Science content.

In line with efforts to improve the quality of education, the Government of Rwanda emphasizes the importance of aligning teaching and learning materials with the syllabus to facilitate the learning process. Many factors influence what pupils learn, how well they learn and the competences they acquire. Those factors include the relevance of the specific content, the quality of teachers' pedagogical approaches, the assessment strategies, and the instructional materials.

In this regards, Rwanda Basic Education Board (REB) is implementing the "Rwanda Quality Basic Education for Human Capital Development" Project. Some of the Project's objectives are:

(a) increase teacher content knowledge; (b) improve classroom teaching practices; (c) ensure availability of critical teaching materials and ICT tools in the classroom; and (d) provide continuous support to teachers in their work. The Sub-component 1.2 of the project has the aim of enhancing teacher effectiveness for improved student learning through different ways of supporting professional development of Mathematics and Science teachers.

Firstly, the project is helping teachers to use technology to improve their way of teaching through a complete yet simple package to be used in the classroom. This package includes the scripted lessons developed in One Note.

Secondarily, the project helped teachers from schools without electricity by developing the sample scripted lessons as presented in this book. They are developed to serve you as reference of lessons that respect the 5E Instructional Model. This model consists of cognitive stages of learning that comprise 5 phases: E*ngage*, E*xplore*, E*xplain*, E*laborate*, and E*valuate*.

Through this approach, learners redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment. As a result, learners interpret objects and phenomena observed in their real-life experience and internalize those interpretations in terms of their current conceptual understanding.

Even though this book contains the guidance on the main steps of the lesson, you are requested to regularly plan your lessons as usual depending on the current situation of your class environment: level of tudents, teaching materials, and motivating situation available at your school.

I wish to sincerely express my appreciation to the people who contributed towards the development of this book, particularly, REB staff, UR-CE Lecturers, Teachers, and experts from Local and international Organizations for their technical support.

Dr. MBARUSHIMANA Nelson

Director General, REB

ACKNOWLEDGEMENT

I wish to express my appreciation to the people who played a major role in the development of this book for Mathematics lessons sampled from scripted lessons of Lower Secondary (S1-S3). It would not have been successful without active participation of different education stakeholders.

I owe gratitude to University of Rwanda College of Education and other schools in Rwanda that allowed their staff to work with REB in the in-house textbook production initiative.

In addition, gratitude is extended to Rwanda Basic Education Board staff, lecturers and teachers who dedicated their time and supported the writing and proofreading of this document. Their commitment and invaluable inputs were very critical to finalizing this document.

Finally, I would also like to extend my gratitude to REB-SPIU and UR-SPIU, under quality Basic Education Project for providing all the facilities that were required.

Joan MURUNGI

Head of CTLR Department

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INTRODUCTION

Rwanda Basic Education Board (REB) is implementing the "Rwanda Quality Basic Education for Human Capital Development" Project.

The subcomponent 1.2 of this project is being implemented by REB in collaboration with University of Rwanda College of Education (UR-CE). The subcomponent aims at enhancing teacher effectiveness for improved student learning through support of professional development of Mathematics and Science teachers.

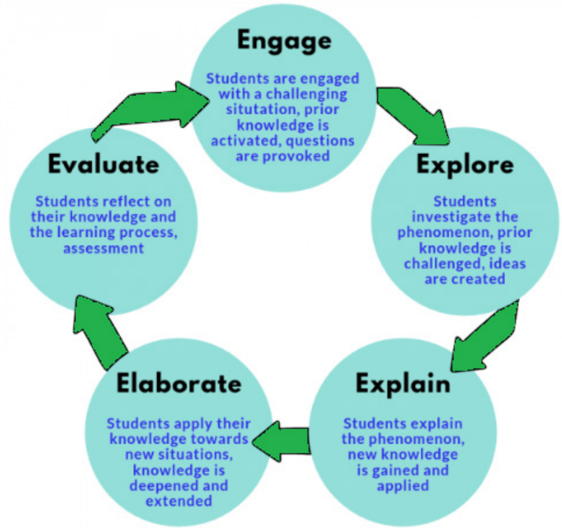
Firstly, the project is helping teachers to use technology to improve their way of teaching through a complete yet simple package that includes the scripted lessons developed in One Note to be used in the classroom. These scripted lessons in One Note incorporate the 5E instructional Model.

Secondarily, the project helps teachers from schools without electricity by developing, in Microsoft word, the sample scripted lessons. This booklet contains such lessons and serves as a reference to competence-based teaching and learning that infuses the 5Es Instructional Model to ensure consistency and coherence in the learning of the Mathematics and Science content.

The detailed explanation of this model is given in the following paragraphs.

The 5Es instructional model

"The 5E Model of Instruction is a teaching and learning model that promotes active learning. It states that teaching and learning progresses through **five** phases: **Engage, Explore, Explain, Elaborate and Evaluate.**



In this model, students are involved in more than listening and reading. They learn to ask questions, observe, model, analyse, explain, draw conclusions, argue from evidence, and talk about their own understanding. With the 5 Es instructional model, students work collaboratively with peers to construct explanations, solve problems, and plan and carry out investigations."

Phase 1: Engage

The first phase of the 5E Model engages students by having them mentally focus on a phenomenon, object, problem, situation, or event. The activities in the Engage phase are designed to help students make connections between past and present learning experiences, expose prior conceptions, and organize thinking toward the essential questions and learning outcomes of the learning sequence.

The role of the teacher in the Engage phase is to present a situation, identify the instructional task, and set the rules and procedures for the activities. The teacher also structures initial discussions to reveal the range of ideas, experiences, and language that students use which become resources for upcoming lessons.

Teaching Strategies

- Raises questions or poses problems
- Elicits responses that uncover students' current knowledge
- Helps students make connections to previous work
- Posts learning outcomes and explicitly references them in the lesson
- Invites students to express what they think
- Invites students to raise their own questions

Phase 2: Explore

Once students have engaged in activities, they need time to explore ideas. Explore activities are designed so all students have common, concrete experiences which can be used later when formally introducing and discussing scientific and technological concepts and explanations. Students have time to investigate objects, events, or situations. As a result of their mental and physical involvement in these activities, students question events, observe patterns, identify and test variables, and establish causal relationships.

The teacher's role in the Explore phase is to facilitate learning. They initiate activities and allow time and opportunity for students to investigate objects, materials, and situations. The teacher coaches and guides students as they record and analyse observations or data and begin constructing models or initial explanations.

Teaching Strategies

- Provides or clarifies questions or problems
- Provides common experiences
- Observes and listens to students as they interact
- Acts as a consultant for students
- Encourages student-to-student interaction
- Asks probing questions to help students make sense of their experiences and redirect them when necessary
- Provides time for students to puzzle through problems

Phase 3: Explain

The Explain phase consists of two parts. First, the teacher asks students to share their initial models and explanations from experiences in the Engage and Explore phases. Second, the teacher provides resources and information to support student learning and introduces scientific or technological concepts. Students use these resources and information, as well as ideas of other students, to construct or revise their evidence-based models and explanations. In engineering, students design solutions to problems based on established criteria.

Teaching Strategies

- Encourages students to explain concepts and definitions in their own words
- Asks for justification (evidence) and clarification from students
- Formally provides definitions, explanations, and information through mini-lecture, text, internet, or other resources
- Builds on student explanations
- Provides time for students to compare their ideas with others and if desired revise their ideas

Phase 4: Elaborate

Once students have constructed explanations of a phenomenon or design solutions for a problem, it is important to involve them in further experiences that apply, extend, or elaborate the concepts, processes, or skills they are learning. Some students may still have misconceptions, or they may only understand a concept in terms of the exploratory experience. Elaborate activities provide time for students to apply their understanding of concepts and skills. They might apply their understanding to similar phenomena or problems.

Teaching Strategies

- Expects students to use vocabulary, definitions, and explanations provided previously in new contexts
- Encourages students to apply the concepts and skills in new situations
- Provides additional evidence, explanations, or reasoning
- Reinforces students' use of scientific terms and descriptions previously introduced
- Asks questions that help students draw reasonable conclusions from evidence and data

Phase 5: Evaluate

It is important that students receive feedback on the quality of their explanations. Informally, this may happen throughout the learning sequence. Formally, the teacher can also administer a summative evaluation at the end of the learning sequence. The Evaluate phase encourages students to assess their understanding and abilities and allows teachers to evaluate individual student progress toward achieving learning goals and outcomes.

Teaching Strategies

- Asks open-ended questions such as, “Why do you think…?” “What evidence do you have?” “How would you answer the question?”
- Observes and records notes as students demonstrate individual understanding of concepts learned and performance of skills
- Uses a variety of assessments to gather evidence of student understanding
- Provides opportunities for students to assess their own progress

When this model is used in the lessons, learners interpret objects and phenomena they observe in their real-life experience and internalize those interpretations in terms of their current conceptual understanding.

Scripted lesson is a structured lesson which is presented in a way that explains each step of the lesson in a direct instruction. It shows what the teacher says, what he/she does and indicates expected answers/findings of students in the whole process of a lesson from the beginning to the end.

The following part contains examples of lessons selected from scripted lessons prepared in One Note. They will serve as reference of lessons with the structure of 5Es instructional model.

SCRIPTED LESSONS FOR SENIOR 1

1.1 First Lesson from unit 1

SUBJECT: Mathematics	GRADE: S1	UNIT: 1
LESSON TITLE: Introduction to set concept. **Duration:** 2 periods or 80 Minutes. **Teaching material**: chalks, pens, models or pictures. **Learning materials**: notebooks, pens, Mathematics student's book -S1.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (25 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson.	Begin by gaining students' attention.

	Teacher: Observe the image and group shapes basing on the number of sides  **Students**: Shapes are grouped into quadrilaterals (4 sides), triangles (3 sides) , pentagon (5 sides), hexagon (6 sides), heptagon (7 sides).	Ask students to observe the picture and asks them to sort out / group them basing on shape and size. You may use real shapes drawn on cards.
	Teacher: let us do the activity 1 in small groups **Activity 1:** In small groups visit school compound nearby the class and Write different names of at least 5 items/objects observed.	Help students to work in small groups the engaging activity 1. Give time to students to think and note down their ideas and then present their working steps to the whole class.

	a) From what you have found complete the table Kitchen | Garden | Teachers'room | Playground | ... b) What criteria did we follow to classify the observed items? **Students**: .... (**Present the** expected answers which may vary depending on students' observations). **Teacher**: Good! In today's lesson, we are going to continue with set concept . By the end of this lesson, you will be able to: • Define a set • Give examples of sets • Appreciate the presence of sets in real life context.	Move around to verify if all students are actively participating and provide guidance for students in needs. Communicate the lesson title and related instructional objective to students. Use learning objectives to set instructional objective with all 5 components **(who-conditions - action verb-content – performance criteria)** students. **Example of instructional objective:** *Instructional objective: Using/ given collection of objects , learners will be able to correctly classify them according to the common features, define a set , give example of sets and appreciate the presence of sets in real life context.*

Kitchen	Garden	Teachers'room	Playground	...

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<td>Teacher: let us do activity 2 in pairs

Activity 2:
1. Identify and list any ten items at your home that can be grouped together.
2. Explain why an item is in one group but not in the other.
3. What is a set?

Students:
• Ten items at your home that can be grouped together: types of fruits, kitchen materials, children' toys, types of shoes, clothes' size, ...
• Items may be in one group but not in another because of the common characteristics based on to form group.
• A group of objects with common and well defined feature / characteristic is called a set.
• An object in a set is called an element.</td>
<td>In pairs , ask students to do the engaging activity 2 and use different probing questions to students to lead them to understand and clarify the concepts

Invite students to present or give their expected answers:</td>
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<tr>
<td>Lesson development

(45 min)</td>
<td>Teacher: students let us do the activity 3 in pairs

Activity 3: 10min
1. For each of the following sets list at least 4 elements. Kitchen utensils, Our school Garden flowers, Mathematical tools set, students of our class, Teachers of our school.</td>
<td>In pairs, ask students to do the exploration activity and use different probing questions to students to lead them to define a set</td>
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	2. By using capital letters for sets and small letters for elements, Use mathematical representation to express the membership. **Students :** 1. • Some kitchen utensils are: knife, spoons, salad spinner, sauté pan, saucepan... • Some elements of school garden are : fruit trees, cabbages, flowers... • Do the same for the other sets 2. Let K be the set of kitchen utensils, k, s, w, p and r be knife, spoon, whisk, saucepan and ruler . Then $k \in K$, $r \notin K$, $s \in K$,.... **Teacher:** Well done students. From the above activity, we notice that: • A group of items with a common well defied feature is called a set. • An object or item in a set is called a member or an element of the set. • In general sets are represented by capital letters (Eg: A, C,V,W...) and elements by small letters. • If a is an element of the set W, we denote $a \in W$ and we read a belongs to W. • If b is an element that does not belong to W, we denote $b \notin W$	Invite students to present their expected answers to the whole class Use probing questions to help learners come up with a good and complete summary

	Activity 4: 1. List at least 4 elements of the following set: Set of available fruits at home. 2. Choose the correct answer from the following: A. An object in a set is called : A : Element B: Set C: List D: None of them B. A group or collection of objects is called : A : Element B: Set C: List D: Group **Students:...**	Ask students to work in pairs the application (elaboration) activities and provide time for students to think, elaborate and share their ideas on set concepts like element, belonging and not belonging to a set.
	Lesson summary • A set is a collection or group of well-defined objects also called element /members. • Well defined means the feature must be clear to enable everyone to decide which object belongs to the set and which object does not. • In general sets are represented by capital letters (Eg: A,C,V,W...) and elements by small letters If a is an element of the set W, we denote $a \in W$ and we read a belongs to W If b is an element that does not belong to W, we denote $b \notin W$	Use different questions to help students recall key concepts of the lesson and ensure that the summary is written down by all students. During harmonization/ making a general summary, provide time for students to ask questions on what they do not understand well.

Assessment **(8 min)**	1. List at least 4 elements of the following set: Set of available vegetables at home. 2. Read each of the following statements and decide if it is a set or not. Explain your answer. • A collection of all the days in a week beginning with the letter T • The group of girls in your class. • A collection of beautiful flowers in a garden. **Students:...**	Individually , ask students to do the activity of formative assessment (**evaluation**) Provide opportunities to students for asking questions, and corrective feedback or positive feedback are given as well.
Conclusion **(2min)**	**Teacher:** We are coming to the end of our lesson. As we conclude, let's review some of the key points that we learned. We all remember that: • A Set is a group of items with a common feature. • An object or item in a set is called a member or an element of the set. • In general sets are represented by capital letters and elements by small letters. **Teacher:** Thank you, As a home work, you are requested to do activities below and others found on page 9-10 of S1 Mathematics book for Rwandan schools. 1. List at least 4 elements of the following set : wild animals 2. Let 2,3,4,5,6,7 be elements of set A ; 2,4,7,8 be elements of set B; 2,4 be elements of set C. Fill in the blanks by using $\notin$ *or* $\in$:	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

	a) 2………A b) 9………A c) 3………C d) 8…………. B e) 10……….C Thank you for your participation in this lesson.	

1.2 Second Lesson from unit 1

SUBJECT: Mathematics	**GRADE:** S1	**UNIT:** 1
LESSON TITLE: Description of set **Duration:** 2 periods or 80minutes. **Teaching material**: Chalks, Books **Learning materials**: Note books, pens, calculators, S1 Mathematics book.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (10 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? And who can give examples of sets by listing at least 3 objects to make a set. **Students:** We have studied Introduction to set concept. 3 objects to make a set are: notebook, pen, and pencil can form a set of school materials.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Dear students, let us do the following activity in pairs. **Activity 1:** 1. Give example of a set. 2. Write symbolically the following. i) a is an element of set A, ii) b is not a member of the set A. **Students:** **1.** a set of even numbers. 2. i) a is an element of is symbolized by $a \in A$. ii) a is not an element of A: $a \in A$.	Help students to do the **engaging** activity in pairs.

	Teacher: Good! In today's lesson, we are going to continue with Description of set. And by the use of geometric materials, you will be able to: differentiate finite from infinite set.	Communicate the lesson title and related instructional objective to students.
Lesson development **(50 Minutes)**	**Teacher**: Let us do the following activity in the groups. **Activity 2:** 1. List any 5 elements of Kitchen utensils 2. Which description can be given to the set of the following letters a,b,c,d and e. 3. List all elements of integers greater than 10. What do you observe? 4. Let V ={x/x is a student of our class} i) Give two examples of members of V. ii) How many students are in our class? 5. In terms of number of members, compare sets given in 3 and 4 **Students' answers:** 1. kitchen utensils: spoon, fork, plate, cup, knife, 2. a,b,c,d and e can be described as the first five letters of the English alphabet. 3. integers greater than 10 Z={11,12,13,14,15,16,...}, I observed that they make an infinity of numbers. 4. Answers depend on students who are in the class.	Students must be given time to think and note down their ideas. Invite them to work on the **exploration** activity in groups. Ask students to present their findings in plenary session and guide them to harmonize their findings.

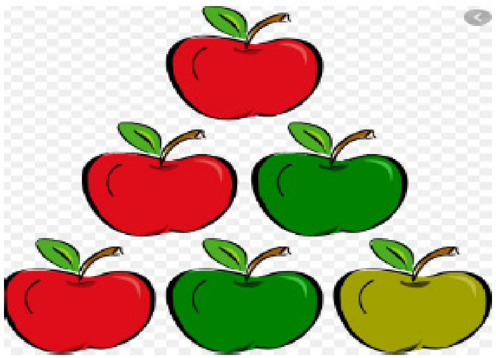
	Teacher: well done students. From the above activity, we notice that: • The set V of students of our class is finite since its members can be counted and the list has an end. • The set of integers greater than ten is infinite because not all members of it can be listed down. • The number of elements of a finite set , A say, is called its cardinal and is denoted by #A or n(A). • The cardinal of infinite set is undefined.	Guide them to **explain** clearly the concepts of the day.
	Teacher: Dear students, in your group, do the following activities: **Activity 3** Write each of the following sets in roster form and also in set-builder form. Specify if the set is finite or infinite. Determine its cardinal. i) Set of all natural numbers which divide 24. ii) Set of add numbers. iii) Set of even numbers less than 25. iv) Set of letters used in the word "MASSACHUSETTS". v) Set of names of the first five months of a year. vi) Set of all two digits numbers which are perfect squares. vii) Set of letters used in the word "EDUCATION". **Students' answers:** **(i)** Roster Form: {1, 2, 3, 4, 6, 8, 12, 24}; Set-Builder Form: {x : x is a natural number which divides 24 completely}, Finite, cardinal=8	Provide **elaboration** activity to be done in groups and choose one group member to present.

	(ii) Roster Form: {1,3,5, 7,...}; Infinite, no Cardinal Set-Builder Form: {x: x is an odd natural number}. **(iii)** Roster Form: {2, 4, 6, 8, 10, 12, 12, 14, 16, 18, 20, 22, 24}; Set-Builder Form: {x: x is an even natural number less than 25}. **(iv)** Roster Form: {m, a, s, c, h, u, e, t}; Set-Builder Form: {x: x is a letter used in the word 'MASSACHUSETTS'}. **(v)** Roster Form**:** {January, February, March, April, May}; Set-Builder Form: {x: x is name of the first five months of a year} **(vi)** Roster Form: {16, 25, 36, 49, 64, 81}; Set-Builder Form: {x: x is a perfect square two-digit number} **(vii)** Roster Form: {e, d, u, c, a, t, i, o, n}; Set-Builder Form: {x : x is a letter used in the word 'EDUCATION'}.	Remember to address common misconceptions.
	Summary: Finite set: We cancount its elements Infinite set: It has many elements we cannot count thel There are three methods commonly used to describe or represent a set: Statement form, Roster/Listing form and Set builder form. E.g: i) Statement form The set A of the first five letters of the English alphabet. ii) Roster form: $\{a,b,c,d,e\} = A$ iii) Set Builder form: A= {x/x is if one of 5 letters of english alphabets} Note: In Roster form or tabular form, elements of the set are listed, separated by commas and enclosed in curly brackets { } .	Use different questions to help students highlight key concepts of the lesson to be written down as a summary.

Assessment **(15min)**	**Teacher**: Thank you very much. Now, let us do an individual activity for **assessment** 1. Specify the form in which each of the following sets is represented, then write it in other two forms. For each set, determine its cardinal. (a) The set of colors of a rainbow. (b) The set of colors of the Rwandan flag. (c) M= {11, 12, 13, 14, 15, 16, 17, 18, 19}. (d)R= {x/x is a country neighbouring Rwanda}. 2. Give one example of infinite set and describe it using the three forms of set representation. **Students' answers:** 1. a) i) It is described in statement form. *A*(c)=7 ii) in roster form; C= {red, blue, yellow, green, indigo, violate, orange} iii) in set builder form; C= {x/x is such that x is colour of rainbow} b) i) It is described in statement form. n(F)=3 ii) in roster form: F= {red, green, yellow} iii) in set builder form; F= {x/x is the colour of Rwandan flag} c) i) It is described in roster form. n(m)= ii) in statement form M is set of natural number between 10 and 20 iii) in set builder form M= {x/x is 10<x<20} d) i) It is described in Set builder form. ii) in roster form R= {Burundi, Uganda, tanzanie, DRC}	Provide activity to be done as assessment or **evaluation**.

	2. Example of infinite: set of prime numbers. a) in statement form: set of prime numbers. b) in roster form: S= {2,3, 5,7,11...} c) in set builder form: S= {x/x is prime number}.	
Conclusion **(5min)**	**Teacher**: As, we are coming to the end of our lesson, we have seen that: A set can be represented using three forms: • Roster form, Set builder form and statement form. • There exist finite sets or infinite sets. • The number of elements in a finite set A is called its cardinal denoted by n(A). The cardinal of infinite set is undefined, We cannot count the number of elements for an infinite set. **Teacher**: Thank you for your participation in this lesson	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.3 First Lesson from unit 2

SUBJECT: Mathematics	**GRADE**:S1	**UNIT**: 2
LESSON TITLE: Operations on natural numbers		
Duration: 2 periods		
Teaching material: Two flip charts.		
Learning materials: notebooks, pens, calculator, S1 Mathematics book (from page 41 to page 43).		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction **(15 min)**	**Teacher:** Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Students observe the photo and answer to the questions  a) How many red apples are there? b) How many green apples are there? c) How many pink apples are there?	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

	d) How many apples are there? **Students' answers** a) Red apples are 3 b) Green apples are 2 c) Pink apple is 1 d) Total number of apples is 3+2+1=6. **Teacher**: Let us review the previous lesson on the Natural Number by doing the following activity: **Activity 1:** Marry went to the market and bough 3 boxes of water containing 12 bottles each, at 3600 Frw each box, she also bought 30 eggs at 2400 Frw. a) How many bottles of water did Marry buy? b) How much money did she pay for each bottle? c) How much money did she pay for all bottles? d) How much money did she pay for all items bought? e) Reached at home, she found 13 eggs broken. How many eggs did she remain with? **Students' answers:** a) Number of bottles Marry bought is 3×12 bottles = 36 bottles b) Amount of money Marry payed for each bottle 3600 Frw÷12 = 300 Frw c) Amount of money Marry payed for all bottles is 300 Frw × 36= 10,800 Frw	Helps students to work in pairs the **engaging** activity. Give time to students to think and note down their ideas and then present their working steps to the whole class. Moves around to verify if all students are actively participating and provide guidance for students in needs.

	d) Amount of money Marry payed for all items is 10,800 Frw +2400 Frw = 13,200 Frw e) Number of eggs Marry remains with is (30 - 13) eggs = 17 eggs. **Teacher:** let us brainstorm and find out the answers for the key Question: "*What are the operations that can be performed on natural numbers?*" **Students:** There are four operations which can be performed on natural numbers and these operations are **addition, subtraction, multiplication and division.** **Teacher:** You are right. Today we are going to study the four operations and their properties in the set of Natural Numbers. By the end of this lesson, you will be able to: • Perform operations on natural numbers. • Solve application problems involving operations on Natural Numbers.	Use brainstorming technique to help students to quickly answer the key question Communicate the lesson title and related instructional objective to students. Use learning objectives to set instructional objective with all 5 components **(who- conditions - action verb- content – performance criteria)** **Example of instructional objective:** *using a diagram of set on handouts, you will be able to perform operations on natural numbers and correctly solve problems involving operations on sets.*

Lesson development (50 min)	**Teacher:** Let us do the activity in pairs **Activity 2:** 1. Work out the following and give your comment on the answer. • 1740 +2009 • 1220-1059 • 567 X 19 • 2700:3 • 35-67 • 12:8 2. Perform and compare the results • 255+478 and 478+255 • 12 X 4 and 4 X 12 • (12 + 4)+15 and 4 + (12+15) • (78 X 13) X 7 and 78 X (13 X 7) • 5(586 +798) and (5 X 586) +(5 X 798) • 12 + 0 • 12 X 1 **Students' answers** 1. • 1740 +2009 =3749, addition of 2 natural numbers is a natural number • 1220-1059=161, subtraction of 2 natural numbers is a natural number	Asks students to work in pairs the **exploration** activity and provide time for students to think, write and share their ideas to the whole class.

	• 567 X 19=10773, multiplication of 2 natural numbers is a natural number. • 2700:3=900, division of 2 natural numbers is a natural number. • 35-67= -32, subtraction of 2 natural numbers cannot be a natural number. • 12:8=1.5, division of 2 natural numbers cannot be a natural number 2. • 255+478=733 and 478+255=733 **255+478 = 478+255,** changing the place of terms in addition does not change the answer. • (78 X 13) X 7=7098 and 78 X (13 X 7) =7098 **(78X13) X 7=78 X (13 X 7),** changing the place of parenthesis in multiplication does not change the answer. • 12 X 4 = 48 and 4 X 12=48, changing the place of terms in multiplication does not change the answer. • (12 + 4)+15 = 31 and 4 + (12+15)= 31, changing the place of parenthesis in addition does not change the answer. • 5(586+798)=6920and (5X586)+(5X798) =6920 5(586 +798) = (5 X 586) +(5 X 798), multiplication is distributed to addition. • 12 + 0 = 12, adding zero to a number does not change anything • 12 X 1=1, multiplying one to a number does not change anything	

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Teacher: Well done students . From the above activity, we notice that:

Addition and multiplication of two natural numbers is always a natural number.
Subtraction of two natural numbers is not always a natural number $(a-b)\in\mathbb{N}$ if only $a>b$
Division of two natural numbers is not always a natural number. $(a\div b)\in\mathbb{N}$ if only $a=nb$ where $n\in\mathbb{N}$

Teacher: Dear students , again from the above activity, we can deduce the following properties:

Addition and multiplication of natural numbers satisfy the following properties:

Closure property: if $a,b\in\mathbb{N}, a+b\in\mathbb{N}$ and $ab\in\mathbb{N}$

Commutative property: if $a,b\in\mathbb{N}, a+b=b+a$ and $ab=ba$

Associative property: if $a,b,c\in\mathbb{N}, (a+b)+c=a+(b+c)$ and $(ab)c=a(bc)$

Identity element

If a is a natural number: $a+0=a$ and $ax1=a$, 0 is an identity element for addition and 1 is an identity element for multiplication.
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Use probing questions to lead students to discover different properties related to the operations on natural numbers and help them to clearly understand properties through explanations.

Helps students to generalize the properties of operations on natural numbers.
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	Distributive property $if\ a,b,c \in \mathbb{N}, a(b+c) = ab+ac$ $(a+b)c = ac+bc$ **Teacher:** Let us do the following activities. **Activity 2.3.3.** 1. Using distributive property, work out the following and explain your working steps (a) 45 X (50 + 30) (b) (181 + 94) X 26 2. Indicate where the operation is possible or not in the set of natural numbers. Explain (a) 4 X (45 – 22) (b) (10 – 39) X 5 (c) (4 8:12) +30 (d) (6 4:7) X 1 3 3. A pool contains 45,000 liters of water. How long does it take to be filled by a hose that can distribute 15 liters per minute? 4. An airport has a plane landing every 10 minutes. How many planes land in one day?	Ask students to work in pairs the application activities (**elaboration**) and provide time for students to think, elaborate operation properties on natural numbers and share their ideas to the whole class.

	Students 'answers 1. (a) 45 X (50 + 30) =3600 (b) (181 + 94) X 26=7150 2. (a) 4 X (45 – 22) =92 it is possible. (b) (10 – 39) X 5: it is impossible because 10-39 is not defined in the set of natural numbers. (c) (4 8÷12) +30 =34 it is possible. (d) (6 4÷7) X 1 3: it is impossible because 64÷7 is not defined in the set of natural numbers 3. Required time $= \frac{4500}{15} = 300$ minutes 4. Number of planes $= \frac{24 X 60}{10} = 144$	Remember to address common misconceptions.

	Lesson summary: Addition and multiplication of natural numbers satisfy the following properties: **Closure property:** *if* $a,b \in \mathbb{N}, a+b \in \mathbb{N}$ *and* $ab \in \mathbb{N}$ **Commutative property:** *if* $a,b \in \mathbb{N}, a+b=b+a$ *and* $ab=ba$ **Associative property:** *if* $a,b \in \mathbb{N}, (a+b)+c=a+(b+c)$ *and* $(ab)c=a(bc)$ **Identity element** If a is a natural number: $a+0=a$ and $ax1=a$, 0 is an identity element for addition and 1 is an identity element for multiplication. **Distributive property :***if* $a,b,c \in \mathbb{N}, a(b+c)=ab+ac$ $(a+b)c=ac+bc$	Use different questions to help Students recall key concepts of the lesson and ensure that the summary is written down by all students. During harmonization/ making a general summary, provide time for students to ask questions on what they do not understand well.
Assessment (10 min)	**Teacher:** Individually, let us do an activity for assessment 1. The municipal head gardener wants to buy young trees to plant along the main street of the town. The young trees cost 27 Frw each, and he has an amount of 9 400 Frw for trees. He needs 324 trees. Do you think he has enough money? 2. In Musanze District, a farmer harvested 34 500 kg of potatoes in the first season and 24 750 kg of potatoes in the second season. Find the total harvest. 3. In a city, there were 45 600 girls in secondary schools and 39540 boys. Find the total number of students in the city.	Ask learners to do, individually, the activity of formative assessment (**evaluation**).

	Students 'answers 1. Money that he needs =27X324=8,748 Frw He has enough money because money that he has, is more than that he wants: 9400 Frw > 8748 Frw. 2. Total harvest: 34,500 kg + 24,750 kg = 59,250 kg 3. Number of students 45,600 + 39,540 = 85,140 students.	Provide opportunities to students for corrective feedback or positive feedback on formative assessment.
Conclusion (5min)	**Teacher:** We are coming to the end of our lesson. As we conclude, let's review some of the key points that we learned. We all remember that • Addition/multiplication of two natural numbers is always a natural number. The two operations satisfy closure property ` • subtraction / division of two natural numbers is not always a natural number. The two operations do not satisfy closure property • Addition and multiplication of two natural numbers satisfy the commutative property, but subtraction and division do not • Addition and multiplication of two natural numbers satisfy the associative property, but subtraction and division do not • 0 is an identity element for addition and 1 is an identity element for multiplication. • Multiplication is distributive with addition **Teacher:** Thank you; As a home work, you are requested to do more activities found in the exercise 2.2 **on page 43 of S1 Mathematics student book** We shall meet in the next lesson where you will present answers for the home work.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.4 Lesson from unit 3

SUBJECT: Mathematics	**GRADE:** S1	**UNIT:** 3

LESSON TITLE: Intercepts and steepness: the y-axis and x-axis intercepts.

Duration: 1 period or 40 minutes.

Teaching material: A squared chalkboard, coloured chalk, Graph or squared /graph book.

Learning materials: Note books, pens, calculators, geometric materials, S2 Mathematics book.

<table>
<tr><th>Section</th><th>Step –by- step instructions and content</th><th>Teachers' notice</th></tr>
<tr><td>Introduction

(5 Min)</td><td>Teacher: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time?

Students: We studied the Graphs of a straight-line

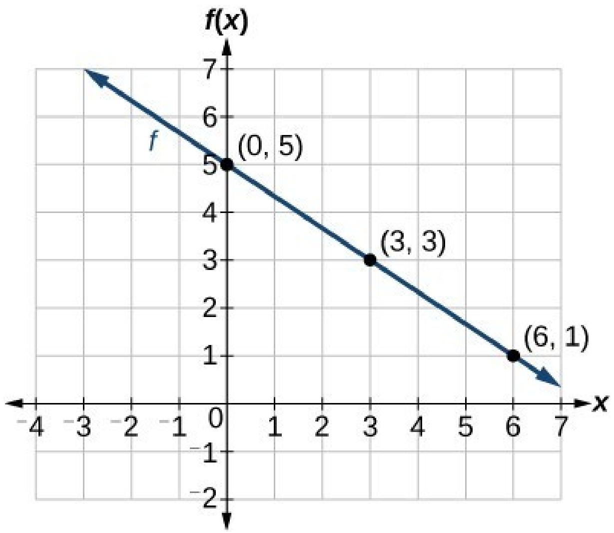
Teacher: Given the function $f(x)=-\frac{2}{3}x+5$,can you complete the table of values below:

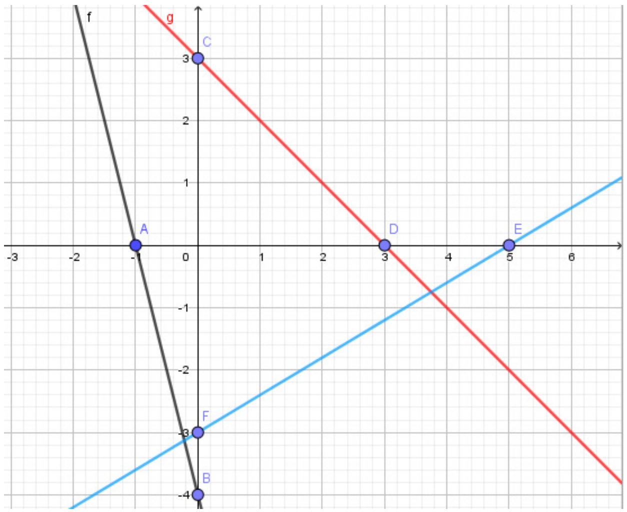
| x | 0 | 3 | 6 |
| f(x) | | | |

Observe the following graph.</td><td>Begin by gaining students' attention.

Identify students with special educational needs and plan how to help them accordingly.</td></tr>
</table>

x	0	3	6
f(x)			

	 Referring to the above table of values, what do you notice? Is it the graph for $f(x) = -\frac{2}{3}x + 5$? **Students:...**	
	Teacher: Dear students, observe the graph and answer the questions:	Helps students to work in pairs the **engaging** activity. Give time to students to think and note down their ideas and then present their working steps to the whole class.



a) How many straight lines do we have?

b) Which of these lines cross the x-axis, y-axis?

Students: There are four straight lines, the green line crosses the x-axis and all of the remaining three lines are Crossing the y-axis.

Teacher: Good! In today's lesson, we are going to continue with **the y-axis and x-axis intercepts**.

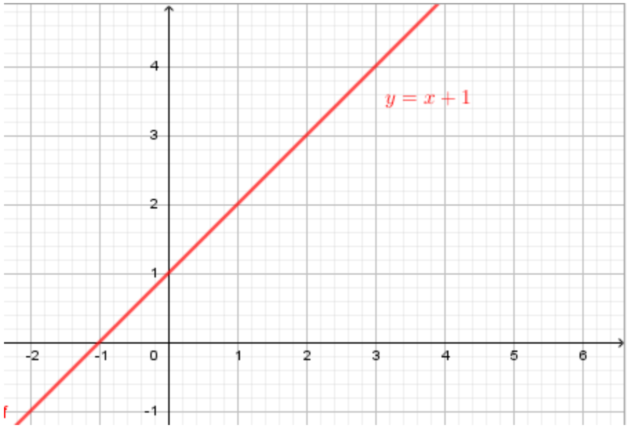
And at the end of the lesson, you will be able to:

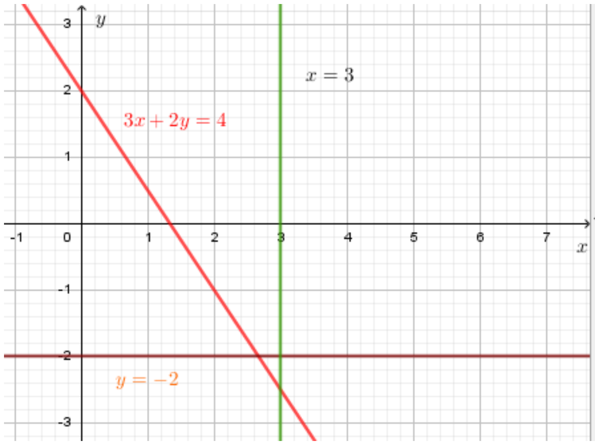
- Define x-axis and y-axis intercepts.
- Determine the coordinates of x-axis and y-axis intercept of a linear function.
- Graph a linear function by using x-axis and y-axis intercepts.

Communicate the lesson title and related instructional objective to students.

Show students axis, and straights lines passing through axis.

You can use a chart or a video showing two axes.

Lesson development (25 Minutes)	**Teacher**: Let us do the activity in pairs. **Activity 1** **a**) Define a linear function. b) Write down the general form of a linear function. c) Plot the graph of the linear function **Students'Answers:** a) Linear functions are the equations whose graph is a straight line in an XY plane. b) The general form of a linear function is y = mx +c. Where m and c are real numbers m ≠ o. For example, see the graph of $y = x+1$ and c=1  **Teacher:** Well done students, do the following activity **Activity 2:** Consider the linear functions: x = 3; y= -2 and 3x+2y=4 a) In the same graph plot each line. b) From your graph say whether or not the line crosses the axes.	Give an activity to recall the previous lesson and ask learners to do the **exploration** activities in pairs Students must be given time to think and note down their ideas.

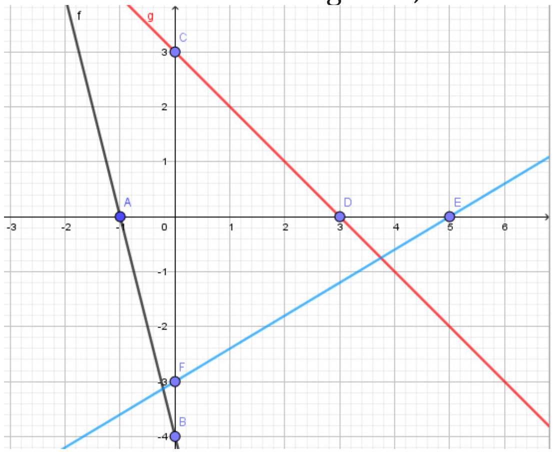
	c) State the coordinates of the point of intersection for each line if any. If your lines intersect, state the coordinates of the common point. **Teacher:** Let us brainstorm and find out the answers for the key Question: **Key question:** How do we call the point where a line crosses the axes? **Students' answers:**  • The line *a* crosses x-axis intercept and y-axis intercept. • The line *b* does not cross x-axis, it crosses y-axis only, line c does not cross x-axis. • The point at which a linear function cuts the x-axis is called x-axis intercept. In this case, y=0 and P=(x,0) • The point at which a linear function cuts the y-axis is called y-axis intercept. In this case, x=0, • To find y-axis intercept we let x=0 and then we find the value of y. In this case, x=0 and P=(0,y)	Asks students to present their findings in plenary session and help them to harmonize their findings (**explanation** phase). Clarify x- intercept, and y-intercept using examples.

- The line which is parallel to x-axis does not have x-axis intercept.
- The line which is parallel to x-axis does not have x-axis intercept
- We can join the intercepts and we get the graph of a linear function.

Teacher: Well done students. Do the given activity

Activity 3

For each of the following lines, find the x-axis and y-axis intercept.



Students' answers

Teacher: Thank you. Work in groups and do this activity for application

1. look at the following equations

(i) $5x + 2y = 0$

(ii) $y - 3x - 1 = 0$

(iii) $2x + y = 3$

a) write each equation in the form $y = mx + c$.

Provide **exploration** activity to be done in groups.

Provide **elaboration** activities to be done in pairs.

In each group with different working steps, choose one group member to present.

	b) Using a table of values represent each equation graphically. c) Use your graph to find the value of x and y intercept in each case. 2. Find the y-intercept of the following without drawing the graphs. (a) $y = 3x + 7$ (b) $7 - 2x = 4y$ (c) $4y + x - 8 = 0$ **Students' answer:** 1. a) (i) $y = \frac{-5}{2}x$ (ii) $y=3x+1$ (iii) $y=-2x+3$ 2. a) y-intercept is 7 b) y-intercept is $\frac{-7}{4}$	
	Summary: • General form of linear function: $y=mx+c$ • y-intercept is c while x-intercept is from this equation: $x=my+d$, write d as x-intercept.	**Summarize** the concept and guide students to write down the content.

	• The point at which a linear function cuts the x-axis is called x-axis intercept. In this case, y=0 and P=(x,0) • The point at which a linear function cuts the y-axis is called y-axis intercept. In this case, x=0, • To find y-axis intercept we let x=0 and then we find the value of y. In this case, x=0 and P=(0,y).	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (8 min)	**Teacher**: Thank you very much. Now, You are going to do an individual activity for a**ssessment** (evaluation): Find the y-intercept of the following without drawing the graphs. (a) $y = 3x + 7$ (b) $7 - 2x = 4y$ (c) $4y + x - 8 = 0$ **Students' answers:** a) y-intercept is 7 b) y-intercept is $\frac{7}{4}$ c) y-intercept is $\frac{8}{4} = 2$	Give students an activity for evaluation. Provide opportunities for corrective feedback or positive feedback to students.

Conclusion (2min)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: • The point at which a linear function cuts the x-axis is called x-axis intercept. In this case, y=0 and P=(x,0) • The point at which a linear function cuts the y-axis is called y-axis intercept. In this case, x=0, • To find y-axis intercept we let x=0 and then we find the value of y. In this case, x=0 and P=(0,y) • The line which is parallel to x-axis does not have x-axis intercept. • The line which is parallel to x-axis does not have x-axis intercept • We can join the intercepts and we get the graph of a linear function. **Teacher:** Thank you for your participation. As homework, do activities found in the S1 Mathematics students' book on page 76.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.5 Lesson from unit 4

SUBJECT: Mathematics	**GRADE:** S 1	**UNIT 4**
LESSON TITLE: Commission **Duration:** 40minutes **Teaching material**: Charts, Textbooks and others **Learning materials**: Notebooks, pens, calculators, S1 Mathematics book.		

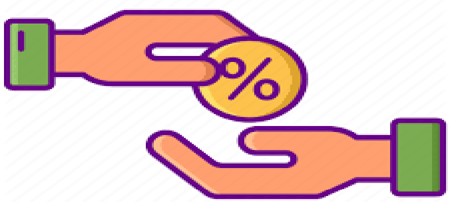
Section	**Step –by- step instructions and content**	**Notice to the teacher**
Introduction (7 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied how to calculate percentage.	Guide students to formulate a recall on the prerequisite of the lesson.
	Teacher: Observe the picture below and answer questions that follow: 	Leads learners to observe the picture and ask them questions leading to the topic of the day (engaging).

	a) What do you observe on the picture? b) What reward can you give to the person who has done something for you? **Students' answers:** a) We see the percentage b) We may give him/her some money. **Teacher**: Good! In today's lesson, we are going to continue with commission. And by the use of percentage, you will be able to: • Define commission. • Calculate commission. • Solve problems involving commission. **Teacher:** Let us do the following activities in pairs. **Activity 1** Suppose you are the manager in charge of sales in a company. a) Discuss in your group, ways you would use to reward your sales people who sell more than the target given to them, without necessary increasing their monthly basic salary or retainer. b) How would you ensure that they get the extra reward for the extra sales they bring? c) What is the name of that extra-reward?	Students must be given time to think and note down their ideas. Share learning objectives with the learners.

	Students' answers: a) I can give them a motivation such as (certificate or add a small amount to his/her salary). b) I can add that increment to his/her existing salary. c) That form of payment is called **"commission"**	
Lesson Development (25 min)	**Teacher**: In your respective small groups, do the following activities: **Activity 2** An insurance lady sales sold insurance policies worth 440,000FRW. If she gets 9% for the total sales made, a) How much money did she get? b) How can we call the money she gets? **Students' answers:** a) Commission $= \frac{9X440,000}{100} = 3960\text{Frw}$ b) The money is called commission **Teacher:** well done students. From the above activity, we notice that: • A commission is the money paid to sales or agent's representative for the sales made. • The calculation of commission is as follows: Total sales multiply by commission percentage	Give them an **exploration** activity. Use different questions to probe students to understand the content (exploration).

	Teacher: dear studets , **in small groups, discuss the following activity:** **Activity3** A company's sales representative sold goods worth 6760000FRW in a certain month. The representative earns a salary of 150240FRW and get a commission of 15% of sales above 5 200 000FRW. Calculate how much the sales representative earned that month. **Students expected answers:** Commission $= \frac{10X(6,760,000-5,200,000)}{100}$ $= \frac{10X1,560,000}{100} = 156,000\text{Frw}$ Total earning = Salary + Commission = (150,240+156,000) = 306 240 Frw **Teacher:** dear students, let us do the activity for application in pairs	Give students the **elaboration** activities.

	Activity 4: A sales lady receives a commission of 5% for the first sale of 80 000rwf and 6% for sales above80 000 Frw. In one month she made sales amounting to 168 000 Frw. Find the total commission that month. **Students" expected answers:** Commission for the first 80 000 Frw $=\frac{5X80,000}{100}$ = 4 000 Frw Commission for excess of 80 000Frw $=\frac{6X(168,000-80,000}{100}=5,280$ Frw The total commission earned that month = (4 000+5 280) = 9 280 Frw **Teacher:** Thank you, take you notebooks, and do the following application activity.	*While students are working, move around to each group and ask some probing questions leading them to correct results.* In each group with different working steps, choose one group member to present their findings.
	Lesson summary A commission is the money paid to sales or agents representative for the sales made.	Remember to address common misconceptions.

	 The formula for calculating commission is: Total sales x commission percentage.	*Provide an opportunity where students can ask questions, where the teacher can help every learner depending on his/her special educational needs* Explain well how to calculate commission when you are given the percentage commission and the total amount.
Assessment (5 min)	**Teacher:** Students let **individually** do the activity of formative assessment **Activity**: Provide more questions to allow students apply skills and knowledge. Questions individually. 1. Sharon makes money by commission rates. She gets 17% of everything she sells. If Sharon sold 37000frw worth of items this month, what is her salary for the month? 2. An employee of a jewelry store sold a piece of jewelry for $2,500. She received 6.75% commission for the sales. How much commission did she earn?	Give students an activity for evaluation Provide opportunities for corrective feedback or positive feedback to students.

	Students" expected answer: 1. Amount of money made = (Amount sold × Commission percentage) $= 0 + \frac{37,000 \text{ x } 17}{100}$ $=$ 6290 frw 2. Part = %(whole) X=0.0675(2500) X=168.75	
Conclusion (3 min)	**Summary** **Teacher:** We are coming to the end of our lesson. As conclusion, let's see some of the key points that we learned. • **A** commission is the money paid to sales or agents representative for the sales made. • A commission is calculated as follows: **Total sales x commission percentage** **Teacher:** Thank you; As a home work, you are requested to do activities below 1. Peter receives a monthly salary of 120 000 FRW plus a commission of 12% on all sales. Last month he made sales worth 1 200 000 FRW. How much did he earn that month? 2. Mrs. Uwamahoro sells charity tickets. She gets 160 FRW for every 8 tickets she sells. How much will she get for selling 480 tickets?	Summarise the lesson and give students a homework.

3. A mobile money agent received a commission of 40 000 FRW for a transaction worth 1 280 000 FRW. Find the rate of his commission.

Expected answers for students:

1. Commission $= \frac{1,200,000 \text{ x } 12}{100} 144,000$

   That month he earn 144000+120000=264000 Frw

2. 8 tickets=160rwf

   1 ticket $= \frac{160}{8}$

   480tickets $= \frac{160 \text{ x } 480}{8} = 9,600 \text{ Frw}$

3. Commission $= \frac{1,280,000 \text{ x } R}{100}$

   40 000 $= \frac{1,280,000R}{100}$

   4 000 000=1 280 000R

   R= $= \frac{4,000,000}{1,280,000}$

   R=3.125%

   Thank you for your participation in this lesson..

1.6 Lesson from unit 5

SUBJECT: Mathematics	GRADE: S1	UNIT 5:
Lesson title: Sharing quantities using ratios		
Duration: 40 minutes.		
Teaching material: flip chart, figures showing sharing.		
Learning materials: Note books, pens, calculators, S1 Mathematics book.		

Section	Step –by- step instructions and content	Teachers' notice
Introduction (10 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the simplification of ratios. **Teacher:** who can give an example of ratios and simplify **Students:** 30:50=3:5, ……	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Do the following activity. **Activity: 1** 1) Observe the figure below answer the questions a) Ratio of girls to boys. b) Ratio of girls to boys. c) Ratio of girls to all people. d) Ratio of boys to all people.	Tell students the materials needed and give them a small time to take them. Give them engaging activity Teacher can use a concrete activity (practical work).

2) There are thirty eggs on the plate to be shared by all children. How many eggs for all boys? How many eggs for Girls? How did you calculate the answers?

Students' Answers

1. a) 2:3
   b) 3:2
   c) 2:5
   d) 3:5

2. There are 30 eggs and 5 children (3boys &2 girls)

Each child receives $\frac{30 \text{ eggs}}{5} = 6$ eggs

Numbers of eggs for boys $6x3$ eggs= 18 eggs

Numbers of eggs for girls $6x2$ eggs= 12eggs

3 boys and 2 girls in the class share 30 eggs.

You can use other material because eggs can be broken easily

	Teacher: You are good learners. Let us brainstorm on key question? How can we share quantities? **Teacher:** Good! In today's lesson, we are going to continue with a new lesson on ratios. By the end of this lesson, you will be able to: • Use ratio to solve problems involving proportional relationships. • **S**hare quantities using ratios where the total shares are a factor of the amount.	Using questions, learners arrive to notice the word ***sharing.*** Guide learners to discover the objectives of the lesson and key words.
Lesson development **(23 minutes)**	**Teacher**: There are many cases in real life where people or organisation group need to share items or resources in a given ratio (example of local associations of people and students). Follow the lesson and you are going to be expert in sharing. **Teache**r: Let us do the activity in pairs **Activity 2** **S**uppose two old men from your village have come to you to arbitrate after they disagreed over how to share 7000 FRW such that for every 2 FRW that the first man gets, the other one gets 3 FRW. (i) In what ratio would you share the money between them? (ii) Tell your partner how you would share the money and how much each would get.	Teacher must use the local examples. Students must be given time to think and note down their ideas. Emphasize new concepts.

	Answer i) The ratio in which money is shared is 2: 3 ii) Sum of ratio =2+3=5	Invite them to work on the **exploration** activity in pairs.
	The first man gets $\frac{7000x2}{5} = 2800\text{ FRW}$ The second man gets $\frac{700x3}{5} = 4200\ \text{ FRW}$ **Teacher**: Let us do the activity in pairs	Ask students to present their findings in plenary session and guide them to harmonize their findings.
	Activity 3 **A** father may want to share 24 acres of land among his two sons. One of them who is disabled gets double of what the other son gets. a) Write the ratio in which the father will share the plot of land. b) What area will each get? c) Explain how you have got your answer.	Provide **elaboration** activities
	Students' answer The father would share the land in the ratio of 2:1. Assume the whole land is first subdivided into equal parts whose number is equal to the sum of the two values in the ratio i.e. 2+1 = 3 parts. The disabled son gets 2 parts out of 3 parts of the whole. i.e. 23 of 24 acres = 23 × 24 acres = 16 acres The other son gets 1 part of 3 parts of the whole. i.e. 13 of 24 acres = 13 × 24 acres = 8 acres.	In each group with different working steps, choose one group member to present.

	Notice the two proportions add up to the whole 18 + 6 = 24 acres. **Teacher:** well done students. From the above activity, we notice that: Sharing quantities using ratio a:b; We proceed as follows Sum of values of ratios: a+b, First share $=\frac{a}{a+b}$ of the quantity, Second share $=\frac{b}{a+b}$ of the quantity, To share a quantity into two parts in the ratio *a:b* , the quantity is split into *a+b* equal parts. The required parts became $\frac{a}{a+b}$ and $\frac{b}{a+b}$ **Teacher**: Let us do the activity individually **Activity 4** Share 38 400 FRW between Linda and Jean in the ratio 5:7 respectively. **Answer** 38 400 FRW is to be shared in the ratio 5:7. It is split into 12 equal parts i.e 5 + 7 = 12 equal parts. The amount Linda receives 5 /12 × 38 400 FRW = 16 000 FRW Jean receives 7/ 12 × 38 400 FRW = 22 400 FRW	Let students work in groups, this will promote among other competencies: (i) Critical thinking skills (ii) Problem solving (iii) Cooperation and interrelation among learners Help learners to evaluate their findings and to harmonize using it in sharing quantities using ratios. Remember to address common misconceptions.

	Activity 5 **I**ngabire, Mugenzi and Shamarima have jointly invested in buying and selling of shares in the Rwanda stock exchange market. In one sale, they realized a gain of 1 080 000 FRW and intend to share it in the ratio 2:3:4 respectively. How much did Mugenzi get? ***Expected answer for students:*** Mugenzi's share $=\frac{3 \text{ x } 1,080,000}{2+3+4}$ Frw = 360,000 Frw	Invite students to work in groups and do the activity for elaborating. Ensure the participation of each learner
	Summary: To share a quantity into two parts in the ratio *a:b*, the quantity is split into *a+b* equal parts. The required parts became $\frac{a}{a+b}$ and $\frac{b}{a+b}$ To share a quantity into three parts in the ratio *a:b:c*, the quantity is split into *a+b+c* equal parts. The required parts became $\frac{a}{a+b+c}$, $\frac{b}{a+b+c}$ and $\frac{c}{a+b+c}$	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

Assessment **(8 min)**	**Teacher**: Thank you very much. Now, You are going to do an individual activity for assessment **Assessment activities** **K**aterina, Nina and Paul contributed to buy a lottery ticket. They contributed 10$, 6$ and 4$ respectively. They agreed to share any winnings in the ratio as dollars they contributed. these friends get Lucky and their ticket won 120000$. a) Write the ratio in which that money will be shared. b) How much dollars will each obtain? **Answer** As agreed by the three friends, the winnings of $ 120 000 need to be shared amongst them in the same ratio as the money they each contributed towards the ticket. Katerina: Nina:Paul the ratio is 10:6:4 Total amount to be shared is 120000$ among 20 total equal parts. Katerine will obtain $\frac{120000\$ \text{ x } 10}{20} = 60000\$$ Nina will obtain $\frac{120000\$ \text{ x } 6}{20} = 36000\$$ Paul will obtain $\frac{120000\$ \text{ x } 4}{20} = 24000\$$	Provide opportunities for corrective feedback or positive feedback to students.

Conclusion **(2min)**	**Teacher**: As, we are coming to the end of our lesson, we have seen how sharing quantities using ratios. As homework, go and do activities found in the S1 Mathematics students' book **on page 127**. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.7 Lesson from unit 6

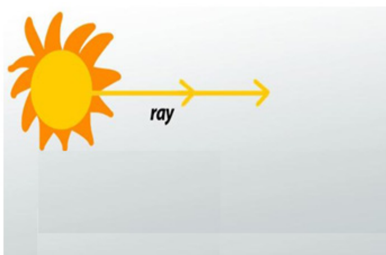
SUBJECT: Mathematics **GRADE :** S1 **UNIT 6:**

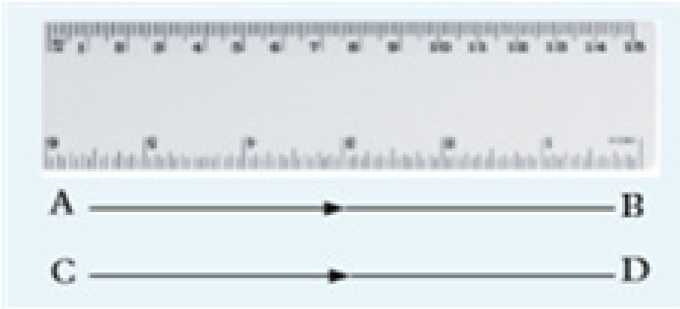
LESSON TITLE: Parallel and transversal lines and their properties.

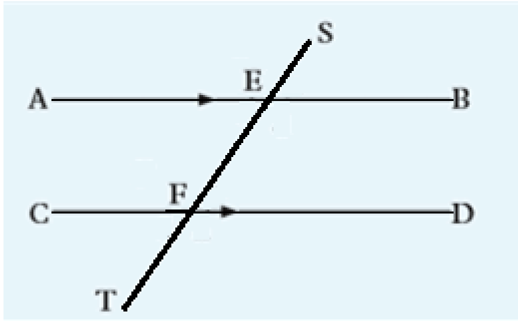
Duration: 2 periods or 80 minutes.

Teaching material: Flip charts.

Learning materials: Internet, geometrical materials, reference books, writing materials, chalks and chalkboard.

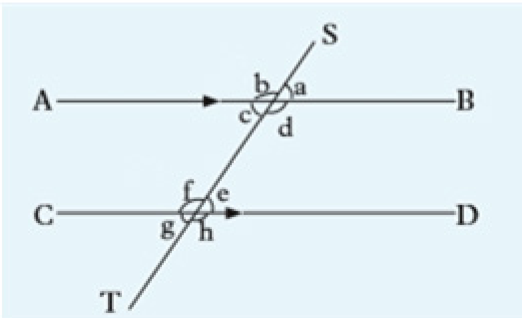
Section	Step-by-step instructions and content	Notice to the Teacher
Introduction (20 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied angles on a straight line and angles on a point. **Teacher:** very good! Observe the following pictures and tell us the sum of angles on straight line and at a point?   **Students:** The sum of angles on straight line is 180^0 and the sum of angles at a point is 360^0.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

	Teacher: Let us individually do the following activity about angles on parallel lines. **Activity:** 1. Using the edges of a ruler, draw a pair of parallel lines as shown in the figure bellow:  Put arrow heads at the centre of the line to show that the two lines are parallel. 2. Draw a straight line to cut lines AB and CD at points E and F respectively. Prolong this line (ST) on either side of the parallel lines as shown in the figure bellow:	Guide learners to perform this **engaging** activity individually and guide them to use necessary and appropriately the materials for drawing.



What is the name of the line ST above?

3. Name all angles made at the point E by a, b, c, d and all angles made at the point F by e,f, g , h .
4. Observe the figure below and compare angles a and c, angles b and d. How do you find the sum of angles a and b, sum of angles c and d.



Use the same figure and observe angles e and g, angles f and h. How do you find the sum of angles f and e, sum of angles g and h.

<table>
<tr>
<td></td>
<td>5. Observe on the figures, angles a, c, e and g. What do you notice?
6. Using the same figure, observe angles b, d, f and h. What do you notice?

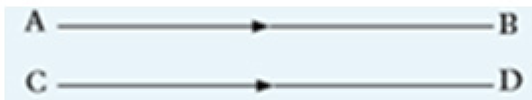
Students: ... (They will give different answers)

Teacher: Good! In today's lesson, we are going to continue with parallel and transversal lines and their properties.

And by the end of this lesson, you will be able to construct the argument of angles on parallel and transversal lines and solve related problems.</td>
<td>Communicate the lesson title and related instructional objective to students.</td>
</tr>
<tr>
<td>Lesson development

(50min)</td>
<td>Teacher: asks students to do activity in groups

Activity:
1. Using the edges of a ruler, draw a pair of parallel lines as shown in the figure bellow. Put arrow heads at the centre of the line to show that the two lines are parallel.



2. Draw a straight line to cut lines AB and CD at points E and F respectively. Prolong this line (ST) on either side of the parallel lines and using a paper, trace angles a and b as shown in the figure below;</td>
<td>In groups, ask students to do the exploration activity and use different probing questions to students to lead them to find out different properties related to angles on parallel and transversal lines</td>
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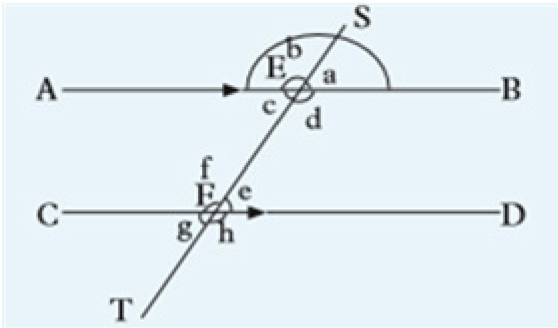
</table>

	 3. Cut out the traced angles a and b. 4. Use the cut out angle to measure other angles on the diagram e.g. angles c, d, e, f, g and h. 5. Compare the size of angle pairs a and e, b and f. What do you notice? What is the name of the angle pairs? 6. Compare the size of the angle pairs d and f, e and c. What do you notice? What is the name of the angle pairs? 7. Compare the size of the angle pairs a and c, e and g. What do you notice? What is the name of the angle pair?	Students must be given time to think and note down their ideas and provide time to them to present their findings to the whole class
	Students : ... **Teacher:** well done students. From the above activity, we notice that: 1. The line ST which cuts parallel lines AB and CD is called a transversal line. Transversal line is a straight line which cuts through two lines on the same plane at distinct points. 2. Angles that are on the same relative position when a transversal cuts through two points are called corresponding angles.	Use probing questions to help learners come up with a good and complete summary.

When the two lines are parallel, the corresponding angles are equal.

Examples of **corresponding angles** are :

a=b   c=d

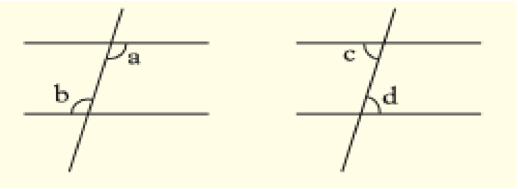
e=f   g=h

Angles a and b, c and d, e and f, g and h are corresponding angles.

3. Pairs of **interior angles** on the opposite side of a transversal

(One on each intersection) are called alternate angles.

Examples of **alternate angles** are as shown in Figure below.



alternate angles

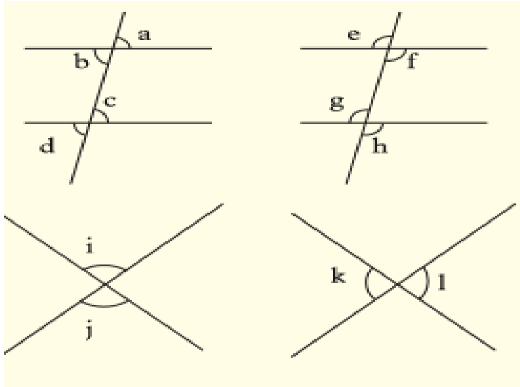
a=b and c=d

Angles a and b, c and d are alternate angles.

Alternate angles are equal

4. Angles which are opposite each other where two straight lines intersect or Cuts each other are called vertically opposite angles.

Examples of vertically opposite angles are as shown in Fig. 6.43 below.



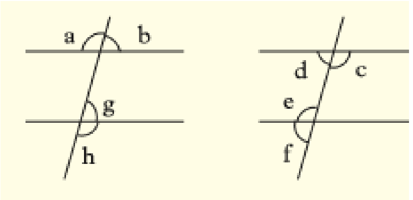
opposite angles

a=b , c=d , e=f

g=h , i=j , k=l

Angles a and b, c and d, e and f, g and h, i and j, k and l are vertically opposite angles. Vertically opposite angles are equal.

5. Angles that add up to 180° are called supplementary angles.



supplementary angles

$a+b=180^{\circ}$

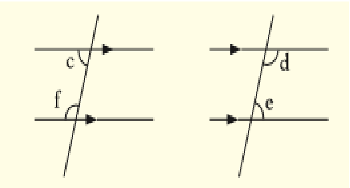
$g+h=180^{\circ}$

$d+c=180^{\circ}$

$e+f=180^{\circ}$

Angles a and b, c and d, e and f and g and h are supplementary angles.

6. Pairs of interior angles on the same side of the transversal are Called co-interior angles.



c and f, d and e are pairs of co-interior angles.

$c + f = 180^{\circ}$; $d + e = 180^{\circ}$

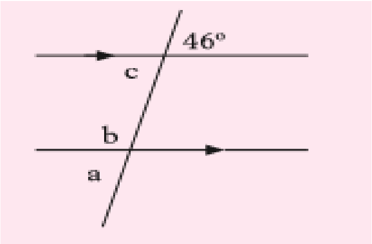
Therefore, co-interior angles are supplementary.

Teacher: let us work in groups and do the following activities.

Activity 1:

Observe the given figure and calculate the angles marked with letters in each of the following :

Ask students to work in pairs the application (elaboration) activity and provide time for students to think, elaborate and share their ideas on angles of parallel and transversal lines .

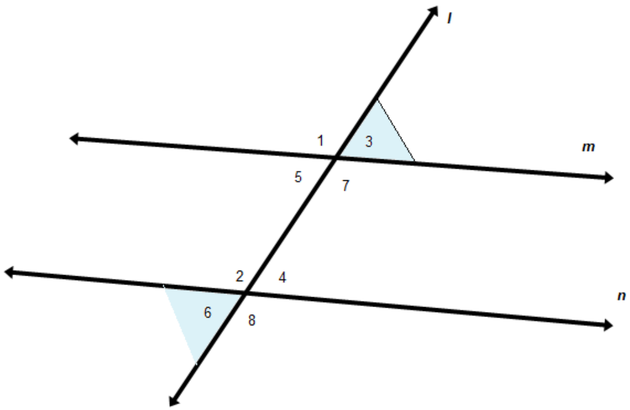


Students ' answer:

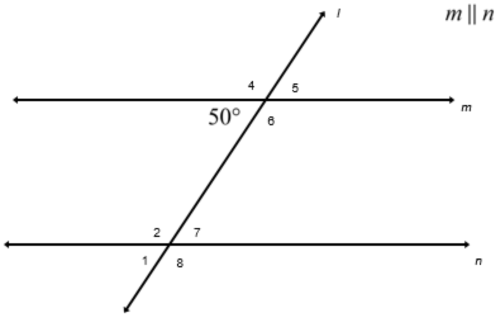
c = 46° (vertically opposite angles)
a = c = 46° (corresponding angles)
b = 180° – a(angles on a straight line/ supplementary angles)
b = 180° – 46°
b = 134°

Activity 2:

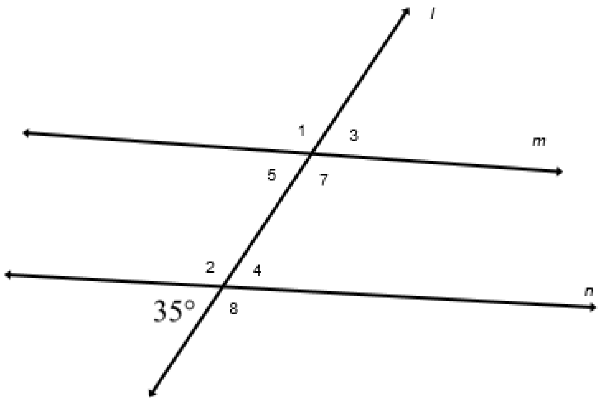
Observe the figure and choose among the given answers what type of angles are ∠3 and ∠6?



	◯ A Alternate Interior Angles ◯ B Alternate Exterior Angles ◯ C Corresponding Angles ◯ D Vertical Angles ◯ E Same Side Interior	
	Lesson summary • **A transversal line** is a straight line which cuts through two lines in the same plane at two distinct points. • **Corresponding angles** are angles that occupy the same relative position when a transversal cuts through two straight lines. • **Alternate angles** are pairs of interior angles on the opposite side of a transversal (one on each intersection point). • **Supplementary angles** a pair of angles on a straight line that add up to 180°. • **Co-interior angles** are pairs of angles on the same side of a transversal. Such angles are supplementary • Angles which are opposite each other where two straight lines intersect or cuts each other are called **opposite angles**	Use different questions to help students recall key concepts of the lesson and ensure that the summary is written down by all students.
Assessment (8min)	**Teacher: L**et individually do the following activities: 1. Given the measure of one angle, find the measures of as many angles as possible. What are the measures of the remaining angles?	Individually , ask learners to do the activity of formative assessment (evaluation).

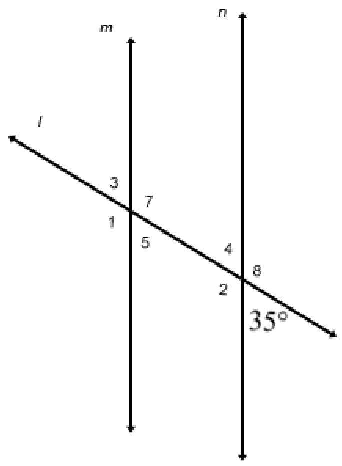


2. Given the measure of one angle, find the measures of as many angles as possible. Which angles are congruent to the given angle?

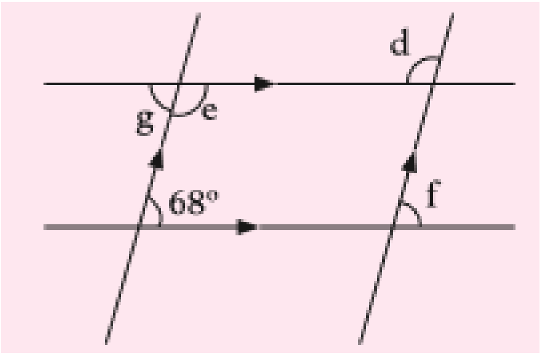


Provide opportunities to students for asking questions, and corrective feedback or positive feedback to are given as well

3. Given the measure of one angle, find the measures of as many angles as possible. What are the measures of the remaining angles?



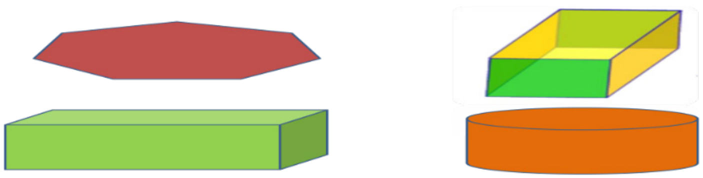
4. Calculate the angles marked with letters in each of the following

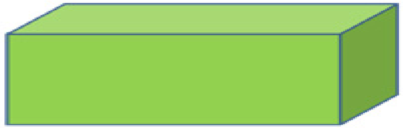


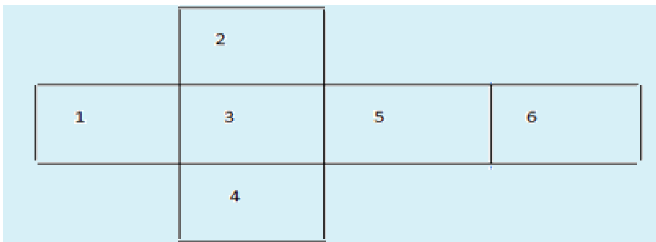
Conclusion (2min)	**Teacher:** We are coming to the end of our lesson. As we conclude, let's review some of the key points that we learned. We all remember that: **A transversal line** is a straight line which cuts through two lines in the same plane at two distinct points. **Corresponding angles** are angles that occupy the same relative position when a transversal cuts through two straight lines. **Alternate angles** are pairs of interior angles on the opposite side of a transversal (one on each intersection point). **Supplementary angles** are pair of angles on a straight line that add up to 180°. **Co-interior angles** are pairs of angles on the same side of a transversal. Such angles are supplementary angles which are opposite each other where two straight lines intersect or cuts each other are called **opposite angles.** **Teacher:** Thank you; As a home work, you are requested do activities found in the **on page 151 of s1 Mathematics book.**	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.8 Lesson from unit 7

SUBJECT: Mathematics	GRADE:S1	UNIT: 7
LESSON TITLE: Surface area of a cuboid		
Duration: 40 minutes		
Teaching: Solids with different shapes		
Learning materials: Note books, pens, calculators, geometric materials, S1 Mathematics book		

Section	Step –by- step instructions and content	Teachers' notice
Introduction (5 min)	**Teacher**: Hello students, how are you? **Students**: Fine **Teacher:** Welcome to this mathematics lesson. Take your exercise book, a pen, a ruler and a pencil and then enjoy the lesson.	Great learners and energize them to attract their attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher (cont): here we have solids with different shapes. Look at them and tell us which one is a cuboid and explain the reason. 	Show learners the exciting figures that motivate them to participate fully in the lesson.

	Students show a cuboid:  **Teacher:** Who can show us the surface of cuboid? **Students:** the all visible outside parts of a cuboid. **Teacher**: Anyone to remind us how to find a surface area of a rectangle? **Students: A = L** W **Teacher:** Anyone to remind us how to determine a surface area of cuboid? **Students:** A = 2 Base area + lateral area. **Teacher:** well done**,** what do you think that today's lesson will be about? **Students:** Today's lesson is "surface **area of a cuboid",** **Teacher:** Good**,** I wish that each of you at the end of the lesson, you will be able to calculate the surface area of the cuboid correctly.	**Engage** learners to discover the new lesson and probe student's predictions.

Lesson development (25 minutes)	**Teacher:** Dear students, let us do the following activity in small groups. **Activity** 1: i) Draw a well labelled net of the cuboid. ii) How many faces does the cuboid have from the net? iii) How would you calculate the area of the cuboid using the net? iv) Use the net to calculate its area in terms of l, w, and h. **Students' answer**: Drawing a cuboid. (i)  (ii) a cuboid has 6 faces (iii) An area of cuboid is calculated by summing the areas of its faces. **Area =** Area of rectangle 1 + Area of rectangle 2 + ……..+ Area of rectangle 6 **(iv) Area =** Area of a base + Area of a base + area of small lateral face + Area of small lateral face + Area of large lateral face + Area of lateral face.	Invite them to work on the **exploration** activity in groups. Ask students to present their findings in plenary session and guide them to harmonize their finding Help learners to choose the group to present and ask members from other groups to supplement what the group has presented Guide learners to explain how to find the surface area of a cuboid.

$= (l\times w) + (l\times h) + (h\times w) + (l\times w) + (l\times h) + (h\times w)$

$= 2lw + 2lh + 2wh$

Teacher: let us brainstorm and find out the answers for the key Question:

Key question: How can you calculate the total surface area of a cuboid?

Teacher: Dear learners, from this activity we come to lean that : the surface area of a cuboid of length l, width w and height h is given by **2lw + 2lh + 2wh.**

Teacher (cont): Dear learners, try also this activity

Activity 2

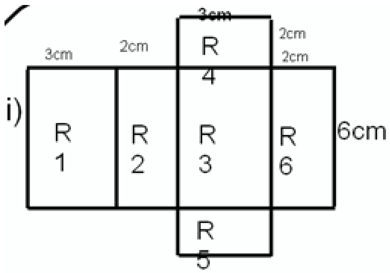
i) Show the possible net of a cuboid which measures 6 cm by 3 cm by 2 cm.

ii) Find the area of each rectangle from the net

iii) Calculate the total area the net

Students ' answer:

i)



ii)

$R1=3.6=18cm^2$

$R2=2.6=12cm^2$

$R3=3.6=18cm^2$

$R4=3.2=6cm^2$

$R5=3.2=6cm^2$

$R6=6.2=12cm^2$

iii) Total area= $(18+12+18+6+6+12)cm^2= 72cm^2$

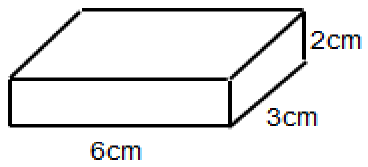
Provide an activity for reinforcing new concepts (elaboration).

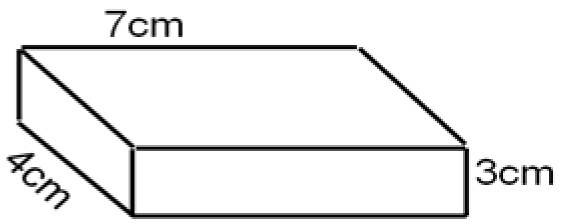
Invite them to present their findings in plenary session and guide them to harmonize their findings.

Help learners to choose the group to present and ask members from other groups to supplement what the group has presented

Clarify and reinforce the new concepts.

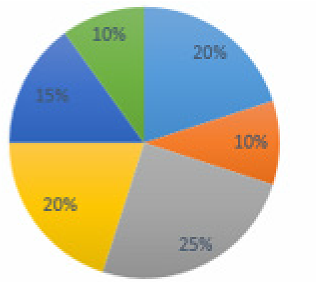
	Teacher: Dear students, have you noticed that the total surface area of a cuboid is calculated from the surface of its net and if L is the length, w is width and h is height, the surface area is given by 2Lw+2Lh+2wh	Remember to address common misconceptions if they appear.
	Teacher: Dear learners, by applying the formula we come to learn , do also this activity to see if you are able to apply it **Activity 3** The net of a cuboid consists of a series of rectangles. i) How many rectangles are there? ii) What is the surface area of the cuboid if it measures 6 cm by 3 cm by 2 cm? **Students' answer:** i) 6 rectangles ii) S.A=2lw+2lh+2wh=$(2\times6\times3)cm^2+(2\times6\times2)cm^2+(2\times3\times2)cm^2=36+24+12 = 72cm^2$	Give learners the elaboration activity bringing them to apply the new concepts
	Lesson summary: **Teacher:** Dear students as you come to say, we can **summarize** our lesson as follow: • The surface area of a cuboid can be calculated from its net by adding the area of all faces • The surface area of a cuboid of length l, width w and height h is given by 2lw + 2lh + 2wh	

Assessment (8 min)	**Teacher**: Thank you very much. For making sure that you have understood, take your exercise notebook and do this activity: **Activity for assessment**: Find the surface area of this cuboid  **Students answer the activity for assessment as follow** Given that area of cuboid is given by A= 2lw + 2lh + 2wh with L = 6cm, w = 3cm and h = 2cm Then , A = $(2\times6\times3)$ cm^2 = 36 cm^2 + 24 cm^2 + 12 cm^2 = 72 cm^2	Give learners an individual assessment to determine the level at which the lesson objectives have been achieved (evaluation) Provide opportunities for corrective feedback or positive feedback to students.
Conclusion (2min)	**Teacher**: Dear students, well done. As, we are coming to the end of our lesson, let us conclude that: The surface area of a cuboid is calculated from its net and it is given by 2lw + 2lh + 2wh where l is the length, w is the width and h is height As homework, go and find the area of this cuboid.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

	 Thank you for your participation in this lesson.	

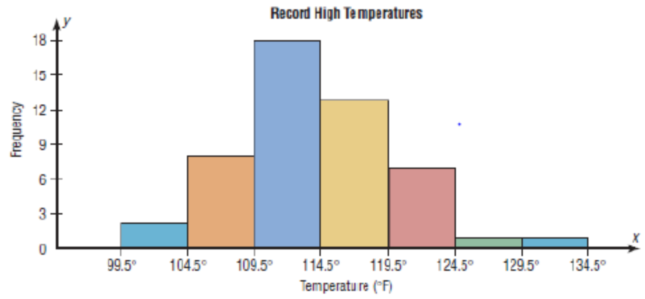
1.9. Lesson from unit 8

SUBJECT: Mathematics	GRADE:S1	UNIT: 8
LESSON TITLE: Pie chart		
Duration: 40 minutes		
Teaching material: chalks, pens, pictures, Manila papers		
Learning materials: notebooks, pens, student's book -S1		
Section	**Step –by- step instructions and content**	**Teachers' notice**

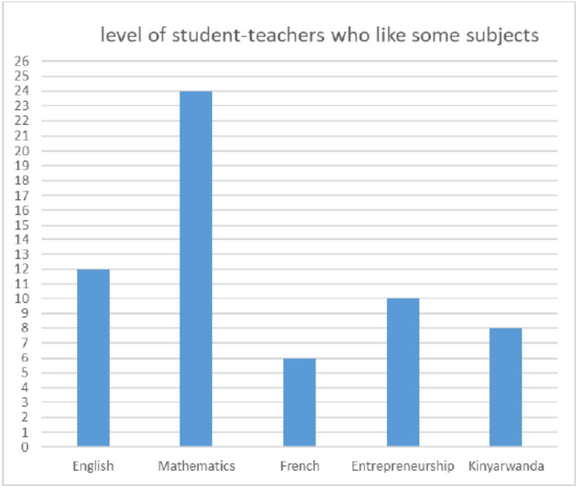
Introduction **(5 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what he/she knows about data presentation in statistics ? **Students**: Data in statistics can be presented in tables, bar charts, histograms, Pie Chart, etc. **Teacher:** Good. Observe and name each of the following representations. 	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

Item	Printing	Transporta-tion	Paper cost	Binding	Royalty	Promo-tion
% Expendi-ture	20%	10%	25%	20%	15%	10%

Students: It is a table of data



Students: This is a histogram



Students: This is a bar chart

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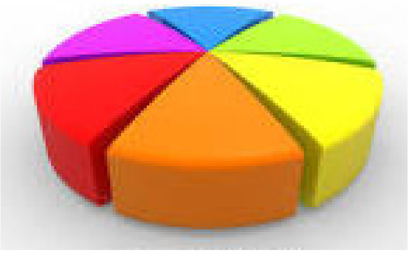
Teacher: Observe the picture below and answer to questions that follow:



1. What Shape is represented?
2. How many subdivisions can you observe on the diagram?
3. The subdivisions of the diagram are equal or not equal? why?

Students: The diagram looks like a circle, the diagram has 6 subdivisions, the subdivisions of the diagram are not equal, because they have different portions.

Teacher: Good! In today's lesson, we are going to continue by learning a Pie Chart as one of data representations . And by the end of this lesson you will be able to:

- Explain how pie charts are used to present information
- List the characteristics of a pie chart
- Interpret data presented in pie charts
- Explain the process used to create pie charts and make pie charts.

</td>
<td>

Help students to work out the **engaging** activity

Communicate the lesson title and related instructional objective to students.

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

Lesson development

(25 Minutes)

Teacher: let us discuss and do the following activity in groups:

Activity 1

Below is a table of confirmed cases about Covid-19 pandemic in certain period.

Country	A	B	C	D
Confirmed cases	453	90	1453	6917

a) What is the country with large number of cases about covid-19?

b) State any two ways of spreading Covid-19

c) Does covid-19 has medicine?

d) What are 3 measures of preventing Covid-19?

e) Can you try to present the number of cases above on a pie chart? explain how you did it?

Students' answers:

a) It is C.

b) i) Sharing the same materials

ii) kissing and greetings with hands

c) Measure of preventing Covid-19 are:

i) Well wear the face masks.

ii) Wash your hand many time with clean water and soap.

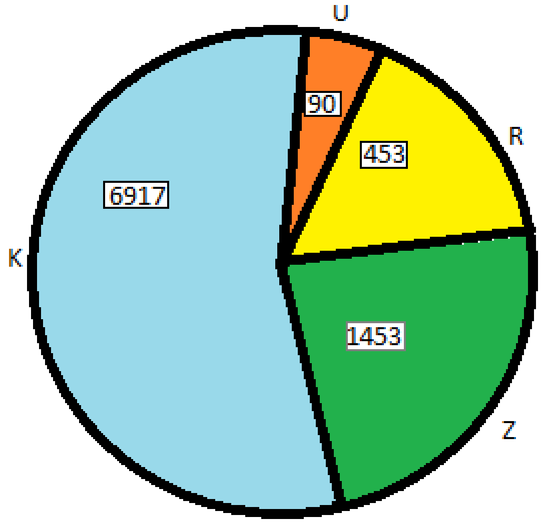
iii) Avoid unnecessary trips and stay at home.

d) Yes, the pie chart can be represented on a circle and by presenting data in sectors.

Invite students to work on the **exploration** activity in groups and choose one group member to present.

Let students work in groups and Remember to address common misconceptions.

Invite students to work in groups and do the activity for constructing a pie chart.



Teacher: Do the following activity in groups.

Activity 2:

Shows grades scored by 15 candidates who sat for a certain test

Grade	A	B	C	D	E
Number of candidates	2	5	4	1	3

a) If the data above are to be represented in a circle how many degrees will each Grade occupy?

b) Using a pair of compasses and a ruler, represent the degrees of each grade.

c) Can you provide the name of the subdivided circle?

Guide learners to explain how to draw a pie Chart.

Invite learners to do these 2 elaboration activities in groups.

Let the groups present findings to the whole class.

Students' expected answers

a) The degrees are found by

$$\frac{\textit{value of component} \times 360}{\textit{Total value}}$$

The total value = 2+5+4+1+3 =15

Then the degree of $A = \frac{2 \times 360}{15} = 48°$

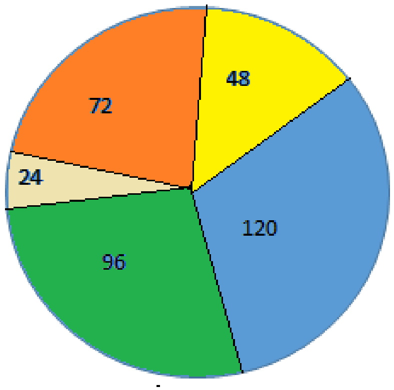
$$B = \frac{5 \times 360}{15} = 120°$$

$$C = \frac{4 \times 360}{15} = 96°$$

$$D = \frac{1 \times 360}{15} = 24°$$

$$E = \frac{3 \times 360}{15} = 72°$$

b)

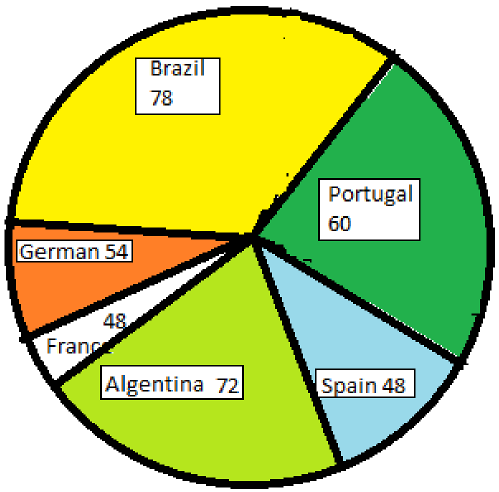


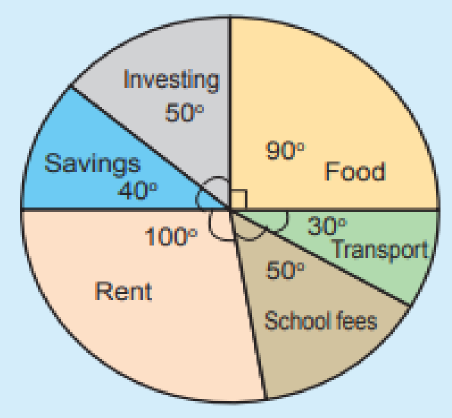
Teacher: In pairs, let us do the following Activity.

Activity 4

In 2016, some people were asked to predict the national team which would win the World Cup. Their predictions were as follow:

National team	Number of prediction
Brazil	13
German	9
France	8
Argentina	12
Portugal	10
Spain	8

	Represent the above information in a pie graph **Students' expected answers:** **Pie Chart**  	
	Lesson summary: • **A** pie chart is a circular graph which is used to represent data. • Various observations of the data are represented by the sectors of the circle. • The total angle formed at the Centre is 360°. • The whole circle represents the sum of the values of all the components.	Use different questions to help students recall key concepts of the lesson and ensure that the summary is written down by all students.

	Sizes may be numbers, fractions or percentages. • The angle at the Centre corresponding to the particular observation component is given by $\frac{\text{Value of the component}}{\text{Total value}} \times 360^0$	
Assessment (8 min)	**Teacher:** Thank you very much. Now, You are going to do an individual activity for assessment: The pie-chart below represents the monthly expenditure of Amina's salary. Study it and answer the questions that follow. If 240,000 Frw is spent on transport, a) How much does she earn? b) How much more money is spent on rent than on savings? 	Individually , ask learners to do the activity of formative assessment (**evaluation**)

	Students' answers : a) on transport $30^0 = \frac{240\ 000 \times 360}{earned\ money}$ Earned money $= \frac{240\ 000 \times 360}{30}$ = 2 880 000 Frw b) Rent: $\frac{2\ 880\ 000 \times 100}{360}$ = 800 000Frw Savings $\frac{2\ 880\ 000 \times 40}{360}$ = 320 000 Frw Money spent on rent more than savings = 800 000Frw-320 000 Frw = 480 000 Frw	Provide opportunities to students for asking questions. Give them corrective feedback or positive feedback.
Conclusion (2min)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: A pie chart is a circular graph which is used to represent data. The angle at the Centre corresponding to the particular observation component while drawing a pie chart is given by: $\frac{\text{Value of the component}}{\text{Total value}} \times 360^0$ **Teacher:** Thank you for your participation.	Summarize verbally main points, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

1.10 Lesson from unit 9

SUBJECT: Mathematics **GRADE:** S1 **UNIT 9:**

LESSON TITLE: Definition of key terms used to describe probability.

Duration: 2 periods or 80 minutes.

Teaching material: books, chalk, coins, playing card, die and classroom chalkboard

Learning materials: notebooks, pens, calculators, S1 Mathematics book (from page 231 to page 232)

Section	Step –by- step instructions and content	Teachers' notice
Introduction (15 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. **Teacher**: Let us observe the picture and discuss the following: How does the referee do with a coin to start a football match? Why does he/she do so? 	Begin by gaining students' attention. Providing to the learners into their group these materials: coins, playing cards and die. Identify students with special educational needs and plan how to help them accordingly.

	Teacher: Dear students, let us do the following activity in groups: **Activity:** Carry out the following a) Toss a coin once and record what you obtain. b) Roll a die once and record what do you obtain. c) Shuffle the cards, pick one card from the deck and compare it with the card picked by your neighbour. **Students' expected answers**: a) Head or tail(H,T) b) 1,2,3,4,5 or 6 c) Each type of card can be picked. **Teacher**: Thank you for your wonderful work! In today's lesson we are going to study probability, especially **the definition of key terms used to describe probability** and by the end of this lesson, you will be able to define key terms used to describe the probability.	Invite learners to do the **Engaging** activity into their groups Communicate the lesson title and related instructional objective to students.
Lesson development (50Minutes)	**Teacher**: Let us do the flowing activity. **Activity:** Toss a coin twice as an experiment. a) What are all possible results do you obtain? Use set notation to write results. b) In set notation Write the result of obtaining exactly one head? c) In set notation write the result of obtaining three heads	Invite learners to work on the **exploration** activity in pairs. Emphasize new concepts.

	Students' expected answers: a) S={HH,HT,TH,TT} b) A ={TH,HT} c) {} **Teacher:** Dear students! Basing on your result we are going to define the key terms used to describe probability. Probability is simply how likely something is to happen and the following terms are used to describe it. (a) **An experiment** is any activity or process through which data is obtained and analyzed. (b) **Possible outcomes** are defined as the All likely results of an experiment. (c) **A sample space** is the set of all possible outcomes that may occur in a particular experiment, usually denoted by S. (d) **An event** is a set consisting of possible outcomes of an experiment with the desired qualities. It is a subset of a sample space. **Teacher:** Dear students, I think you have understood these terms used to describe probability. Now, do the following application activity in groups. Toss a coin three times a) Write down the sample space. b) List outcomes of the following events: i) Exactly three heads are obtained ii) At last one head is obtained iii) At most two tails are obtained	Ask students to present their findings in plenary session and guide them to harmonize their findings. Clarify the concept and guide students to write down the content. Remember to address common misconceptions. Let students work in groups, and do the application (**elaboration**) activity. this will promote: (i) Critical thinking skills (ii) Problem solving (iii) Cooperation and interrelation among learners

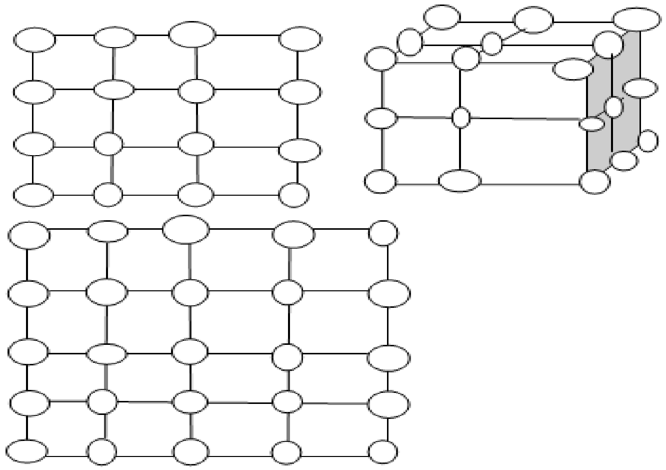
	Students' expected answers: a) S={HHH, HHT, HTH, THH,TTH, THT, HTT, TTT} b) i) HHH, ii) HHT, HTH, THH,TTH, THT, HTT iii) HHH, HHT, HTH, THH,TTH, THT, HTT.	
	Lesson summary: **Random Experiment**: A random experiment is one in which all the possible results are known in advance but none of them can be predicted with certainty. **Outcome**: The result of a random experiment is called an outcome. **Sample Space**: The set of all the possible outcomes of a random experiment is called Sample Space, and it is denoted by '*S*'. **Event**: A subset of the sample space.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (10 min)	**Teacher**: Thank you very much. Now, You are going to do an individual activity for a**ssessment:** 1. Define the following terms: a)Random experiment b) Event c) Possible outcomes d) Sample space 2**.** An experiment consists of rolling two dies. Construct a sample space.	Give students an activity for evaluation. Provide opportunities for corrective feedback or positive feedback to students.

	Students' expected answers: 1. See in slide 9(concept clarification) 2. S = { (1,1),(1,2),...,(6,6)} n(S) = 36.	
Conclusion (5min)	We are coming to the end of our lesson. As we conclude, let's remember the key points that we learned. We have seen the definition of these terms: **Experiment, possible outcomes, sample space,** and **event.** **Teacher:** Thank you for your participation in this lesson.	Summarize the main points verbally.

SCRIPTED LESSONS FOR SENIOR 2

2.1. Lesson from unit 1

SUBJECT: Mathematics	**GRADE: S2**	**UNIT: 1**
Lesson title: Operation on indices and their properties		
Duration: 2 periods or 80 minutes. It is a lesson with many steps.		
Teaching material: Yellow oranges arranged in a square, rectangle and in a cube.		
Learning materials: notebooks, pens, calculators, geometric materials, S2 mathematics book.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (15 min)	**Teacher:** Hello students, how are you? **Students:** Fine, Thank you sir/madam. **Teacher:** It is time for mathematics' lesson, Take your exercise book, a pen, a ruler and a pencil. Do we have students who are absent today? **Students:** Peter and Tom are absent Sir/ Madam (example). **Teacher**: Before going to the new lesson, let us make correction of the homework that I gave you last time. Submit the work and make correction.	Great learners and attract their attention. Identify students with special educational needs and plan how to help them accordingly.

	Teacher: Dear students look at these models (arrangement of oranges).  **Teacher:** Without counting, who can tell us how many oranges are on each model? **Students:** On first model there are 16 oranges, on second model there are 27 oranges while on third model, there are 25 oranges. **Teacher:** Dear students, how do you find the number of each one? **Students:** we have multiplied the number of oranges that are on sides 16 oranges = 4 oranges $\times$ 4 27 oranges = 3 oranges $\times$ 3 $\times$ 3 25 oranges = 5 oranges $\times$ 5	Show learners the figures and let them observe it and answer to the related questions. Then harmonize their answers.

	Teacher: Dear students, is there any other ways of writing these products? **Students**: Yes Sir/Madam, for example 16 oranges = 4^2 oranges 27 oranges = 3^3 oranges 25 oranges = 5^2 oranges **Teacher:** Dear students, is there any name given to those numbers on top of 4, 3 and 5? **Answer:** Yes, they are known as **indices**, exponents, or powers. **Teacher**: Well done, today's lesson is "**operation on indices and their properties.** I wish that at the end of this lesson, working in group, each learner will be able to state and apply the properties of indices to solve mathematical problems correctly.	**Engage** learners to discover the new lesson and probe student's prediction.
Lesson development (45 minutes)	**Teacher:** Dear students, the first case we are going to look at, is the ***multiplication law***. Therefore, in your respective groups, do the following activity. **Activity 1:** Write the following numbers as products of two numbers where the two numbers are not equal and different from 1. 1. For example: $16 = 2 \times 8 = 2^1 \times 2^3$ (a) 8 (b) 243 2. Write the short form of the prime products of the numbers you wrote (for example $2^1 \times 2^3 = 2^4$) in 1 (a) and 1(b)	Invite them to work on the **exploration** activity on multiplication law in groups. Ask students to present their findings in plenary session and guide them to harmonize their findings

3. Find the relationship between the index of the products and the indices of the numbers.

Expected answer for Students:

1. (a) 8 = 2×4 (b) 243= 9×27

2. (a) 8 = 2×4, in index notation, $2^3 = 2^1 \text{ x } 2^2$ and from this 3 = 1+2

(b) 243= 9×27, in index notation $3^5 = 3^2 \text{ x } 3^3$ and from this 5 = 2+3

3. From (2) it is clear that $2^1 \text{ x } 2^2 = 2^{1+2}$ and $3^2 \text{x} 3^3 = 3^{2+3}$

Teacher: Dear students, from this activity we come up that multiplying two numbers written in index form with the same base leads to writing the base and adding the powers. This means that for all $a \in \mathbb{R}$ *and* $a \neq 0$, and for all $x, y \in \mathbb{Z}$;

$$a^x \text{ x } a^x = a^{x+y}$$

Teacher: Dear students, try also with the following activity:

Activity2: Simplify each of the following expressions by giving your answer in index form.

(a) $10^2 \times 10^5$ (b) z × z × z

Expected answer for Students:

a) $10^2 \times 10^5 = 10^7$ (b) z × z × z =

Teacher: Dear students, being in your groups, try with the following activity

Simplify: $4x^3y^3 \text{ x } 5x^4y^5$

Help students to choose the groups to present and ask members from other groups to supplement the presented content.

Clarify and reinforce the new concept.

Remember to address common misconceptions if they appear.

Provide an activity for reinforcing your **explanation** and

Invite them to present their findings

Clarify the concept of multiplication law

	Expected answer for Students: $4x^3y^3 \times 5x^4y^5 = 20x^7y^8$ **Teacher:** Students, I am sure you noted that if there are numbers (coefficients) and more than one letter (variables) to be multiplied, the coefficients are multiplied together and letters are multiplied separately because each represents a different value. **Teacher:** Dear students, the second case that we are going to look at; is the ***division laws of indices***. For better understanding, do this activity in your groups. **Activity 3:** Given the following fraction $\frac{32}{16}$ a) Write the numerator and the denominator in index form b) Simplify the new expressions and explain your working steps. c) Find the relationship between the power of the quotient and that of numerator and denominator in their index forms. **Expected answer for Students:** (a) $= \frac{32}{16} = \frac{2^5}{2^4}$	Invite them to work on the **exploration** activity on division law of indices in groups. Ask students to present their findings in plenary session and guide them to harmonize their findings.

	(b) $\frac{2^{4+1}}{2^4} = \frac{2^5 \times 2^1}{2^4} = 2^1$: Prime factoring the denominator and numerator and writing them in index form then using multiplication law of indices, the numerator changed into a product of two indices including one similar to the numerator, then simplify by 2^4. (c) Subtracting the index of denominator from index of numerator, we have 5-4 =1 , which means that $\frac{2^5}{2^4} = 2^{5-4}$ **Teacher**: Dear students, from this activity, we observe that • For any real numbers a, x and y, the following identity holds: if we can write: $\frac{a^x}{a^y} = a^{x-y}$ and if $x \leq y$ **we can write:** $\frac{a^x}{a^y} = \frac{1}{a^{y-x}}$. • When two numbers of the same bases are divided, the base is re-written, but the power of denominator is subtracted from the power of numerator. **Teacher**: Dear students, from this formula, let us analyze the different cases that can arise for the different values of x and y . **Case 1:** For any value of a ≠ 0 and b ≠ 0, we have $\frac{a^x}{b^y}$	Clarify and reinforce the new concept. Remember to address common misconceptions if they appear.

Case 2: However, if a = b and $x = y$. we have , hence

$$\begin{cases} \frac{a^x}{a^x} = a^{x-x} = a^0 \\ \quad \text{and} \\ \quad \frac{a^x}{a^x} = 1 \end{cases} \text{, hence } \boldsymbol{a^0 = 1}$$

Case 3. if a = b, then we have the same base and $\frac{a^x}{a^y} = a^{x-y}$ (if $x > y$)

and $\boldsymbol{\frac{a^x}{a^y} = \frac{1}{a^{y-x}}}$ **(if $\boldsymbol{x < y}$)**

Case 4. Considering the case $x > y,\ a^{x-y} = \frac{a^x}{a^y}$ and if

$x = 0,$ then $a^{-y} = \frac{1}{a^y}$

Case 5. Considering the case $x < y,\ \frac{1}{a^{y-x}} = \frac{a^x}{a^y}$ and y=0, then

$\frac{1}{a^{-x}} = \frac{a^x}{1} = 1$

	Teacher: Dear students, apply these properties to do the following activity: **Activity 3:** **1.** Simplify the following: (a) $\frac{125}{625}$ (b) $12x^4y^3 \div 3x^3y^2$ 2) Find the value of x if $\frac{2^x}{32} = 8$ **Answers from Students:** 1. (a) $\frac{125}{625} = \frac{5^3}{5^4} = \frac{1}{5^{4-3}} = \frac{1}{5}$ (as $3 \leq 4$) (b) $\frac{12x^4y^3}{3x^3y^2} = 4x^{4-3}y^{3-2} = 4xy$ 2. For $\frac{2^x}{32} = 8$, then $\frac{2^x}{2^5} = 2^3$ Which means that: $2^{x-5} = 2^3$. As bases are the same, $x-5=3$ and $x=8$	Invite them to work on the **exploration** activity on **power of powers** in groups. Ask students to present their findings in plenary session and guide them to harmonize their findings.
	Teacher: Dear students, the third case that we are going to handle is the case that contains the ***power of powers***. But for better understanding, do the following activity	Provide an activity for reinforcing your explanation.

	Activity 4 1. Write the following numbers in index notation (a) 4 (b) 27 2. Square each of these numbers. 3. Find the relationship between the indices of the square numbers and the index form of their results. **Expected answer for students:** 1 & 2. (a) 4 = 2 x 2 , Then the answer is: $4 = 2^2$ (b) Similarly, 27 = 3 x 3 x 3. Then $27 = 3^3$ **3**. Relationship, $4^2 = 16$ $27^2 = 729$ $4^2 = 2^4$ the same $27^2 = 3^6$ $(2^2)^2 = 2^4$ $(3^3)^2 = 3^6$ $2^4 = 2^4$ $3^6 = 3^6$ **Teacher:** Dear learners, basing on your findings, you see that When a number written in index form, is raised to another power, the indices are multiplied. $(a^x)^y = a^{xxy}$.	Invite them to present their findings. Explain to learners the other similar cases.

	Teacher: Dear students, to understand more, try also with the following exercises (a) $(3^2)^x$ (b) $(xy^2)^3$ (c) $(2^3)^2$ **Expected answers for Students:** (a) $(3^2)^x = 3^{2x}$ (b) $(xy^2)^3 = x^3y^6$ (c) $(2^3)^2 = 2^6 = 64$ **Teacher:** Dear students, when a number, written in index form, is raised to another power: • The indices are multiplied $(a^x)^y = a^{xy}$ • This is similar as a^n x b^n =$(ab)^n$ • All the numerals which are in the brackets are raised to the power of the bracket $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$	Provide an activity to reinforce the concept
	Teacher: Dear students, try to do also the following Calculate: (a) $\left(\frac{2}{3}\right)^3$ (b) $\left(\frac{a}{b}\right)^4$ **Students:** (a) $\left(\frac{2}{3}\right)^3 = \frac{8}{27}$ (b) $\frac{a^4}{b^4}$	Invite them to work on the exploration activity on **fractional indices** in groups.

	Teacher: Dear students, the last case we are going to deal with, is the case where we have the ***fractional indices***. Now, try with the following activity **Activity 5** Given that $9 = 3^2$ a) Find the exponent of nine b) Find the square root for the number of each side. What do you get? c) What can you conclude? Students (' answers): (a) $9^1=3^2$ (b) $9^{\frac{1}{2}} = 3^{\frac{1}{2}} = 3$ (c) **Relationship**: $9^{\frac{1}{2}}$ means the square root of 9 **Teacher:** Dear students, from this activity, we identify that $$a^{\frac{n}{m}} = \sqrt[m]{a^n}$$ • If $n=1$, we have $a^{\frac{1}{m}} = \sqrt[m]{a}$, **example:** $64^{\frac{1}{3}} = \sqrt[3]{64^1} = \sqrt[3]{4^3} = 4$ • If $m=2$, this means the square root of that number power n. It is simply written without mentioning the root number as follows: $a^{\frac{n}{2}} = \sqrt{a^n}$	Invite them to work on the exploration activity on fractional indices in groups. Ask students to present their findings in plenary session and guide them to harmonize their finding

	From m = 3, the root number is mentioned and we have the cube root, the fourth root, fifth root, sixth root,... i.e $a^{\frac{n}{2}} = \sqrt[3]{a^n}$	
	Teacher: Dear students, try with the following activities: 1) Simplify : (a) $10^2 \times 10^5$ (b) $z \times z \times z$ (c) $4x^3y^3 \times 5x^4y^5$ 2) Without using a calculator, simplify: (a) $\frac{125}{625}$ (b) $\frac{12x^4y^3}{3x^3y^2}$ (c) $14p^9q^6r^2 \div 2pq$ **Answers from Students:** 1. (a) $10^2 \times 10^5 = 10^{2+5} = 10^7$ (b) $z \times z \times z = z^{1+1+1} = z^1$ (c) $4x^3y^3$ x $5x^{3+4}y^{3+5} = 4x^7y^8$ 2) (a) $\frac{125}{625} = \frac{5^3}{5^4} = \frac{1}{5^{4-3}} = \frac{1}{5^1} = \frac{1}{5}$ (as 3< 4) (b) $\frac{12x^4y^3}{3x^3y^2} = 4x^{4-3}y^{3-2} = 4xy$ (as 3< 4 *and* 2 < 3) (c) $14p^9q^6r^2 \div 2pq$ $= \frac{14p^9q^6r^2}{2pq} = 7p^{9-1}q^{6-1}r^2 = 7p^8q^5r^2$	Invite them to work on the elaboration activity in groups. Ask students to present their findings in plenary session and guide them to harmonize their finding

	Teacher: Dear students, from what we come to see, let us summarize our lesson as follow : For any real number a≠0 , the properties of indices include: **(a) Multiplication law:** a^x x $a^y = a^{(x+y)}$ **(b) Division law :** $a^x \div a^y = \frac{a^x}{a^y} = a^{x-y}$ **(c) Power law :** $(a^x)^y = a^{x \times y} = a^{xy}$ and $(a \times b)^n = a^n \times b^n$ **(d) Zero index:** a^0 **=** 1 for all values of a **(e) Negative indices:** $a^{-x} = \frac{1}{a^x}$ for $a \neq 0$ **(f) Fractional indices:** $a^{\frac{n}{m}} = \sqrt[m]{a^n}$ and $a^{\frac{1}{m}} = \sqrt[m]{a^1} = \sqrt[m]{a}$	Using different questions, motivate learners to summarize the lesson
Assessment (15min)	**Teacher:** Dear students, individually, do the following questions to make sure that you have understood 1. (a) $2^{-3} \times 4^5 + 3^2 \times 3^{-4}$ (b) $(32^{-1} \times 64) \div \left(16^2 \times \frac{1}{4^{-2}}\right)$ (c) $\frac{8^{-4} \times 8^4}{4^{-2} \times 4^2}$	Give learners an individual assessment (**evaluation**) to determine the level at which your objective have been achieved.

	2. (a) $\frac{3x^0 - 4x^0 \times (6xy)^0}{4xy^0}$ (b) $(243)^{\frac{1}{5}} + \left(\frac{1}{512}\right)^{\frac{-1}{9}}$ **Expected answers from Students:** 1. (a) $2^7 + 3^{-2}$ (b) $2 \div 2^{12} = 2^{-11}$ (c) 1 2. (a) $\frac{3-4\times 1}{4x} = -\frac{1}{4x}$ (b) 3+2= 5	Let them do the following assessment in their exercises notebook and present the work to the teacher. Provide opportunities for corrective feedback or positive feedback to students.
Conclusion (5min)	**Teacher:** well done students, go and do the following as a homework: 1. Find the value of the following a) $256^{0.5} + 27^{\frac{-1}{3}}$ b) $64^{\frac{-1}{3}} - 13$	Summarize verbally the main points, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

c) $\sqrt{36x^{8}m^{-12}Z^{6}}$ if $x = 2, m = 1$ and $z = 2$

2. Simplify:

a) $p^2 \times p^3 \times p^4$,

b) $3 \times 7^2 \times 3^2$,

c) $6 \times y^2 \times 3 \times y$,

d) $2a^2b \times 4a$ b

3. Find the value of x for $\frac{2^x}{32} = 8$

4. Simply:

(a) $\left(\frac{128}{512}\right)^3$

(b) $(x^3y^{-5})^4$

(c) $(x^{-3}3y^2 3z^{2n})^2$

Thank you for your participation.

2.2 Lesson from unit 2

SUBJECT: Mathematics	GRADE: S2	UNIT: 2
Lesson title: Numerical value of a polynomial		
Duration: 40 minutes.		
Teaching and learning materials: A yellow orange, a car toy or any other moving toys, notebooks, pens, Mathematics books for S2.		

Section	Step –by- step instructions and content	Teachers' notice
Introduction **(10 Minutes)**	**Teacher**: Hello students, how are you? Welcome to Mathematics lesson. Look at here; we have a yellow orange and a car toy to be used in this lesson. Take your exercise book, a pen, a ruler and a pencil and I think that you will enjoy this lesson.	Begin by gaining students' attention. Plan how you will help learners with special educational needs. Give students the time for taking the learning materials.
	Teacher: Dear students last time we learned types of polynomials. What is the difference between a polynomial from a monomial? Give examples. **Students:** A monomial is an algebraic expression formed by one term, while a polynomial is the one that is formed by many terms. An example of binomial is $3x - 6$	Give students the **engaging** activity to be done in pairs or in groups.

	Teacher: Today we are going to continue with polynomials. By the end of this lesson, through working in groups, every student will be able to evaluate algebraic expressions for some specific value(s) of the variable(s) and to appreciate the role of numerical values of polynomials in simplifying mathematical expressions correctly. **Teacher**: Let us start now; look at this falling orange. Who can give us the formula for calculating its speed as you leant in primary? **Students:** V(t) = $u+at$ where u is the initial velocity, a the acceleration and t the time. **Teacher**: Who can give us the formula for calculating the distance covered by an orange while falling? **Students:** d (t) = $ut+\frac{1}{2}at^2$ **Teacher**: You see that this formula looks like a polynomial. Let us take an example that the distance covered by a car is given by $d(t)=2t+5t^2$ What is the distance covered by this car after t = 20 seconds? Deduce the value of $2x+5x^2$ for x=20. **Students:** When t =20 seconds, $d=2.20+5(20)^2$ m = 2040m. In the same way, for x=20, $2x+5x^2=2.(20)+5(20)^2=2040$. **Teachers**: Dear students, today, we are going to determine numerical values of polynomials.	When you ask a question, give a pause for students to think and say or write their ideas. Communicate the lesson title and related instructional objective to students.

Lesson Development (20 Min)	Dear students, in your respective groups, do the following activity **Activity 2.2.2:** Consider the polynomial expressions below. If x = 2 and y = 3, Substitute x and y by their respective values. After, discuss the results with your classmate. (a) $x^2 + y + 1$ (b) $3x^2 + 2y - 3$ **Expected answers for students:** (a) $x^2 + y + 1 = (2)^2 + (3) + 1 = 8$ (b) $3x^2 + 2y - 3 = 3(2)^2 + 2(3) - 3 = 15$ **Teacher:** Thank you. The value obtained when substituting values of unknowns in a polynomial is called a numerical value of that polynomial. It is a single value of the polynomial found after replacing variable(s) by specific numerical value(s). **Teacher**: Dear learners, try again with this activity: **Activity 2.2.3:** If x = 3, y = −2 and z = 5, find the value of : (a) $xy + z^2$ (b) $(x + y)(3x - 4z)$	**Exploration** activity: Let students do this activity in groups. Invite groups to present answers When presenting, remind the students that it is good to put unknown into brackets before substituting them with values to avoid confusions. **Guide students to explain** the concepts. Provide more related activities for **elaboration** stage.

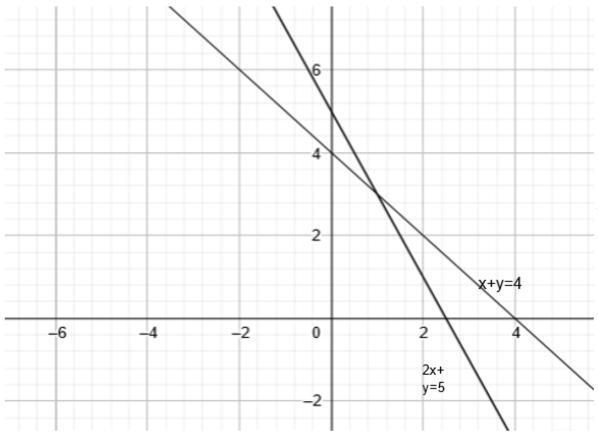
	Student's answers: (a) $xy + z^2 = (3)(-2) + (5)^2 = -6 + 25 = 19$ (b) $(x + y)(3x - 4z)[3 + (-2)][3(3) - 4(5)] = (1)(-11) = -11$ **Teacher**: Thank you dear students. Now do the following activity individually. **Activity 2.2.4:** Given that $x = 4$, $y = 3$ and z = 2, find the numerical value of the following polynomials (a) $2x - y + 7$ (b) $4x - 2y + 2z$ (c) $5x - y - z$ (d) $3x - 3y + 4z$ **Students' answers :** (a) $2x - y + 7 = 2(4) - (3) + 7 = 12$ (b) $4x - 2y + 2z = 4(4) - 2(3) + 2(2) = 14$ (c) $5x - y - z = 5(4) - (3) - (2) = 15$ (d) $3x - 3y + 4z = 3(4) - 3(3) + 4(2) = 11$ **Teacher**: Thank you. Is there any problem?	These activities can be done in pairs or individually. Provide opportunity where students can ask questions.

	Summary: **Teacher**: Dear students, let us summarize what we learn to day. What do you mean by: a) Evaluating a polynomial? b) To find the numerical value of a polynomial? **Students' answer:** a) Evaluating a polynomial means finding a single numerical value for the expression or polynomial. **Example**: $a^2b + ab^2$ for a = -2, b = 3 becomes: $(-2)^2x3+(-2)(3)^2 = -6$ b) To find the numerical value of a polynomial, variables are substituted by specific numerical values.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment **(7 Minutes)**	**Teacher:** Thank you very much. Now, You are going to do an individual activity for a**ssessment:** 1) If $E = \frac{1}{2}mv^2$, find E when m 27 and $V=\frac{1}{3}$ 2) If $xy = 5$ and y =2 , find: (a) x (b) $2(x+y)$	Give students an activity for **evaluation** and explain related instructions.

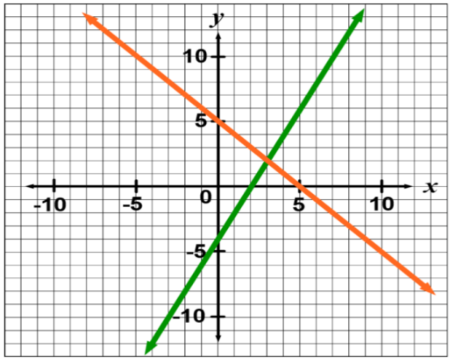
	Student's answer: 1) $E=\frac{1}{2}(27)\left(\frac{1}{3}\right)^2=\frac{1}{2}\times(27)\times\frac{1}{9}=\frac{3}{2}$ 2) (a) By put the value of y in , we obtain $x(2)=5$ then $x=\frac{5}{2}=2.5$ (b) $2(2.5+2)=4.5$ **Teacher**: Thank you for your correct answers.	Mark the work of learners and give students the feedback.
Conclusion (2Minutes)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: 1. Evaluating a polynomial means finding a single numerical value for the expression or polynomial. 2. To find the numerical value of a polynomial, variables are substituted by specific numerical values. 3. Finding the value of a polynomial helps in determining the value of any physical quantity while having a formula. Thank you for your participation. As homework, go and find the distance **d** and a velocity **v** of a car at the time t= 30^{th} second given that: $d(t)=2+3t-4t^2$ $v(t)=3-8t$ See you in the next lessons.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.3 Lesson from unit 3

SUBJECT: Mathematics	**Grade** : S2	**UNIT 3:**
Lesson title: **Solving simultaneous linear equations**.		
Duration: 2 periods or 80 minutes.		
Teaching material: Flipped charts or slides with activities and others with graphs.		
Learning materials: Internet or reference books, writing materials, chalks and chalkboard.		
SECTION	**Step-by-step instructions and content**	**Notice to the teacher**
Introduction (15 min)	**Teacher**: Good morning/afternoon class, welcome again in the lesson of mathematics. Can one tell us what we learnt last time? **Students**: We studied the definition and examples of simultaneous linear equations. **Teacher:** Can one of you give us the example of simultaneous linear equations? **Students:** Yes, it is made of two linear equations that must satisfy the same thing. For example $\begin{cases} 3x - y = 8 \\ x - 2y = 1 \end{cases}$	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Thank you, as you learnt the meaning of simultaneous linear equations, let us start our lesson by doing a short review on how to draw the graph of a linear equation in a Cartesian plane. Work in group the following activity:	Give students an **engaging** activity to be done in groups.

	Activity 3.2.1 a) Draw on the same Cartesian plane the lines representing the following equations: $x + y = 4$ $2x + y = 5$ b) Find on the graph the point of intersection of the two lines. c) What can you say on the coordinate of the point of intersection in b)? Questions that can be asked to different groups: **Teacher**: How do you draw your graph? Did you respect scales or graduation? Wait for 10 minutes. **Expected answer for students:**  S= {(1,3)} **Teacher:** Thank you, how many points are necessary to draw a line? **Students:** Two points that satisfy a linear equation are sufficient to draw its line.	While students are working, move around to each group and ask some probing questions leading them think about the correct answer. Invite groups to present their findings. Guide students to harmonize answers. Highlight how to graph a linear equation on a Cartesian plan. Remind students to use a correct graduation.

Lesson development **Step 1**: 25 minutes	**Teacher:** Thank you; We are now going to study how to solve graphically the simultaneous linear equations. In the previous activity, we solved a linear equation graphically. Simultaneous linear equations can be solved by plotting the two straight lines for the given equations then note the coordinates of **the intersecting point**. If for example the point of intersection is (1, 3), the solution set of the simultaneous linear equations is $S = \{(1,3)\}$. We are going to study this method and more other methods. **1. The Graphical Method:** **Teacher**: Work in groups and do the following activity: **Activity 2** Represent the following simultaneous equations on a Cartesian plane and indicate the solution set. $y = 2x - 4$ $y = -x + 5$ **Expected answers from students:** $y = 2x - 4$ $y = -x + 5$	Make sure they understand the point of intersection and how to check it both graphically, and algebraically. Provide the **exploration** activities. While students are working, move around to each group and ask some probing questions leading them to correct answers. Ensures students write accurately the solution set



At the point they cross, both equations must be true, since that point is on both lines.

They appear to cross at (3, 2).

Let's check that in both equations.

Substitute $x = 3$ and $y = 2$ into both equations and see if both equations are true.

$y = 2x - 4$

$(2) = 2(3) - 4$

$2 = 2$ correct

$y = -x + 5$

$(2) = -(3) + 5$

$2 = 2$ correct

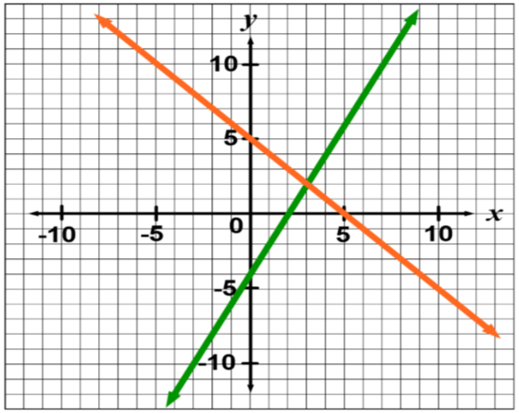
Teacher: Thank you, how many solutions for

$y = 2x - 4$

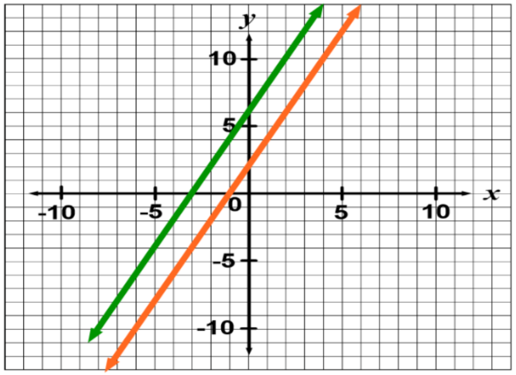
$y = -x + 5$

did you get?

Invite groups to present their findings in a whole class discussion.

	Student: The solution set of our simultaneous equation has one solution. $S=\{(3,2)\}$ **Teacher:** Very good, we are now going to work together. I will show you the graph and you will tell me the number of solutions for the simultaneous equations for such lines. **Note: The Number of Solutions** **Type 1: One Solution**  **Students**: The two lines intersect in exactly one point. The solution is the point at which they intersect.	For each type, show them the graph and ask a question. The examples of such system is to be provided after.

Type 2: No Solution

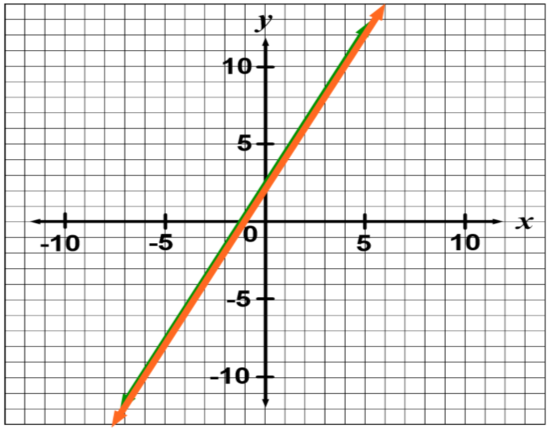


Students: Lines are parallel, they never meet.

There is no solution to their simultaneous linear equations.

$S = \varnothing$ or S= { }.

Type 3: Infinite Solutions



	Students: The lines overlap at all points. Their equations give the same line. They meet in all real values of x. This means that the solution set is the set of all real numbers $S = \mathbb{R}$. **Teacher**: Can you summarize the number of cases we found? **Students**: Simultaneous linear equations can have either: **One solution**, if the lines meet at one point. **No solution**, if they never meet as they are parallel. **Infinite solutions**, if they all lay on the same line. **Teacher**: Take your notebooks and geometric materials and do the following activities in groups: **Activity 3.** 1) How many solutions does this system have? $y = 2x - 7$ $y = 3x + 8$ Chose one : A) 1 Solution B) No solution C) Infinite solutions **Students**: After solving, we found that the answer is (A), The system has 1 solution which is ..... 2) How many solutions does this system have? $3x - y = -2$ $y = 3x + 2$ Chose one : A) 1 Solution B) No solution C) Infinite solutions	Guide students to summarize the types of solutions for simultaneous linear equations. Give them application (**elaboration**) activities.

	Students: After solving, we found that the answer is (C), The system has infinite solutions. The solution set is $S=\mathbb{R}$ 3) How many solutions does this system have? $y = 4x$ $2x - 0.5y = 0$ Chose one : A) 1 Solution B) No solution C) Infinite solutions **Students**: After solving, we found that the answer is (C), The system has infinite solutions. The solution set is $S=\mathbb{R}$. **Teacher**: Thank you. Now do this activity individually. **Question**: Solve graphically the following simultaneous equations $3x + y = 5$ $6x + 2y = 1$ How many solutions does this system have? Chose one : A) 1 Solution B) No solution C) Infinite solutions **Students**: After solving, we found that the answer is (B), The system has no solutions. The solution set is $S=\varnothing$. **Teacher**: Thank you for your answers. In the next period we will continue with another method for solving simultaneous linear equations.	Teacher invites students to work in groups the activity 3.2.3. Invite them to present answers and guide the whole class to harmonize the results. Provide an evaluation activity for this step. It can be done individually.

Step 2: **30 minutes**	**Solving by Substitution:** **Teacher**: In the previous period we saw how to solve the simultaneous linear equations graphically. Now let us study another method. Proceed by doing this activity in groups. **Activity 4** Consider the equations: $2x + y = 7$ ....(i) $3x - 2y = 0$ .....(ii) a) Using equation (i), express **y** in terms of ***x*** in equation form and label this equation (iii) b) Substitute the value of y (in terms of x) from equation (iii) into equation *(ii)* to have equation (iv) in terms of x only. c) Solve equation (iv) d) Find the value of x c) Solve equation (iv) to get the exact value of x. d) Substitute the exact value of x in equation (i) or (iii) to get the value of y. e) Confirm whether the values of x and y satisfy both equations (i) and (ii) f) Guess the name that can be given to this method of solving Simultaneous equations?	Provide an engaging activity to study the second methods. Invite students to work in groups the activity 4. Invite them to present answers and guide the whole class to harmonize the results.

	Students' answer: Consider the equations $2x + y = 7$ ………(i) and $3x - 2y = 0$ ……..(ii) $2x + y = 7$ a) $y = 7 - 2x$ …. (iii) b) Substitution $3x - 2y = 0 \Rightarrow 3x - 2(7 - 2x)$ ….. (iv) c) $3x - 14 + 4x = 0$ $7x = 14$ $x = 2$ d) Using equation (i) $2x + y = 7 \Rightarrow 2(2) + y = 7$ $4 + y = 7$ $y = 3$ e) Verify answers using equations (i) and (ii) when $x = 2$ and $y = 3$ $2x + y = 7 \Rightarrow 2(2) + 3 = 4 + 3 = 7$ ……….. True And $\therefore$ RHS = LHS = 7 $3x - 2y = 0 \Rightarrow 3(2) - 2(3) = 6 - 6 = 0$ ……… True ***f)*** This is called a substitution method. **Steps to be followed in substitution method:** Step 1: Using one equation for your choice, express one variable in terms of the other. Step 2: Substitute the expression into the other equation and solve for the variable. Step 3: Substitute the numerical value you found into EITHER equation and solve for the other variable.	Guide the whole class to harmonize steps followed when solving the simultaneous linear equations by the substitution method.

	<u>Step 4</u>: Write the solution as S={(x, y)} **Teacher:** Thank you; Now, do the following application activities in pairs. **Activity 5** 1) Solve the system using substitution method. $2x - 3y = -1$ $y = x - 1$ 2) The solution to the system of linear equations below Is the point (x, y). $y = 8x + 18$ $3x + 3y = 0$ What is the value of $x + y$? Chose the correct answer. A) -4 B) 0 C) 2 D) 4 3) Solve the following system by substitution. $-3x - 3y = 12$ $-4x - 7y = 7$ 4) The solution to the system of linear equation below is the point (x,y). What is the value of x-y? $y+2x=-14$ $y=2x+18$	Provide application (**elaboration**) activities that lead students to exploration, explanation and elaboration stages.

Chose the correct value:

A	19
B	17
C	10
D	10

Expected answer for students:

1) Step 1: Substitute one equation into the other equation.

Since one equation is already solved for *y*, I'll substitute that into the other equation.

$2x - 3(x - 1) = -1$

Step 2: Solve the new equation.

$2x - 3(x - 1) = -1$

$2x - 3x + 3 = -1$

$x = 4$

Step 3: Substitute the solution into either equation and solve

$2x - 3y = -1$

$2(4) - 3y = -1$

$8 - 3y = -1$

$-3y = -9$

$\mathbf{y = 3}$

$\mathbf{y = x - 1}$

y = (4) − 1

y = 3

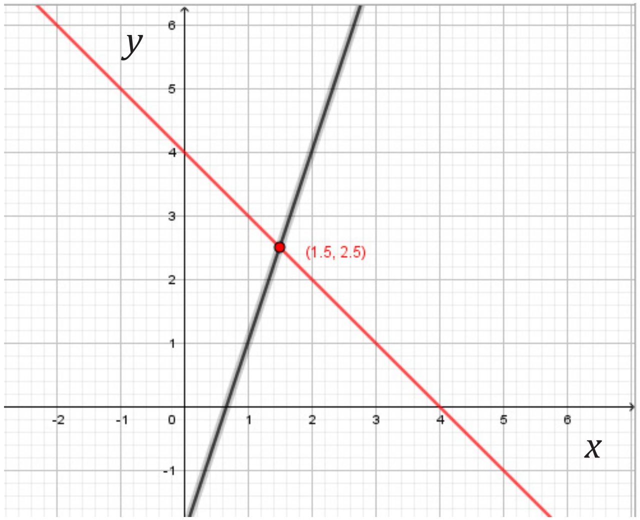
We have now x = 4 and y = 3

Let students do this activity in pairs.

Invite pairs with different working steps to present answers.

	Solution, continued: Check: See if (4, 3) satisfies both equations : $2x - 3y = -1$ $2(4) - 3(3) = -1$ $8 - 9 = -1$ $-1 = -1$ $y = x - 1$ $(3) = (4) - 1$ $3 = 3$ The ordered pair satisfies both equations, The solution set is S= {**(4, 3)**}. 2) The Correct answer is on B 3) **Answer: S**= {**(-7, 3)**} 4) The point of intersection is P(-8;2).	
	Summary See the main step seen above for solving simultaneous linear equations: a) Graphically b) By substitution.	Use different questions to help students recall key concepts of the lesson to be written down as a summary. You can use slides or flipcharts on which you wrote this summary.

Assessment (8 Minutes)	**Teacher**: Thank you; Now work individually the following: Solve this simultaneous equation by substitution and then represent the solution graphically. **Question1** $\begin{cases} 3x - y = 2 \\ x + y = 4 \end{cases}$ **Question 2** $\begin{cases} 2x = 3y + 2 \\ 2x = 6 + y \end{cases}$ **Expected answers for students:** 1) 3x-y = 2 and y = 4-x. 3x-(4-x)=2 3x-4+x=2 4x=2+4 4x=6 x =3/2 Then, y = 4- (3/2) =5/2	Provide activities to be done individually as assessment (**evaluation**), mark students and give them the feedback.



Then S= {**(3/2;5/2)**}.

2) 2x =3y+2 and y =2x-6

2x -3y = 2 and y=2x-6

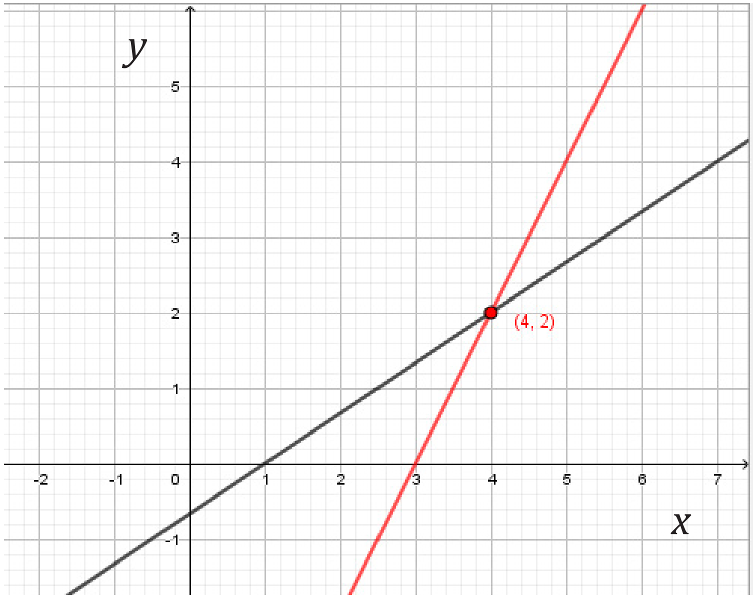
Then 2x-3(2x-6) =2

2x-6x+18=2

-4x=-16

x= 4

Therefore, y =2x-6= 2(4)-6=8-6= 2

	 S= {**(4;2)**}.	
Conclusion (2 Minutes).	**Teacher**: We are coming to the end of our lesson. As we conclude, remember that we learnt how to solve simultaneous linear equations graphically and by substitution. As a home work, you are requested do more activities found in the **S2 Mathematics book on page 73.** Thank you for your participation.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.4 Lesson from unit 4

SUBJECT: MATHEMATICS	**GRADE:** S2	**UNIT4:**
Lesson title: Proportional changes		
Duration: 40 minutes		
Teaching and learning materials: notebooks, pens, calculators, geometric materials, S2 mathematics book (from page 88 to page 94)		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction **(10 min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. I think that you are ready to study. Can you tell me the lesson you studied last time? **Students**: Yes Sir/ Madam; We learned to express ratios in their simplest form. **Teacher:** Good! Remember that it had been also studied in S1. You are therefore expected to be well versed with how the operations are carried out. Now, do the following activity. **Activity 4.1** **a**) Express the following as fraction i) 9 to 27 ii) 6 to 18 b) Write the ratios found in (a) in their simplest form.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly. Invite the students to work in groups on the **engaging** activity 4.1 to assess the prerequisites of students before starting the new lesson.

	Expected answer from students: a) i) $\frac{9}{27}=\frac{1}{3}$ ii) $\frac{6}{18}=\frac{1}{3}$ b) $\frac{1}{3}$	
	Teacher: Good! In today's lesson, we are going to study **proportional changes.** And by the end of this lesson, you will be able to: • Compare quantities using proportions. • Define proportions and give some of its properties. In this lesson you only need notebooks, pens, calculators, geometric materials, and the S2 Mathematics books. **Teacher:** Let $\frac{3}{5}$ and $\frac{9}{15}$ be two ratios. How do we call this expression? $\frac{3}{5}=\frac{9}{15}$ **Students:** when two ratios are written in this form $\frac{3}{5}=\frac{9}{15}$ it is called a **proportion. S**imply, a proportion is a statement that **two ratios are equal**.	Communicate the lesson title and related instructional objective to students. Allow students to get their materials before moving on.

Lesson development (20 min)	**Teacher:** Continue to work in your groups the following activity: **Activity 4.2** a) Find x if $\frac{12}{x}=\frac{36}{9}$ **Expected answer from the students:** 36x = 108 x = 3 **Teacher:** Very good! Now, you know that when you have the proportion $\frac{a}{b}=\frac{c}{d}$, this means that $a\times d=b\times c$. Let us see the third property called **Inverse (reciprocal) property.** Do the following activity: **Activity 4.3** if 7a=3b and b ≠ 0, find the ratio a:b ***Expected answer from the students:*** If 7a = 3b then $\frac{a}{b}=\frac{3}{7}$ **Teacher:** Thank you very much! From the result of this activity, you see that If $\frac{a}{b}=\frac{c}{d}$ then $\frac{b}{a}=\frac{d}{c}$ Now, try to do the following activities:	Provide the exploration activity. **Clarify** the concept and guide students to write down the content. Invite students to work in groups on the other **exploration** activity **Clarify** the concept and guide students to write down the content.

	Activity 4.4 (a) If $\frac{x}{y} = \frac{5}{3}$ find the ratio $\frac{y}{x}$ (b) $\frac{m}{n} = \frac{5+x}{-2+x}$ Find the ratio $\frac{n}{m}$ ***Expected answer from students:*** a) $\frac{y}{x} = \frac{3}{5}$ b) $\frac{n}{m} = \frac{-2+x}{5+x}$ **Activity 4.5** If $\frac{x}{y} = \frac{3}{4}$ find the ratio of $\frac{4}{3}$ ***Expected answer from students:*** $\frac{4}{3} = \frac{y}{x}$	Guide the students to work in groups on the **elaboration** activity by applying the property of cross multiplication and solving for unknown. Invite the students to work in groups on the other **elaboration** activity.
	Teacher: In this lesson, let us summarize what we have learnt in this lesson **Summary** • A **proportion** is a mathematical statement that expresses the equality of two ratios. • **Properties of proportions**:	Guide the learners to summarize the lesson by focusing on how to state proportions and properties of proportions.

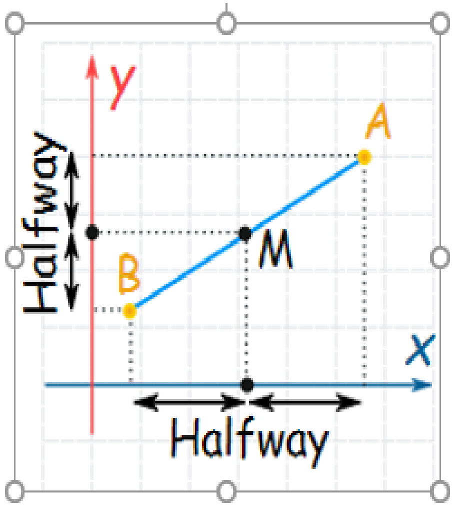
	Mean-extreme or cross multiplication: If $\frac{a}{b}=\frac{c}{d}$, then $ad=bc$. Mean-extreme switching property: If $\frac{x}{2}=\frac{y}{3}$, $\frac{x}{y}=\frac{2}{3}$ Inverse property: If $\frac{a}{b}=\frac{c}{d}$ then $\frac{b}{a}=\frac{d}{c}$.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (8 min)	**Teacher**: Thank you very much! Now, you are going to do an individual activity for assessment**:** Use cross products to solve the proportion a) $\frac{2}{6} = \frac{5}{x}$ b) $\frac{6}{4} = \frac{x}{9}$ c) $\frac{5}{25} = \frac{x}{20}$ ***Expected answers from students:*** **a) x = 15** **b) x =** $\frac{54}{4}=\frac{27}{2}$ **c) x = 4**	Give students an activity to be done individually for **evaluation**, mark the work for each one and Provide opportunities for corrective feedback or positive feedback to students.

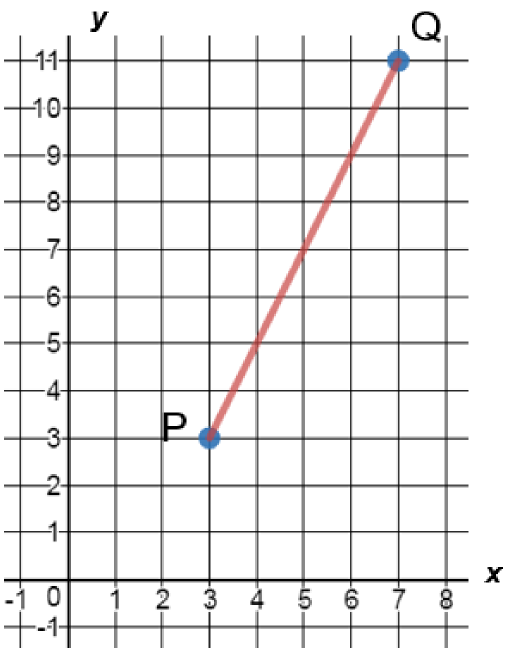
Conclusion (2 min)	**Teacher:** We are coming to the end of our lesson. As we conclude, let us review some of the key points that we learned about proportion change. In this lesson, we talked about the following concepts: 1. The meaning of a proportion; 2. properties of proportions that are: mean-extreme or cross multiplication, mean-extreme switching property and inverse property. We will see the last property next time. As homework, try to make a research on the equivalence of proportions. Thank you for your participation.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.5 Lesson from unit 5

SUBJECT: MATHEMATICS	**GRADE:** 2	**UNIT 5:**
Lesson title: Midpoint of a line segment		
Duration: 40 minutes.		
Teaching and learning materials: A ruler, a protractor, set square, a tape measure		
Section	**Step –by- step instructions and content**	**Teacher's notice**
Introduction (7 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied in geometry senior one? **Students**: We studied the definition of a point; a line, angles, triangles etc. **Teacher:** Who can tell us the difference between a line and a point? **Students:** In geometry, a **point** marks one position while a **line** is a set of points which are joined together.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Let us start it by doing this activity Please, take a piece of gridded paper. a) Draw vertical lines with 4cm b) Mark point A and C on extremities of the lines c) Mark point B in the middle of this line segment. c) What can you say about the measures AB and BC ?	

	Expected answers from students: For example length AB = 2cm and length BC =2cm AB and BC have equal length when you measure them from the middle point B. AB and BC are called line segments of the same length and B is the mid-point of the line segment AC. **Teacher**: Good! In today's lesson, we are going to continue with the meaning of a mid-point of a line segment. By the end of this lesson, you will be able to use geometric materials to: • Define a line segment and midpoint correctly. • Recite the midpoint formula accurately. • Apply the midpoint to solve related problems without any difficult.	Tell students the materials needed and give them a small time to take them. Explain instructions and provide an **engaging** activity. Communicate the lesson title and related instructional objective to students.
Lesson Development (25min)	**Teacher:** Workout the following activity **Activity 5.1** a) Using a ruler, draw a line segment AB of length 10 cm. b) Mark Point M , 5 cm from A towards B. Measure and compare the lengths AM and MB. What can you say about these two-line segments AM and MB? **Expected answer from the students**: a)  b) The segment AM = MB = 5cm	Give learners the **exploration** activity. Students must be given time to think and note down their ideas. Emphasize new concepts.

	Teacher: Well done students. Midpoint "**is defined as the point halfway between the endpoints of a line segment**". A midpoint divides a line segment into two equal segments.  M is a midpoint of the line segment AB Because $\lvert AM \rvert = \lvert MB \rvert$ **Teacher:** Please work in pairs this activity. **Activity 5.2** Consider the points P and Q in the Cartesian Plane.	When harmonizing students' findings, guide them to deduce clear meaning of a midpoint of a line segment (**Explanation** phase). Invite them to work on the **elaboration** activity in pairs.



i) Find the coordinates of the points P and Q.

ii) Measure the length of the line segment PQ.

iii) Find a half of the line segment PQ and name the coordinate of the point M in the middle.

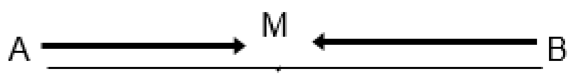
iv) If the coordinates of P and Q are (x1, y1) and (x2, y2) respectively, what could be the coordinates of the point M.

v) How did you find the coordinates of M?

During group activity 5.2

move to each group to verify their progress and guide them where necessary.

	Expected answer from the students: i) The coordinates of point P and Q are P(3.3) and Q(7,11) ii) The length of segment PQ is 8.9 L.U iii) The half of the segment PQ is a point at (5,7) coordinate. iv)The midpoint of segment PQ has a coordinates of (5,7) v) using Cartesian plane, I count the squares from P to Q on x and y-axis, and I find that the middle point M has (5,7) coordinates **Teacher:** Well done students. Midpoint coordinates “can also be found by using the following formula: **M =** $\left(\frac{X1+X2}{2},\frac{Y1+Y2}{2}\right)$ Where P(x1, y1) and Q (x2, y2) respectively. **Teacher:** Let us now do the following activity to apply what you have just learnt. **Activity 5.3.** If the points K and P are in a Cartesian plane such that K(3,9) and P(1,3). Find the coordinates of the midpoint T of the line segment $\overline{PQ}$. Show all your working steps. **Answer’s students :** the coordinates of midpoint T are found by using T = $\left(\frac{X1+X2}{2},\frac{Y1+Y2}{2}\right)$ We find that T has coordinates$\left(\frac{3+1}{2},\frac{9+3}{2}\right)$, Therefore, T(2,6).	Invite students to Present their findings and harmonize their answers. Let students work in groups, this will promote among other competencies: (i) Critical thinking skills (ii) Problem solving (iii) Cooperation and interrelation among learners.

	Summary: **Midpoint** “is defined as the point halfway between the endpoints of a line segment”. A midpoint divides a line segment into two equal segments. To find the midpoint coordinates of a line segment AB, you use **the formula** $M = (\frac{X1+1}{2}, \frac{Y1+Y2}{2})$ Where A (x1, y1) and B (x2, y2). The midpoint of a line segment is the point half away from two given points a midpoint divides a line segment into two equal segments. Then M is the midpoint of line AB.  	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment **(5 Min)**	**Teacher**: Thank you very much. Now, you are going to do an individual activity for assessment: Answer to the following questions: 1. Choose the correct coordinates of the midpoint between the indicated P and Q?	Provide questions to be done individually for **evaluation; C**orrect them and plan how to support students with difficulties (who failed).

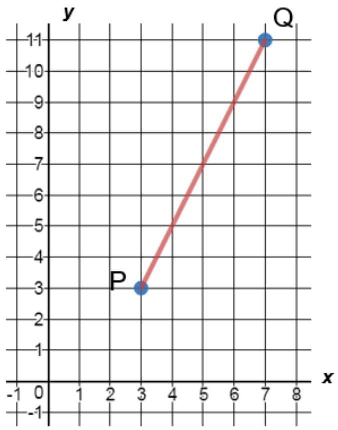
A (4, 9)

B (−5, −4)

C (5, 6)

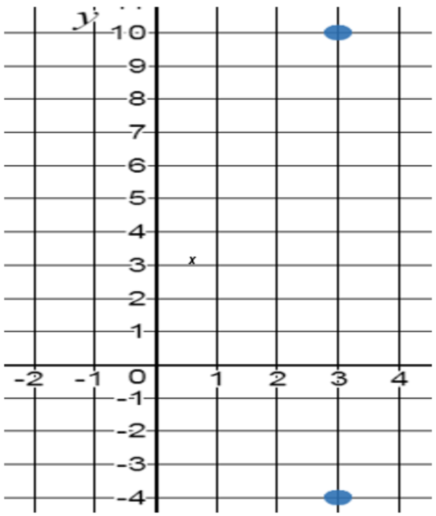
D (5, 7)

E I need help



ANSWER: D

2. What is the midpoint between the indicated points?



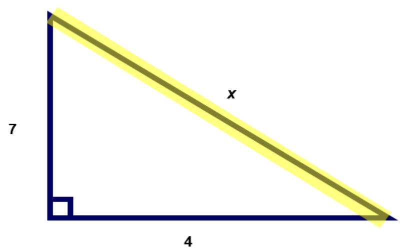
Provide opportunities for corrective feedback or positive feedback to students

	ANSWER: (3,3) 3. Choose the correct answer of the midpoint between (k, $6k$) and ($5k$, $-4k$)? ◯ A (3*k*, *k*) ◯ B (3*k*, 5*k*) ◯ C (6*k*, *k*) ◯ D (6*k*, 5*k*) ◯ E I need help **ANSWER: A**	
Conclusion (3 min)	**Teacher:** We are coming to the end of our lesson. As we conclude, let us s review some of the key points that we learned about the Midpoint. If A (x1, y1) and B (x2, y2) are points of a Cartesian plane, the midpoint M of the line segment AB has the following coordinates: **M** = $(\frac{X1+1}{2}, \frac{Y1+Y2}{2})$. As homework, you will do activity 5.2 which is on page 95 in S2 Mathematics- students' book. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.6 Lesson from unit 6

SUBJECT: MATHEMATICS	**GRADE:** S2	**UNIT 6:**
Lesson TITLE: Proof of Pythagoras' theorem		
Duration: 80 minutes.		
Teaching and learning materials: Apparatus for Pythagoras theorem, cut-outs for right angled triangles, and squares.		

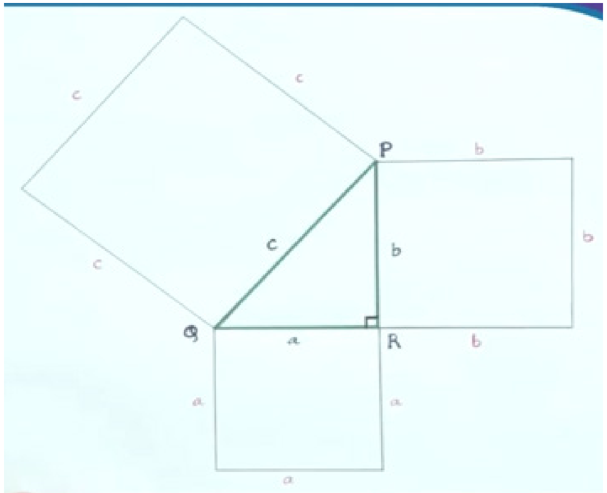
Section	Step –by- step instructions and content	Notice for the teacher
Introduction (15 min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students:** Last time we studied the introduction to Pythagoras theorem. **Teacher**: Thank you, observe this hen and the tree; There is a relation between distance from the hen to the foot of the tree, its height and the distance from the hen to the top of the tree. What is your observation?	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

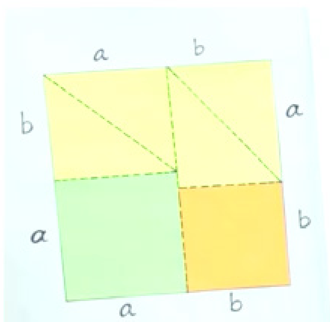
	 In this lesson, you will need a T-square and a ruler. Take them from your documents. **Students:** The distance hen - top of the tree is larger.	Tell students the materials needed and give them a small time to take them.
	Teacher: Good! Dear students, Join your groups and do the following activity: **Activity 6.2.1.** a) State the Pythagoras theorem b) Give the algebroic expression used to calculate the length of the third sides in the figure below: 	Introduce the lesson by an **engaging** activity related to the previous lesson.

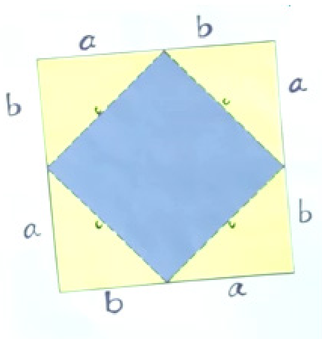
	Expected answer from the students: **a)** Pythagoras theorem states that "in a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides". **b)** $4^2 + 7^2 = x^2$ $16 + 49 = x^2$ **Teacher**: Thank you very much! Now, in today's lesson, we are going to study **how to prove Pythagoras' theorem.** **Key question**: What is the relationship between hypotenuse and other two sides of a right angled triangle? **The objectives of this lesson are the following:** By the end of this lesson, you will be able to: • Use algebra to prove the Pythagoras' theorem you mentioned above. • Use Pythagoras theorem to calculate the lengths of sides for a right angled triangle.	Communicate the lesson title and related instructional objective to students.
Lesson development (40 min)	**Teacher**: Dear students, let us form groups of four students where you are going to collaborate doing the following activity. **Activity 6.2.2** 1. Draw the right angled triangle whose sides are a, b, c and name it T 2. Draw a square on the hypotenuse of triangle T 3. Draw the same triangle T on each side of square such that a side of square become hypotenuse of a triangle and form another square	Ask the learners to join their groups and discuss these **exploration** activities

4. Find the Area of a large square, triangles and smaller square

What do you notice?







5. Express the area of the large square in terms the areas of triangles and small square in blue.

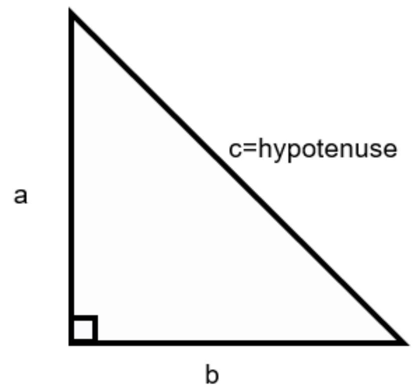
Move around in the classroom to help those who have difficulties.

Activity 6.2.3

1. Draw the right-angled triangle ABC such that AB=4cm, BC=3cm, AC=5cm and <ABC=90 degrees
2. Draw a square on each side of triangle ABC
3. Find the area of each square drawn on each side of triangle ABC
4. Compare the area of square on the hypotenuse to the area of square on other two sides.

Students:...

Teacher: Thank you for your answers. Pythagoras' theorem states that in a right triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.



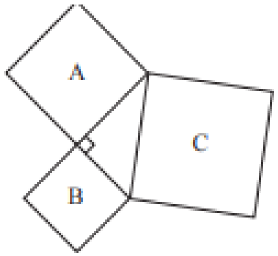
$$c^2 = a^2 + b^2$$

Activity 6.2.4

Use Figure below to copy and complete the following, given that A, B,C represent areas of the three squares.

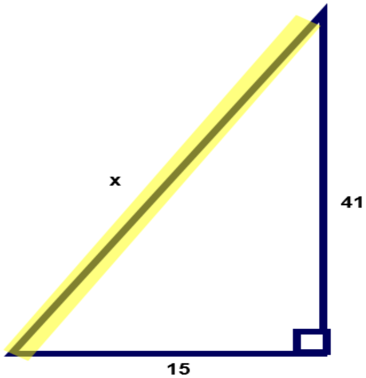
Using the same groups, ask learners to do this activity and then after let them present their findings.

Guide the class to harmonize answers and help them to clarify the concept.

	 (a) A = 28 cm^2, B=17 cm^2, C = ... (b) A= .....cm^2, B = 167 cm^2, C = 225 cm^2 (c) A = 4.55 cm^2, B = ... cm^2, C = 6.89 cm^2 (d) A = 22.09 cm^2, B = 87.8 cm^2, C = ... cm^2 (e) A = ...cm^2, B = 50.13 cm^2, C = 126.21 cm^2 (f) A =125.44 cm^2, B =...... cm^2, C = 233.16 cm^2 **Expected answer from the students:** (a) C = (28+17) cm^2= 45cm^2 (b) A = (225 - 167) cm^2 = 58 cm^2 (c) B = (6.89 – 4.55) cm^2 = 2.34 cm^2 (d) c = (22.09 + 87.8) cm^2 = 109.89cm^2 (e) A = (126.21 – 50.13) cm^2 = 76.08cm^2 (f) B = (233.16 – 125.44) cm^2 = 117.72cm^2	Give them another **elaboration** activities to be done in groups.

Activity 6.2.5

What is the value of x?



Answer: 152 + 412 = x^2

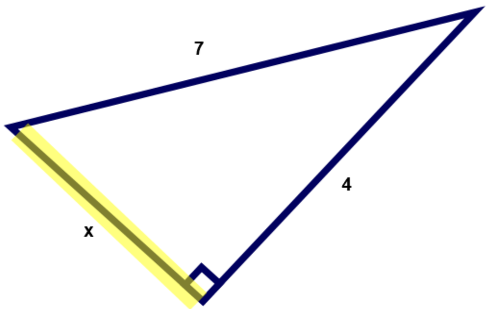
225 + 1681 = x^2

1906 = x^2

X ≈ 43.66

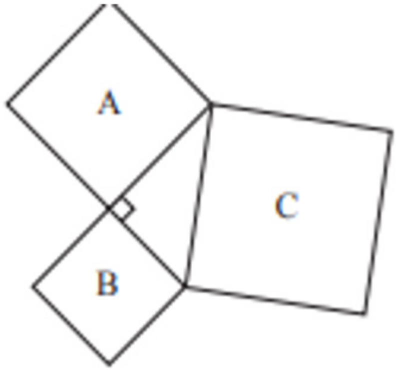
Activity 6.2.6

What is the length of the third side?



Harmonize answers.

	Expected answer from the students: $x^2 + 42 = 72$ $x^2 + 16 = 49$ $x^2 = 33$ $x \approx 5.74$ **Teacher:** As we have seen, Pythagoras' theorem concerns areas of the square on the sides of a right angled triangle. Its main use, however, is in calculating lengths. It also provides us with a test for a right-angled triangle. A triangle is right-angled, whenever the square of the length of the longest side equals the sum of the squares of the lengths of the other two sides.	
Assessment (15 Minutes)	**Teacher**: Right! Now, you are going to do an individual activity for **assessment:** **Activity for Assessment** 1. Lengths of the sides of four triangles are shown. Identify which of the triangles are right angled, and explain your method. (a) AB = 24 cm, BC = 10 cm, AC = 26 cm (b) DE = 7 cm, EF = 8 cm, FD = 13 cm (c) GH = 10.6 cm, HF = 5.6 cm, IG = 9.0 cm (d) JK = 16 mm, KL = 34 mm, LJ = 30 mm **Expected answer from the students:** **(a),(c),(d)** 2. Figure below is a right-angled triangle with squares A, B and C on its sides.	Give them the activities to be done individually as an assessment (**evaluation**). Provide opportunities for corrective feedback or positive feedback to students.

	 Find the length of the third side of the triangle if the area of squares. (a) A = 144 cm^2, B = 25 cm^2 (b) B = 16 cm^2, C = 25 cm^2 (c) A = 4.53 m^2, C = 6.89 m^2 Answer: a) c=$\sqrt{144cm^2+25cm^2}=13cm$ b) a = $\sqrt{25cm^2-16cm^2}=3cm$ c) b=$\sqrt{6.89m^2-4.53m^2}\approx ?cm$	
Conclusion (10 min)	**Teacher:** We are coming to the end of our lesson. As we conclude, **Pythagoras' theorem** states that "in aright triangle the square of the hypotenuse is equal to the sum of the squares of the other two sides": $a^2 + b^2 = c^2$ Now I want to give you a homework assignment so that you try to apply what we have learned today.	Summarize the main points verbally, conclude and give students a homework that may include remedial,

	1. The sides of a rectangle are 7.8 cm and 6.4 cm long. Find the length of the diagonal of the rectangle. 2. The length of the diagonal of a rectangle is 23.7 cm and the length of one side is 18.8 cm. Find its perimeter. Thank you for your participation in this lesson.	consolidation or extended activities depending on the feedback from assessment.

2.7 Lesson from unit 7

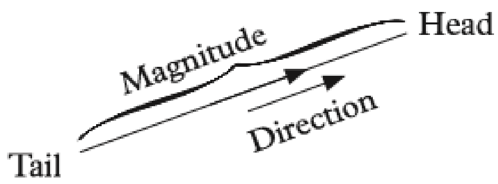
SUBJECT: MATHEMATICS	**GRADE**: 2	**UNIT 7**:
Lesson title: **Equality of vectors.** **Duration**: 80 minutes. **Teaching and learning materials**: Chalk, mathematical sets, exercise books, pens.		
Section	**Step –by- step instructions and content**	**Notice for the teacher**
Introduction (10min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the concept of a vector, Definition and properties of a vector.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Previously as you say, we have learnt the meaning of a vector and its properties. Now, let us begin by reviewing the previous lesson with a short revision using an activity related to vectors. **Teacher**: Work in pairs the following: **Activity 7.3.1**: a) What is a vector? b) How can you present a vector geometrically?	Provide the **engaging activity** and give them related instructions.

c) Give example of vectors in real life.

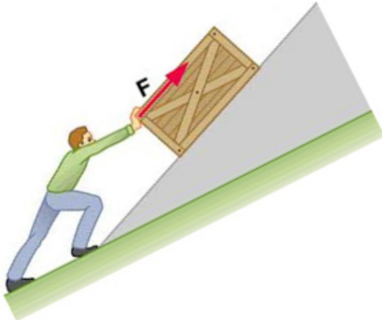
Expected answer from the students:

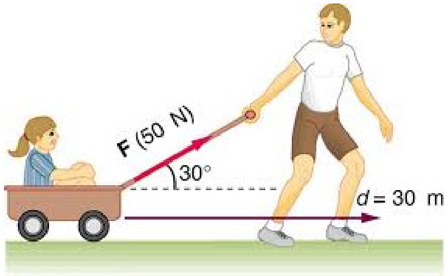
a) A vector is any quantity that has both magnitude and direction.

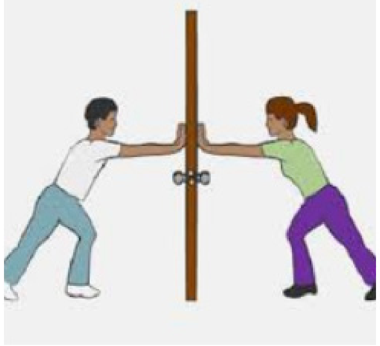
b)



c) Example of vector is the force used to push objects.





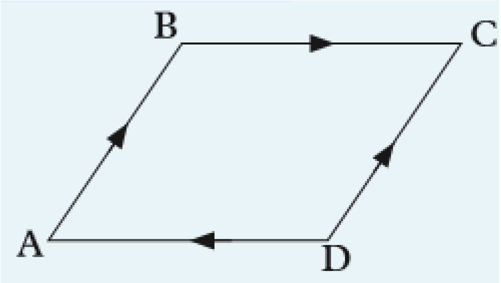
	Teacher: Good! In today's lesson, we are going to study Equality of vectors. By the use of geometric materials, you will be able to identify equal vectors and Solve problems related to equality of vectors accurately.	Communicate the lesson title and the objectives of the lesson.
Lesson development (50 Min)	**Teacher**: Dear students, I want two volunteer students to come in front of the other. Now, try to push one another in the opposite direction.  **Teacher**: Why no student displaces the other? Why one student displaces the other? **Students**: None displaces the other because they have equal forces. One student displaces the other because they have different forces. **Teacher**: Thank you very much students! When two forces F1 and F2 with the same direction but with different orientation are acting on the same point, you can have: F1+F2 =0 when they are of the same magnitude F1-F2 or F2-F1 when they do not have the same magnitude.	In a whole class discussion, choose two students of approximately equal size and tell them to come in front of and push one another but before, tell them to wash their hands. If none displaces the other, ask why? If one displaces the other, also ask why? Students must be given time to think and note down their ideas.

Remember that a vector joining two points A and B is noted by $\vec{AB}$, but we are going to **use bold letters** to represent vector without using an arrow.

Now, in groups of four students, do the following activity:

Activity 7.3.2

Observe the figure below that is in a shape of a parallelogram and discuss the questions that follow:



a) Compare the magnitudes and directions of vector **AB** and **DC**. What do you notice? What is the name given to such vectors?

b) Compare the magnitudes and directions of vectors **DA** and **BC**. What do you notice?

Expected answer from the students:

a) **AB** and **DC** have the same magnitude and direction. **AB** = **DC**, meaning **AB** and **DC** are parallel vectors.

b) **DA** and **BC** have the same magnitude but different directions. **BC** = - **DA**, they are parallel vectors.

Emphasize new concepts

Guide students to form groups and do this **exploration** activity in groups.

During group activity,

Move to each group to verify their progress and guide them where necessary.

For each group working activity, let students Present their findings, and harmonize their answers.

Concept clarification

Teacher: basing on the results of this activity, what are the conditions required for vectors to be equal or equivalent?

Students: Equal vectors must be equal in magnitude and have the same direction.

Teacher: Yes, remember that Vectors that are parallel and equal in magnitude but opposite in direction are called **opposite vectors.**

Teacher: Dear students, thank you very much.

Now, continue to work in your respective groups on the following activity:

Activity 7.3.3:

What name can you give two vectors which have the same magnitude and direction? You are going to choose a card that indicates the proper name for these two vectors among the following cards.

A: Opposite vectors

B: Equal vectors

C: Equivalent vectors

i) A iii) B v) A & B vii) B & C

ii) B iv) C vi) A & C

When harmonizing students' findings, guide them to deduce clear meaning of equal or equivalent vectors (**explanation** stage).

Still in groups, ask the students to work on the application or **elaboration** activities. Help them to form groups and instructs how the activity is going to be performed.

Expected answer from the students:

True answer is (**vii**) because two vectors of the same magnitude and direction, you can call them Equal or Equivalent vectors.

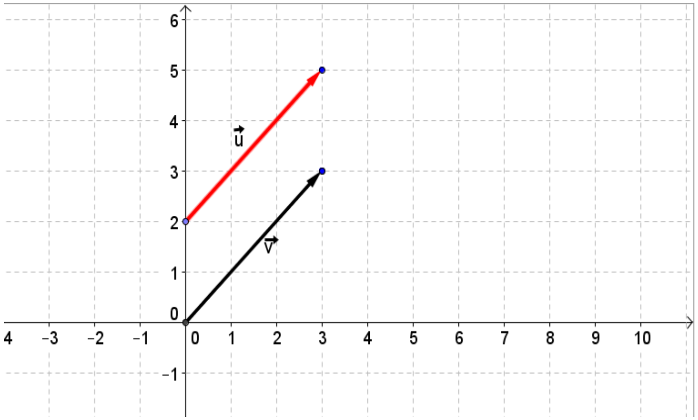
Activity 7.3.4:

Draw and name:

(i) Two equal vectors

(ii) Two opposite vectors

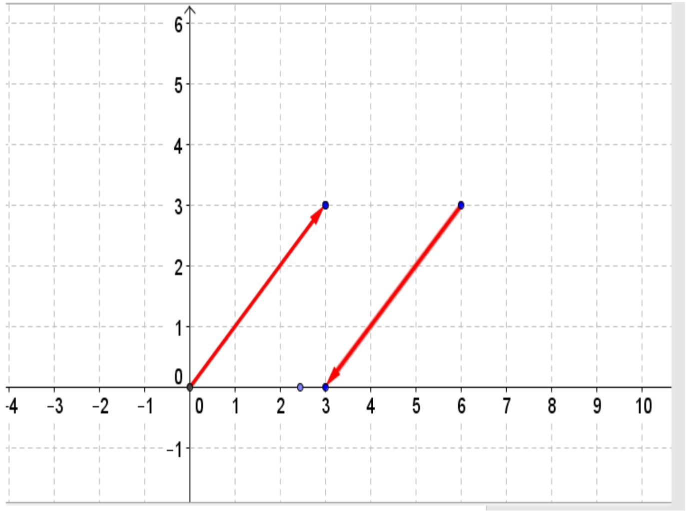
Expected answer from the students:



Vector u and v are equal.

Teacher: Nore that if $\overrightarrow{U} = \begin{pmatrix} x_1 \\ y_1 \end{pmatrix}$ and $\overrightarrow{V} = \begin{pmatrix} x_2 \\ y_2 \end{pmatrix}$

$$\overrightarrow{U} = \overrightarrow{V} \text{ means } x_1 = x_2 \text{ and } y_1 = y_2$$



$\vec{U} = -\vec{V}$

Teacher: Still in groups, work on these application activities.

Activity 7.3.5:

Given that $\vec{U} = \begin{pmatrix} 20x \\ -4 \end{pmatrix}$ and $\vec{V} = \begin{pmatrix} 10 \\ 5+y \end{pmatrix}$

a) Find the values of x and y if $\vec{U} = \vec{V}$

b) Find the values of x and y if $\vec{U}$ and $\vec{V}$ are opposite.

Expected answer from the students:

a) $\vec{U} = \begin{pmatrix} 20x \\ -4 \end{pmatrix}$ and $\vec{V} = \begin{pmatrix} 10 \\ 5+y \end{pmatrix}$

Use different questions to help students recall key concepts of the lesson and be written down as a summary.

if $\vec{U} = \begin{pmatrix} 20x \\ -4 \end{pmatrix}$ and $\vec{V} = \begin{pmatrix} 10 \\ 5+y \end{pmatrix}$

$20x = 10$ and -4 = 5+y

$x = \frac{10}{20}$ and - 4 - 5= y

$x = \frac{1}{2}$ and $y = -9$

b) if $\vec{U} = -\vec{V}$ then $\begin{pmatrix} 20x \\ -4 \end{pmatrix} = -\begin{pmatrix} 10 \\ 5+y \end{pmatrix}$

$20x = -10$ and -4=-5-y

$x = \frac{-10}{20}$ and - 4 + 5= -y

$x = \frac{-1}{2}$ and $y = -1$

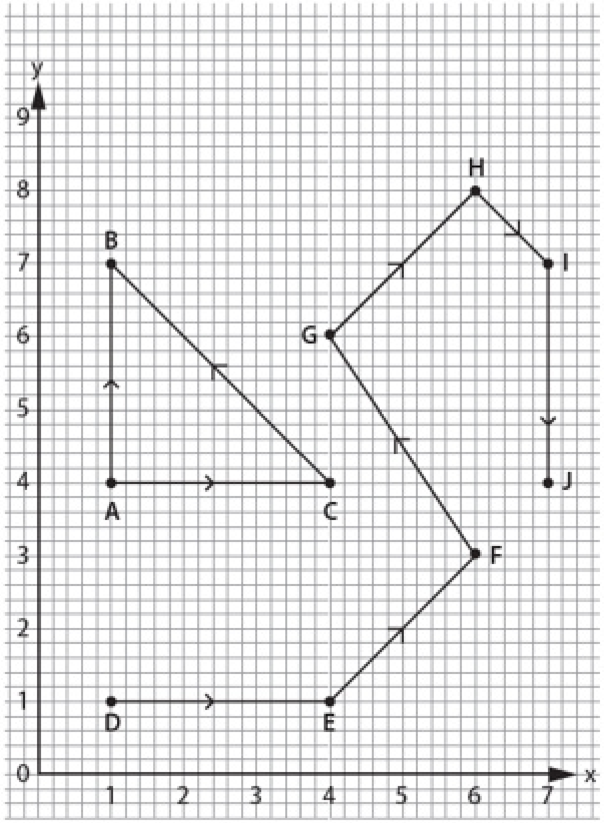
Activity 7.3.6:

Given that $\vec{a} = \begin{pmatrix} k \\ -1 \end{pmatrix}$ and $\vec{b} = \begin{pmatrix} 5k-32 \\ 3x-16 \end{pmatrix}$

find the values of k such that $\vec{a} = \vec{b}$

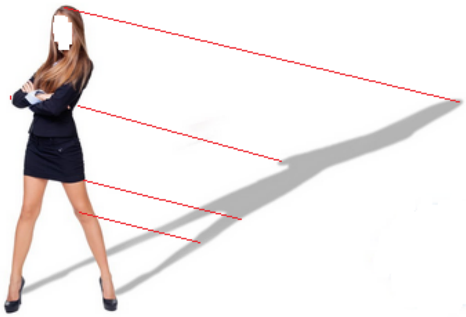
Expected answer from the students:

K = 5k -32 and -1 = 3x – 16
K – 5k = -32 and -1 + 16 = 3x
-4k = -32 and 15 = 3 x
K = 8 and x = 5

Assessment (10 Min)	**Teacher**: Very good! Now, you are going to do an individual activity for assessment: **Activity:** 1. Figure below shows vectors on a Cartesian plane. 	Let the students do these activities individually and submit their answer sheet for **evaluation**. Provide opportunities for corrective feedback or positive feedback to students.

	(a) List all the vectors that are equivalent to: (i) **AC** (ii) **GH** (b) Is vector **AB** equivalent to vector **IJ**? Give a reason. **Expected answer from the students:** a) (i) **DE** (ii) **EF** b) The vector AB is not equivalent to IJ, they are opposite vectors because they have opposite direction.	
Conclusion (10 min)	We are coming to the end of our lesson. Now, I want to give you homework so that you try to apply what we have learned today. **Homework** 1. Given that **r** = $\begin{pmatrix} -6a \\ -3 \end{pmatrix}$ and **s** = $\begin{pmatrix} a-14 \\ 2y-27 \end{pmatrix}$ If **r** = **s**, find the values **a** and y 2. Given that, a = $\begin{pmatrix} -11x \\ y-1 \end{pmatrix}$ and **b**= $\begin{pmatrix} 3-7x \\ 8y-23 \end{pmatrix}$ If **a** = **b**, find the value of x and y Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.8 Lesson from unit 8

SUBJECT: Mathematics	GRADE:S2	UNIT: 8
LESSON TITLE: Parallel projection of a point on a line. **Duration:** One period of 40 minutes. **Teaching material**: A torch, rulers and set squares.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction **(5** Minutes**)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We did a test on orthogonal projection. **Teacher**: Good! Apart from orthogonal projection, there are other types of projections. Today we are going to study one of them. Here we have a torch and rulers. We will use them in this lesson. Take your exercise book, a pen, a ruler, a pencil and then participate.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly. Tell students the materials needed and give them a small time to take them.
	Teacher: Dear students, look at a shadow of a stable person. 	Give them an **engaging** activity to be done in a whole class discussion. You can use a chart or a video showing image of an object on a soil under the sun's lays.

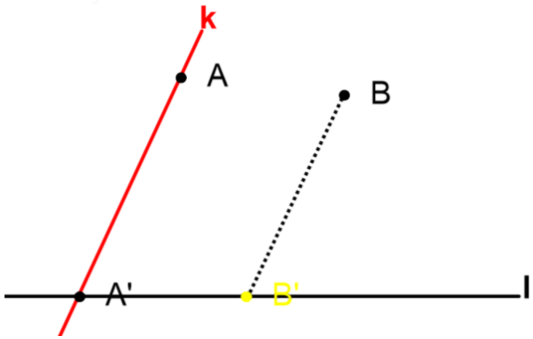
	If you join each part and its image by a line: head, arms, legs, etc. Can you guess how these images are formed? Where are images formed? **Students:** Lines joining each object (part) and its image are parallel. We see that images are formed on the ground. **Teacher**: In this lesson, we are going to study how image of a point (object) is formed on a line under the parallel projection in the direction of a given line. **Teacher**: Today's lesson is entitled "Parallel projection of a point on a line". Through working in groups, students who use geometric materials will be able to: • Draw correctly two parallel lines using mathematical sets, • Construct appropriately the image of a point under a parallel projection on a given line in an indicated direction. • Identify without a problem the images of points under the parallel projection given the projection lines and directions. Dear students, Are you ready? **Students**: Yes, we are ready. You need a ruler and a T-square.	You can also ask students to discuss the next position of a set square put on a wall and fall vertically following the surface of a wall. Communicate the lesson title and related instructional objective to students.
Lesson development **(24 Min)**	**Teacher**: Dear students work in groups and do the following activity for constructing two parallel lines. **Activity 8.2.1:** 1) In your notebook draw a line and label it **l** and plot point **A** anywhere not on line **l.**	Invite students to work on the **exploration** activity in pairs.

2) Draw another line **k** passing through point **A** intersecting **l** at **A'.**

3) Mark point B anywhere not on line **l** and **k**.

4)Through **B**, draw a dashed line parallel to **k** to meet **l** at **B′**

Students' answers:



Teacher: Dear students, How are lines k and BB'? Where are points A' and B'?

Student's answer:

We notice that lines k and BB' are parallel. The point **A'** and **B'** are formed on the same line **I.**

Teacher: With such a result, B′ is the image of B under the parallel projection on the line l. We say also that B' is the projection or the image of B on the line I. i.e A'= Im(B).

In such a mapping A′ is also the projection of A on the line l.

This transformation is called parallel projection because the line joining the point **B** (object) and its image **B'** is parallel to the line **k** (BB' //k).

The line **k** is called the direction line.

Move to every group and ask probing questions.

Ask students to present their findings in plenary session

During harmonization guide students to build their knowledge on a parallel projection

Use different questions to probe students to be able to explain the concept.

Clarify the concept (**explanation** stage).

Teacher: Thank you; who can now tell us how to find the image of a point under a parallel projection?

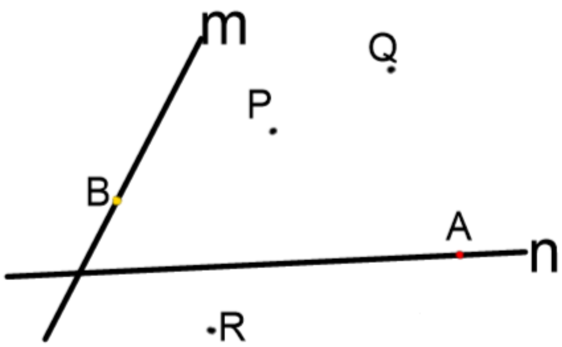
Students: To construct the image of a point under the parallel projection , first draw both projection line and direction line then draw the dashed line passing through the given point parallel to the direction line. The intersection of the line joining the point and its image with the projection line is the image of the given point.

Teacher: Thank you. **The image of a point under the parallel projection is also a point.**

Now work in group this application activity:

Activity 8.2.2:

Consider the figure below



Construct the image of all the points under the parallel projection:

i) On line **n** in the direction of line **m.**

ii) On line **m** in the direction of line **n.**

This section of the lesson will promote among others competencies":

(i) Critical thinking skills,

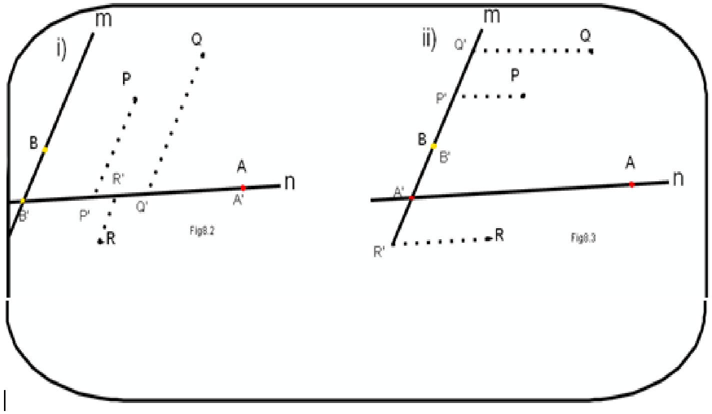
(ii) Problem solving,

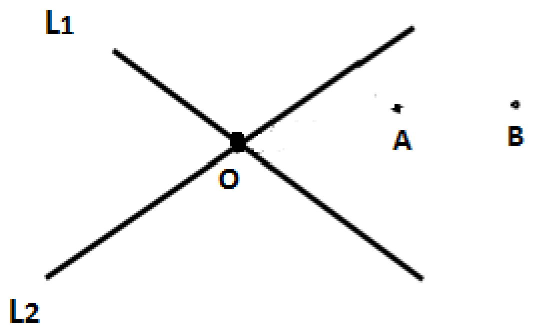
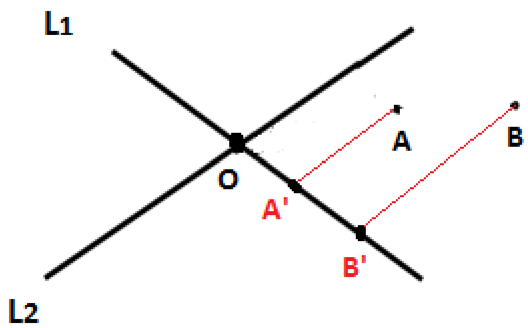
(iii) Cooperation and interrelation among students.

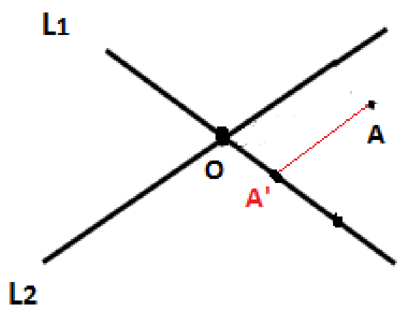
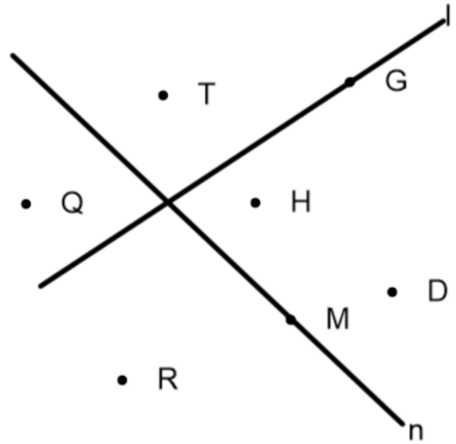
Remember to address common misconceptions.

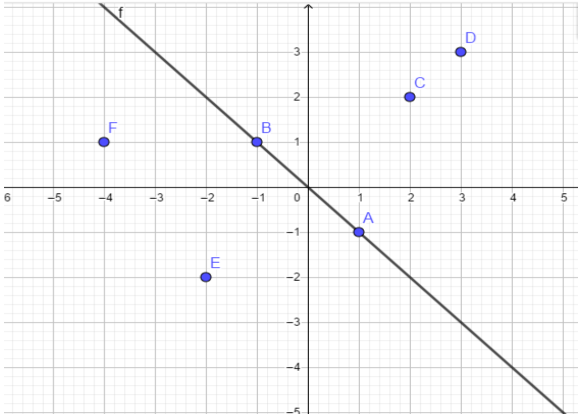
During harmonization, provide time for students to ask questions on what they do not understand well.

Provide **elaboration** activities to be done in groups.

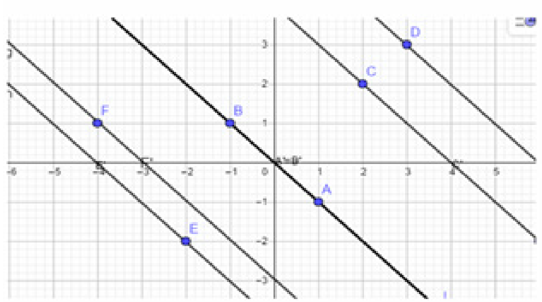
	Students 'answers: 	Invite students to present their answers to the whole class.
	Teacher: Dear students, to plot the image of a point **Q** under parallel projection, you draw a line parallel to the direction line passing through the given point Q and the intersection point of that line and the projection line is an image of the point. This means that Q'= Im(Q)= intersection of QQ' and the line **m.** Now, work individually the following activity	Harmonize answers to address misconceptions.
	Activity 8.2.3 Using plain paper, ruler and compasses, copy the diagram below and construct the image of point **A** and **B** under parallel projection on line **L1** in direction of line **L2**	Provide another elaboration activity.

	 **Answer for students:**  A’ is the image of A and B’ is the image of B. AA’//L2 and BB’//L2	
	Summary: To plot the image of a point **A** under the parallel projection with direction line L2 on the line L1, you draw a line **AA’** parallel to L2. The image of A is the point **A’** which is the intersection L1 and the line **AA’**.	Give students an activity for evaluation

		Guide students to recall key elements of the lesson to be written down as a summary.
Assessment (8 min)	**Teacher**: Thank you very much. Now, you are going to do an individual activity for a**ssessment:** Consider the figure below:  Construct the image of each of the following points under the parallel projection online n in the direction line l.	Provide opportunities for corrective feedback or positive feedback to students

Conclusion (3 min)	As we are coming to the end of our lesson, we conclude that: • To construct the image of a point under the parallel projection, first draw both projection line and direction line then draw the dashed line passing through the given point and parallel to the direction line. Its intersection with the projection line is the image of the given point. • The image of a point under the parallel projection is also a point. **As a homework** , go and do the following activity Activity 8.2.4: Construct the image of each the following points under the parallel projection on x-axis in direction of line **m** (with equation y = - x) and state their coordinates. 	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

Expected answers for students:

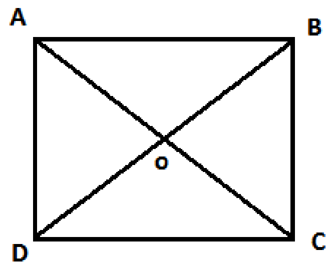


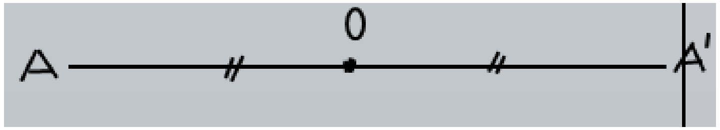
Im(F)= F’(-3;0); Im(E)=E’(-4;0); Im(A)=A’(0;0); Im(B)=B’(0;0); …

Thank you for your participation in this lesson.

2.9 Lesson from unit 9

SUBJECT: Mathematics	GRADE: S2	UNIT: 9
LESSON TITLE: Central symmetry and its Properties **Duration**: 40 minutes **Teaching material**: Geometrical instruments **Learning materials**: Notebooks, pens, calculators, geometric materials, S2 Mathematics book		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (5 Minutes)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the introduction to isometries.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Take a squared paper, try to show its diagonals and find the center of the square. Measure and compare lengths from the center to extremities of each diagonal. How are they? **Students**: The two points are at the same distance from the center and they are on the same line. **Teacher**: We are going to study the transformation called Central symmetry under which the object and image are on the same line and they are at the same distance from the center.	Provide the **engaging** activity. Show students symmetric objects. You can use a chart or a video showing two symmetric points or objects.

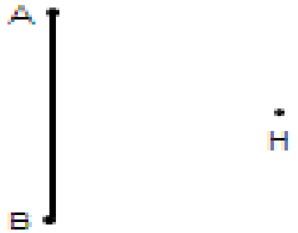
	Teacher: Good! In today's lesson, we are going to continue with central symmetry as one type of isometries. And by the use of geometric materials, you will be able to: • *Explain central symmetry;* • *Explore properties of central symmetry.*	Tell students the materials needed and give them a small time to take them. Communicate the lesson title and related instructional objective to students.
Lesson development (25 Minutes)	**Teacher**: observe the figure below:  If we consider the center of a square, One extremity A of a diagonal is an object, its image is C. Compare the distance OA and OC, how are they? **Students**: OA = OC. This means that the object and the image are equidistant from the centre O and they are opposite one another.	Students must be given time to think and note down their ideas. Invite them to work on the **exploration** activities in pairs. Ask students to present their findings in plenary session and guide them to harmonize their findings.

	Teacher: Do the following activity: **Activity 9.1.2** Take a rope and mark its extremities as the starting point by **A** and the ending point by **A'**. Find the midpoint of that rope and mark it by **O**. a) compare the distance AO and OA' . How are they? b) What can you say about point O? **Students' answers:**  a) OA = OA' b) O is the centre of the line segment A A' **Teacher:** Well done students. **The central symmetry** is a transformation under which the image is inverted upside down (opposite) about a point called the centre. The object and the image are equidistant from the centre and the corresponding points lie on opposite sides of the centre. **If A' is the image of A under the central symmetry with center O, we write A'= Im (A) and |OA| = |OA'|.**	In each group with different working steps, choose one group member to present. Remember to address common misconceptions. Refer to the result and ask some questions leading students to give properties of central symmetry.

Properties of Central Symmetry

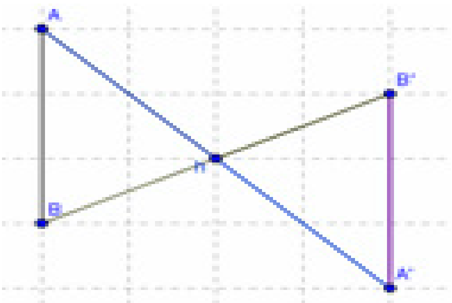
Activity 9.1.3:

Copy the point A in your notebook and label the figure clearly as shown below:



1. Join point A to H. Extend line AH to A´ the image of A (such that AH = HA´).
2. Similarly join BH and extend it to B' the image of B (such that BH = HB').
4. Join the points A'B' in that order to obtain a line segment.
5. Describe line segment A'B' formed in relation to line AB.
6. How the sizes of line segment AB and A'B' are related?

Students' answers

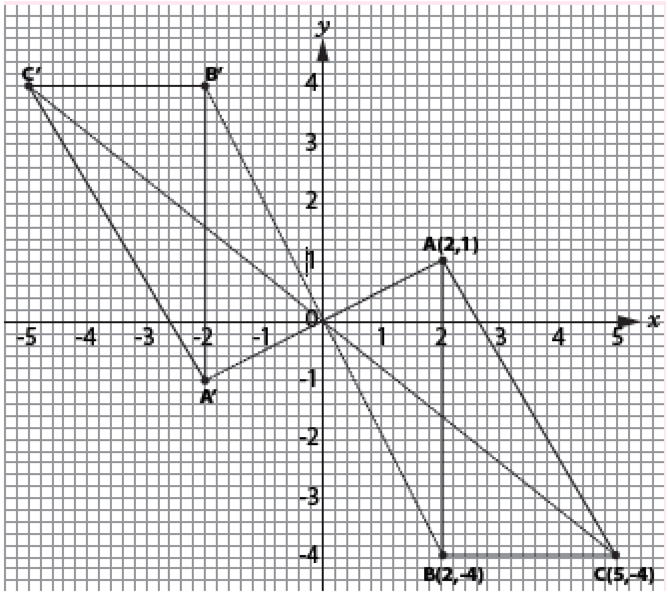


Invite students to work in groups and do the **elaboration** activity for elaborating properties of central symmetry.

	The line segment A'B' is the image of the line segment AB i)AH = HA' ii) BH =HB' iii) AB =A'B' **Teacher:** Basing on the results of this activity what are Properties of Central Symmetry? **Students' answers:** 1) An object and its image have same shape and size. 2) A point on the object and its image are equidistant from the centre. 3) The image of the object is inverted. 4) Central symmetry is fully defined if the object and the centre are known. **Teacher:** Thank you. Work in groups and do this activity **Activity 9.1.4:** *Triangle ABC has vertices at A(2, 1), B(2, -4) and C(5, -4).* *Find the image of ΔABC under the central symmetry with centre O(0, 0). State the coordinates of the image.*	

Students' answer:

Let the image be A´B´C´ be the image of A BC.



The coordinates of the triangle image are:

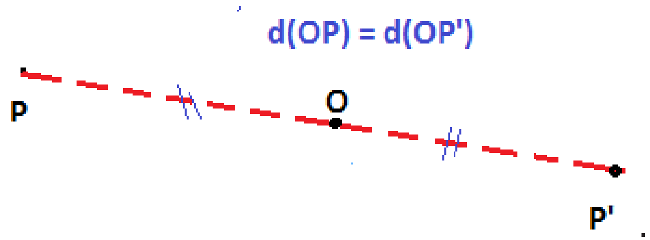
A´(-2, -1), B´(-2, 4), C´(-5, 4).

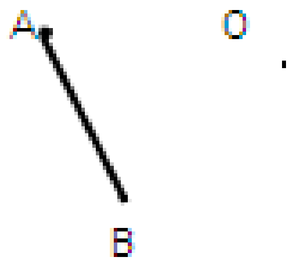
Summary:

The central symmetry is a transformation under which the image is inverted upside down (opposite) about a point called the centre.

The object and the image are equidistant from the centre and the corresponding points lie on opposite sides of the centre.

Use different questions to help students recall key concepts of the lesson to be written down as a summary.

	If A' is the image of a point A under the central symmetry with center O, we write A' = Im (A). To find the image of a point P under the central symmetry of center O, draw a dashed line passing PO ; the image P' of P is such that the distance OP = OP'  The following are properties of the central symmetry: 1) An object and its image have same shape and size. 2) A point on the object and its image are equidistant from the centre. 3) The image of the object is inverted.	
Assessment (7 minutes)	**Teacher**: Thank you very much. Now, You are going to do an individual activity for assessment: 1) Define the following term: a) Isometry. b) Central symmetry. 2. State the properties of centre symmetry. 3) Copy the point A in your note book and label the figure clearly as shown below:	Give them an activity for assessment (**evaluation**). Provide opportunities for corrective feedback or positive feedback to students.



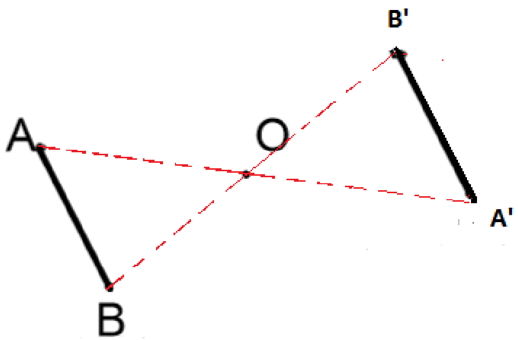
1) Find the image A'B'of the line segment AB under the central symmetry with center O.

2) Describe the image A´B´ formed in relation to the line segment AB.

3) How do the sizes of line segment AB and the image A´B´´ are related?

Students' answers:

1)



2) The image A'B' of the AB is inverted.

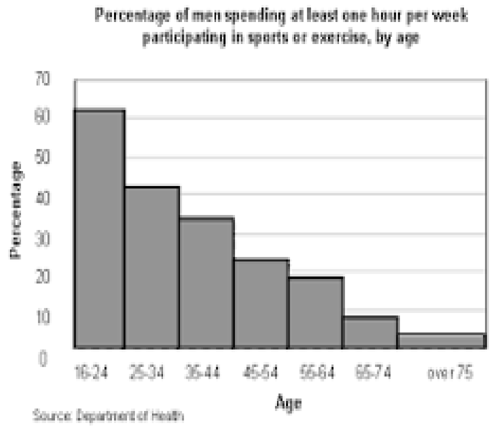
3) The line segment AB and the line segment A´B´ have the same length.

Conclusion (3 Minutes)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: 1) An isometry is a transformation that does not change the size of shape and image, the central symmetry is an isometry because the size of image is equal to the size of the object. 2) Image of an object under the central symmetry is inverted upside down vis- a- vis the center. Thank you for your participation. As homework, go and do activities found in the S2 Mathematics students' book on page 153. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.10 Lesson from unit 10

SUBJECT: Mathematics	**GRADE:** S2	**UNIT** 10:
LESSON TITLE: Class size in grouped data		
Duration: 40 minutes		
Teaching material: Books, chalk, and classroom chalkboard.		
Learning materials: Notebooks, pens, calculators, geometric materials, S2 Mathematics book		

Section	Step –by- step instructions and content	Teachers' notice
Introduction **(5 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the **Frequency distribution table for grouped data.**	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Take a picture that I put on your desks and geometric materials.	Tell students the materials needed and give them a small time to take them.



	Observe it, what do you see? How are the sides of rectangles? Give the interval which describes the base for each rectangle. **Expected answer for students**: We are seeing rectangles of different heights. Their bases have the same size but each one has an interval that describes its base. **Example** of rectangles observed is: **A rectangle of base [16-24[and height of 60.** **Teacher**: Thank you very much. When you are given the data, we are going to see how to make such intervals for the bases and what the heights represent. **Teacher**: Good! In today's lesson, we are going to continue with Data presentation: class boundary and histogram.	Give them an **engaging** activity. Show students a picture and ask them to observe it and to answer to questions given on a handout.

	And by the use of notebooks, pens, calculators, you will be able to: • Make a frequency distribution table of a grouped data • Determine class size.	Communicate the lesson title and related instructional objective to students.
Lesson development **(25 Minutes)**	**Teacher**: Now, get your hand out (reed on the flip chart), read the next activity and try to work on it. **Activity 10.2.1** The following data represent marks scored by a group of 40 students in math sets. 78, 46, 55, 47, 77, 63, 52, 52, 62, 46, 77, 47, 40, 35, 67, 61, 58, 52, 42, 40, 48, 57, 66, 54, 75, 78, 75, 59, 75, 47, 59, 35, 62, 53, 72, 57, 51, 69, 55, 57. Find: a) The numbers of students who scored between 30 and 39. b) The numbers of students who scored between 40 and 49. c) The numbers of students who scored between 60 and 79. d) Represent the above information in table of 5 groups of marks and indicate for each group the number of students belonging to that group **Expected answer for students**: a) Students who scored between 30 and 39 are 2 students. b) The number of students who scored between 40 and 49 is 9. c) The number of students who scored by 60 and 79 is 15.	Invite students to work on the **exploration** activity in pairs. Ask students to present their findings in plenary session and guide them to harmonize their findings (**Explanation**).

d)

Marks	No of students
30-39	2
40-49	9
50-59	14
60-69	7
70-79	8
Total	**40**

Teacher: Thank you for your wonderful work. *You can see that marks were presented in the form of intervals which are similar to the ones you saw on the rectangles of previous activity.*

Now, we are going to study how to determine class boundary and construct frequency distribution table. Consider the following activity

Activity 10.2.2

Consider the following frequency table representing the mass (to nearest kg) of a group of 40 students

Mass	Numbers of students
30-39	2
40-49	9
50-59	14
60-69	7
70-79	8
TOTAL	**40**

Emphasize new concepts.

Provide **elaboration** activities (*they can be written clearly on handouts, flip charts or on slides)*

In each group with different working steps, choose one group member to present.

Determine:

a) The number of classes

b) The class width

c) The class whose frequency is 9

d) How many students scored less than 60 and greater than 49?

Expected answer for students:

a)

Class	**Number of students**	**Class boundaries**
30-39	2	29.5-39.5
40-49	9	39.5-49.5
50-59	14	49.5-59.5
60-69	7	59.5-69.5
70-79	8	69.5-79.5
TOTAL	40	

b) The difference between upper boundaries and lower boundaries is 10 kg

i) This difference is called class size, class interval or class width

ii) All class sizes are equal.

c) The class whose frequency is 9 is 40-49

d) i) The students who scored less than 60 is 2+9+14 = 25 students

ii) the students who scored greater than 49 is 14+7+8 = 29 students

	Teacher: Dear students, is it clear? Basing on your results, we are going to see what the class boundary and class limits are and how there are used to construct the histogram. Frequency distribution table for Grouped Data is a table consisting of columns of class/groups and the number of observations in each class or the class frequency, denoted by **f.** For example, for the class 30-39, the number 30 is called the **Lower Class Limit** and 39 is called the **Upper Class Limit**. If the frequency for the class 30- 39 is 2 (**f** =2) this means that there are two students whose marks are between 30 and 39. The class limits can be extended to the nearest value of the accuracy chosen for effective recording and the construction of histogram. For example, 40 – 49 can be extended to 39.5 – 49.5 by subtracting 0.5 from the lower and adding it to the upper class limit. Hence 39.5 and 49.5 become class boundaries. • Lower class boundary is the average of lower limit of the class and the upper limit of the previous class • The upper class is the average of the upper limit of the class and the lower limit of the next class The difference between the upper class boundary and the lower class boundary is called **the class interval**, **class width**, or **class size**, i.e. ***class interval = upper class boundary- lower class boundary*** **Teacher:** Dear students, I think you have understood what the class boundary and the class interval are.	Harmonize answers and address misconceptions. Invite students to work in groups and do another **elaboration** activity.

	Work in group the following activity: **Activity 10.2.3** Consider the following data on the diameters of 40 ball bearings that were recorded in mm. 51, 43, 42, 53, 38, 52, 51, 42, 45, 53, 50, 40, 53, 41, 42, 53, 61, 33, 65, 47, 35, 44, 67, 53, 54, 48, 47, 27, 36, 48, 27, 53, 66, 44, 52, 60, 37, 47, 49, 43 Make a grouped frequency table using classes, 26–30, 31–35 , 36–40, 41–45 ,.... and determine class boundaries. **Expected answer for students: ...**	
	Summary: • A histogram is a bar diagram that represents the frequency distribution of a continuous data. • The class boundary between the first and the second class is given by the mean of upper limit of the first class and lower limit of the second class. • Between one class and the next, the class limits have a gap between them. There is a disconnection between any two consecutive classes. • The class boundaries mark the boundaries of the rectangular bars in the histogram. • The height of the bars is also proportional to the respective frequencies.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

Assessment **(7 min)**	**Teacher**: Thank you very much. Now, You are going to do an individual activity for a**ssessment:** 1. The data below shows the masses (in grams) of 50 carrots taken from a plot of land on which the effect of a new fertilizer was being investigated. 103, 95 ,105, 117, 93 ,112, 111, 108, 73 ,109 ,66, 99, 87, 98 76 ,67 ,107, 119, 103 ,95, 77, 88, 65 ,107, 85, 94 ,101, 104 72, 92 , 82 ,90, 118 ,103 ,100 ,75, 102, 116, 82 ,105 ,114 106 ,70, 116 ,112 ,97 ,63, 111, 118, 91 Make a frequency distribution table for this data 2. A hand span is the distance (length) from the end of the thumb to the end of the small finger when the hand is fully open. Table 10.8 shows the hand spans of some 21 children measured in centimeters. 18.4 ,17.4, 20.7 14.3, 20.0, 19.0 ,18.5 ,21.7, 17.5 ,18.1 ,19.3 ,16.9 ,19.8 15.9, 21.2, 18.7, 19.2 ,16.6, 14.8 ,17.8 ,16.0 Make a frequency distribution table, grouping the data into four classes starting with 14.0 – 15.9.	Give students an activity to be done individually for **evaluation**. Provide opportunities for corrective feedback or positive feedback to students.

Students' answers:

1)

Mass in grams	Tally	frequency
60-69	////	4
70-79	///// /	6
80-89	//////	5
90-99	//////////	10
100-109	//////////////	14
110-119	///////////	11
		21

2)

Hand span	Tally	frequency
14.0-15.9	///	3
16.0-17.9	///// /	6
18.0-19.9	////////	8
20.0-21.9	///	4
		21

Correct them and give them constructive feedback.

Conclusion **(3 min)**	**Teacher**: As, we are coming to the end of our lesson, we have seen that: A histogram is a bar diagram that represents the frequency distribution of a continuous data. The class boundaries mark the boundaries of the rectangular bars in the histogram. The height of the bars is also proportional to the respective frequencies. As homework, go and do activities found in the S2 Mathematics students' book on page 188. Exercise 10.2 question 1. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

2.11 Lesson from unit 11

SUBJECT: Mathematics	**GRADE:** S2	**UNIT 11:**
Lesson title: Use of tree diagram to determine probability		
Duration: 80 minutes		
Teaching material: Chalk board, balls, coins, cards, and a die		
Learning materials: notebooks, pens, calculators, balls, coins, die and senior two mathematics book		
Section	**Step –by- step instructions and content**	**Notice to the teacher**
Introduction **(15 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: Yesterday, we studied tree diagrams and total number of outcomes. **Teacher:** Today we are going to start by making a short review on previous lesson with an activity. **Teacher:** Work in group the following activity: **Activity:** 1) What is a tree diagram? 2) What is the total number of outcomes? 3) What is the total number of outcomes when a coin is tossed? 4) Determine the total number of outcomes when a die is rolled?	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

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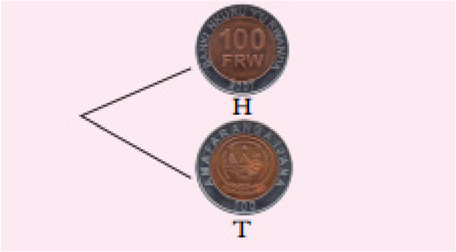
Expected answer for students:

1. A tree diagram is simply a way of representing a sequence of events. It has branches and sub-branches which help us to see the sequence of events and all the possible outcomes at each stage.
2. The total number of outcomes is the number of all likely results of an experiment.
3. When a coin is tossed the total number of outcomes is 2: head and tai.



4. The total number of outcomes when a die is rolled is 6: Face 1, Face 2, Face 3, Face 4, Face 5 and Face 6.

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<td>Guide learners towards the right answer.</td>
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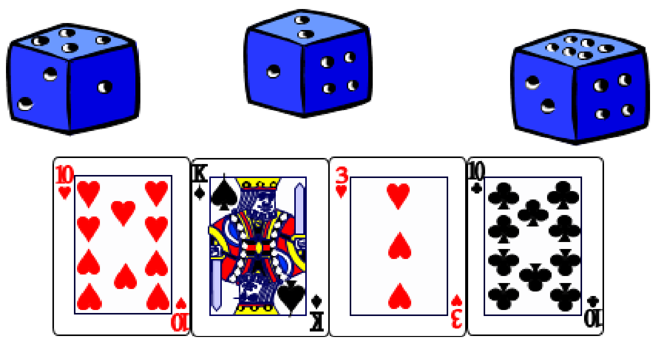
Teacher: Observe the following different objects:



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Show students different objects and give them an

Engaging activity.

You can use a chart or a video showing these different objects.

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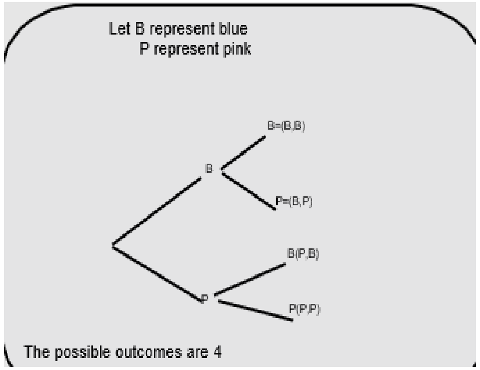
	Activity: **Teacher:** What are the names of those objects? **Students**: They are cards and dice **Teacher**: Referring to the previous lesson, for which purpose do we use die, coin, and cads? **Students:** we use these objects to play games in which the winning is based on the probability where the total number of outcomes depends on an event to happen. **Teacher**: Good! Class In today's lesson, we are going to continue with the use of tree diagrams to determine probability. And by the use of balls, coins, cards and a die, you will be able to accurately determine the probability by using tree diagram in a provided time.	Communicate the lesson title and related instructional objective to students.
Lesson development (45 Minutes)	**Teacher**: Let us start today's lesson by doing the following activity: **Activities 11.2.0** A bag contains 2 yellow balls and 2 pink balls. Uwase picked two balls one after the other. With the aid of a tree diagram, show all the possible outcomes. How many outcomes are there?	Display and ask students to perform the **exploration** activities in groups. Collect answers and guide the whole class to harmonize them.

Students' answer:

Let B represents blue and P represents Pink,



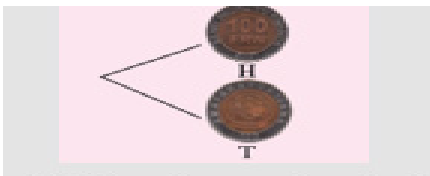
The number of possible outcomes is 4.

Teacher: Thank you! Now also do this activity.

Activity 11. 2. 1

When a coin is tossed once, there is a probability of obtaining a head or a tail. Using a tree diagram, determine the probability of obtaining a head.

Expected answer for students:

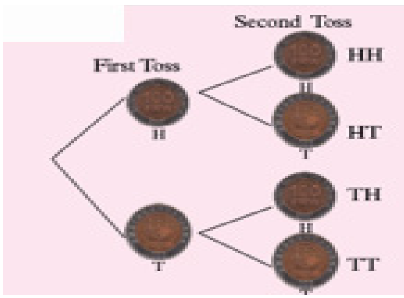


We obtain 2 outcomes from tossing a coin. These are Head (H) and Tail (T). Then the probability of obtaining head is 1/2.

Ask students to perform the second **exploration** activity in pairs.

Lead discussion,

moderate and guide students to conclude.

	Teacher: Thank you. From your answers, we have seen that: • Tossing one-coin n times is the same as tossing n coins at once. For example, the number of outcomes for tossing 3 coins at once is the same as the number of outcomes for tossing one coin three times. The way we used to represent the outcomes is called tree diagram. • We use numerical values to express the probability of an event (A) of the sample space S. **Probability of A = P(A) =** $\frac{Favorable\ outcomes}{Possible\ outcomes} = \frac{n(A)}{n(s)}$ **Teacher:** Dear students, now do this activity: **Activity 11.2.2** A coin is tossed twice. Determine the probability of obtaining two heads. **Expected answer for students:**  We have four outcomes: HH, HT, TH and TT. Therefore, the probability of obtaining 2 heads (HH) is 1/4.	Clarify the concept (**explanation** stage) and guide students to the correct content. Ask students to perform **elaboration** activities in pairs.

Teacher: Good, In the first toss, we get either Head (H) or tail(T). On getting a H in the first toss we can get a H or T in the second toss. Likewise, after getting a T in the first toss, we can get a H or a T in the second toss. This is illustrated using the tree diagram.

Now do this activity in pairs.

Activity 11.2.3

Three coins are tossed simultaneously.

a) How can you use tree diagram to determine possible outcomes?

b) i) Illustrate the outcomes of having two heads.

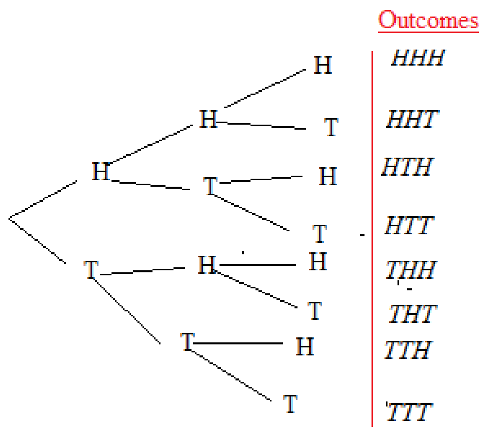
ii) Show the outcomes of having 3 tails.

iii) Illustrate the outcomes of having two tails or two heads.

c) Determine the probability of each case in (b).

Expected answer for students:

a) The related tree diagram:



Lead discussion, moderate, and guide students to conclude.

In each group with different working steps, choose one group member to present.

We see that there are 8 outcomes.

b) i) Outcomes of having two heads are HHT, HTH, THH.

ii) Outcome of having 3 tails is one: TTT.

iii) Outcomes of having two tails or two heads are HHT, HTH, HTT, THH, THT, and TTH.

c) The probability of each case in (b).

P(having two heads) = $\frac{3}{8}$

P(having 3 tails) = $\frac{1}{8}$

P(having two tails or two heads) = $\frac{6}{8}$

Teacher: Again, work out the following:

Activity 11.2.4:

A coin is tossed twice.

(a) Represent the outcomes on a tree diagram.

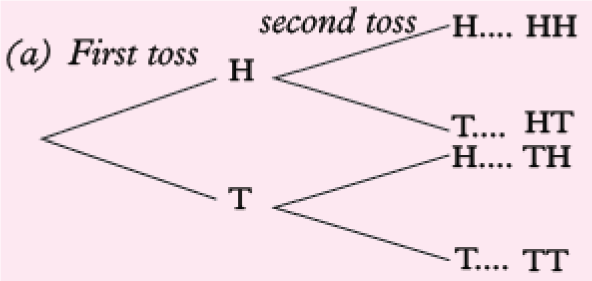
(b) Determine the following probabilities.

(i) Getting H followed by T

(ii) Getting two heads

(iii) Getting head and tail irrespective of order.

Expected answer for the students:



(b) $P(HT)$

$$= \frac{\text{Number of events where } H \text{ is followed by } T}{\text{Total number of possible outcomes}}$$

$$= \frac{1}{4}$$

(c) $P(HH)$

$$= \frac{\text{Number of ways of getting two heads}}{\text{Total number of possible outcomes}} = \frac{1}{4}$$

(d) There are two ways of getting a head and tail without caring about the order in which they follow one another i.e. HT or TH.

We determine this probability as follows:

We determine this probability as follows;

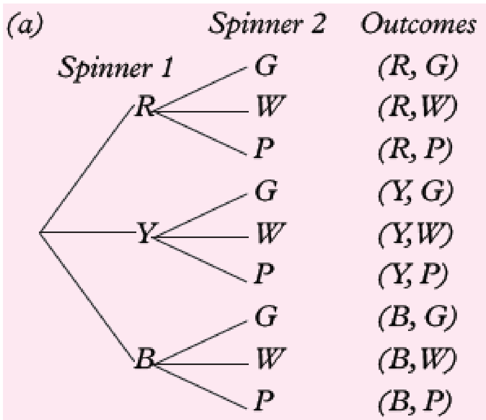
$$\frac{\text{Number of ways of getting } HT \text{ or } TH}{\text{Total number of possible outcomes}} = \frac{2}{4} = \frac{1}{2}$$

	Summary: **Teacher:** class let us review some of the key points that we learned. • Tree diagram shows all possible events. The first event is represented by a dot. From the dot, branches are drawn to represent all possible outcomes of the event. The probability of each outcome can be written on each branch. • Tree diagrams are particularly useful in probability since they record all possible outcomes in a clear and uncomplicated manner. • Probability of A= p(A) = $\frac{Favorable\ outcomes}{Possible\ outcomes} = \frac{N(A)}{N(S)}$	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (15 min)	**Teacher**: Thank you very much. Now, you are going to do an individual activity for a**ssessment:** **Activity 11.2.5** 1) Mutoni spins two spinners, one of which is coloured red, yellow and blue and other is coloured green, write and purple. (a) Draw a tree diagram for the experiment. (b) What is the probability that the spinners stop at "B" and "G"? (c) Find the probability that the spinners do not stop at "B" and "G". (d) What is the probability that the first spinner does not stop at "R"? 	Give them activities to be done individually as assessment (evaluation). Provide opportunities for corrective feedback or positive feedback to students.

2) Using a tree diagram, determine all possible combinations of outcomes and the probability of obtaining even side when a die is tossed once.

Expected answer for the students

1)



(b) Number of possible outcomes n(S) = 9

Probability that the spinners stop at (R,G) = 1/9

(c) The probability that the spinners do not stop at "B" and "G" is *= 1 – 1/9 = 8/9*

(d) Probability that the first spinner stop at "R" = 1/3.

Probability that the first spinner does not stop at "R" = 1 –1/3 = 2/3

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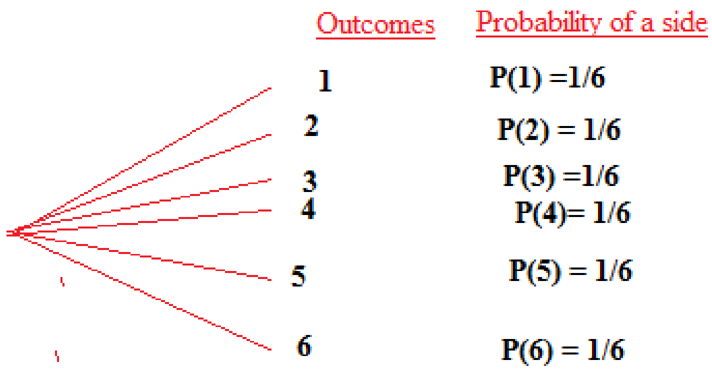
2) When a die is tossed once:



Probability of finding an even number
= P(2)+P(4)+P(6)=3/6=1/2.

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Conclusion

(5min)

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Teacher: We are coming to the end of our lesson. As we conclude, we saw that

Tree diagrams are particularly useful in probability since they record all possible outcomes in a clear and uncomplicated manner.

Probability of A= P(A) = $\frac{Favorable\ outcomes}{Possible\ outcomes} = \frac{N(A)}{N(S)}$

Now I want to give you a homework, you are requested to do all questions:

Homework:

1. In a bag containing 3 oranges, 2 mangoes and 4 apples, two of the fruits are picked at random one after the other with replacement.

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Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

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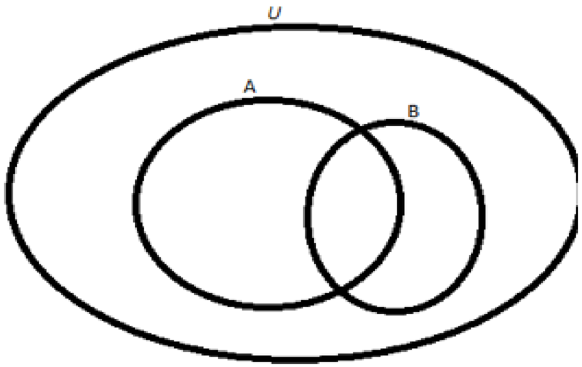
	Determine the probability of getting: (a) An orange followed by a mango (b) Two oranges (c) A mango and an apple irrespective of the order 2. A coin is tossed. Use a tree diagram to show all the possible outcomes of the experiment. 3. Using a tree diagram, determine all the possible outcomes that can be obtained when a coin is tossed three times and determine the probability of obtaining 3 heads. Thank you for your participation in this lesson.	

SCRIPTED LESSONS FOR SENIOR 3

3.1. LESSON FROM UNIT 1

SUBJECT: Mathematics	GRADE: S3	UNIT 1:
LESSON TITLE: Solve a mathematical problem using Venn diagram involving 2 sets.		
Duration: 40 minutes.		
Teaching material: Charts with Venn diagrams.		
Learning materials: Notebooks, pens, calculators, Charts, S3 Mathematics book.		

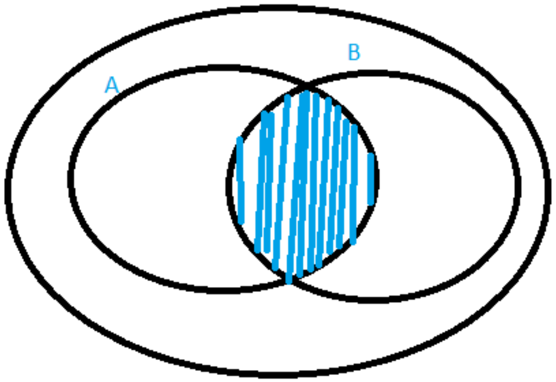
Section	Step –by- step instructions and content	Teachers' notice
Introduction **(5 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the Intersection, Union ad Complement of sets. **Teacher:** Good! then write mathematically **a) Intersection of sets A and B** **b) Union of sets A and B**	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

	Students' Answer: Intersection of sets A and B is $\mathbf{A \cap B}$ b) Union of sets A and B is $\mathbf{A \cup B}$	
	Teacher: Good! In today's lesson, we are going to continue with a new lesson on Venn diagrams. Do the following activity. **Activity:** Observe the figure below and answer to the questions  1. What do you observe? 2. Shade the region representing: i) A and B ii) A or B iii) Not B iv) Not A and not B	Guide students to do the **engaging** activity that links to the new lesson.

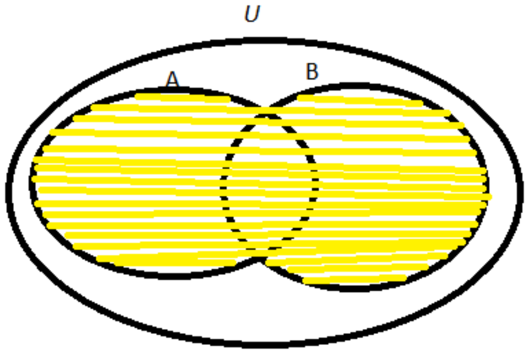
Answers for students:

1. Sets A and B included in the set U.

2. a)

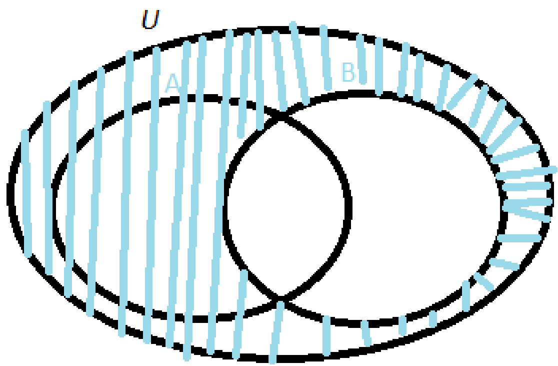


ii) A or B

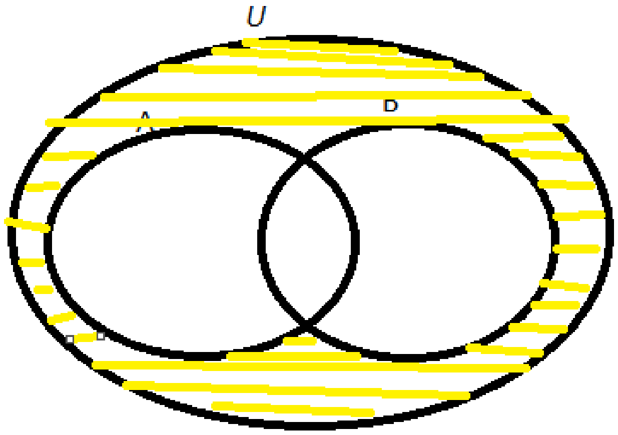


When harmonizing answers, emphasize the mining of A and B, A or B, not B, not A and not B.

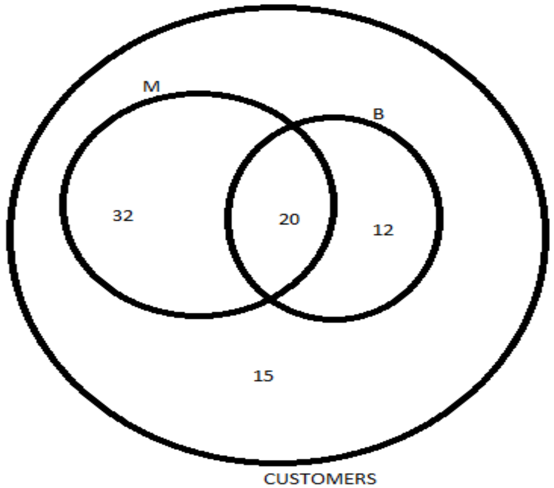
iii) Not B



iV) Not A and not B



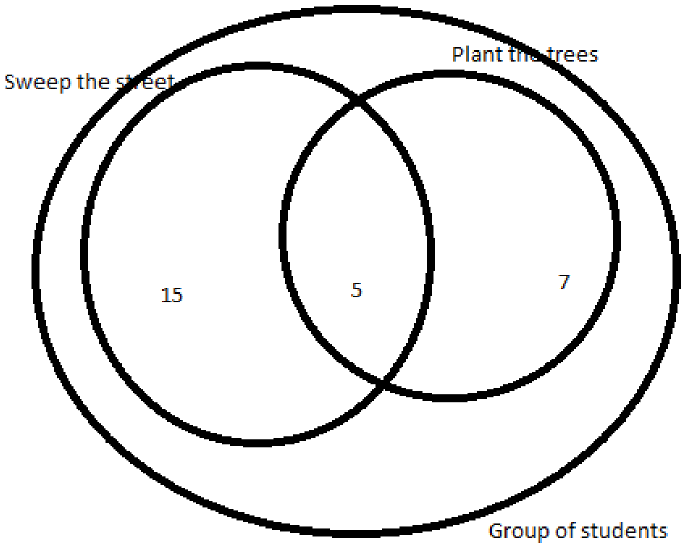
	Teacher: Well done. By the end of this lesson, you should be able to: • Express and represent a mathematical problem related to 2 sets using a Venn diagram. • Solve a mathematical problem involving 2 sets using Venn diagram. • Appreciate the importance of sets in solving a mathematical problem.	Communicate the lesson title and learning objectives to students.
Lesson development (20 Minutes)	**Teacher**: Thank you. We see that Intersection of sets A and B is **$A \cap B$ and represents elements which are common to both sets A and B.** Union of sets A and B is **$A \cup B$** and represents all combined elements of A and B where each one is written once. Now, join your groups and do the activity below. **Activity 1.2.1** A survey was carried out in a shop to find the number of customers who bought bread or milk or both or neither. Out of a total of 79 customers for the day, 52 bought milk32 bought bread and 15 bought neither milk nor bread. (a) Represent the situation above using Venn diagram. (b) How many customers bought both milk and bread. (c) How many customers bought only one item?	Harmonize students' answers and give them **exploration** activities. Students must be given time to think and note down their ideas.

	Students' answer Let M the set of customers who bought milk, B the set of customers who bought breads, we have:  (b) 20 (c) 32+12=44 **Teacher**: Thanks. Now do the following activity in pairs. **Activity 1.2.2** In a cleanup exercise carried out in Nyagatare town, a group of students were assigned duties as follows; all of them were to collect waste papers. 15 were to sweep the streets but not plant trees along the streets; 12 were to plant trees along the streets, 5 of them were to plant the trees and sweep the streets.	Ask students to present their findings in plenary session and guide them to harmonize their findings. Choose groups with different working steps to present their findings.

(i) Draw a Venn diagram to show this information.

(ii) Use the Venn diagram in (i) above to calculate the number of students in the group.

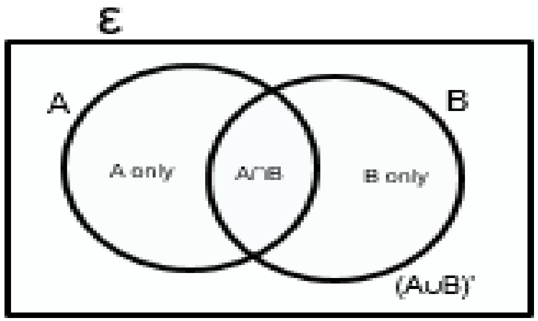
Students' answer:

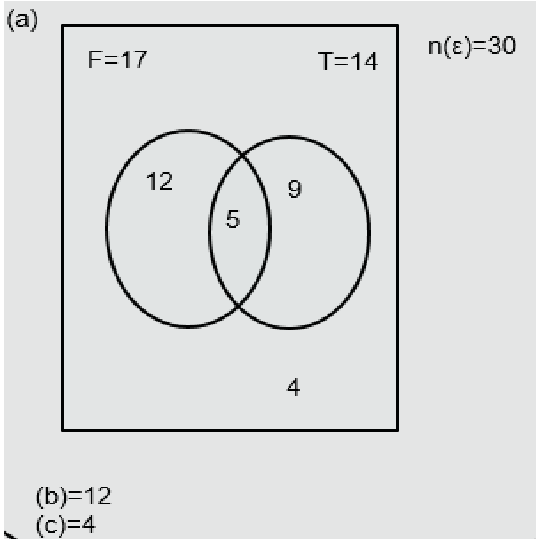
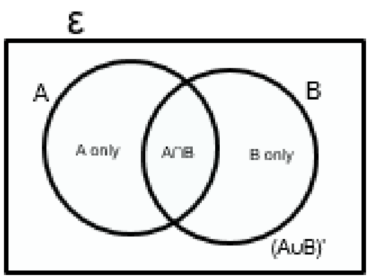


ii) i) 15+12=27

Teacher: Thank you. Let us clarify these concepts. When representing and solving set problems involving two sets, follow the following steps:

- Clarify the common elements between two sets,
- Clarify the elements of A, not elements of B,

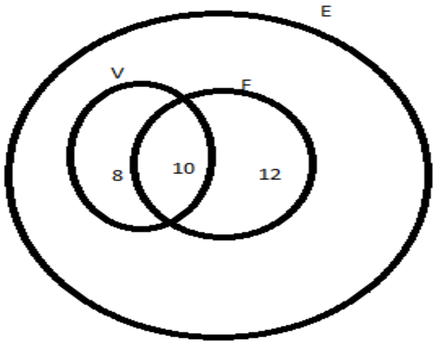
	• Clarify the elements of B not element of A, • Clarify the elements of A or B, • Clarify the elements of not A and not B, • Represent the problem using Venn diagram.  where ε is the set of all items surveyed in a problem on set. **Teacher**: Now, you are going to deepen your understanding by doing this activity: **Activity 1.2.3** Students of senior three class were asked about the sports they play; 17 of them play football, 14 play tennis, 5 of them play both football and tennis. Given that there are 30 pupils in the class, (a) Draw a Venn diagram to show this information. (b) How many students who play football but not tennis? (c) How many students who play neither football nor tennis?	**Clarify** the concept (**explanation**) and guide students to write down the content. Invite students to work in groups and do the **elaboration** activity.

	Students' answer: 	
	Summary: During the representation and solving problems involving two sets A and B, follow the following diagrams:  where ε is the set of all items surveyed in that problem.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

Assessment (10 min)	**Teacher**: Thank you very much. Now, you are going to do an individual activity for a**ssessment:** choose 1 problem and solve it **Activity** 1. In a class of 30 students, students are required to take part in at least one sport chosen from football and volleyball 18 play volleyball, 22 play football. Some play the two sports. (a) Draw a Venn diagram to show this information. (b) Use your diagram to help determine the number of students who play the two sports. 2. Five members of Mathematics club conducted a survey among 150 students of Senior 6 about which careers they wish to join among Engineering and Medical related courses. 83 want to join Engineering, 58 want to join medical related courses. 36 do not want to join any of the careers. Represent the data on the Venn diagram. Find the number of students who wish to join both careers. 3. In a school of 232 students, 70 are members of Anti-AIDS club, 30 are members of debating club and 142 do not belong to any of the mentioned clubs. (a) Represent the information on the Venn diagram. (b) Use the Venn diagram to calculate the number of students who belong to one club only.	Guide learners to do individually the activity for **evaluation.** Provide opportunities for corrective feedback or positive feedback to students.

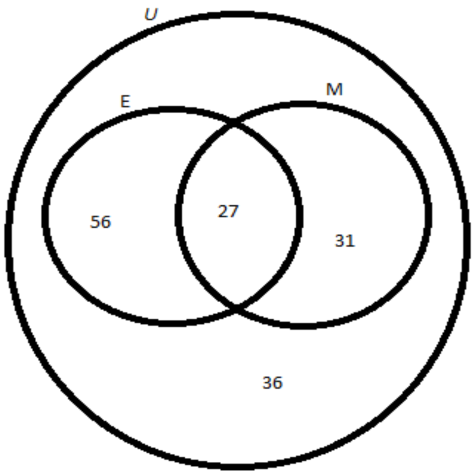
Students' Answer:

1. a)

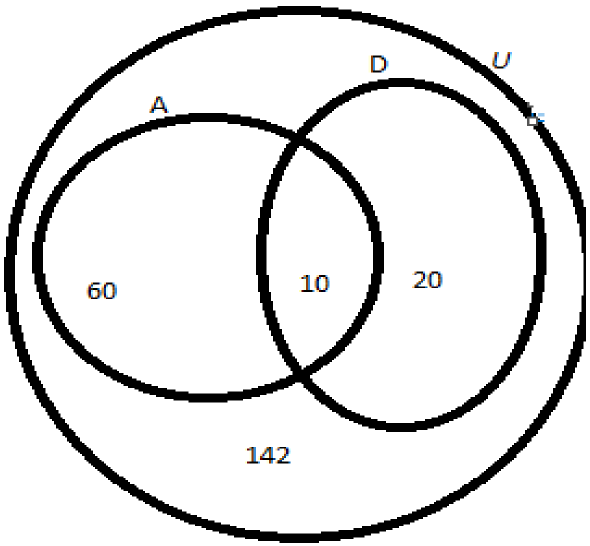


b) Number of students who play the sports=10 students

2. a)



b) Number of students who wish to join both careers=27students

	3. a)  b) Number of students who belong to Anti-AIDS CLUB=60 students. Number of students who belong to Debating club=20 students	

Conclusion (5 min)	**Teacher**: As we are coming to the end of our lesson, we have seen that: Some mathematics problems can be solved by Venn diagram. As homework, go and do activities found in the S3 Mathematics students' book on page 5 and 6. Thank you for your participation in this lesson. See you later.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.2 Lesson from unit 2

SUBJECT: Mathematics	GRADE: S3	UNIT 2:
LESSON TITLE: Converting a number from base 10 to any other base and vice versa. **Duration:** 40 minutes **Teaching material**: Notebooks, pens, calculators, chalk. **Learning materials**: Notebooks, pens, calculators, S3 Mathematics book.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (5 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the examples for different number bases. **For example,** when you have the number 258, you can need to write it in the number base 2**.**	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Thank you. But before continuing, try to discuss the meaning of the following concept: (i) A digit (ii) A numeral (iii) A place value (iv) Abacus (v) Number base	Give students an **engaging** activity.

	Students' answers: A number is an idea expressing a concept of what we count; A numeral is a way to express a number in writing or the symbol that represents the number. The number system that we use today is a place value system. **Teacher**: Good! In today's lesson, we are going to continue with Converting a number from base 10 to any other base and vice versa. By the use of pens and notebooks, you will be able to: • Convert numbers from base ten to any other base and vice versa.	Communicate the lesson title and related instructional objective to students.
Lesson development (25 Minutes)	**Teacher**: This lesson will help you to answer to this equation. Now try to work in groups the following activity: (i) Divide 425 by 6 and write down the remainder. (ii) Divide the quotient obtained in (1) above and write down the remainder. (iii) Repeat this process of division by 6 until the quotient is less than 6 which you should treat as a remainder and write it down. (iv) Write down the number made by the successive remainders beginning with the first one on the right going to the left. (v). Give the relationship between the considered number (425) and the number obtained in (iv) above.	Invite students to work on the **exploration** activity in groups. Students must be given time to think and note down their ideas.

Students' answer:

Let's do successive divisions

$425 \div 6 = 70$ Remainder is 5
$70 \div 6 = 11$ Remainder is 4
$11 \div 6 = 1$ Remainder is 5
$1 \div 6 = 0$ Remainder is 1

↑ order of writing a new base number

To get the answer, read the remainders upwards to obtain 1545.

$\therefore 425_{10} = 1\ 545_6$

The answer is read as; one, five, four, five base six

Teacher: Now we can say that the number obtained by combining remainders is the expression of 425 in the number base 6.

Then, try to summarize how to convert a number from base 10 to any other base.

Students' answer:

(i) Perform successive divisions of the number by the required base.

(ii) The new number is obtained by writing down the remainders beginning with the first remainder on the right to the last remainder on the left.

Teacher: Thanks, now work in groups this activity:

Activity 2.2.3

Convert 194_{10} to base 8

Ask students to present their findings in plenary session and guide them to harmonize their findings.

Emphasize new concepts (**explanation** phase).

Invite students to work in groups and do the **elaboration** activities to deepen the convention of numbers from base 10 to another base and vice versa (the number of activities will depend on the time available).

Students' answer:

194 is divided by 8 successively

until the remainder is less than 8.

8	194	
8	24	Rem 2 ↑
8	3	Rem 0
	0	Rem 3

$194_{10} = 302_8$

Activity 2.2.4

Convert 23_{10} to base 2.

2	23	Remainder
2	11	 1
2	5	 1
2	2	 1
2	1	 0
	0	 1

To convert from base 10 to base 2

$\therefore\ 23_{10} = 10111_2$

Teacher: Thank you. Now let us see how to convert a number from any base to the number base 10.

Let students work in groups, this will promote among other competencies:

(i) Critical thinking skills

(ii) Problem solving

(iii) Cooperation and interrelation among learners

Activity 2.2.5

Consider the number 145 given in base six. Using number place value method;

(a) Find the value of digit 1, 4 and 5 in the base 6.
(b) Add up the values obtained in part (a) above.
(c) What is the base of the obtained value?

Student's answer:

(a) $145_{six} = 1 \times 6$ sixes + 4 sixes + 5 ones

(b) $(1 \times 6^2) + (4 \times 6^1) + (5 \times 6^0)$

$= (1 \times 36) + (4 \times 6) + (5 \times 1)$

$= 36 + 24 + 5$

$= 65_{ten}$

(c) base 10

Teacher: Well done students. To convert from any other base to base 10:

1. Multiply every digit in the number by its place value.
2. Add the results.

Teacher: Now do the following activity in pair

Activity 2.2.6

Express 415_{eight} as a number in base ten.

	Expected answers for students: We use place values to change from base six to base 10. $415_{eight} = (4 \times 8^2) + (1 \times 8^1) + (5 \times 6^0)$ $= (4\times64) + (1\times8) + (5 \times 1)$ $= 256 + 8 + 5$ $= 269$ $\therefore 415_{eight} = 269_{ten}$	
	Summary: To convert from base ten to another base: 1. Do successive division by the required base noting the remainders at every step. 2. Write down the remainders from the last to the first one . 3. These remainders make up the required number. To convert from any other base to base 10: 1. Multiply every digit in the number by its place value. 2. Add the results. Thank you for your participation in this lesson.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (7 min)	**Teacher**: Thank you very much. Now, You are going to do an individual activity for a**ssessment:** 1. Convert the following numbers from base 10 to base 5. (a) 50 b) 36 2. Convert the following numbers in base 10 to base 9. (a) 82 (b) 190	Give students an activity to be done for **evaluation** Provide opportunities for corrective feedback or positive feedback to students.

3. Convert the following numbers in base 10 to specified base.

(a) 5204 to base6

(b) 800 to base 2

(c) 954 to base 8

(d) 512 to base 3

4. Convert the following numbers from specified base to 10.

(a) 859 (b) 10012

(c) 23435 (d) 123

(e) 6157

Answers for students

1. a) 200_5 b) 121_5
2. a) 101_9 b) 231_9
3. a) 10010001_2 b) 40032_6
   c) 110100000_2 d) 1672_8

Teacher: Thanks, if you finish, try also the following

1. Convert the following numbers from base 10 to base 5.

(a) 50 b) 36

2. Convert the following numbers in base 10 to base 9.

(a) 82 (b) 190

3. Convert the following numbers in base 10 to specified base.

(a) 5204 to base6 (b) 800 to base 2

(c) 954 to base 8 (d) 512 to base 3

4. Convert the following numbers from specified base to 10.

(a) 859 (b) 10012

(c) 23435 (d) 123 (e) 6157

	Students'answers: 1. a) 200_5 b) 121_5 2. a) 101_9 b) 231_9 3. a) 10010001_2 b) 40032_6 c) 110100000_2 d) 1672_8	
Conclusion **(3 min)**	**Teacher**: As, we are coming to the end of our lesson, we have seen that: To convert from base ten to another base: 1. Do successive division by the required base noting the remainders at every step. 2. Write down the remainders from the last to the first one. 3. These remainders make up the required number. To convert from any other base to base 10: 1. Multiply every digit in the number by its place value. 2. Add the results. Thank you for your participation. As homework, go and do **Activity 2.2.7:** Given that $85_{10} = 221_x$. Find the value of *x*. In addition, you will do more activities found in the S3 Mathematics students' book on page 19. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.3 Lesson from unit 3

SUBJECT: Mathematics	GRADE: S3	UNIT 3
Lesson title: Simplification of algebraic fractions **Duration**: 80 minutes **Teaching materials:** Ruler, flip chart, chalk board **Learning materials:** notebooks, pens, calculators and Senior three Mathematics book		
Section	**Step –by- step instructions and content**	**Notice to the teacher**
Introduction **(8 min)**	**Teacher**: Welcome to Mathematics lesson. I think that you are ready for today's lesson. Who can tell us what we studied last time? **Students**: In the last session, we studied the meaning and examples of algebraic fractions. **Teacher:** Now, give us an example of an algebraic fraction? **Students:** For example, $\frac{2ab+2}{4}$; $\frac{x+1}{x^2}$ are algebraic fractions.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Hence, Work in group the following activity: **Activity 3.1** 1. What is an algebraic fraction? 2. Given the following mathematical expressions, which ones are algebraic fractions? a) $2x$ b) $\frac{1}{2x+1}$ c) $\frac{5}{y}$ d) x^2+4 e) $\frac{2x+5}{x^2-2}$	Engaging activity 3.1 Ask students to work in groups.

	3. State the condition of existence of an algebraic fraction in the set of real number. **Expected answers from students:** 1. An algebraic fraction is a fraction of two different algebraic expressions: 2. The algebraic fractions are: b) $\frac{1}{2x+1}$ c) $\frac{5}{y}$ and e) $\frac{2x+5}{x^2-2}$ 3. In the set of real numbers, an algebraic fraction exists only if the denominator is not equal to zero. The values of the variable that make the denominator zero are called a restriction on the variable(s). **Teacher**: Thank you. Note that an algebraic fraction can have more than one restriction depending on the mathematics expression taken as denominator. We have just finished to make a review on previous lesson. Today we are going to continue with the simplification of algebraic expressions. **Teacher**: In today's lesson, we are going to continue with simplification of an algebraic fraction. By the end of this lesson, you will be able to: • Simplify an algebraic fraction. • Recognize the rules to be applied in the simplification of algebraic fractions.	Communicate the lesson title and related instructional objective to students.

Lesson development (40 Minutes)	**Teacher:** Workout the following activity **Activity 3.2** Given the following algebraic fractions: i) $\frac{3ab}{4a^2b}$ ii) $\frac{15x^3y}{3xy^5}$ a) After mentioning the restriction on the existence, find the common factor of the denominator and the numerator? b) Divide the numerator and the denominator by the common factor found in (i) above c) Compare the results obtained with the initial algebraic expression. **Expected answer for students:** i) $\frac{3ab}{4a^2b} = \frac{3}{4a}$ ii) $\frac{15x^3y}{3xy^5} = \frac{5x^2}{y^4}$ **Teacher:** Thank you, then what is the name of the process of writing an algebraic fraction into its simplest form? **Students:** The process of writing an algebraic fraction into its simplest form is called **"Simplification of an algebraic fraction"**	Lead them to do the activity in groups, Invite some groups to present answers in a whole class discussion and then guide them to harmonize their answers. Students must be given time to think and note down their ideas.

	Teacher: That is exact. Now, do the following activity: **Activity 3.3**: Simplify the following fractions and note the restrictions a) $\frac{2x-2}{(x-2)(x-1)}$ b) $\frac{x^2-2x-15}{4x-20}$ **Expected answers for students:** $\frac{2x-2}{(x-2)(x-1)} = \frac{2(x-1)}{(x-2)(x-1)} = \frac{2}{x-2}; x \neq 2; x \neq 1$ $\frac{x^2-2x-15}{4x-20} = \frac{(x-5)(x+3)}{4(x-5)} = \frac{x+3}{4} : x \neq 5$ **Teacher:** Good, then do the following activities **Activity 3.4** For each of the following fractions: Write the restrictions on the variables. Simplify the algebraic fractions. i) $\frac{8x^2y^3}{2x^3y}$ ii) $\frac{2y-14}{y^2-2y+1}$ iii) $\frac{x^2-y^2}{3x^2-3xy-9xy^2}$ **Expected answer for students:** i) $\frac{8x^2y^3}{2x^3y}$ its restriction: $x \neq 0; y \neq 0$ $= \frac{4y^2}{x}$	Emphasize new concepts. Invite them to work on the exploration activity in pairs. Ask students to present their findings in plenary session and guide them to harmonize their findings. Let students work in groups, this will promote among other competencies: (i) Critical thinking skills (ii) Problem solving

	ii) $\frac{2y-14}{y^2-2y+1}$; its restriction: $y^2-2y+1 \neq 0$ $\frac{7y-7}{y^2-2y+1} = \frac{7(y-1)}{(y-1)(y-1)} = \frac{y-1}{y-1} = 1$ **iii)** $\frac{x^2-y^2}{3x^2-6xy-9xy^2}$ **its restriction:** $x \neq 0$ **,** $3x^2-6xy-9xy^2 \neq 0$ Then, $\frac{x^2-y^2}{3x^2-6xy-9xy^2} = \frac{x^2-y^2}{3x(x-2y-3y^2)}$	(iii) Cooperation and interrelation among students. Guide students to clarify the concept of simplification of algebraic fractions.
	Teacher: Summary: A fraction is in its simplest form if its numerator and denominator do not have common factors. To simplify means to divide both numerator and denominator by the common factor or factors. If both the numerator and denominator of a fraction have more than one term, we simplify the fraction by: (i) Factorizing both numerator and denominator where necessary. (ii) Cancelling by the common factor.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

Assessment (15 min)	**Teacher**: Thank you very much. Now, you are going to do an individual activity for assessment**:** Simplify the following algebraic fratcions: a) $\frac{2x-2}{x^2-2x+1}$ b) $\frac{x^2-9}{6x-18}$ c) $\frac{4y-2}{2y^2-4y-1}$ d) $\frac{2x^2+5x^3}{2x^2+4x^3}$ 2) Simplify and note restrictions $\frac{2x^2+6x^3}{2x^2+4x^3}$ **Expected answer from students:** a) $\frac{2x-2}{x^2-2x+1} = \frac{2(x-1)}{(x-1)(x-1)} = \frac{2}{x-1}$ b) $\frac{x^2-9}{6x-18} = \frac{x^2-9}{6x-18} = \frac{(x-3)(x+3)}{6(x-3)} = \frac{(x+3)}{6}$ c) $\frac{4y-2}{2y^2-4y+1} = \frac{2(2y-1)}{(2y-1)(2y-1)} = \frac{2}{2y-1}$ **2)** $\frac{2x^2+6x^3}{2x^2+4x^3} = \frac{2x^2(1+3x)}{2x^2(1+2x)}$ $\frac{2x^2(1+3x)}{2x^2(1+2x)} = \frac{1+3x}{1+2x}$ The restriction of $\frac{1+3x}{1+2x}$ is $x \neq -\frac{1}{2}$.	Invite learners to perform assessment individually. Mark the work for each student, Make the correction on the chalk board in a plenary session. Then provide opportunities for corrective feedback or positive feedback to students.

Conclusion (7 min)	**Teacher**: As we are coming to the end of our lesson, we have seen that: To simplify algebraic fractions, start by factorizing out as many numbers as you can for the numerator, next find a common factor in the denominator and divide both numerator and denominator by this common factor. Now, I want to give you a homework, you are requested do more activities found in the S3 Mathematics book on page 34 up 35. See you next time!	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.4 Lesson from unit 4

SUBJECT: Mathematics	GRADE:S3	UNIT 4
LESSON TITLE: Graphical solution of simultaneous linear equations in two unknowns		
Duration: 80 minutes		
Teaching material: Geometrical instruments, flipped charts		
Learning materials: Notebooks, pens, calculators, geometric materials, S3 Mathematics book		

Section	Step –by- step instructions and content	Teachers' notice
Introduction (15 Minutes)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Remember we learnt how to solve simultaneous linear equations in S2 by using different methods. Who can remind us those different methods we studied of solving simultaneous linear equations in S2? **Students:** The different methods that we learnt of solving simultaneous equations in S2 are: solving by the graphical method, by substitution, by elimination, by comparison and by rule.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Let us start our lesson by doing a short review about how to draw a linear equation in a Cartesian plane. Work in group the following activity:	Provide an **engaging** activity.

Activity 4.2.1:

Given the following system of equations :

$$2x+10y=-3 \text{ and } -x+6y=17$$

(i) Draw the graph of each equation on the same Cartesian plane.

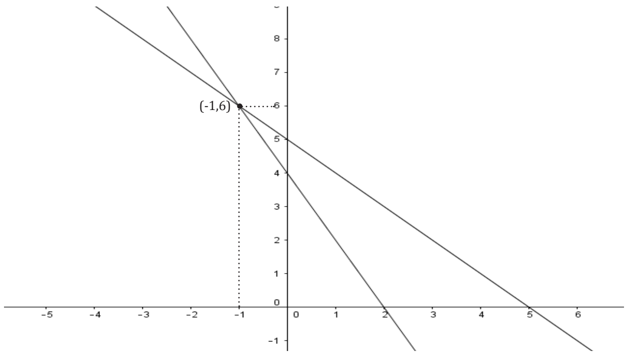
(ii) Find the coordinates of intersection of the lines.

(iii) Replace the coordinates of intersection into each equation.

(iv) What do you notice?

Student's answer:

i)



ii) The point of intersection is (-1,6)

iii) equation :

2x+y =4

2(-1)+6=4

-2+6=4

4=4 It is correct,

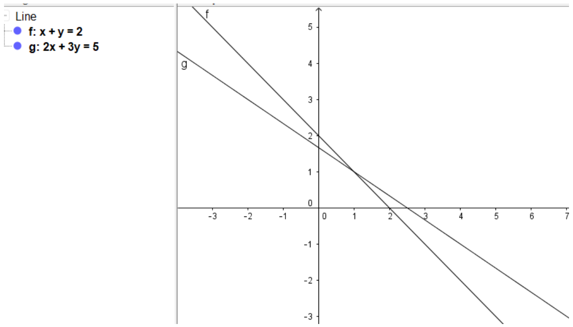
You can use a chart slides on which you wrote the questions.

	x+y=5 -1+6=5 5=5 correct. This point verifies the two equations. iv) I notice that graph can help us to solve simultaneous linear equations by writing the coordinates of point of intersection as solution set. **Teacher**: Good! In today's lesson, we are going to continue with Graphical solution of simultaneous linear equations in two unknowns. And by the use of geometric materials, you will be able to: • **S**olve graphically simultaneous linear equations in the Cartesian plane; • Interpret graphical solutions of simultaneous linear equations.	Communicate the lesson title and related instructional objective to students.
Lesson development (40 Minutes)	**Teacher:** Now, the key question becomes the following**:** How do we call the coordinates of the point of intersection of the lines representing the equation of the system? **Students**: The coordinates of the point of intersection make a solution set of the simultaneous linear equations. **Teacher:** Thanks a lot, then go back to your groups and do this activity: **Activity4.2.2** By plotting the graphs of system of equations given below, find their solutions. i) $\begin{cases} x+y=2 \\ 2x+3y=5 \end{cases}$	Invite them to work on the **exploration** activity in groups. Students must be given time to think and note down their ideas.

(ii) $\begin{cases} 2x - y + 6 = 0 \\ 2x - y + 2 = 0 \end{cases}$

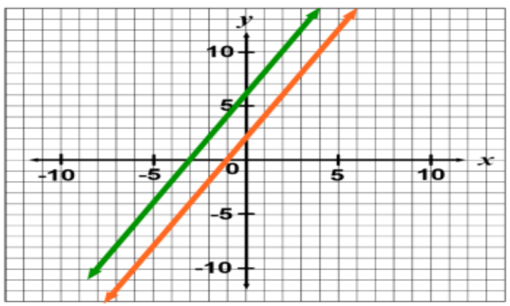
Students' answers:

i) $\begin{cases} x + y = 2 \\ 2x + 3y = 5 \end{cases}$



These two lines intersect at the point (1,1) , then the solution set is {(1,1)} i.e: x=1 and y=1.

ii) $\begin{cases} 2x - y + 6 = 0 \\ 2x - y + 2 = 0 \end{cases}$



The two lines are parallel and therefore the solution set is empty.

Ask students to present their findings in plenary session and guide them to harmonize their findings.

In each group with different working steps, choose one group member to present.

Teacher: Thank you very much. Can you help me to summarize how you proceed to solve graphically the simultaneous linear equations?

Students: To solve a system of linear equations, we proceed as follows

(i) Draw the line representing the equation of the system

(ii) Find the coordinates of intersection point.

(iii) Write down the solution set.

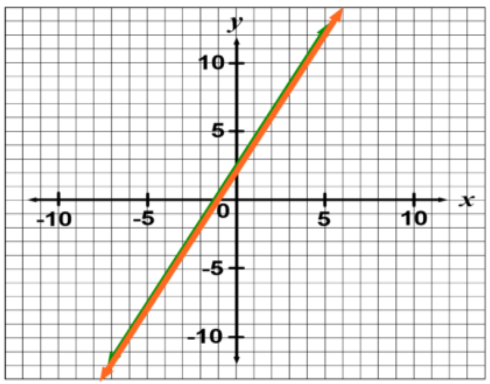
Teacher: Now, work in pairs on the following activity

Plotting the graph of system of equations given below and find the solution.

$$\begin{cases} 2x - y + 2 = 0 \\ 4x - 2y + 4 = 0 \end{cases}$$

Students' answer:

$$\begin{cases} 2x - y + 2 = 0 \\ 4x - 2y + 4 = 0 \end{cases}$$



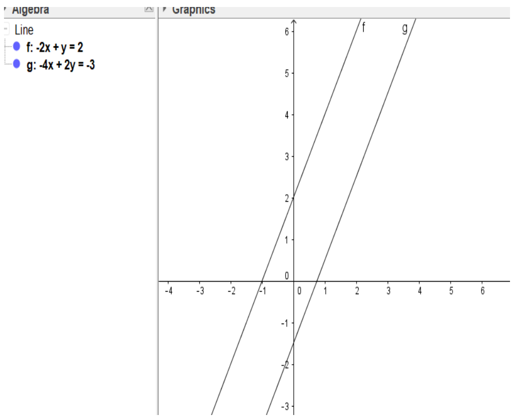
If the lines coincide, there is infinite number of solutions.

Remember to address common misconceptions.

Refer to the result and ask some questions leading students to highlight the concept (**explanation** stage)

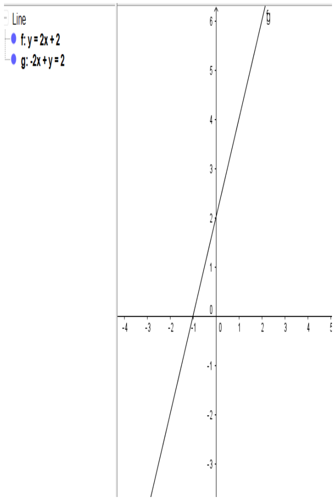
Provide an **elaboration** activity to be done in pairs.

	Summary: **Steps to follow when solving graphically simultaneous linear equations.** (i) Draw the line representing the equation of the system (ii) Find the coordinates of intersection point. (iii) Use these coordinates to write down the solution set.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (15 minutes)	**Teacher**: Thank you very much. Now, You are going to do an individual activity for a**ssessment:** Solve the following simultaneous linear equations using the graphical method: a) $\begin{cases} y+2x=5 \\ x-20y=20 \end{cases}$ b) $\begin{cases} y-2x=2 \\ 2y=4x-3 \end{cases}$ c) $\begin{cases} y=2x+2 \\ 2y=4x+4 \end{cases}$ **Students answer:** b) $\begin{cases} y-2x=2 \\ 2y=4x-3 \end{cases}$	Provide an activity to be done individually for **evaluation.** Collective feedback or positive feedback to all students is necessary.



Since these two lines are parallel the solution is {}.

c) $\begin{cases} y = 2x + 2 \\ 2y = 4x + 4 \end{cases}$



Since the two lines are coincident then the solution is **R.**

Conclusion (10 Minutes)	**Teacher**: As we are coming to the end of our lesson, we have seen that: While solving a system of two linear equations, three cases are possible: • Unique solution, if the lines meet at one point. • No solutions, if the lines are parallel. • Infinite solutions, if the lines coincide. **Teacher:** thank you; as a home work, work out the following: 1) A learning institution employs men and women during the school vacation. A day's wage for 3 men and 2 women is 4 000 FRW. For 1 man and 5 women the wage is 3 500 FRW. i) If a man earns x FRW and a woman y FRW per day, write two equations in terms of x and y for the given situation. ii) Combine two equations and explain what you obtain. iii) What will be the solution of two equations taken together. **Expected answer for Students:** **i)** Let x be the wage of a man per day and y be the wage of a woman per day. Then, the first equation is $3x+2y=400$ and the second equation is $x+5y=3500$. **ii)** If we take the two equations together, we get simultaneous equations to be solved. **iii)** The value of x and the value of y are obtained by solving the simultaneous equations. The solution is the set made by the ordered pair (x,y). 2) You are requested do more activities found in the **on page 47 of S3 Mathematics book.**	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.5 Lesson from unit 5

SUBJECT: Mathematics	GRADE: S3	UNIT 5
LESSON TITLE: Solving quadratic equations by factorization. **Duration**: 40 minutes **Teaching material**: Pens, Chalks. **Learning materials**: Notebooks, pens, calculators, S3 Mathematics student's book.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction **(5 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: Last time we studied how to solve quadratic equations using the graphical method.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: Are you ready? **Students**: yes we are ready. **Teacher**: Thank you. Work in groups and do the following activity: **Activity 5.3.1:** Factorize the expression of the left side of following quadratic equation: i) $x^2 - 7x + 12 = 0$ ii) $-3x^2 + 16x - 5 = 0$ iii) $x^2 - 4 = 0$	Give students an **engaging** activity.

Students answer:

i) $x(x-3)-4(x-3)=0$

$(x-3)(x-4)=0$

ii) $(x-5)(3x-1)=0$

iii) $(x-2)(x-2)=0$

Teacher: Now the key question of the day becomes how to solve quadratic equations by factorization method? Basing on your answers, we have $(x-3)(x-4)=0$

When is this equality possible?

Students: $(x-3)(x-4)=0$ is possible if $x-3=0$ or if $x-4=0$

Teacher: You are right, x-3=0 when x=3 and x-4=0 when x=4. We now find the value of x for the quadratic equation $x^2-7x+12=0$.

Teacher: Good! In today's lesson, we are going to continue with solving quadratic equations using the **factorization method**.

And by the end of this lesson, you will be able to:

- Solve quadratic equations using factorization method.
- Write the solution of the equation.
- Write a quadratic equation with given roots.

Communicate the lesson title and related instructional objective to students.

Lesson development (25 Minutes)	**Teacher**: Work again in group this activity **Activity 5.3.2** Factorize and then solve each of the following quadratic equation i) $x^2 + 6x + 8 = 0$ ii) $2x^2 + 4x = 0$ **Students' answers** i) $(x + 2)(x + 4) = 0$ $(x + 2) = 0$, $x = -2$ $(x + 4) = 0$ $x = -4$ S= {-4, -2} ii) 2x(x+2) =0 x=0 x=-1 **Teacher:** Thank you. When you find x= -2 and x=-4, you have to write the set of solution $S = \{-4, -2\}$. What is now the set of solution for the second equation 2x(x+2) = 0? **Students**: The solution set is $S = \{-1, 0\}$	Invite them to work on the **exploration** activity into groups. Students must be given time to think and note down their ideas. Ask students to present their findings in plenary session and guide them to harmonize their findings.

	Teacher: Exactly. Now, Workout the following activities in pairs: **Activity 5.3.3** By using factorization method, solve the following quadratic equations *a)* $7 + 3x^2 - 22x = 0$ *b)* $x^2 + 10x = 24$ **Students' answers:** a) A + b = -22 a $\times b = 21$ -21-1=-22 -21 $\times -1$ =21 Thus: $(x + 21)(x + 1) = 0$ $(x + 21) = 0$ $x = -21$ $(x + 1) = 0$ $x = -1$ S= {-21, -1} b) a+b=-10 a $\times b = 24$ 6+4=-10 6×4 =24 $(x - 6)(x - 4) = 0$	Provide more **explanation** on how to solve equation by factorization Provide **elaboration** activities to be done in groups. In each group with different working steps, choose one group member to present. Remember to address common misconceptions.

$(x-6)=0 \qquad x=6$

$(x-4)=0 \qquad x=4$

S= {4,6}

Teacher: Very good. Work in your group the following activity:

Activity 5.3.4

1. Solve the following quadratic equations by using factorization $x^2+3x+2=0$
2. Can the following equations be solved by factorization? Write True/ False and write down the solution set of equation.

   a) $x^2+10x=24$

   b) $x^2=4x-3$

   c) $6x^2-29x+35=0$

   d) $6x^2-x+1=0$

Students answer:

1) We need to find two numbers a and b whose sum is 3 and their product is 2.

   a=1 b=2

   $x^2+3x+2=0$

$(x-a)(x-b)=0$

$(x-1)(x-2)=0$

$(x-1)=0 \qquad x=1$

$(x-2)=0 \qquad x=2$

S= {1,2}

2) a) We need to find two number a and b whose sum is 10 and their product is -24

a =12

b = -2

$(x-a)(x-b)=0$

$(x-12)(x+2)=0$

$(x-12)=0 \qquad x=12$

$(x+2)=0 \qquad x=-2$

S= {-2,12}

b) $\boldsymbol{x}\ (x-1)-3(x-1)=0$

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

$(x-3)=0 \qquad x=3$

$(x-1)=0 \qquad x=1$

S= {1,3}

c) $(2x-5)(3x-7)=0$

$(2x-5)=0 \qquad x=\frac{5}{2}$

$(3x-7)= \qquad x=\frac{7}{3}$

S=$\{\frac{5}{2},\frac{7}{3})$

d) No solution.

	Summary: When solving quadratic equations by factorization method, follow the procedures below. i) Factorize the given quadratic equation and get the linear factors. ii) Equate each linear factor to zero. iii) Solve the linear factors and write the solution set. **Note**: For all real numbers a, b, c , k and t; if $ax^2 + bx + c = a(x-k)(x-t) = 0$ We have $(x-k) = 0$ or $(x-t) = 0$ And then the set of solution is S={k,t}	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (7 min)	**Teacher**: Then as an assessment, solve the following quadratic equation by factorization. **Activity 5.3.5** a) $x^2 + 9x + 14 = 0$ b) $x^2 - 11x - 12 = 0$ c) $a^2 - 2a + 1 = 0$ **Expected answers from students:** $a)\ x(x+7) + 2(x+7) = 0$ $(x+7)(x+2) = 0$ $(x+7) = 0$ $\quad x = -7$ $(x+2) = 0$ $\quad x = -2$ S= {-7,-2}	Give them an assessment to be done individually for **evaluation**. Provide opportunities for collective feedback or positive feedback to students.

	$b)\ (x+8)(x-9)=0$ $(x+8)=0 \qquad x=-8$ S= {-8,9} $c)\ (a-1)(a-1)=0$ $(x-1)=0 \qquad x=-1$ $(x-1)=0 \qquad x=-1$ S={1}.	
Conclusion (3 min)	**Teacher**: Thank you. As, we are coming to the end of our lesson, we have seen that: When $ax^2+bx+c=a(x-k)(x-t)=0$ $(x-k)=0$ or $(x-t)=0$ S={k,t} **Teacher:** Thanks, write this activity in your notebooks as homework. **Activity 5.3.6** 1. factorize the following: a) x^2+4x+3 b) x^2-2x-8 c) v^2-36 2. Solve the following quadratic equations. $2x^2-5x+3=0$ $4x^2-2x=0$ Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.6 Lesson from unit 6

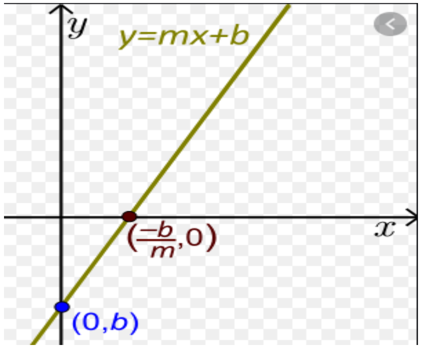
SUBJECT: Mathematics	GRADE: S3	UNIT 5

Lesson title: Linear functions

Duration: 40 minutes

Teaching material: books, rulers, graph papers, chalk, and classroom chalkboard

Learning materials: notebooks, pens, pencils, geometric materials, S3 Mathematics book (from page 85 to page 87).

Section	Step–by-step instructions and content	Teachers' notice
Introduction (5 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Are you ready to study? **Students**: Yeas Sir, we are ready.	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.
	Observe the flowing graph and discuss in pairs: 	Tell students the materials needed and give them a small time to take them. Give the **engaging** activity to students.

<table>
<tr>
<td></td>
<td>1) How do you call the points (0, b) and $(\frac{-b}{m}, 0)$?
2) How is the graph of the function y = mx + b?

Expected answer for student
1) These points are y-intercepts and x-intercept respectively.
b) The graph of this function is a straight line.

Teacher: Good! In today's lesson, we are going to continue with linear functions. By the end of this lesson, you will be able to:
• Define the linear function
• Plotting the graph of linear function.</td>
<td>Communicate the lesson title and related instructional objective to students.</td>
</tr>
<tr>
<td>Lesson development

(25 Minutes)</td>
<td>Teacher: Take your notebooks and do the following activity in groups:
Activity:
Given the table below:
<table>
<tr><td>x</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>4</td></tr>
<tr><td>y</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>4</td></tr>
</table>
i) Plot the point in Cartesian plane.
ii) Explain the behaviour of the shape obtained.
ii)Write dawn the relationship between x and y in form of equation.
2) Copy and complete the table below
<table>
<tr><td>x</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>y=2x-1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td>
<td>Invite students to work on the exploration activity in groups.

Ask students to present their findings in plenary session and guide them to harmonize their findings.</td>
</tr>
</table>

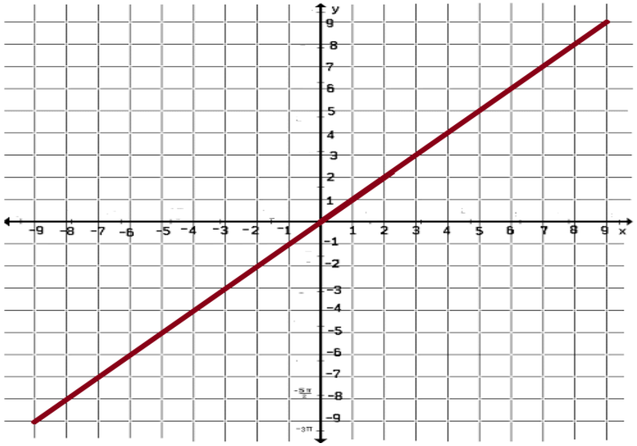
i) Use the coordinates of table to plot the graphs.
ii) what is your conclusion about the graph obtained?

Teacher: I think you have finished, let groups present their findings.

Expected answer for students:

Solution

1. i) The point plotted in Cartesian plane

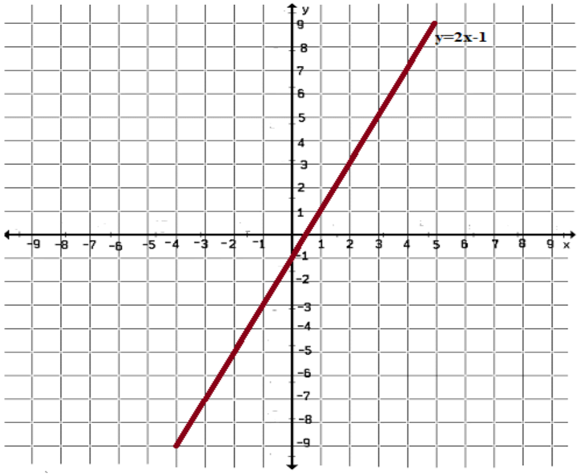


ii)The shape obtained is a straight line.
iii) the relationship between x and y is: y = x.

2)

x	-3	-2	-1	0	1	2	3
y=2x-1	-7	-5	-3	-1	1	3	5

i) graph of y=2x-1



	ii) This is a straight line **Teacher: Thank you** students. Basing on form of the graph found in your results what is the name of a function of the form **y=mx+c**, where m and c are real numbers and what its graph it represents? **Expected answer of learners**: the function of the form **y=mx+c**, where m and c are real numbers is called a **linear function**. Its graph represents a straight line. **Teacher:** wonderful answer! Now take your notebooks and geometric materials and do the following application activity	Guide students to explain more clearly the linear function. (**explanation**). Remember to address common misconceptions.

	Application activity Which of the following functions is linear function? i) y= x1 ii) y=2 iii) 2x+y=1 iv) $y=x^2+1$ v) y=x(x1) vi) xy =1 **Expected answer for students:** i) y= x1 is a linear function ii) y=2 is a linear function iii) 2x+y=1 is a linear function iv) $y=x^2+1$ is not a linear function v) y=x(x1) is not a linear function vi) xy=1 is not a linear function	Invite students to work in groups and do the application (**elaboration**) activity
	Summary **Teacher:** you have done a wonderful work, a) Now what is the general form of linear function? b) What might you have in order to draw a line representing linear function in Cartesian plane? **Expected answer for students**: a) The general form of linear function is **y=mx+b** b) In drawing a line representing linear function we need to have x and y coordinates representing that function.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

Assessment

(7 min)

Teacher: Thank you very much. Now, You are going to do an individual activity for a**ssessment.**

Activity:

a) Copy and complete the table below.

x	-3	-2	-1	0	1	2	3
y = -x+3							

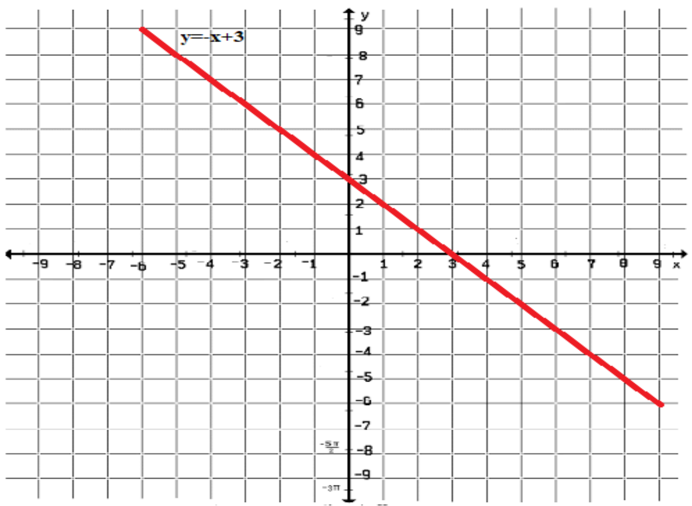
b) Plot the graph of the function y= -x+3

Expected answer for learners

a)

x	-3	-2	-1	0	1	2	3
y=-x+3	6	5	4	3	2	1	0

b)



Give students an activity to be done individually for **evaluation**.

Provide opportunities for collective feedback or positive feedback to students.

Conclusion (3 min)	**Teacher:** We are coming to the end of our lesson. As we conclude, we saw that the function of the form **y = mx+c**, where m and c are real numbers is called a linear function. **Teacher:** Thank you; We shall meet in the next lesson.	Summarize verbally main points of the lesson.

3.7 Lesson from unit 7

SUBJECT: Mathematics	**GRADE:** S3	**UNIT 7**
LESSON TITLE: Compound interest (step by step method)		
Duration: 40 minutes		
Teaching material: flipchart, chalkboard, drawings		
Learning materials: Notebooks, pens, calculators, S3 Mathematics book		

Section	Step –by- step instructions and content	Teachers' notice
Introduction (10 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the simple interest. **Teacher:** Given that : Principal, : Time and : rate. Can you recall the formulation of the simple interest **i**? **Students:** The simple interest is $i = \frac{P \times r \times t}{100}$ where **i** : simple interest **P**: Principal **t**: Time r: rate	Begin by gaining students' attention by using oral questions to gain the time. Identify students with special educational needs and plan how to help them accordingly.

Teacher: Good! You remember what we studied. Take your notebooks and do the following activity.

Activity 7.3.1

Mugisha borrows 8000 Frw from a bank at an interest rate of 10%.

i) Calculate the interest after one year

ii) Add the interest after one year to the principal and calculate the interest of sum after another year

iii) Calculate the simple interest of the principal after two years

iv) Compare the interest in ii) and iii). What do you notice?

Student's Answer:

i) Interest after one year $= \frac{Pxrxt}{100} = \frac{8000x1x9}{100} = 800$ Frw

ii) New principal $= 8000 + 800 = 8800$ Frw

interest for the second year $= \frac{PXrxT}{100} = \frac{8800X1X10}{100} = 880$ Frw

Total interest $= 800 + 880 = 1680$ Frw

iii) Simple interest of the principal after two years

$= \frac{Pxrxt}{100} = \frac{8000x2x9}{100} = 1600$ Frw

iv) The interest calculated in ii) is greater than the interest calculated in iii).

Teacher: Thank you, now the key question is related to how to calculate the compound interest.

By the end of this lesson, you will be able to:

- Define compound interest,
- Calculate compound interest using step by step method,

Give students an **engaging** activity.

If possible show to learners the different figures of banks and money and other companies.

Guide learners to discover the terms like compound interest and formulate the key question.

Discuss learning objectives with learners.

	• Solve problems involving compound interest, • Appreciate role of compound interest in banking. Therefore, as future entrepreneurs, you are asked to participate actively in this lesson.	
Lesson development (20 Minutes)	**Teacher**: I would like to ask you to be careful in this new lesson. Do the following activity. **Activity 7.3.2** 10 000 FRW is invested at 10% per year. i) Find the interest after 1 year ii) Find the amount of accumulated money after 1 year iii) If the accumulated money is the new principal at the beginning of the second year, find the interest iv) What is the accumulated amount after the second year v) If the accumulated amount after the second year is the principal at the beginning of the third year, find the accumulated amount after 3 years. vi) find the interest after three years **Student's Answer:** Principal: P=10000Frw Rate: r=10% i) interest after 1 year $= \frac{PXrxt}{100} = \frac{10000x10x1}{100} = 1000$ Frw	Invite them to work on the **exploration** activity in pairs. Students must be given time to think and note down their ideas. Ask students to present their findings in plenary session and guide them to harmonize their findings.

	ii) Amount of accumulated money after 1 year $= 10000 + 1000 = 11000$ Frw iii) Interest of accumulated money for the second year $= \frac{PXrxt}{100} = \frac{11000x10x1}{100} = 1100$ Frw iv) Accumulated amount after the second year $= 11000 + 1100 = 12100$ Frw v) interest of accumulated money for the third year $= \frac{PXrxt}{100} = \frac{12100x10x1}{100} = 1210$ Frw. Accumulated amount after the third year $= 12100 + 1210 = 13310$ Frw vi) Interest after three years $= 13310 - 10000 = 3310$ Frw	Guide learners to **explain** more how to find the compound interest step by step.
	Teacher: That is good! You see that *Interest:* $i = \frac{PXrxt}{100}$ *Accumulated amount = principal + interest* *Compound interest = accumulated amount - principal* *Now do this activity in groups.*	Provide **elaboration** activities.
	Activity 7.3.3 Jane borrows a sum of 8 000 FRW at 10% p.a. simple interest and lends that to Neza at the same rate compound interest. How much will Jane gain from this transaction after 3 years?	In each group with different working steps, choose one group member to present.

	Student's Answer: Interest paid by Jane (simple interest) $= \frac{PXrxt}{100} = \frac{8000x10x3}{100} = 2400$ Frw Interest paid by Neza to Jane: Interest after one year $= \frac{PXrxt}{100} = \frac{8000x10x1}{100} = 800$ Frw Accumulated amount $= 8000 + 800 = 8800$ Frw New interest $= \frac{PXrxt}{100} = \frac{8800x10x1}{100} = 880$ Frw New accumulated amount $= 8800 + 880 = 9680$ Frw New interest $= \frac{PXrxt}{100} = \frac{9680x10x1}{100} = 968$ Frw New accumulated amount (after 3 year) $= 9680 + 968 = 10648$ Frw Interest after three years $= 10648 - 8000 = 2648$ Frw Neza pays to Jane 2648 Frw of interest Jane will gain $= 2648 - 2400 = 248$ Frw.	Harmonize the work of students.
	Summary: Compound interest is the interest calculated on the initial principal and also on the accumulated interest of the previous periods of a deposit or loan. Compound interest=Accumulated amount-principal I=A-P Compound interest can be calculated step by step through compound interest generated with the principal.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.

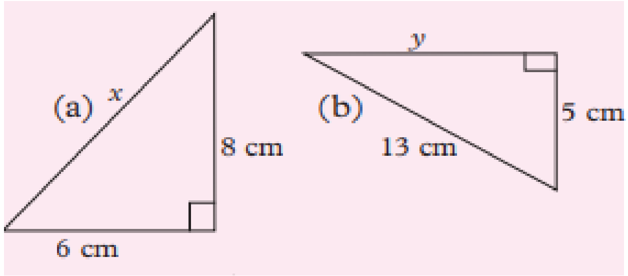
Assessment (7 min)	**Teacher:** It is good. Now take your exercises books and do individually the following activity for assessment. 1) Kamari borrows 3 800 FRW from Jane at 10% per year. compound interest. At the end of each year, he pays back 910 FRW. How much does he owe Jane at the beginning of the third year? 2) Find the compound interest earned on 90 000 FRW for 3 years at 7% per year. **Expected answer for students:** 1) Interest after one year $= \frac{3800x10}{100} = 380$ FRW New capital $= (3800 + 380) - 910 = 3270$ FRW Interest for the second year $= \frac{3270X10}{100}$ =327FRW Total interests $= 380 + 327 = 707$ FRW At the beginning of the third year, Jane owes 707FRW 2) Interest after the first year $= \frac{90000x7}{100} = 6300$ FRW New capital $= 90000 + 6300 = 96300$ FRW Interest after the second year $= \frac{96300x7}{100} = 671$ FRW New capital $= 96300 + 6741 = 103041$ FRW Interest after the third ye year $= \frac{103041x7}{100} = 7212.87$ FRW New capital $= 103041 + 7212.87 = 110253.87$ FRW Total interest earned $= 110253.87 - 90000 = 20253.87$ FRW	Invite students to work individually the activity for assessment (**evaluation**). Mark each one and provide opportunities for corrective feedback or positive feedback to students.

Conclusion **(3 min)**	**Teacher**: As, we are coming to the end of our lesson, we have studied the Compound interest and how to calculate it. The Compound interest is the interest calculated on the initial principal and on the accumulated interest of the previous periods of a deposit or loan. As homework, go and do activities found in the S3 Mathematics students' book on page 109& 110. Thank you for your participation in this lesson.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.8 Lesson from unit 8

SUBJECT: Mathematics	GRADE: S3	UNIT 8
LESSON TITLE: Median theorem of right-angled triangle		
Duration: 80 minutes		
Teaching material: flip chart, chalk board and Geometrical instruments.		
Learning materials: Notebooks, pens, calculators, pencil, geometric materials and S2 Mathematics book.		

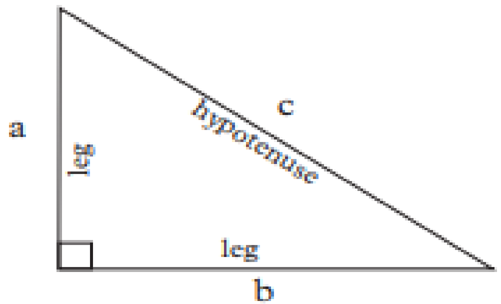
Section	Step –by- step instructions and content	Teachers' notice
Introduction **(20 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Who can tell us what we studied last time? **Students**: We studied the Pythagoras theorem. **Teacher:** Today we are going to start by making a short review on Pythagoras theorem. **Students:** Yes Teacher. **Teacher:** Now work in pairs the following activity: **Activity:** 1) State the Pythagoras theorem. 2) Write down the formula of Pythagoras theorem. 3) In Figure below, work out the missing measurements on the right angled triangles	Begin by gaining students' attention by giving different questions for revision. Identify students with special educational needs and plan how to help them accordingly. Then, provide an engaging activity.



Expected answer for students

5) **Pythagoras theorem** states that the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.

6) Consider the right-angled triangle in Figure below



Pythagoras theorem $a^2 + b^2 = c^2$

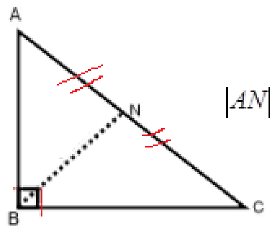
3) a) Triangle (a) Use Pythagoras theorem $a^2 + b^2 = c^2$

Let a = 6 cm, b = 8 cm; c = x cm, 62 + 82 = x^2

$36 + 64 = x^2$

$100 = x^2$

Finding the square root of 100, $x = \sqrt{100}$ cm , x = 10 cm

	b) Triangle (b) Use Pythagoras theorem $a^2 + b^2 = c^2$, a = 5 cm, b = y cm and c = 13 cm $b^2 + y^2 = 132$ $25 + y^2 = 169$ $y^2 = 169 – 25$ $y^2 = 144$ Finding the square root of 144, y = 12 cm.	
	Teacher: Good! In today's lesson, we are going to continue with Median theorem of a right- angled triangle. By the use of geometric materials, you will be able to: • State the median theorem • Apply the median theorem • Appreciate the use of median theorem in solving problems. And you will do them accurately and in the provided time.	Communicate the lesson title and related instructional objective to students. Tell students the materials needed and give them a small time to take them. You can use a chart showing median theorem.
Lesson development (35 Minutes)	**Teacher**: Draw a right-angled triangle, with a line from a right angle of the triangle to the midpoint of an opposite side (hypotenuse) of a right angle. The length of that line is a half-length of hypotenuse.  $\|AN\| = \frac{1}{2}\|AC\|$	Invite them to work on the **exploration** activity in pairs. Ask students to present their findings in plenary session and guide them to harmonize their findings. Provide more **explanation** on the median theorem.

How can we call that theorem?

Students: That theorem is called “ **Median theorem**” **Teacher:** Thank you very much.

We are going to study the median theorem.

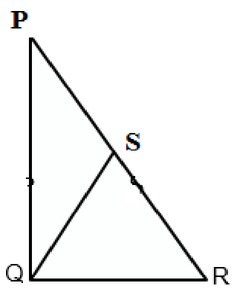
The median theorem of a right-angled triangle states that: *the median from the right-angled vertex to the hypotenuse is half the length of the hypotenuse.*

Teacher: Then, Class do this activity in pairs.

Activity 8.2.1

1. Draw any right-angled triangle PQR, with dimensions of your choice and $\angle Q = 90°$.
2. Measure and locate the midpoint of the hypotenuse PR and label it S.
   Join vertex Q to points with a straight line.
3. Measure and compare the lengths QS and the hypotenuse PR. What do you notice?
4. Measure and compare the lengths QS with PS and RS. What do you notice?

Expected answer for students



Provide exploration and explanation activities

In each group with different working steps, choose one group member to present

3) QS is a half of PR (QS = PR) means QS = PR

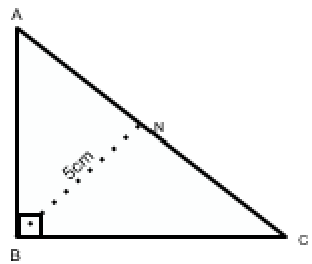
All are equal i.e QS = PS = RS

The segment PS and SR are equal since the median QS subdivides the right angled triangle into two similar isosceles triangles

Teacher: Then do this application activity.

Activity 8.2.2

In a right-angled triangle ABC, line AC is the hypotenuse and AN is 5 cm long. What is the length of the hypotenuse?



Expected answer for students

Students: Median BN = $\frac{1}{2}AC$ (Hypotenuse)

$5\text{ cm} = \frac{1}{2}AC$

AC = 10 cm

Teacher: How do we call this theorem? State it.

The median theorem of a right-angled triangle states that: the median from the right-angled vertex to the hypotenuse is half the length of the hypotenuse.

Median = 1 /2 Hypotenuse

Provide the **elaboration** activities to be done in pairs or in groups.

Median subdivides the right-angled triangle into two similar isosceles triangles.

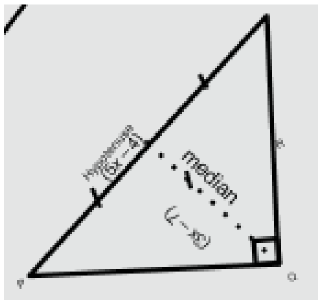
Teacher: Again, work in pairs this activity

Activity 8.2.3

In a right-angled triangle, the median to the hypotenuse has a length of (3x – 7) cm. the hypotenuse is (5x – 4) long. Find the value x, hence find the length of the hypotenuse**.**

Students: Yes teacher let's try

Expected answer for students



Median = (3x-7) cm, **PR = (** 5X-4) cm

By median theorem we know that **Median = 1/2 (PR).**

By cross multiplication

$2(3x - 7) = 5x - 4$

$6x - 14 = 5x - 4$

$x = 10$ cm

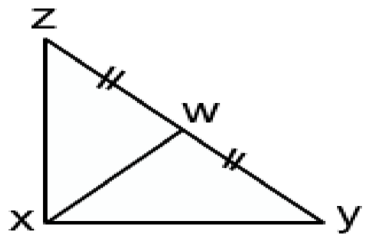
Hence , the length of the hypotenuse is

$(5x - 4)$ cm $= (5 \times 10 - 4)$ cm

$= 46$ cm

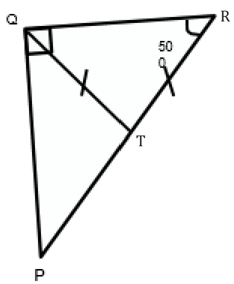
<table>
<tr><td></td><td>Summary:

The median theorem of a right-angled triangle states that: the length of median from the right-angled vertex to the hypotenuse is half the length of the hypotenuse



Median = 1/2 Hypotenuse
XW =1/2 (YZ)= WZ = WY.</td><td>Use different questions to help students recall key concepts of the lesson to be written down as a summary.</td></tr>
<tr><td>Assessment

(20 min)</td><td>Teacher: Thank you very much. Now, You are going to do an individual activity for assessment.
Activity:
1) The figure below shows right-angled triangle PQR. QT is the median to the hypotenuse and ∠QRP = 50°. Find ∠PTQ.


</td><td>Give students an activity to be done individually for evaluation.

Mark students and provide opportunities for corrective feedback or positive feedback to students.</td></tr>
</table>

	Expected answer for students <QRP= 50°, Triangle TQR is isosceles means angles <TQR = < TRQ Then <TRQ = 50° Means < TRQ = 50° < QTR = 180- (50+50) = 180° – 100° = 80° < PTQ = 180° – 80° = 100° 2) In a right-angled triangle, the median to the hypotenuse is 4.5 cm. What is the length of the hypotenuse? **Expected answer for students** Median = 1/2 hypotenuse 4.5 cm= 1/2Hypothenuse, hypotenuse = 4.5cm×2= 9 cm	
Conclusion (5 min)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: **The median theorem of a right-angled triangle states that** the median from the right-angled vertex to the hypotenuse is half the length of the hypotenuse Thank you for your participation. **As homework**, go and find answers for the following questions 1) One side of a right triangle is 12 cm. The median to the hypotenuse is 7.5cm. Find the: (a) length of the hypotenuse. (b) length of the third side. 2) The two legs of a right-angled triangle are 4.5 cm and 6 cm long. Find the length of the median from the right-angled vertex to the hypotenuse.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3) Triangle KLM is right-angled at vertex L and ∠LKM =24°. N is the midpoint of the hypotenuse KM. Find the value of angle:

(a) KLN (b) LNM

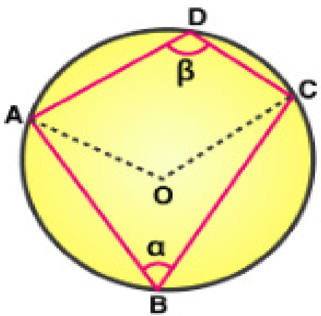
4) In a right-angled triangle EFG, the hypotenuse is $(3x + 8)$ cm long. The median to the hypotenuse is $(5x – 10)$ cm long. Find the value of x hence find the length of the median.

Note that you can also do activities found in the S3 Mathematics students' book on page 120.

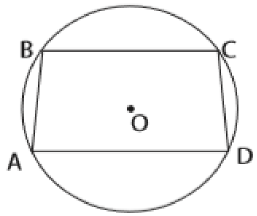
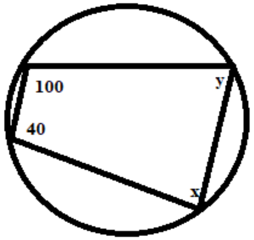
Thank you for your participation in this lesson.

3.9 Lesson from unit 9

SUBJECT: Mathematics	**GRADE:** S3	**UNIT 9**
Lesson title: Angles in a cyclic quadrilateral.		
Duration: 80 minutes		
Teaching material: Two flip charts, pair of compasses, ruler, chalks, and classroom chalkboard.		
Learning materials: notebooks, pens, pencil, calculators, geometric materials, S3 Mathematics book (from page 154 to page 158).		

Section	Step –by- step instructions and content	Teachers' notice
Introduction **(20 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Observe the figure on flip chat and discuss what you see on it.  **Teacher:** After observing the picture, what do you think is today's lesson? **Expected answer for learners:** today's lesson is angle in cyclic quadrilateral.	Begin by gaining students' attention. Tell students the materials needed and give them a small time to take them. Identify students with special educational needs and plan how to help them accordingly. Give them an **engaging** activity.

	Teacher: very good! In today's lesson, we are going to study the angle in cyclic quadrilateral and by the end of this lesson, you will be able to: • Define a cyclic quadrilateral • Classify the opposite angles of cyclic quadrilateral • Identify the interior angles and exterior angles • State the properties of angles in a cyclic quadrilateral.	Communicate the lesson title and related instructional objective to students.
Lesson development **(40 minutes)**	**Teacher**: Now take your note book and geometric material and do the flowing activity. **Activity 9.5.1** 1. Draw a circle centre O using any convenient radius. 2. On the circumference, mark points A, B, C and D in that order and join them to form a quadrilateral. 3. Measure angles ABC and ADC. Find their sum. 4. Measure angles BAD and BCD. Find their sum. 5. What do you notice about the two sums in 3 and 4? 6. Are the pairs of angles in 3 and 4 adjacent or opposite? 7. Do the other members of your class have the same observations as you do? 8. Produce side AB of the quadrilateral, and measure the exterior angle so formed. What is the size of this angle? compare with that of interior ∠ADC? While students are working, move around to each group and ask some probing questions leading them to correct results: Which instrument can be used to measure angle, what is the difference between adjacent and opposite angle?	Invite them to work on the **exploration** activity in groups. Ask students to present their findings in plenary session and guide them to harmonize their findings. In each group with different working steps, choose one group member to present.

	Expected answer for students: 1)  The sum of angle BAD and BCD is equal to 180^0. The pair of angles are opposite. For all the members of the class, the sum of two pairs of opposite angles should add up to 180^0 An exterior angle B is equal to opposite interior angle ADC. **Teacher**: thank you very much for your wonderful work. Basing on your answers, we are going to study the angle in cyclic quadrilateral. Take your notebooks and books and do the following activity in groups: **Activity:** Find the angles *x* and *y* in the figure below. 	**Clarify** the concept and guide students to write down the content (**explanation**). Remember to address common misconceptions.

Break for 5min

Teacher: I think you finished, let groups present their findings.

Expected answer for students:

Solution

$\angle x = 180° - 100°$ (Opposite angles in a cyclic quadrilateral add up to 180°.)

$x = 80°$

$y = 180° - 40°$ (Opposite angles in a cyclic quadrilateral add up to 180°.)

$y = 140°$

Teacher: Dear students, is it clear? What is a cyclic quadrilateral?

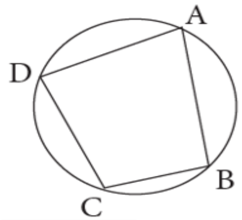
Expected answer for Student: cyclic quadrilateral is a quadrilateral whose vertices all lie on a circle.

Teacher appreciate: you are right!!!!!

Now let us go ahead on the theorem used in cyclic quadrilateral angles.

Theorem 5.1

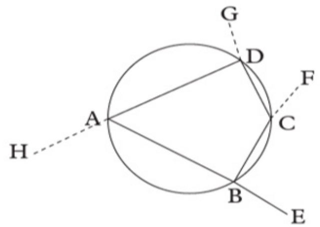
*T*he opposite interior angle of a cyclic quadrilateral are supplementary or add up to 180º



Angles BAD, CBA, DCB and ADC are the interior angle of quadrilateral.

Theorem 5.2

I*f one side of a cyclic quadrilateral is produced, the exterior angle formed is equal to the opposite interior angle of the quadrilateral.*



$<BAD = \angle DCF$

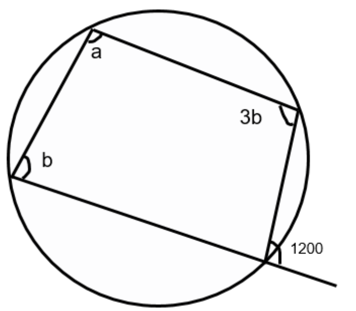
$\angle ABC = \angle ADG$

Activity 9.5.3 (Application activities):

Take your notebook and do the flowing activity in your groups.

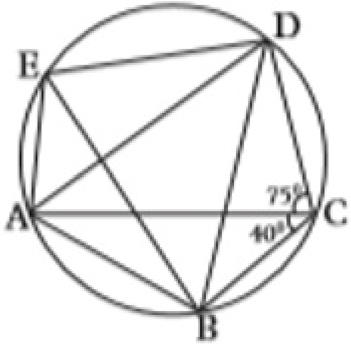
Application activity

Find angles a and b in the Figure below.



Give learners the application (**elaboration**) activities.

	Expected answer for students: a = 120° (Exterior angle of a cyclic quadrilateral is equal to opposite interior angle.) b + 3b = 180°, opp. angles of a cyclic quadrilateral. 4b = 180°, b = 45° $<CDB=180^0-(70^0+55^0)=180^0-125^0=55^0$ $<CDA=<CDB+<BDA=55^0+40^0=95^0$	
	Summary 1) what is a cyclic quadrilateral? 2) what do you know about: a) The opposite interior angles of cyclic quadrilateral. b) The exterior angle of cyclic quadrilateral and its opposite interior angle **expected answers for learners:** 1) Cyclic quadrilateral is a quadrilateral whose vertices all lie on a circle. 2) a) the sum of opposite interior angles is equal to 180^0 b) The exterior angle of cyclic quadrilateral is equal to its opposite interior angle of that cyclic quadrilateral.	Use different questions to help students recall key concepts of the lesson to be written down as a summary.
Assessment (10 min)	**Formative Assessment** 1. A, B, C, D and E are five points, in that order, on the circumference of a circle	Invite learners to do the questions of formative assessment (**evaluation**)



(a) Write down all angles in the figure equal to ∠ACB.

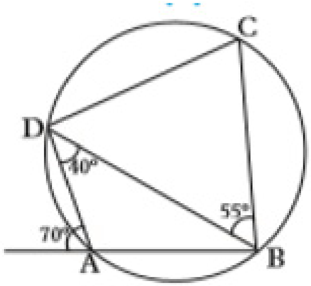
(b) Write down all angles in the figure supplementary to ∠BCD.

(c) If ∠ACB = 40° and ∠ACD = 75°, find the size of ∠DEB.

2. In Figure below, find:

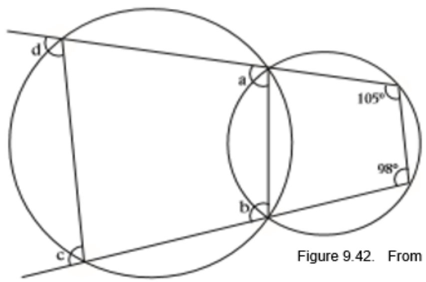
(a) ∠BCD

(b) ∠CDA.



3. Figure below, consists of two intersecting circles. Use it to find the angles marked by letters.

Correct them where there are wrong and guide them well to unsure that the objectives are achieved.

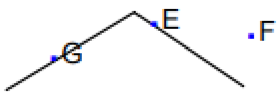
	 Figure 9.42. From RE ***Expected answer for students:*** 1) a)<AEB and <ADB c) <DEB+(75^0+40^0)=180^0 <DEB=180^0-115^0=65^0 2) a) <BCD+<DAB=180^0 <DAB=180^0-<BCD=180^0-70^0=110^0 <BCD=180^0-<DAB=180^0-110^0=70^0 b) <BCD=70^0 3)a=98^0, b=105^0, c=98^0, d=105^0	Provide opportunities for corrective feedback or positive feedback to students.
Conclusion (10 min)	We are coming to the end of our lesson. As we conclude, let's review some of the key points that we learned. Opposite angles of a cyclic quadrilateral (a quadrilateral with its four vertices lying on the circumference of a circle) are supplementary (i.e. they add up to 180°). If one side of a cyclic quadrilateral is produced, the exterior angle thus formed equals the interior opposite angle.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on thefeedback from assessment.

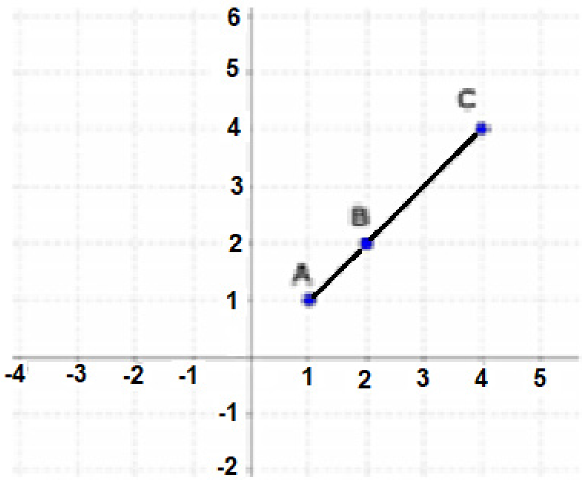
	Teacher: Thank you; As a homework do questions 4 and 5 of exercises 9.4 in the student book page158. We shall meet in the next lesson where you will submit answers for the homework.	

3.10 Lesson from unit 10

SUBJECT: Mathematics	GRADE: S3	UNIT10
Lesson title: Collinear points **Duration:** 40 minutes **Teaching material**: Ruler, flip chart, board and Geometric materials **Learning materials**: Notebooks, pens, calculators, geometric materials, S2 Mathematics book.		

Section	Step –by- step instructions and content	Teachers' notice
Introduction (5 Min)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. **Teacher:** Observe carefully the figure and try to answer the related questions;  What do you observe from the figure? How trees are located? How can we call objects which lie on the same line? **Expected answers from students.** a) From the figure we see trees planted on a line. b) Trees are located on a single straight line. c) The objects lie the same line are called **"collinear objects"**	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly. Give students an **engaging** activity.

	Teacher: Well done students, In today's lesson, we are going to continue with collinear points and by the use of geometric materials, you will be able to accurately and in the provided time: • State the conditions and properties of co linearity. • Verify co linearity of points using vector laws. • Make applications of collinearlity in proportion division of line.	Communicate the lesson title and related instructional objective to students.
Lesson development (25 Minutes)	**Teacher:** Dear students, in small groups, do the following activity: **Activity 1:** 1. Draw a line and put the points A, B , C so that they will be on the same straight line or collinear points. 2. Draw a line and put the points E, F ,G, so that they will not be on the same line or not be collinear points. 3. Try to define what are collinear points. **Expected answers from students:** 1) For example the points A, B and C in Figure below are collinear because they lie on a single straight line.  2) Points E, F and G in Figure below are not collinear because they don't lie on the same straight line. 	Provide an activity for **exploration** to reinforce the concept of collinear points. Invite them to present their answers in a plenary session. Refer to the result and ask some questions leading students to give properties of collinear points (**explanation** phase).

	3) Collinear points are those three or more points which lie on a single straight line. **Teacher:** Dear students, to know if three or more points are collinear, we use the properties of collinear points which are called " vector laws" **Teacher:** Let us now do the following activity in small groups to check if three or more points are collinear and by using vector laws: **Activity 2:** Observe the straight line in the Cartesian plane which accommodates points A, B and C.  a. Determine the column vector $\overrightarrow{AB}$ and $\overrightarrow{BC}$. b. Express the vector $\overrightarrow{AB}$ in terms of $\overrightarrow{BC}$. c. Using the results from (b), state the conditions for collinearity.	Provide **elaboration** activities to be done in pairs or in groups.

Expected answers from students:

a) From the figure, we have points A(2, 4), B (0, −2) and C (−1, −5) . The following are coordinates of vectors **OA, OB** and **OC**.

b) **OA**(1, 1) , **OB** (2, 2) and **OC**(4, 4)

OB – **OA** = k(**OC** – **OB**) ,

Then, (2, 2) – (1, 1) = k [(4, 4) – (2 ,2)]

(1, 1) = k (2, 2) and for both coordinates we find that

$1 = 2k \Rightarrow k = 1/2$

c) **AB** = ½ **BC.** If **AB** = *k***BC** where k is a scalar, then **AB** is parallel to **BC.** Since B is a common point between vectors **AB** and **BC**, then A, B and C lie on a straight line, i.e. the points A, B and C are collinear.

Teacher: Well done students, let us now do in pairs the following activities 3 and 4:

Activity 3:

Show that the points A (0, -2), B (2, 4) and C (-1, -5) are collinear.

Expected Solution from students:

Knowing that: **AB** = *k***BC**, with AB and BC vectors, k is a scalar.

OB – **OA** = k(**OC** – **OB**)

(2, 4) – (0, −2) = k [(−1, −5) – (2 ,4)]

(2, 6) = k (−3, −9)

i) $2 = -3k \Rightarrow k = -2/3$

ii) $6 = -9k \Rightarrow k = -6/9 = -2/3$ Since the value of k is the same for the two cases (i) and (ii) i.e. **AB**$= -2/3$ **BC**, and B is a common point of two vectors AB and BC, then points A, B and C are collinear.

Activity 4:

For what value of k are the following points collinear? A(1, 5), B(k, 1) and C(11, 7).

Expected Solution from students:

Let the points be A, B and C. For the points to be collinear, B can be a common point and therefore we get AB = a BC where a is a scalar **AB** = **OB** – **OA** $\Rightarrow (k, 1) - (1, 5) = (k-1, -4)$

BC = **OC** – **OB** $\Rightarrow (11, 7) - (k, 1) = (11-k, 6)$

Hence $(k-1, -4) = a(11-k, 6)$

We get $-4 = 6a \Rightarrow a = -4/6 = -2/3$ and $k - 1 = a(11-k)$ Substituting the value of a, $k - 1 = -2/3\,(11-k) \Rightarrow 3(k-1) = -2(11-k) \Rightarrow 3k - 3 = -22 + 2k \Rightarrow 3k - 2k = -22 + 3$ Hence $k = -19$

Teacher: Well done students, let us now do in small groups the following application activity

a) Show that the points P, Q and R are collinear, if P, Q and R are (0,3), (1,2) and (-1,4) respectively.

b) Plot these points on a Cartesian plane

Expected solution from students:

P(0,3), Q(1,2) and R(-1, 4)

a) Vector **PQ = Q –P =** $\begin{pmatrix}1\\2\end{pmatrix} - \begin{pmatrix}0\\3\end{pmatrix} = \begin{pmatrix}1\\-1\end{pmatrix}$

Vector **QR = R – Q =** $\begin{pmatrix}-1\\4\end{pmatrix} - \begin{pmatrix}1\\2\end{pmatrix} = \begin{pmatrix}-2\\2\end{pmatrix}$

Points P, Q and R are collinear points if: PQ = K QR , where k is a scalar

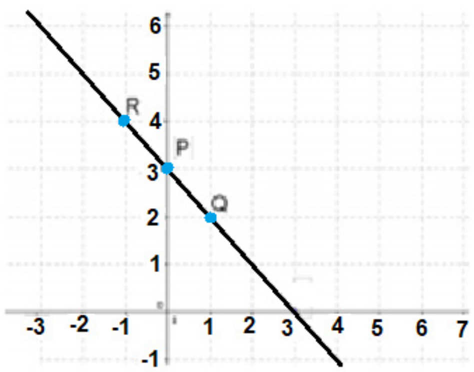
$$\begin{pmatrix}1\\-1\end{pmatrix} = k\begin{pmatrix}-2\\2\end{pmatrix}$$

$$\begin{pmatrix}1\\-1\end{pmatrix} = \begin{pmatrix}-2k\\2k\end{pmatrix}$$

$$\begin{cases}1 = -2k\\-1 = 2k\end{cases} \quad \begin{cases}k = \frac{-1}{2}\\k = \frac{-1}{2}\end{cases}$$

Since the values of K is the same , points P, Q and R are collinear.

b)



	Lesson summary. **Teacher:** Dear students, From the above activities, we notice that: • Three or more points are said to be collinear if they lie on the same straight line. If A, B and C are three points on the same straight line ABC, then vector **AB=k BC** , k is the coefficient of proportionality and k = AB:BC. It can take positive or negative real values.	Through different questions, help learners to recall what collinear points mean. Tell learners also to write the summary in their notebooks.
Assessment (8 min)	**Teacher:** Dear students, by working individually, answer the following questions to check if you have understood 1. Define the co linearity of points? 2. State the condition for points A,B and C to be collinear points? 3. Verify whether the following points are collinear or not a) P(−1, 1), Q(5, 1) and T(−2, 4) b) R(2, 0) (b) X(−2, 3), Y(7, 0) c) Z(1, 2) (c) R(1, 2), S(4, 0) T(−2, 4) 4. Given three points A (2, 2), B (3, 3) and C (6, 6). a) Plot all points on the Cartesian plane b) Join the points A, B and C. C) What can you conclude about the points A, B and C? **Expected answers from students:** 1. Collinear points are those three or more points, which lie on a single straight line. 2. The conditions for points A, B, and C to be collinear points are: a) Make vector **AB** and **BC.** b) Express **AB** in terms of **BC** as **AB= k BC** where k is a scalar (a number)**.**	Give to students an individual assessment to determine the level of which the objectives have been achieved (**evaluation**). Provide opportunities for collective feedback or positive feedback to students.

3. Vector **PQ** = (5,1) - (-1,1) = (5+1, 1-1)= (6, 0)

Vector **QT**= (-2,4) –(5,1)= (-2-5,4-1) = (-7,3)

verify if vectors **PQ** = k **QT**

So, (6,0)=k(-7,3).

Then 6=-7k and 0=3k

6/-7= k and 0/3= k

K= 6/-7 and k = 0

Since the values of k are different, the points P, Q and T are not collinear.

OA(2, 2) , **OB** (3, 3) and **OC**(6, 6)

OB – **OA** = k(**OC** – **OB**) and

(3, 3) – (2, 2) = k [(6, 6) – (3 ,3)]

(1, 1) = k (3, 3) and for both coordinates we find that 1 = 3k ⇒ k = 1/ 3

AB = 1/3 **BC.** If **AB** = *k* **BC** where k is a scalar, then **AB** is parallel to **BC.** Since B is a common point between vectors **AB** and **BC**, then A, B and C lie on a straight line, i.e. the points A, B and C are collinear.

Conclusion (2min)	**Teacher:** Dear learners, as we are coming to the end of our lesson, let us conclude by reviewing some of the key points that we learned. We all remember that: • Three or more points are said to be collinear if they lie on a single straight line. If A, B and C are three points on the same straight line ABC, then vector $\overrightarrow{AB} = k\overrightarrow{BC}$ • k is the coefficient of proportionality, $k = \frac{AB}{BC}$. It can take positive or negative real values. Teacher: Dear students, as homework, go and do activities found in the S3 Mathematics students' book on page 177.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment

3.11 Lesson from unit 11

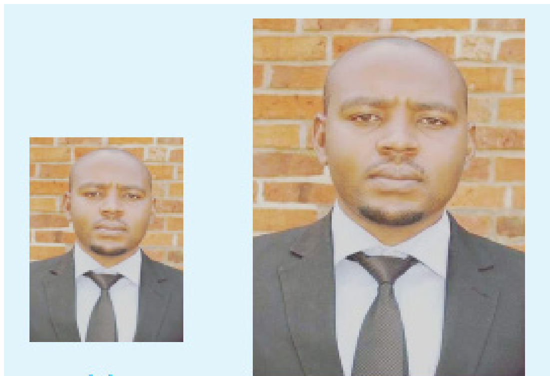
SUBJECT: Mathematics	**GRADE:** S3	**UNIT 11:**

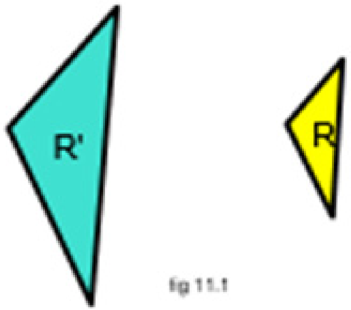
LESSON TITLE: Introduction, definition and properties of enlargement.

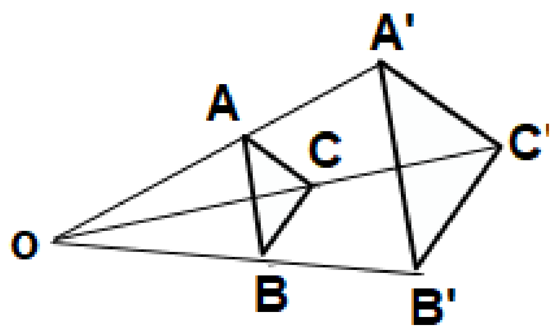
Duration: 40 minutes

Teaching material: Charts, Textbooks and others.

Learning materials: Notebooks, pens, calculators, S3 Mathematics book.

Section	Step –by- step instructions and content	Teachers' notice
Introduction **(5 Min)**	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. **Teacher:** Let us observe the picture and answer questions.  (a) (b) 1. Compare the shapes of the two pictures. What do you notice? 2. How many times picture (b) is bigger than picture (a)	Begin by gaining students' attention. Identify students with special educational needs and plan how to help them accordingly.

	3. What is the name of the transformation that transforms picture (a) to picture (b)? **Answer from students:** 1. They have the same shape, but different size. 2. The picture (b)is twice the picture (a). 3. The name of transformation is Enlargement.	
	Teacher: Dear students, let us work in group and do the following activity: **Activity:** a) Observe the two figures. What do you notice?  fig 11.1 b) By measuring sizes and angles of the two figures, determine how many times figure (R') is bigger than figure (R). c) What is the name of the transformation that transforms (R) to (R')? **Students' answers:** a) The shapes are different in size but they are similar. b) R' is two times R c) The transformation is enlargement	Through an engaging activity leads students to explore and understand the concept of enlargement Communicate the lesson title and related instructional objective to students.

<table>
<tr><td></td><td>Teacher: Key question: What is the name of action of increasing or decreasing the size of a 2D shape without changing its angles.
Teacher: Good! In today's lesson, we are going to Definition and properties of enlargement.
And by the end of this lesson. you will be able to:
• Define enlargement.
• State properties of enlargement</td><td></td></tr>
<tr><td>Lesson development
(25 Minutes)</td><td>Teacher: Dear students, let us work in groups and do the following activity:
Activity 1:
Observe the figure


a) Measure and compare triangles ABC to A'B'C' in terms of corresponding sides. What do you notice?
b) Measure and compare triangles ABC to A'B'C' in terms of corresponding angles. What do you notice?
c) How the lines AA', BB' and CC' are they related?</td><td>Invite students to work on the exploration activity in groups and ask them to present their findings in plenary session.
In each group with different working steps, choose one group member to present.
Remember to address common misconceptions.</td></tr>
</table>

d) Compare the ratios: $\frac{OA'}{OA}$; $\frac{OB'}{OB}$ and $\frac{OC'}{OC}$ What do you notice?

Expected answers:

a) Triangle ABC is smaller than triangle A'B'C'

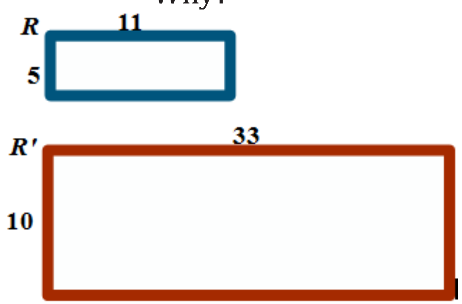
b) They have the same corresponding angles

c) They meet at the same point o.

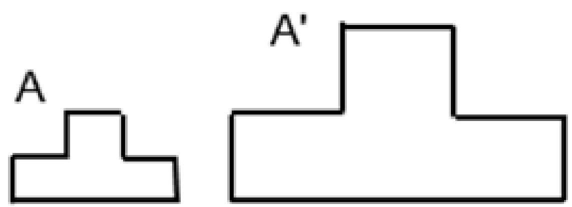
d) They are equal, the ration distance from the centre to the image by the distance from centre to the object is constant

Teacher: Let us observe the figure below and answer the given question.

Activity 2: Is the transformation of R to R' an enlargement or not? Why?



Activity 3: Is the transformation of A to A' an enlargement or not? Explain your answer.



Refer to the result and ask some questions leading students to give properties of enlargement

Invite students to work in pairs and do the activity for elaborating properties of enlargement.

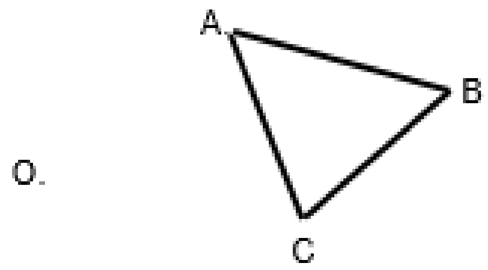
Expected answers:

a) No because the ration of corresponding sides is not constant.

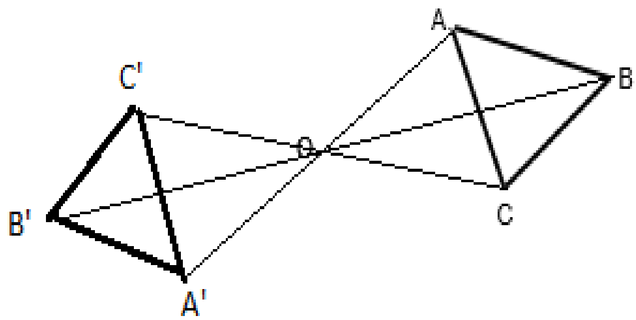
Ie: 33/11=3 and 10/5=2.

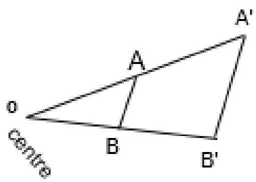
b) Yes it is an enlargement. A' is twice A

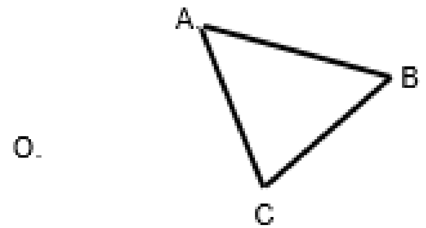
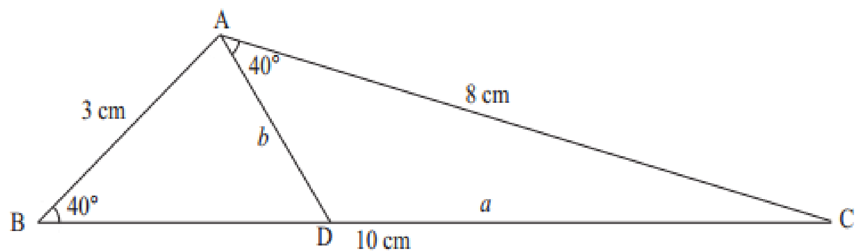
Activity 4: Find the image of triangle ABC below under an enlargement of scale factor 2 and center O.



Students' answers:

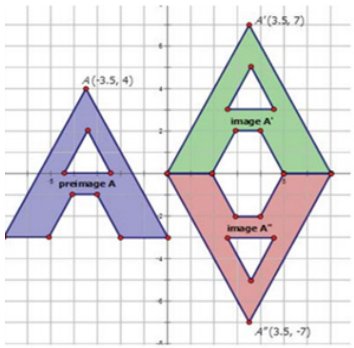
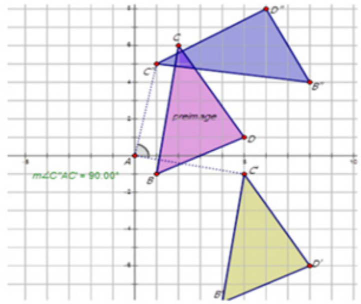


	Lesson Summary: **Teacher:** Dear students, from the above activities, we notice that: • Enlargement is the transformation that changes the size of an object but preserves its shape i.e angles are preserved. • Lines joining the points and their corresponding images by enlargement meet at a common point called center of enlargement. It is denoted by the letter O. • The ratio $\frac{OA'}{OA}$ where A' is the image of A is called the scale factor of enlargement. It is denotedby k  $k = \frac{OA'}{OA} = \frac{OB'}{OB} =$ *scale factor* • A scale factor k is equal to the ratio of corresponding sides. • For an enlargement to be performed, the center and scale factor of enlargement must be known.	Use different questions to help students recall key concepts of the lesson and then asks them to write the summary in their notebooks
Assessment (7 min)	**Teacher:** Dear students, by working individually, answer the following questions to check if you have understood 1. Define the following terms: a) Enlargement b) Scale factor 2. Find the image of triangle ABC below under an enlargement of scale factor 2 and center O.	Give to students an individual assessment to determine the level of which the objectives have been achieved (**evaluation**)

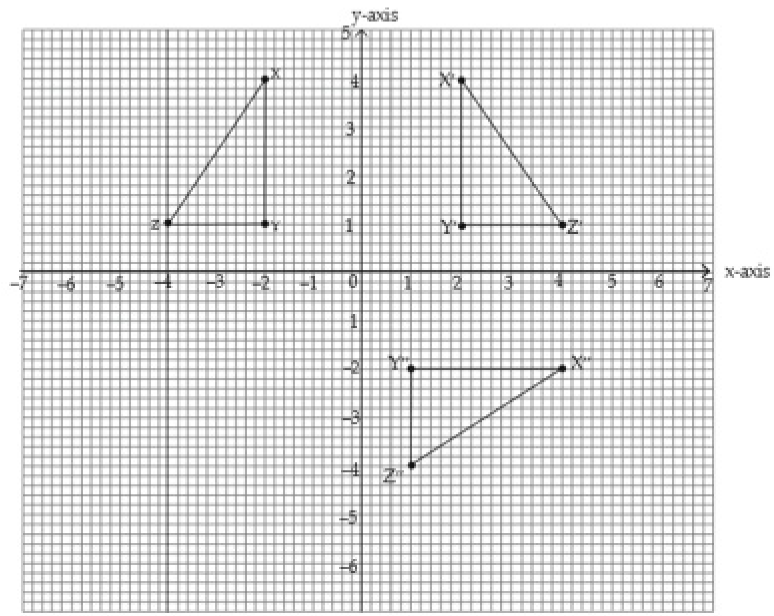
		Provide opportunities for corrective feedback or positive feedback to students.
Conclusion (3min)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: • Enlargement is the transformation that changes the size of an object but preserves its shape i.e angles are preserved. • Lines joining the points and their corresponding images by enlargement meet at a common point called center of enlargement. It is denoted by the letter O. • A scale factor k is equal to the ratio of corresponding sides. • For an enlargement to be performed, the center and scale factor of enlargement must be known. **Teacher:** Dear students, **as homework**,, you are requested to do the following activity; In triangles ABC below, identify two similar triangles in the figure and use them to find the values of *a* and *b* 	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.12 Lesson from unit 12

SUBJECT: Mathematics	**GRADE:** S3	**UNIT 12**
Lesson title: Introduction to composite transformations in 2D.		
Duration: 80 minutes		
Teaching material: Geometrical instruments, flipped charts.		
Learning materials: Notebooks, pens, calculators, geometric materials, S2 Mathematics book.		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction (15 Minutes)	**Teacher**: Welcome again to Mathematics lesson. I am sure you are going to enjoy today's lesson. Remember we learnt single transformation in S2. Who can remind us different types of single transformation (isometrics) that we learnt in S2? **Students:** The different types of single transformations that we learnt in S2 are: • translation, • reflection, • rotation • central symmetry.	Begin by gaining students' attention by asking a simple question for revision. Identify students with special educational needs and plan how to help them accordingly.
	Teacher: observe the picture on flipped chart and answer the questions:	Through an **engaging** activity leads students to be able to think about the composition of transformations.

	 1. What do you think about the figure on the above slide page? 2. Why the same figure is drawn three time with different position? **Students**:.... **Teacher**: Good! In today's lesson, we are going to continue with Introduction to composite transformations in 2D. And by the use of geometric materials, you will be able to: • Define the composite transformation. • Construct an image of object under composite transformation.	Communicate the lesson title and related instructional objective to students.
Lesson development (40 Minutes)	**Teacher:** Dear students, Let us do the following activity in groups to make a review on transformations in 2D. **Activity 1:** Draw triangle XYZ with vertices at (−2, 4), Y(−2, 1), Z (−4, 1). Find the images X'Y'Z' and X''Y''Z'' of XYZ under the following combinations of transformations. (a) A reflection in the line x = 0. (b) A rotation through an angle of 180º about (0, 0).	Ask students to work in pairs or in small groups the **exploration** activities.

Students' answers:



(a) x'(2, 4), y'(2, 1) and z'(4, 1)

(b) x''(4, –2), y''(1, –2) and z''(1,–4)

Teacher: Dear students, work in pairs the following activity:

Activity 2:

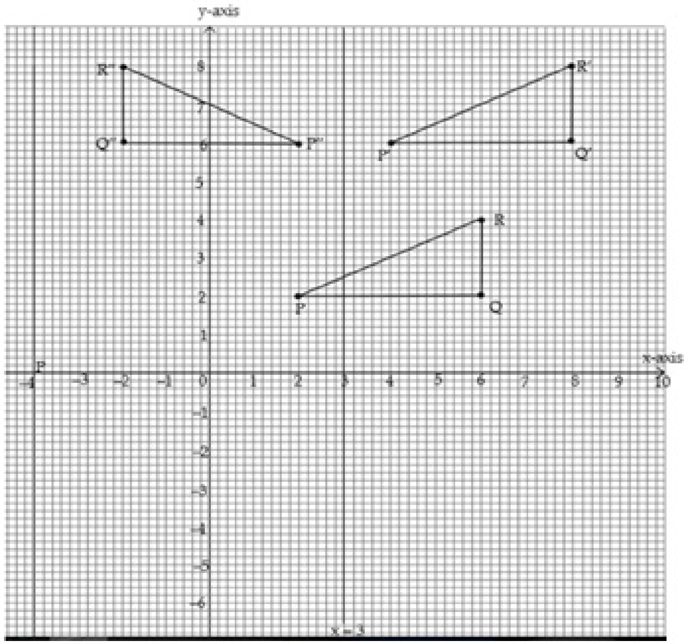
Plot triangle PQR at P(2, 2), Q(6, 2), R(6, 4). Find the image of PQR under the following combinations of transformations; a translation, under vector (2 4) followed by a reflection in the line x=3. Write down the co-ordinates of the final image of point P.

Provide time for them to think, practice and through presentations share their ideas on transformations in 2D in order to enhance their understanding on composite transformation .

After students' presentations, harmonize their findings, **clarify** the new concept through real life example if possible (**explanation** phase).

Give students the **elaboration** activity.

Students 'answers:



The co-ordinates of the final image of point **P** are shown by point **P''(2, 6).**

Teacher: Dear students, From the above activities, we notice that:

- From single transformations: reflection, rotation and translation, we can combine them to get a new transformation.
- Two consecutive transformations or a transformation followed by another one or repeated twice give the new transformation called composite transformation.

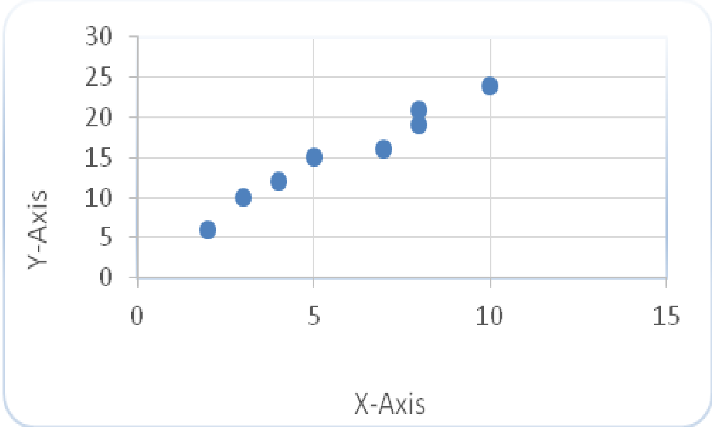
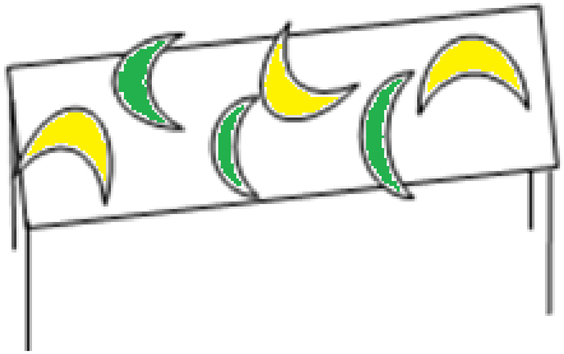
	Lesson summary **Teacher:** Dear students, From the above activities, we notice that: 1. Composite transformation takes place when two or more transformations combine one after another to form a new transformation. 2. One transformation produces an image upon which the other transformation is performed.	Use different questions to help students recall key concepts of the lesson and then asks them to write the summary in their notebooks
Assessment (15min)	**Teacher:** Dear students, by working individually, answer the following questions to check if you have understood 1. Draw triangle XYZ with vertices at X (–2, 4), Y(–2, 1), Z (–4, 1). Find the image of XYZ under the following combinations of transformations: (a) A reflection in the line x = 0. (b) A rotation Through an angle of 180º about (0, 0). 2. (a) Plot the triangle ABC at A (4, 6), B (1, 6), C (1, 4). Draw the line y = 2 and y = x. (b) Plot the image of triangle ABC after reflection in; (i) The y-axis. Label it triangle 1 (ii) The line y = 2. Label it triangle 2. (iii) The line y = x. Label it triangle 3. (c) Write down the co-ordinates of triangles 1,2 and 3.	Give to students an individual assessment (**evaluation**) to determine the level at which the objectives have been achieved Provide opportunities for collective feedback or positive feedback to students.

Conclusion (10 min)	**Teacher**: As, we are coming to the end of our lesson, we have seen that: Two consecutive transformations or a transformation followed by another one or repeated twice give the new transformation called **composite transformation.** **Teacher:** Dear students, **as homework,**, you are requested to do more activities found in the **on page 228 of S3 Mathematics book.**	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

3.13 Lesson from unit 13

SUBJECT: Mathematics	**GRADE:** S3	**UNIT** 13
LESSON TITLE: Scatter diagram		
Duration: 80 minutes		
Teaching material: **Yellow bananas, Sweets, Pens and books**		
Learning materials: Notebooks, pens, calculators, geometric materials, S3 Mathematics book		
Section	**Step –by- step instructions and content**	**Teachers' notice**
Introduction **(15min)**	**Teacher**: Hello students, how are you? **Students**: Fine **Teacher:** Welcome to this mathematics lesson. Take your exercise book, a pen, a ruler and a pencil and then enjoy the lesson. **Teacher :** Did you do the work on plotting points for the data given in the following table: x: 10, 4, 2, 5, 7, 3, 8, 8 y: 24, 12, 6, 15, 16, 10, 19, 21	Great learners and energize the learners to attract their attention. Identify students with special educational needs and plan how to help them accordingly.

x	10	4	2	5	7	3	8	8
y	24	12	6	15	16	10	19	21

<table>
<tr><td></td><td>Students ‘answers
</td><td>Check if they all did the homework and help them to make correction.</td></tr>
<tr><td></td><td>Teacher (cont): Dear students, observe silently on the table and then tell us how yellow bananas are arranged.

Students: Yellow bananas are not in order, they are mixed with the green ones but not in the same line, they are in disorder or they are scattered, ….</td><td>Give students an engaging activity that motivates them to think about the new lesson.

Highlight the word scattered.</td></tr>
</table>

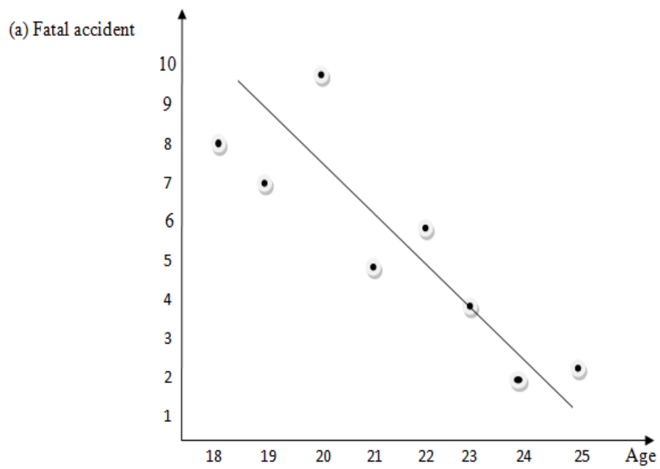
Teacher: Dear students, let us work is mall groups,study the data in table below and answer to questions that follow:

Age (x)	18	19	20	21	22	23	24	25
Fatal accident (y)	8	7	10	5	6	4	2	3

Using a suitable scale (2cm), mark age (x) years on the horizontal axis and fatal accidents(y) on the vertical axis

a. Plot all the points in the Cartesian plane
b. How these points are displayed? do they follow a certain direction
c. How do we call the diagram representing these points?

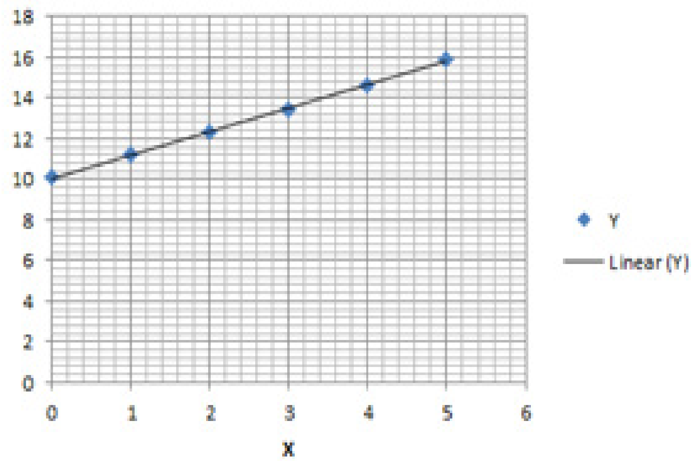
Students: present or give their expected answers:



(b) The points are scattered
(c) Scatter diagram

Engage learners to discover the new lesson and probe student's prediction

Communicate the lesson title and related instructional objective to students. Use learning objectives to set instructional objective with all 5 components **(who- conditions - action verb- content – performance criteria)** students.

	Teacher: well done students, today's lesson is entitled " **Scatter diagram**" and at the end of this lesson, working in group, as students of S_3 you will be able to: • Define correctly a scatter diagram • Draw appropriately a scatter diagram and the line of best fit • Analyze and interpret correctly bivariate data using scatter diagram. • Appreciate the use of scatter diagram to represent information.	
Lesson development (40 Min)	**Teacher:** Dear students, in small groups, draw a scatter diagram for the data given in form of ordered pairs in the following activity: **Activity1:** Plot the following points (x,y) (0.0,10.1), (1.0,11.2), (2.0,12.3), (3.0,13.4), (4.0,14.6) , (5.0,15.9) **Students** do the activity and present their working steps 	Provide an activity for **exploration** and reinforce the skills of plotting the graph. Invite students to present their findings in plenary session and guide them to harmonize their findings.

	Teacher: Dear students, from your observation, what is a scatter diagram? **Students:** A scatter diagram (plot) is a type of a diagram using Cartesian coordinates in a plane to display values of two variables for a bivariate data. **Teacher:** Ok, that's good. Now, we understand what a scatter diagram is. But what is it used for? **Students:** It is used to find the relationship between variables. **Teacher**: Dear students, in small groups, let us do the following activity:	Ask students some questions about the graph they have drawn to help them understand what a scatter graph is. Provide more **explanations** on the meaning of a scatter diagram.
	Activity 3: Given the data below:	

x	10	4	2	5	7	3	8	8
y	24	12	6	15	16	10	19	21

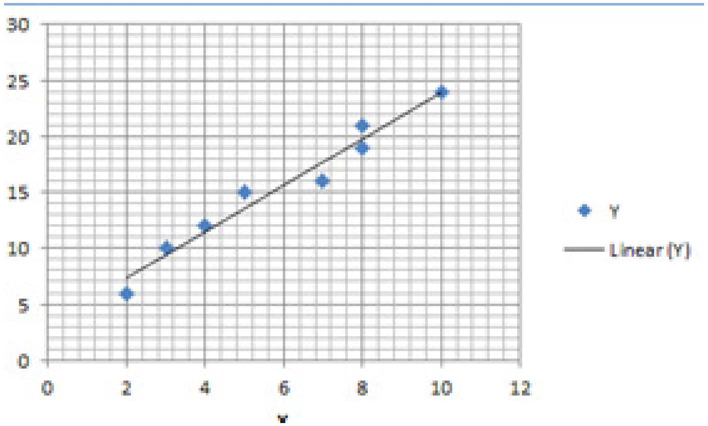
(a) Draw the line of best fit.

(b) Find the equation of the line to estimate the value of x if y=20 and the value of y if x=9

Students' answer:

Give learners an **elaboration** activities to be done in groups.

(a)



(b) Equation of this line is given by:

$y - 24 = \frac{14}{11}(x - 10)$

- if $y = 20$,

$20 - 24 = \frac{14}{11}(x - 10)$

$-44 = 14x - 140$

$x = \frac{96}{14} = 6.8$

- If $x = 9$

$y - 24 = \frac{14}{11}(9 - 10)$

$y = -\frac{14}{11} + 24 = \frac{-14+264}{11} = \frac{250}{11}$

Teacher: Dear students, in pairs, try also the following activity by applying what we come to learn?

Activity 3

The amount of grant allocated to 12 education institution in a certain country in a year is listed together with the population sizes

Population (x) in tens of thousands	29	58	108	34	115	19	136	33	25	47	49	33
Grant (y) in million	8	17	34	10	34	7	41	10	9	13	17	13

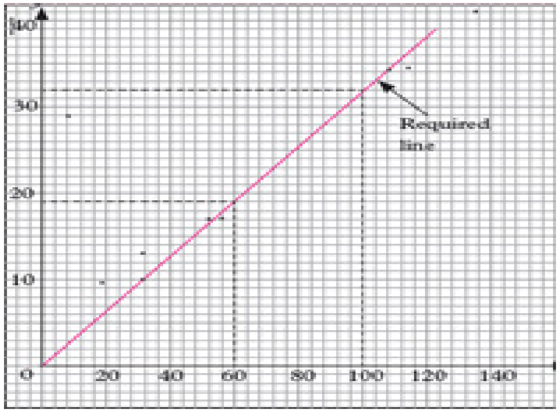
i) Draw the scatter diagram

ii) Draw a straight line passing through the maximum possible points.

iii) What is the name of this line?

Students' answers

i) and ii)



Asks students to work in pairs the application activities and provides time for them to think, elaborate and share their ideas on scatter diagram in order to enhance their understanding.

<table>
<tr><td></td><td>iii) The line obtained is called the line of best fit.
Teacher: Dear students, how can we define a line of best fit?
Students: The line of best fit or trend line is a straight line that best represent the data on a scatter diagram (plot).</td><td></td></tr>
<tr><td></td><td>Lesson summary
Teacher: Dear students, From the above activities, we notice that:
• A scatter diagram (plot) is a type of a diagram using Cartesian coordinates in a plane to display values of two variables for a bivariate data.
• It is used to find the relationship between variables.
• The line of best fit or trend line is a straight line that best represent the data on a scatter diagram (plot).
• The line may pass through some of the points, none of the points or all of the points</td><td>Through different questions, help learners to recall what a scatter diagram and line of best fit are and to recall the use of scatter diagram. Tell learners also to write the summary in their notebooks</td></tr>
<tr><td>Assessment
(15min)</td><td>Teacher: Dear students, by working individually, answer the following questions to check if you have understood
Given the data below:
<table><tr><td>x</td><td>10</td><td>4</td><td>2</td><td>5</td><td>7</td><td>3</td><td>8</td><td>8</td></tr><tr><td>y</td><td>24</td><td>12</td><td>6</td><td>15</td><td>16</td><td>10</td><td>19</td><td>21</td></tr></table>(a) Draw the line of best fit.
(b) Find the equation of the line to estimate the value of x if y = 20 and the value of y if x = 9.
Students’ answer:...</td><td>Give to students an individual assessment to determine the level of which the objectives have been achieved (evaluation).

Provide opportunities for collective feedback or positive feedback to all students.</td></tr>
</table>

Conclusion (10min)	**Teacher:** Dear students, as we are coming to the end of our lesson, let us conclude by reviewing some of the key points that we learned. We all remember that: • A scatter diagram (plot) is a type of a diagram using Cartesian coordinates in a plane to display values of two variables for a bivariate data. • Scatter diagram is used to find the relationship between variables. • The line of best fit or trend line is a straight line that best represent the data on a scatter diagram (plot). This line may pass through some of the points, none of the points or all of the points. **Teacher:** Dear students, **as homework,** go and plot the data in table below and tell the type of relationship between two variables 1. The table below shows the average masses of a group of boys in the age group 5 to 14 years. (table below) (a) Plot the points to obtain a scatter diagram. (b) Use the scatter diagram obtained above to draw the line of best fit and describe its gradient or slope. Find its equation. 2. The table below shows the heights (cm) and the corresponding shoes sizes for a group of people.	Summarize the main points verbally, conclude and give students a homework that may include remedial, consolidation or extended activities depending on the feedback from assessment.

Age (years) (x)	5	6	7	8	9	10	11	12	13	14
Mass (Kg) (y)	24	25	27	28	31	31	28	41	47	55

Height (x)	Shoe size (y)
155	8
158	7
160	7
163	8
165	8
168	9
170	9
173	8
175	9
178	10
180	10

Use the data to draw a scattered diagram. Use the scatter diagram obtained to draw the line of best fit.

Use your graph to estimate the shoe size you expect someone 171 cm tall to wear.

Thank you for your participation in this lesson.

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