Free Quality School Education

Ministry of Basic and Senior Secondary Education

Lesson Plans for

Senior Secondary *Mathematics*

SSS II

Term II

STRICTLY NOT FOR SALE

Foreword

These Lesson Plans and the accompanying Pupils' Handbooks are essential educational resources for the promotion of quality education in senior secondary schools in Sierra Leone. As Minister of Basic and Senior Secondary Education, I am pleased with the professional competencies demonstrated by the writers of these educational materials in English Language and Mathematics.

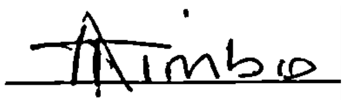
The Lesson Plans give teachers the support they need to cover each element of the national curriculum, as well as prepare pupils for the West African Examinations Council's (WAEC) examinations. The practice activities in the Pupils' Handbooks are designed to support self-study by pupils, and to give them additional opportunities to learn independently. In total, we have produced 516 lesson plans and 516 practice activities – one for each lesson, in each term, in each year, for each class. The production of these materials in a matter of months is a remarkable achievement.

These plans have been written by experienced Sierra Leoneans together with international educators. They have been reviewed by officials of my Ministry to ensure that they meet the specific needs of the Sierra Leonean population. They provide step-by-step guidance for each learning outcome, using a range of recognized techniques to deliver the best teaching.

I call on all teachers and heads of schools across the country to make the best use of these materials. We are supporting our teachers through a detailed training programme designed specifically for these new lesson plans. It is really important that the Lesson Plans and Pupils' Handbooks are used, together with any other materials they may have.

This is just the start of educational transformation in Sierra Leone as pronounced by His Excellency, the President of the Republic of Sierra Leone, Brigadier Rtd Julius Maada Bio. I am committed to continue to strive for the changes that will make our country stronger and better.

I do thank our partners for their continued support. Finally, I also thank the teachers of our country for their hard work in securing our future.



Mr. Alpha Osman Timbo

Minister of Basic and Senior Secondary Education

The policy of the Ministry of Basic and Senior Secondary Education, Sierra Leone, on textbooks stipulates that every printed book should have a lifespan of three years.

To achieve thus, DO NOT WRITE IN THE BOOKS.

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Introduction

to the Lesson Plans

These lesson plans are based on the National Curriculum and the West Africa Examination Council syllabus guidelines, and meet the requirements established by the Ministry of Basic and Senior Secondary Education.

1. The lesson plans will not take the whole term, so use spare time to review material or prepare for examinations.
2. Teachers can use other textbooks alongside or instead of these lesson plans.
3. Read the lesson plan before you start the lesson. Look ahead to the next lesson, and see if you need to tell pupils to bring materials for next time.
4. Make sure you understand the learning outcomes, and have teaching aids and other preparation ready – each lesson plan shows these using the symbols on the right.
5. If there is time, quickly review what you taught last time before starting each lesson.
6. Follow the suggested time allocations for each part of the lesson. If time permits, extend practice with additional work.
7. Lesson plans have a mix of activities for the whole class and for individuals or in pairs.
8. Use the board and other visual aids as you teach.
9. Interact with all pupils in the class – including the quiet ones.
10. Congratulate pupils when they get questions right! Offer solutions when they don't, and thank them for trying.

Learning outcomes

Preparation

KEY TAKEAWAYS FROM SIERRA LEONE'S PERFORMANCE IN WEST AFRICAN SENIOR SCHOOL CERTIFICATE EXAMINATION – GENERAL MATHEMATICS[1]

This section, seeks to outline key takeaways from assessing Sierra Leonean pupils' responses on the West African Senior School Certificate Examination. The common errors pupils make are highlighted below with the intention of giving teachers an insight into areas to focus on, to improve pupil performance on the examination. Suggestions are provided for addressing these issues.

Common errors

1. Errors in applying principles of BODMAS
2. Mistakes in simplifying fractions
3. Errors in application of Maths learned in class to real-life situations, and vis-a-versa.
4. Errors in solving geometric constructions.
5. Mistakes in solving problems on circle theorems.
6. Proofs are often left out from solutions, derivations are often missing from quadratic equations.

Suggested solutions

1. Practice answering questions to the detail requested
2. Practice re-reading questions to make sure all the components are answered.
3. If possible, procure as many geometry sets to practice geometry construction.
4. Check that depth and level of the lesson taught is appropriate for the grade level.

[1] This information is derived from an evaluation of WAEC Examiners' Reports, as well as input from their examiners and Sierra Leonean teachers.

FACILITATION STRATEGIES

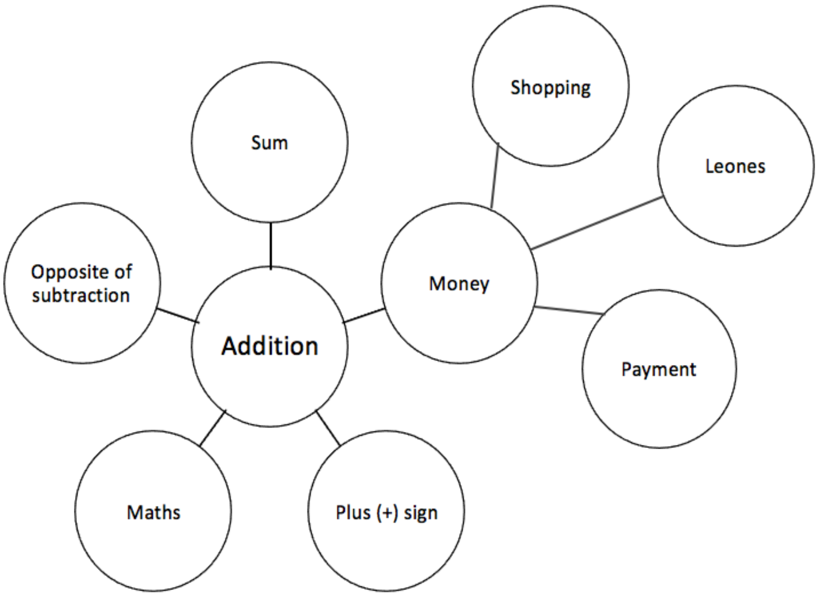
This section includes a list of suggested strategies for facilitating specific classroom and evaluation activities. These strategies were developed with input from national experts and international consultants during the materials development process for the Lesson Plans and Pupils' Handbooks for Senior Secondary Schools in Sierra Leone.

Strategies for introducing a new concept

- **Unpack prior knowledge:** Find out what pupils know about the topic before introducing new concepts, through questions and discussion. This will activate the relevant information in pupils' minds and give the teacher a good starting point for teaching, based on pupils' knowledge of the topic.
- **Relate to real-life experiences:** Ask questions or discuss real-life situations where the topic of the lesson can be applied. This will make the lesson relevant for pupils.
- **K-W-L:** Briefly tell pupils about the topic of the lesson, and ask them to discuss 'What **I** **k**now' and 'What **I** **w**ant to know' about the topic. At the end of the lesson have pupils share 'What **I** **l**earned' about the topic. This strategy activates prior knowledge, gives the teacher a sense of what pupils already know and gets pupils to think about how the lesson is relevant to what they want to learn.
- **Use teaching aids from the environment:** Use everyday objects available in the classroom or home as examples or tools to explain a concept. Being able to relate concepts to tangible examples will aid pupils' understanding and retention.
- **Brainstorming:** Freestyle brainstorming, where the teacher writes the topic on the board and pupils call out words or phrases related that topic, can be used to activate prior knowledge and engage pupils in the content which is going to be taught in the lesson.

Strategies for reviewing a concept in 3-5 minutes

- **Mind-mapping:** Write the name of the topic on the board. Ask pupils to identify words or phrases related to the topic. Draw lines from the topic to other related words. This will create a 'mind-map', showing pupils how the topic of the lesson can be mapped out to relate to other themes. Example below:



- **Ask questions:** Ask short questions to review key concepts. Questions that ask pupils to summarise the main idea or recall what was taught is an effective way to review a concept quickly. Remember to pick volunteers from all parts of the classroom to answer the questions.
- **Brainstorming:** Freestyle brainstorming, where the teacher writes the topic on the board and pupils call out words or phrases related that topic, is an effective way to review concepts as a whole group.
- **Matching:** Write the main concepts in one column and a word or a phrase related to each concept in the second column, in a jumbled order. Ask pupils to match the concept in the first column with the words or phrases that relate to in the second column.

Strategies for assessing learning without writing

- **Raise your hand:** Ask a question with multiple-choice answers. Give pupils time to think about the answer and then go through the multiple-choice options one by one, asking pupils to raise their hand if they agree with the option being presented. Then give the correct answer and explain why the other answers are incorrect.
- **Ask questions:** Ask short questions about the core concepts. Questions which require pupils to recall concepts and key information from the lesson are an effective way to assess understanding. Remember to pick volunteers from all parts of the classroom to answer the questions.
- **Think-pair-share:** Give pupils a question or topic and ask them to turn to seatmates to discuss it. Then, have pupils volunteer to share their ideas with the rest of the class.
- **Oral evaluation:** Invite volunteers to share their answers with the class to assess their work.

Strategies for assessing learning with writing

- **Exit ticket:** At the end of the lesson, assign a short 2-3 minute task to assess how much pupils have understood from the lesson. Pupils must hand in their answers on a sheet of paper before the end of the lesson.
- **Answer on the board:** Ask pupils to volunteer to come up to the board and answer a question. In order to keep all pupils engaged, the rest of the class can also answer the question in their exercise books. Check the answers together. If needed, correct the answer on the board and ask pupils to correct their own work.
- **Continuous assessment of written work:** Collect a set number of exercise books per day/per week to review pupils' written work in order to get a sense of their level of understanding. This is a useful way to review all the exercise books in a class which may have a large number of pupils.
- **Write and share:** Have pupils answer a question in their exercise books and then invite volunteers to read their answers aloud. Answer the question on the board at the end for the benefit of all pupils.
- **Paired check:** After pupils have completed a given activity, ask them to exchange their exercise books with someone sitting near them. Provide the answers, and ask pupils to check their partner's work.
- **Move around:** If there is enough space, move around the classroom and check pupils' work as they are working on a given task or after they have completed a given task and are working on a different activity.

Strategies for engaging different kinds of learners

- For pupils who progress faster than others:
  - Plan extension activities in the lesson.
  - Plan a small writing project which they can work on independently.
  - Plan more challenging tasks than the ones assigned to the rest of the class.
  - Pair them with pupils who need more support.

- For pupils who need more time or support:
  - Pair them with pupils who are progressing faster, and have the latter support the former.
  - Set aside time to revise previously taught concepts while other pupils are working independently.
  - Organise extra lessons or private meetings to learn more about their progress and provide support.
  - Plan revision activities to be completed in the class or for homework.
  - Pay special attention to them in class, to observe their participation and engagement.

Lesson Title: Sequences	**Theme:** Numbers and Numeration

Lesson Number: M2-L049	Class: SSS 2	Time: 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to determine the rule that generates a sequence of terms, and extend the sequence.	**Preparation** Write the sequence of numbers in Opening on the board.	

Opening *(4 minutes)*

1. Write on the board: 2, 5, 8, 11, 14, …
2. Discuss: Look at the numbers on the board. Do you notice any pattern?
3. Allow pupils to share ideas until they determine the pattern. (Answer: 3 is added to each term to get the next term.)
4. Discuss: Can you tell me the next term in the pattern? How do you know?
5. Allow volunteers to respond until they determine the correct answer. (Answer: 17; 3 is added to the last term, $14 + 3 = 17$.)
6. Explain that today's lesson is on sequences. Pupils will be determine the rule that gives a sequence, and using the rule to extend the sequence.

Teaching and Learning *(20 minutes)*

1. Write the following number sequences on the board:
   a. 2, 4, 8, 16, 32, …
   b. 1, 4, 9, 16, 25, …
   c. 1, 3, 5, 7, 9, …
2. Discuss each sequence. Ask pupils to describe the rule for each sequence that gives the next term. Allow them to brainstorm before guiding them to the correct answer.
   Rules:
   a. Each term is multiplied by 2 to get the next term; each term is twice as much as the previous term.
   b. The terms are the squares of consecutive whole numbers; the squares of 1, 2, 3, …
   c. The terms are odd numbers.
3. Explain **sequence:** A list of numbers that follows a rule is called a sequence. Each example on the board is a sequence of numbers.
4. Explain **general term:**
   - The general term can be found for a sequence.
   - The variable n is used to give the general term of a sequence. n represents a number's place in the sequence.
   - For example, look at sequence a. 2 has place $n = 1$, 4 has place $n = 2$, 8 has place $n = 3$, and so on.
   - For each sequence on the board, we can brainstorm to find a general term. That is, we can find an expression using n that applies to every term.

5. Write the general term for sequence a. on the board: 2, 4, 8, 16, 32, …, 2^n, …
6. Explain: Each term in the sequence is 2 raised to the power of its place.
7. Demonstrate with a few terms on the board: $2 = 2^1$, $4 = 2^2$, $8 = 2^3$
8. Explain: The general term can also be used to find a term that comes later in the sequence.
9. Calculate the 6th term of the sequence: $2^6 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 64$
10. Discuss: Does this seem correct? How can you tell if it's correct?
11. Allow pupils to respond. Remind pupils that the 6th term is the next in the sequence. They have already identified that each term is multiplied by 2 to get the next term, so they can find the next term by multiplying 32 ($32 \times 2 = 64$).
12. Explain: This formula can be used to find any term later on in the sequence, even the hundredth or thousandth term.
13. Ask pupils to look at sequence b. on the board.
14. Discuss: What could the general term be in this sequence?
15. Allow pupils to respond, and guide them to the correct answer. (Answer: n^2)
16. Explain: Each term is the square of n, or its place in the sequence.
17. Demonstrate with a few terms on the board: $1^2 = 1$, $2^2 = 4$, $3^2 = 9$
18. Ask pupils to work with seatmates to find the 10th term in the sequence. Ask a volunteer to share their answer and explain. (Answer: 10th term $= 10^2 = 100$)
19. Ask pupils to work with seatmates to write a formula for the general term of sequence c.
20. Allow volunteers to share their ideas, and guide them to the correct answer. (Answer: $2n - 1$)
21. Ask pupils to work with seatmates to find the 30th term of the sequence using the general term.
22. Invite a volunteer to write their solution on the board. (Answer: $2(30) - 1 = 60 - 1 = 59$)
23. Write the following 2 problems on the board: Find the next 3 terms of each sequence. Then, write down the general term:
    a. 2, 4, 6, 8, 10, …
    b. 5, 6, 7, 8, 9, …
24. Ask pupils to work with seatmates to solve the problems.
25. Ask volunteers to share their answers with the class. (Answers: a. 12, 14, 16, $2n$; b. 10, 11, 12, $n + 4$)

Practice *(15 minutes)*

1. Write the following on the board:
    a. For the sequence 3, 6, 9, 12, …, find:
        i. The next 3 terms
        ii. The general term
    b. Find the 6th term in a sequence whose general term is $2n + 3$.
    c. Find the 8th term in a sequence whose nth term is $5n - 1$.

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates if needed.
3. Invite 3 volunteers to write their answers on the board and explain. (Answers: a. i. 15, 18, 21, ii. $3n$; b. $2(6) + 3 = 12 + 3 = 15$; c. $5(8) - 1 = 40 - 1 = 39$)

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L049 in the Pupil Handbook.

Lesson Title: Arithmetic progressions	**Theme:** Numbers and Numeration	
Lesson Number: M2-L050	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to define an arithmetic progression in terms of its common difference, d, and first term, a.	**Preparation** Write the sequence in Opening on the board.	

Opening *(4 minutes)*

1. Write on the board: 8, 14, 20, 26, …
2. Discuss: What is the rule for the sequence of numbers on the board?
3. Allow pupils to share ideas until they determine the pattern. (Answer: 6 is added to each term to get the next term.)
4. Ask pupils to write the next 3 terms of the sequence in their exercise books.
5. Invite a volunteer to write the next 3 terms on the board and explain. (Answer: 32, 38, 44; 6 is added each time.)
6. Explain that today's lesson is on arithmetic progressions. This is a certain type of sequence.

Teaching and Learning *(15 minutes)*

1. Explain:
   - In the sequence on the board, the first term is 8 and the **common difference** is 6. The common difference is a difference that is the same between each term and the next term.
   - A sequence in which the terms either increase or decrease by a common difference is an **arithmetic progression**. It can be abbreviated as AP.
2. Write the following examples on the board:
   - $5, 10, 15, 20, \ldots$
   - $100, 90, 80, 70, \ldots$
   - $10, 7, 4, 1, -2, \ldots$
3. Discuss each sequence. Ask volunteers to give the first term, and the common difference between the terms.
   Answers:
   a. The first term is 5, and the common difference is $+5$.
   b. The first term is 100, and the common difference is -10.
   c. The first term is 10, and the common difference is -3.
4. Explain: In each AP, the letter a is commonly used to describe the first term, and the letter d is used for common difference.
5. Write the following on the board: $a, a + d, a + 2d, a + 3d, \ldots$
6. Explain: This is a general arithmetic progression. The first term is a, and a difference of d is added to each subsequent term.

7. Write the following on the board: Find a and d for each sequence. Then, find the next 3 terms.
   a. $31, 26, 21, 16, \ldots$
   b. $-10, -8, -6, -4, \ldots$
   c. $-40, -20, 0, 20, 40, \ldots$
8. Ask pupils to work with seatmates to solve the problems.
9. Invite 3 volunteers to write the answers on the board and explain.
   Answers:
   a. $a = 31$; $d = -5$; Next 3 terms: $11, 6, 1$
   b. $a = -10$; $d = 2$; Next 3 terms: $-2, 0, 2$
   c. $a = -40$; $d = 20$; Next 3 terms: $60, 80, 100$

Practice *(16 minutes)*

1. Write the following on the board:
   For each of the following, find: a, d, and the next 3 terms.
      a. $6, 8, 10, 12, 14, \ldots$
      b. $0, -4, -8. -12, -16, \ldots$
      c. $-15, -10, -5, 0, \ldots$
   For each of the following, write the first 5 terms of the AP:
      d. $a = 7$ and $d = 12$.
      e. $a = 3$ and $d = -2$.
      f. $a = 20$ and $d = -10$.
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates if needed.
3. Invite volunteers to write their answers on the board and explain.
   Answers:
   a. $a = 6$, $d = 2$, next 3 terms: $16, 18, 20$
   b. $a = 0$, $d = -4$, next 3 terms: $-20, -24, -28$
   c. $a = -15$, $d = 5$, next 3 terms: $5, 10, 15$
   d. $7, 19, 31, 43, 55, \ldots$
   e. $3, 1, -1, -3, -5, \ldots$
   f. $20, 10, 0, -10, -20, \ldots$

Closing *(5 minutes)*

1. Tell pupils they will now have the chance to be creative. Pupils are to write their own AP with 5 terms.
2. Ask pupils to exchange their AP with a partner. Pupils should identify a and d of their partner's AP, and write the next 3 terms.
3. Walk around to check for understanding. If time allows, ask a few volunteers to share their APs.
4. For homework, have pupils do the practice activity PHM2-L050 in the Pupil Handbook.

Lesson Title: Geometric progressions	**Theme:** Numbers and Numeration	
Lesson Number: M2-L051	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to define a geometric progression in terms of its common ratio, r, and first term, a.	**Preparation** None	

Opening *(4 minutes)*

1. Write on the board: 3, 6, 12, 24, …
2. Discuss: What is the rule for the sequence of numbers on the board?
3. Allow pupils to share ideas until they determine the pattern. (Answer: Each term is multiplied by 2 to get the next term.)
4. Ask pupils to write the next 3 terms of the sequence in their exercise books.
5. Invite a volunteer to write the next 3 terms on the board and explain. (Answer: 48, 96, 192; each term is multiplied by 2.)
6. Explain that today's lesson is on geometric progressions. This is another type of sequence.

Teaching and Learning *(15 minutes)*

1. Explain:
    - In the sequence on the board, the first term is 3 and the **common ratio** is 2. The common ratio is the ratio between each term and the one before it.
    - A sequence in which the terms either increase or decrease by a common ratio is a **geometric progression**. It can be abbreviated to GP.
2. Write ratios on the board using terms from the given GP. Show pupils that they are each $2:1$:
    - $6:3 = 2:1$
    - $12:6 = 2:1$
3. Write the following examples on the board:
    - $2, 4, 8, 16, \ldots$
    - $32, 16, 8, 4, \ldots$
    - $1, -2, 4, -8, 16, \ldots$
4. Discuss each sequence. Ask volunteers to give the first term, and the common ratio.

    Answers:
    a. The first term is 2, and the common ratio is 2.
    b. The first term is 32, and the common ratio is $\frac{1}{2}$.
    c. The first term is 1, and the common ratio is -2.
5. Explain:
    - If the numbers decrease as the GP progresses, the common ratio must be a fraction.

- If the numbers alternate between positive and negative digits, the common ratio must be a negative value.

6. Explain: In each GP, the letter a is commonly used to describe the first term, and the letter r is used for the common ratio.
7. Write on the board: $a, ar, ar^2, ar^3, \ldots$
8. Explain: This is a general geometric progression. The first term is a, and a common ratio of r is multiplied by each subsequent term.
9. Write on the board: Find a and r for each sequence. Then, find the next 3 terms.
    d. $5, 10, 20, 40, \ldots$
    e. $-2, -4, -8, -16, \ldots$
    f. $4, -12, 36, -108, \ldots$
    g. $729, 243, 81, 27, \ldots$
10. Ask pupils to work with seatmates to solve the problems.
11. Invite 4 volunteers to write the answers on the board and explain.

    Answers:
    d. $a = 5$; $r = 2$; Next 3 terms: $80, 160, 320$
    e. $a = -2$; $r = 2$; Next 3 terms: $-32, -64, -128$
    f. $a = 4$; $r = -3$; Next 3 terms: $324, -972,\ 2{,}916$
    g. $a = 729$; $r = \frac{1}{3}$; Next 3 terms: $9, 3, 1$

Practice *(16 minutes)*

1. Write the following on the board:
    For each of the following, find: a, r, and the next 3 terms.
    a. $2, -6, 18, -54, \ldots$
    b. $-4, -8, -16, -32, \ldots$
    c. $\frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \frac{1}{16}, \ldots$
    For each of the following, write the first 5 terms of the GP:
    d. $a = 1$ and $r = -4$.
    e. $a = 240$ and $r = \frac{1}{2}$.
    f. $a = \frac{1}{6}$ and $r = 6$.
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates if needed.
3. Invite volunteers to write their answers on the board and explain.

    Answers:
    g. $a = 2$, $r = -3$, next 3 terms: $162, -486, 1{,}458$
    h. $a = -4$, $r = 2$, next 3 terms: $-64, -128, -256$
    i. $a = \frac{1}{2}$, $r = \frac{1}{2}$, next 3 terms: $\frac{1}{32}, \frac{1}{64}, \frac{1}{128}$
    j. $1, -4, 16, -64, 256, \ldots$
    k. $240, 120, 60, 30, 15, \ldots$
    l. $\frac{1}{6}, 1, 6, 36, 216, \ldots$

Closing *(5 minutes)*

1. Ask pupils to be creative. They are to write their own GP with 5 terms.
2. Ask them to exchange their GP with a partner. They should identify a and r of their partner's GP, and write the next 3 terms.
3. Walk around to check for understanding. If time allows, ask a few volunteers to share their GPs.
4. For homework, have pupils do the practice activity PHM2-L051 in the Pupil Handbook.

Lesson Title: nth term of an arithmetic sequence	**Theme:** Numbers and Numeration	
Lesson Number: M2-L052	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to apply the formula to find the nth term of an arithmetic sequence.	**Preparation** None	

Opening *(3 minutes)*

1. Revise arithmetic progressions. Write on the board: Write the first 5 terms of an AP if $a = 3$ and $d = 5$.
2. Ask pupils to write the solution in their exercise books.
3. Invite a volunteer to write the answer on the board and explain. (Answer: 3, 8, 13, 18, 23, …)
4. Explain that today's lesson is on finding any term of an arithmetic progression using a formula.

Teaching and Learning *(20 minutes)*

1. Explain:
   - We have used the common difference to find the next term in an arithmetic progression.
   - There is a formula that gives the general term of an AP. That is, it describes every term in the sequence.
2. Write on the board: $U_n = a + (n-1)d$, where U_n is the nth term of the AP.
3. Explain:
   - This is a formula that can give any term in the sequence.
   - The letter n gives the place of a term in the sequence.
   - In the AP on the board, 3 is the 1st term, 8 is the 2nd term, and so on.
   - The sequence continues so that we even have a 100th term and a 1000th term. The formula on the board allows us to find the values of later terms.
4. Ask pupils to look at the sequence on the board (3, 8, 13, 18, 23, …).
5. Write on the board: What is the 10th term?
6. Solve on the board using the formula, explaining each step:

$$\begin{aligned} U_n &= a + (n-1)d && \text{Formula} \\ U_{10} &= 3 + (10-1)5 && \text{Substitute } a, n, \text{ and } d \\ &= 3 + (9)5 && \text{Simplify} \\ &= 48 \end{aligned}$$

7. Explain: The 10th term of this sequence is 48. If we continued to add 5 and write out each term of the sequence, this is what we would find.
8. Write on the board: What is the 15th term?

9. Ask pupils to work with seatmates to find the 15th term using the formula.
10. Invite a volunteer to write the solution on the board.

Solution:

U_n	$=$	$a+(n-1)d$	Formula
U_{15}	$=$	$3+(15-1)5$	Substitute a, n, and d
	$=$	$3+(14)5$	Simplify
	$=$	73	

11. Write on the board: What is the nth term?
12. Solve for the nth term on the board, explaining each step:

U_n	$=$	$a+(n-1)d$	Formula
	$=$	$3+(n-1)5$	Substitute a and d
	$=$	$3+5n-5$	Simplify
	$=$	$5n-2$	

13. Write on the board: For the AP $5, 8, 11, 14, 17, \ldots$, use the formula to find:
    h. The 10th term.
    i. The 99th term.
    j. The nth term.
14. Ask pupils to work with seatmates to solve the problems. If needed, find the values of a and d as a class. (Answers: $a = 5$, $d = 3$)
15. Invite 3 volunteers to write the solutions on the board and explain.

Solutions:

a.	U_n	$=$	$a+(n-1)d$	Formula
	U_{10}	$=$	$5+(10-1)3$	Substitute a, n, and d
		$=$	$5+(9)3$	Simplify
		$=$	32	
b.	U_{99}	$=$	$5+(99-1)3$	Substitute a, n, and d
		$=$	$5+(98)3$	Simplify
		$=$	299	
c.	U_n	$=$	$a+(n-1)d$	
		$=$	$5+(n-1)3$	Substitute a and d
		$=$	$5+3n-3$	Simplify
		$=$	$3n+2$	

Practice *(12 minutes)*

1. Write on the board:
   Use the formula $U_n = a + (n-1)d$ for the following:
    a. For the AP $1, 4, 7, 10, 13, \ldots$ find:
        i. The 10th term
        ii. The 99th term
        iii. The nth term
    b. The 30th term of an AP is 150 ($U_{30} = 150$). If the common difference is 5, what is the first term of the progression?
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates if needed.
3. Invite volunteers to write their solutions on the board and explain.

Solutions:

a. i. $U_n = a + (n-1)d$ Formula

$U_{10} = 1 + (10-1)3$ Substitute a, n, and d

$= 1 + (9)3$ Simplify

$= 28$

ii. $U_{99} = 1 + (99-1)3$ Substitute a, n, and d

$= 1 + (98)3$ Simplify

$= 295$

iii. $U_n = a + (n-1)d$

$= 1 + (n-1)3$ Substitute a and d

$= 1 + 3n - 3$ Simplify

$= 3n - 2$

b. $U_n = a + (n-1)d$ Formula

$150 = a + (30-1)5$ Substitute U_n, n, and d

$150 = a + (29)5$

$150 = a + 145$

$150 - 145 = a$ Transpose 145

$5 = a$

Closing *(5 minutes)*

1. Ask pupils to write their own AP problem for their partner to solve. Pupils should write the sequence and ask their partner to find a certain term.
2. Ask pupils to exchange questions with a partner. They should use the formula to solve the problem written by their partner.
3. Walk around to check for understanding. If time allows, ask a few volunteers to share their problems.
4. For homework, have pupils do the practice activity PHM2-L052 in the Pupil Handbook.

<table>
<tr><td>Lesson Title: nth term of a geometric sequence</td><td colspan="2">Theme: Numbers and Numeration</td></tr>
<tr><td>Lesson Number: M2-L053</td><td>Class: SSS 2</td><td>Time: 40 minutes</td></tr>
<tr><td>Learning Outcome
By the end of the lesson, pupils will be able to apply the formula to find the nth term of a geometric sequence.</td><td colspan="2">Preparation
None</td></tr>
</table>

Opening *(3 minutes)*

1. Revise geometric progressions. Write on the board: Write the first 5 terms of a GP if $a = 1$ and $r = 2$.
2. Ask pupils to write the solution in their exercise books.
3. Invite a volunteer to write the answer on the board and explain. (Answer: $1, 2, 4, 8, 16$)
4. Explain that today's lesson is on finding any term of a geometric progression using a formula.

Teaching and Learning *(20 minutes)*

1. Explain:
   - We have used the common ratio to find the next term in a geometric progression.
   - There is a formula that gives the general term of a GP. It describes every term in the sequence.
2. Write on the board: $U_n = ar^{n-1}$, where U_n is the nth term of the GP.
3. Explain:
   - This is a formula that can give any term in the sequence.
   - The letter n gives the place of a term in the sequence.
   - In the GP on the board, 1 is the 1st term, 2 is the 2nd term, and so on.
4. Ask pupils to look at the sequence on the board ($1, 2, 4, 8, 16, \ldots$)
5. Write on the board: What is the 10th term?
6. Solve on the board using the formula, explaining each step:

$$\begin{aligned} U_n &= ar^{n-1} && \text{Formula} \\ U_{10} &= 1(2^{10-1}) && \text{Substitute } a, n, \text{ and } r \\ &= 2^9 && \text{Simplify} \\ &= 512 \end{aligned}$$

7. Explain: The 10th term of this sequence is 512. If we continued to multiply by 2 and write out each term of the sequence, this is what we would find.
8. Write on the board: What is the 100th term?
9. Ask pupils to give the steps to find the 100th term. As they describe the steps, write them on the board:

$$\begin{aligned} U_n &= ar^{n-1} \\ U_{100} &= 1(2^{100-1}) && \text{Substitute } a, n, \text{ and } r \end{aligned}$$

$$= 2^{99} \quad \text{Simplify}$$

10. Explain: The answer can be left in index form, because 98 is a very high power that is difficult to calculate.
11. Write on the board: What is the nth term?
12. Solve for the nth term on the board, explaining each step:

$$\begin{aligned} U_n &= ar^{n-1} & \\ &= 1(2^{n-1}) & \text{Substitute } a \text{ and } r \\ &= 2^{n-1} & \end{aligned}$$

13. Write the following problem on the board: For the GP $5, 10, 20, 40, 80, ...$ find:
    a. The 10th term
    b. The 60th term
    c. The nth term
14. Ask volunteers to give the values of a and r. (Answers: $a = 5$, $r = 2$)
15. Ask pupils to work with seatmates to find the solutions. Support them as needed.
16. Invite volunteers to write the solutions on the board.

Solutions:

a.
$$\begin{aligned} U_n &= ar^{n-1} & \\ U_{10} &= 5(2^{10-1}) & \text{Substitute } a, n, \text{ and } r \\ &= 5(2^9) & \text{Simplify} \\ &= 2560 & \text{Answer may be left as } 5(2^9) \end{aligned}$$

b.
$$\begin{aligned} U_{60} &= 5(2^{60-1}) & \text{Substitute } a, n, \text{ and } r \\ &= 5(2^{59}) & \text{Simplify} \end{aligned}$$

c.
$$\begin{aligned} U_n &= ar^{n-1} & \\ &= 5(2^{n-1}) & \text{Substitute } a \text{ and } r \end{aligned}$$

Practice *(12 minutes)*

1. Write on the board:
   Use the formula $U_n = ar^{n-1}$ for the following:
    a. For the GP $3, -6, 12, -24, 48, ...$ find:
        i. The 10th term
        ii. The 99th term
        iii. The nth term
    b. The 6th term of an AP is 486 ($U_6 = 486$). If the common ratio is 3, what is the first term of the progression?
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates if needed.
3. Invite volunteers to write their solutions on the board and explain.

Solutions:

c. i.
$$\begin{aligned} U_n &= ar^{n-1} & \\ U_{10} &= 3(-2)^{10-1} & \text{Substitute } a, n, \text{ and } r \\ &= 3(-2)^9 & \text{Simplify} \\ &= -1536 & \text{Answer may be left as } 3(-2)^9 \end{aligned}$$

ii. U_{99}	$=$	$3(-2)^{99-1}$	Substitute a, n, and r
	$=$	$3(-2)^{98}$	Simplify
iii. U_n	$=$	ar^{n-1}	
	$=$	$3(-2)^{n-1}$	Substitute a and r
d. U_n	$=$	ar^{n-1}	
486	$=$	$a(3^{6-1})$	Substitute U_n, n, and d
486	$=$	$a(3^5)$	
486	$=$	$a(243)$	
$\frac{486}{243}$	$=$	$\frac{243a}{243}$	Divide throughout by 243
2	$=$	a	

Closing *(5 minutes)*

1. Ask pupils to write their own GP problem for their partner to solve. The pupils should write the sequence and ask their partner to find a certain term.
2. Ask pupils to exchange questions with a partner. They should use the formula to solve the problem written by their partner.
3. Walk around to check for understanding. If time allows, ask a few volunteers to share their problems.
4. For homework, have pupils do the practice activity PHM2-L053 in the Pupil Handbook.

<table>
<tr><td>Lesson Title: Series</td><td colspan="2">Theme: Numbers and Numeration</td></tr>
<tr><td>Lesson Number: M2-L054</td><td>Class: SSS 2</td><td>Time: 40 minutes</td></tr>
<tr><td>Learning Outcomes
By the end of the lesson, pupils will be able to:
1. Distinguish between a sequence and a series.
2. Find the sum of the terms of a series by adding.</td><td colspan="2">Preparation
Write the sequences in Opening on the board.</td></tr>
</table>

Opening *(4 minutes)*

1. Revise arithmetic and geometric progressions. Write on the board:
   a. $1, 2, 4, 8, 16, \ldots$
   b. $4, 7, 10, 13, \ldots$
   c. $-1, -7, -13, -19, -25, \ldots$
   d. $2, -6, 18, -54, 162, \ldots$
2. Ask pupils to work with seatmates to determine whether each sequence is an AP or a GP.
3. Ask volunteers to share their answers and explain. (Answers: a. GP; b. AP; c. AP; d. GP)
4. Explain that today's lesson is on series. Series are related to sequences.

Teaching and Learning *(18 minutes)*

1. Explain: When the terms of a sequence are added together, the result is a series.
2. Write on the board:
   a. $1 + 2 + 3 + 4 + 5$
   b. $2 + 4 + 6 + 8 + \ldots$
   c. $5 + 10 + 15 + \ldots + 100$
   d. $-2 - 4 - 6 - 8 - 10$
   e. $50 + 100 + 150 + 200 + \ldots$
3. Explain **infinite series:**
   - Some series carry on forever. These are called infinite series. Among the series on the board, b. and e. are infinite series.
   - It is often impossible to find the sum of infinite series. If you started adding the terms of a. or e., you would go on forever toward infinity.
4. Explain **finite series:**
   - Some series have a certain number of terms. They do not carry on forever, but end at a certain point. Among the series on the board, a., c., and d. are finite series.
   - It is always possible to find the sum of a finite series.
5. Ask pupils to work with seatmates to find the sum of series a.

6. Invite a volunteer to write the answer on the board. (Answer: $1 + 2 + 3 + 4 + 5 = 15$)
7. Explain: In series d., negative numbers are being added together. Recall that when you add negative numbers, it is the same as subtracting.
8. Ask pupils to work with seatmates to find the sum of series d.
9. Invite a volunteer to write the answer on the board. (Answer: $-2 - 4 - 6 - 8 - 10 = -30$)
10. Write the following problem on the board: Find the sum of the first 6 terms of an AP where $a = 10$ and $d = -3$.
11. Ask volunteers to list the first 6 terms of the AP. As they say them, write them on the board: $10, 7, 4, 1, -2, -5, \ldots$
12. Ask pupils to write this sequence as a series in their exercise books.
13. Invite a volunteer to write the series on the board.
    Answer: $10 + 7 + 4 + 1 + (-2) + (-5) + \cdots$
    or : $10 + 7 + 4 + 1 - 2 - 5 + \cdots$
14. Ask pupils to work with seatmates to find the sum of the first 6 terms.
15. Invite a volunteer to write the answer on the board. (Answer: 15)
16. Write the following problem on the board: For the AP where $a = 5$ and $d = 15$:
    a. Write the sequence.
    b. Write the series.
    c. Find the sum of the first 5 terms.
17. Ask pupils to work with seatmates to solve the problem.
18. Invite 3 volunteers to each write part of the answer on the board.
    Answers: a. Sequence: $5, 20, 35, 50, 65, \ldots$
    b. Series: $5 + 20 + 35 + 50 + 65 + \cdots$
    c. Sum of first 5 terms: $5 + 20 + 35 + 50 + 65 = 175$

Practice *(13 minutes)*

1. Write on the board:
    a. Find the sum of the finite series: $2 + 6 + 10 + 14 + 18 + 22$
    b. Find the sum of the first 9 terms of the AP where $a = 10$ and $d = 10$.
    c. Find the sum of the first 4 terms of the AP where $a = -2$ and $d = -3$.
2. Ask pupils to work independently to solve the problems.
3. Invite volunteers to write their solutions on the board and explain.
    Solutions:
    a. $2 + 6 + 10 + 14 + 18 + 22 = 72$
    b. $10 + 20 + 30 + 40 + 50 + 60 + 70 + 80 + 90 = 450$
    c. $-2 - 5 - 8 - 11 = -26$

Closing *(5 minutes)*

1. Ask pupils to write their own series problem for a partner to solve. They should write the series and ask their partner to find the sum.
2. Ask pupils to exchange questions with a partner. They should solve the problem written by their partner.
3. Walk around to check for understanding. If time allows, ask a few volunteers to share their problems.
4. For homework, have pupils do the practice activity PHM2-L054 in the Pupil Handbook.

Lesson Title: The sum of an arithmetic series	**Theme:** Numbers and Numeration	
Lesson Number: M2-L055	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the sum of the first n terms of an arithmetic series.	**Preparation** Write the series in Opening on the board.	

Opening *(4 minutes)*

1. Review addition of short series. Write on the board: $4 + 6 + 8 + 10 + 12 =$
2. Ask pupils to describe the series in their own words. (Example answer: The first number is 4, and the common difference between numbers is 2.)
3. Ask pupils to work with seatmates to find the sum of the series.
4. Ask a volunteer to share the answer. (Answer: 40)
5. Explain that today's lesson is on finding the sum of an arithmetic series with more terms.

Teaching and Learning *(20 minutes)*

1. Explain:
   - When we have a few terms of an AP, it is simple to add them together.
   - In most cases there are more terms than can easily be added. For these, we use a formula.
2. Write on the board: $S = \frac{1}{2}n[2a + (n-1)d]$
3. Explain: This is the formula for the sum of n terms of an AP. Remember that the variable n gives the number of terms, a gives the first term, and d gives the common difference.
4. Use the formula to find the sum of the terms in the series from opening. Write on the board:

$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ &= \tfrac{1}{2}(5)[2(4) + (5-1)2] && \text{Substitute } n, a, \text{ and } d \\ &= \tfrac{1}{2}(5)[8 + 8] && \text{Simplify} \\ &= \tfrac{1}{2}(80) = 40 \end{aligned}$$

5. Explain: This is the same answer we found by adding.
6. Write another problem on the board: Find the sum of the first 12 terms of the AP 10, 8, 6, 4, ….
7. Ask volunteers to give the values of n, a, and d. As they give them, write them on the board. (Answers: $n = 12$, $a = 10$, and $d = -2$)
8. Solve the problem on the board, explaining each step:

$$S = \tfrac{1}{2}n[2a + (n-1)d]$$

$$= \frac{1}{2}(12)[2(10) + (12 - 1)(-2)] \quad \text{Substitute } n, a, \text{ and } d$$
$$= (6)[20 - 22] \quad \text{Simplify}$$
$$= 6(-2) = -12$$

9. Write another problem on the board: Find the sum of the first 16 terms of the AP with $a = 3$ and $d = 4$.
10. Ask pupils to work with seatmates to write the first 5 terms of the AP. (Answer: 3, 7, 11, 15, 19, …)
11. Ask pupils to work with seatmates to solve the problem.
12. Invite a volunteer to write the solution on the board.

Solution:

$$S = \frac{1}{2}n[2a + (n - 1)d]$$
$$= \frac{1}{2}(16)[2(3) + (16 - 1)4] \quad \text{Substitute } n, a, \text{ and } d$$
$$= (8)[6 + 60] \quad \text{Simplify}$$
$$= 8(66) = 528$$

13. Write another problem on the board: An AP with 14 terms has a first term of 20, and a sum of 7. What is the common difference?
14. Discuss: How can we solve this problem?
15. After allowing pupils to share their ideas, explain: The same formula can be used to solve this problem. The unknown value is d. We substitute all of the known values and solve for d.
16. Solve the problem on the board, explaining each step:

$$S = \frac{1}{2}n[2a + (n - 1)d]$$
$$7 = \frac{1}{2}(14)[2(20) + (14 - 1)d] \quad \text{Substitute } n, a, \text{ and } d$$
$$7 = 7[40 + 13d] \quad \text{Simplify}$$
$$1 = 40 + 13d \quad \text{Divide throughout by 7}$$
$$1 - 40 = 13d \quad \text{Transpose 40}$$
$$-39 = 13d$$
$$\frac{-39}{13} = \frac{13d}{13} \quad \text{Divide throughout by 13}$$
$$-3 = d$$

17. Explain: We have solved for d. The formula can be used to solve for any of the variables if one of them is unknown.
18. Write the following problem on the board: An AP has 10 terms, and a sum of 240. If the common difference is 2, what is the first term?
19. Ask pupils to work with seatmates to find the value of a.
20. Invite a volunteer to write the solution on the board.

Solution:

$$S = \frac{1}{2}n[2a + (n - 1)d]$$
$$240 = \frac{1}{2}(10)[2a + (10 - 1)2] \quad \text{Substitute } n, a, \text{ and } d$$
$$240 = 5[2a + 18] \quad \text{Simplify}$$

$$\begin{aligned} 48 &= 2a + 18 && \text{Divide throughout by 5} \\ 48 - 18 &= 2a && \text{Transpose 18} \\ 30 &= 2a \\ \frac{30}{2} &= \frac{2a}{2} && \text{Divide throughout by 2} \\ 15 &= a \end{aligned}$$

Practice *(15 minutes)*

1. Write on the board:
   a. Find the sum of the first 10 terms of an AP with first term 3, and common difference 5.
   b. Find the sum of the first 15 terms of a series where $a = 20$ and $d = -2$.
   c. A series has 20 terms, and the first term is -25. If the sum of the series is 450, what is the common difference?
2. Ask pupils to work independently to solve the problems. They may discuss with seatmates if needed.
3. Invite volunteers to write their solutions on the board and explain.
   Solutions:
   a.
$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ &= \tfrac{1}{2}(10)[2(3) + (10-1)5] && \text{Substitute } n, a, \text{ and } d \\ &= (5)[6 + 45] && \text{Simplify} \\ &= 5(51) = 255 \end{aligned}$$
   b.
$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ &= \tfrac{1}{2}(15)[2(20) + (15-1)(-2)] && \text{Substitute } n, a, \text{ and } d \\ &= \tfrac{1}{2}(15)[40 - 28] && \text{Simplify} \\ &= \tfrac{1}{2}(15)(12) \\ &= (15)(6) = 90 \end{aligned}$$
   c.
$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ 450 &= \tfrac{1}{2}(20)[2(-25) + (20-1)d] && \text{Substitute } n, a, \text{ and } d \\ 450 &= 10[-50 + 19d] && \text{Simplify} \\ 45 &= -50 + 19d && \text{Divide throughout by 10} \\ 45 + 50 &= 19d && \text{Transpose 50} \\ 95 &= 19d \\ 5 &= d && \text{Divide throughout by 19} \end{aligned}$$

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L055 in the Pupil Handbook.

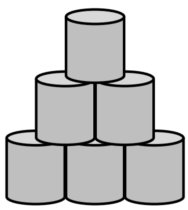
Lesson Title: Numerical and real-life problems involving sequences and series	**Theme:** Numbers and Numeration	
Lesson Number: M2-L056	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to apply sequences and series to numerical and real-life problems.	**Preparation** Write the problems in Opening on the board.	

Opening *(6 minutes)*

1. Review sequences and series. Write on the board:
   a. Write the first 5 terms of your own AP.
   b. Calculate the 10^{th} term of the sequence using the formula.
   c. Calculate the sum of the first 10 terms.
2. Ask pupils to work with seatmates to complete the work on the board. Walk around to check for understanding.
3. Ask 1 group of seatmates to present their work. Answers will vary. Examples:
   a. 2, 5, 8, 11, 14, …
   b. $U_{10} = a + (n-1)d = 2 + (10-1)3 = 2 + 27 = 29$
   c. $S = \frac{1}{2}n[2a + (n-1)d] = \frac{1}{2}(10)[2(2) + (10-1)3] = 5(4 + 27) = 155$
4. Explain that today's lesson is on solving real-life problems using sequences and series.

Teaching and Learning *(15 minutes)*

1. Tell a story: Mr. Bangura sells cans of fish in the market. He decided to display them in a nice way to attract more customers. He arranged them in a stack so that 1 can is in the top row, 2 cans are in the next row, 3 cans are in the third row, and so on. The bottom row has 14 cans of fish.
2. Draw a picture of the top 3 rows on the board to help pupils visualise his stack of cans:



3. Discuss: Can you write a sequence based on this story? What would the sequence be?
4. Allow pupils to share their ideas, then explain: The number of cans in each row forms a sequence.
5. Write the sequence on the board, as shown: 1, 2, 3, 4, …, 14

6. Discuss: Can you calculate the total number of cans in the stack? What steps would you take?
7. Allow pupils to share their ideas, then explain: The stack forms an arithmetic sequence. This means we can make a series and find the sum with the formula from the previous lesson.
8. Ask pupils to give the values of a, n, and d for this problem, and explain. (Answer: $a = 1$, the number of cans in the first row; $n = 14$, the number of rows; $d = 1$, the difference between each row and the next row.)
9. Ask pupils to work with seatmates to calculate the total number of cans.
10. Invite a volunteer to write the solution on the board.
   Solution:

$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ &= \tfrac{1}{2}(14)[2(1) + (14-1)1] && \text{Substitute } n, a, \text{ and } d \\ &= 7(2 + 13) && \text{Simplify} \\ &= 7(15) = 105 \end{aligned}$$

11. Explain: There are 105 cans of fish in Mr. Bangura's display.
12. Write the following problem on the board: Fatu picks mangos from her tree each day. On the first day she picked 2 mangos, on the second day she picked 4 mangos, and on the third day she picked 6 mangos. She continued picking 2 more mangos for each day of mango season.
    a. Write a sequence for the word problem.
    b. How many mangos did she pick on the 10^{th} day?
    c. How many mangoes does she pick in total in 30 days?
13. Find the answer to part a. as a class. Ask volunteers to give the sequence, and write it on the board. (Answer: a. 2, 4, 6, 8, …)
14. Ask pupils to work with seatmates to solve parts b. and c. of the problem.
15. Invite volunteers to write the solutions on the board.
   Solutions:
   b.

$$\begin{aligned} U_n &= a + (n-1)d \\ U_{10} &= 2 + (10-1)2 && \text{Substitute } a, n, \text{ and } d \\ &= 2 + (9)2 && \text{Simplify} \\ &= 20 \end{aligned}$$

   She picked 20 mangos on the 10^{th} day.
   c.

$$\begin{aligned} S &= \tfrac{1}{2}n[2a + (n-1)d] \\ &= \tfrac{1}{2}(30)[2(2) + (30-1)2] && \text{Substitute } n, a, \text{ and } d \\ &= (15)[4 + 58] && \text{Simplify} \\ &= 15(62) = 930 \end{aligned}$$

   She picked a total of 930 mangos in 30 days.

Practice *(18 minutes)*

1. Write on the board:

a. Mrs. Jalloh's business profit rose steadily in each month of last year. In January, her profit was Le 200,000.00, and it increased by Le 50,000.00 each month.
   i. What was her profit in December?
   ii. What was her total profit for the year?

b. A sum of money is shared among 14 people so that the first person receives Le 5,000.00, the next person receives Le 15,000.00, the next Le 25,000.00, and so on.
   i. How much money does the 14th person receive?
   ii. How much money is shared in total?

2. Ask pupils to work independently to solve the problems. They may discuss with seatmates if needed.
3. Invite volunteers to write their solutions on the board. They may come at the same time.

Solutions:

a. Note that $a = 200{,}000$, $d = 50{,}000$, and $n = 12$.

i.

U_n	$=$	$a + (n-1)d$	
U_{12}	$=$	$200{,}000 + (12-1)50{,}000$	Substitute a, n, and d
	$=$	$200{,}000 + 550{,}000$	Simplify
	$=$	$750{,}000$	

Her profit in December was Le 750,000.00.

ii.

S	$=$	$\frac{1}{2}n[2a + (n-1)d]$	
	$=$	$\frac{1}{2}(12)[2(200{,}000) + (12-1)50{,}000]$	Substitute n, a, and d
	$=$	$(6)[400{,}000 + 550{,}000]$	Simplify
	$=$	$6(950{,}000)$	
	$=$	$5{,}700{,}000$	

Her profit for the year was Le 5,700,000.00.

b. Note that $a = 5{,}000$, $d = 10{,}000$, and $n = 14$.

i.

U_n	$=$	$a + (n-1)d$	
U_{14}	$=$	$5{,}000 + (14-1)10{,}000$	Substitute a, n, and d
	$=$	$5{,}000 + 130{,}000$	Simplify
	$=$	$135{,}000$	

The 14th person receives Le 135,000.

ii.

S	$=$	$\frac{1}{2}n[2a + (n-1)d]$	
	$=$	$\frac{1}{2}(14)[2(5{,}000) + (14-1)10{,}000]$	Substitute n, a, and d
	$=$	$(7)[10{,}000 + 130{,}000]$	Simplify
	$=$	$7(140{,}000)$	
	$=$	$980{,}000$	

The total amount shared is Le 980,000.00.

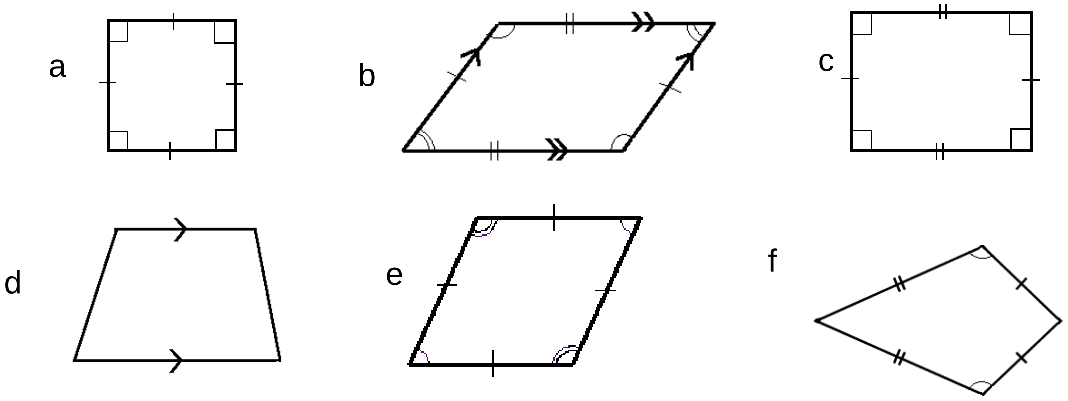
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L056 in the Pupil Handbook.

Lesson Title: Characteristics of quadrilaterals	**Theme:** Geometry	
Lesson Number: M2-L057	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcomes By the end of the lesson, pupils will be able to: 1. Identify and describe characteristics of quadrilaterals: square, rectangle, rhombus, parallelogram, kites, and trapezium. 2. Differentiate between types of quadrilaterals.	**Preparation** Draw the 6 shapes in Opening on the board.	

Opening *(5 minutes)*

1. Draw the following shapes on the board:

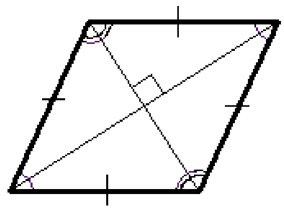


2. Ask pupils to discuss and name each shape with seatmates.
3. Invite volunteers to write the name of each shape on the board. (Answers: a. square; b. parallelogram; c. rectangle; d. trapezium; e. rhombus; f. kite)
4. Explain that today's lesson is on quadrilaterals. These are the 6 different types of quadrilaterals that will be discussed.

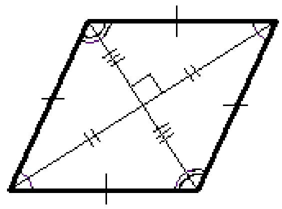
Teaching and Learning *(20 minutes)*

1. Discuss the following shapes. Encourage pupils to share their ideas, and confirm the correct statements:
   - What are the characteristics of a **rectangle**? (Answer: Opposite sides are the same length; opposite sides are parallel; it has 4 right angles.)
   - What are the characteristics of a **square**? (Answer: All sides are the same length; opposite sides are parallel; it has 4 right angles.)
   - What are the characteristics of a **parallelogram**? (Answer: Opposite sides are the same length; opposite sides are parallel; opposite angles are equal.)
   - What are the characteristics of a **trapezium**? (Answer: One pair of opposite sides are parallel)

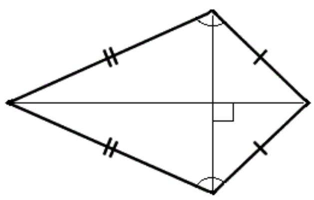
2. Discuss **Rhombus:**
    - What are the characteristics of a rhombus? (Answer: All sides are the same length; opposite sides are parallel; opposite angles are equal.)
3. Draw diagonals in the rhombus on the board, as shown:



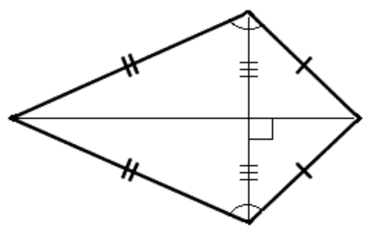
4. Explain:
    - An interesting fact about the rhombus is that its diagonals meet in the middle at a right angle.
    - The diagonals also bisect each other, meaning that the segments on either side of their intersection are equal.
    - The diagonals also bisect the angles.
5. Draw marks on the diagonals to show that the diagonals are bisected:



6. Discuss **kite:**
    - What are the characteristics of a kite? (Answer: It has two pairs of sides with equal lengths, which meet each other; the angles where the two pairs of sides meet are equal)
7. Draw diagonals in the kite on the board, as shown:

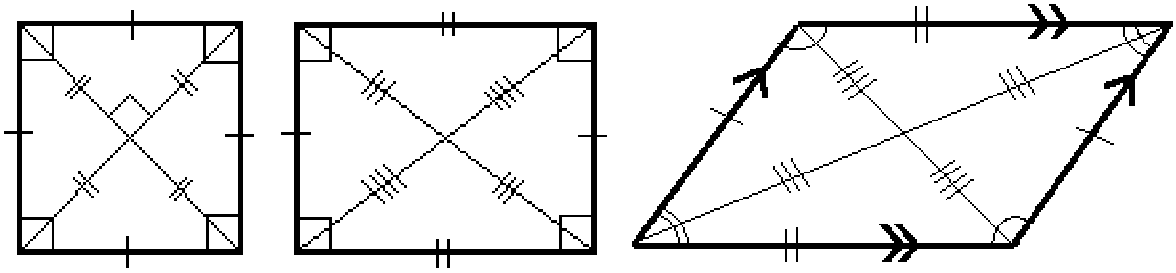


8. Explain:
    - The diagonals of a kite also meet at a right angle.
    - Only one diagonal is bisected.
9. Draw marks on the diagonal to show that it is bisected:



10. Draw diagonals on the square, rectangle and parallelogram (see below) and explain:

- A square is actually a type of rhombus. This means that the diagonals of a square also bisect each other at right angles.
- The diagonals of the rectangle and parallelogram bisect each other, but do not form a right angle.



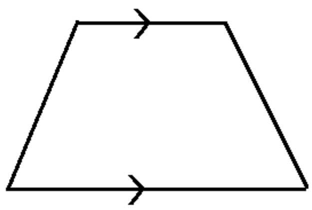
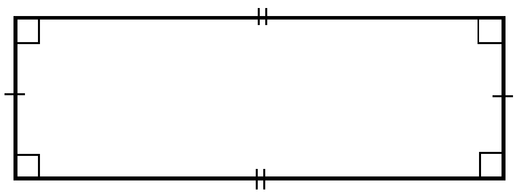
11. Discuss: Several of the shapes on the board can be called "parallelograms" because their opposite sides are parallel. Which shapes can be called parallelograms?
12. Allow pupils to answer and list any they do not list. (Answers: parallelogram, rhombus, square, rectangle)
13. Explain:
    - Although quadrilaterals look very different, they have some characteristics in common.
    - For example, their angles always add up to 360°. You will use this information in the next lesson.

Practice *(12 minutes)*

1. Write on the board: Draw as many types of quadrilaterals as you can that meet the rules below. Draw quadrilaterals for each rule a. – d. Quadrilaterals drawn may meet more than one rule at a time. Label their equal sides and angles, and any right angles:
    a. All 4 sides are equal in length.
    b. It has at least 1 obtuse angle.
    c. It has 4 right angles.
    d. Both sets of opposite sides are parallel.
2. Ask pupils to draw shapes for problems a. – d. They may discuss and compare with seatmates.
3. Discuss each problem as a class: Which shapes did you draw?
   Possible answers:
    a. Square, rhombus
    b. Parallelogram, kite, rhombus, trapezium
    c. Square, rectangle
    d. Square, rectangle, rhombus, parallelogram

Closing *(3 minutes)*

1. Describe 2 shapes using the descriptions a. and b. shown below. Ask pupils to quickly draw them in their exercise books and hold them up. Note that drawings do not have to be exact, and do not need to be drawn with a ruler.
   a. Draw a trapezium that has 1 parallel line approximately twice as long as the other.
   b. Draw a rectangle with length 3 times its width.
2. Look at their drawings to check for understanding.
   Example answers (drawings may differ slightly):

3. For homework, have pupils do the practice activity PHM2-L057 in the Pupil Handbook.

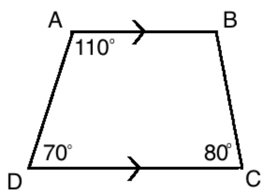
Lesson Title: Interior angles of quadrilaterals	**Theme:** Geometry	
Lesson Number: M2-L058	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the measurement of interior angles of quadrilaterals.	**Preparation** None	

Opening *(2 minutes)*

1. Discuss: What do you know about the angles of quadrilaterals?
2. Allow pupils to share their ideas. (Example answers: The interior angles add up to 360°; squares and rectangles have right angles; opposite angles of a parallelogram are equal.)
3. Explain that today's lesson is on finding the measures of interior angles of quadrilaterals.

Teaching and Learning *(25 minutes)*

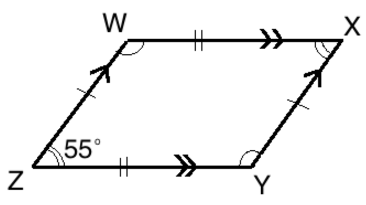
1. Draw trapezium ABCD on the board:



2. Explain:
   - We are given the measures of 3 angles, and we have 1 missing angle, B.
   - We can find the missing angle in a quadrilateral by subtracting the known angles from the sum of the interior angles, 360°.
3. Solve for angle B on the board:

$$\begin{aligned} A + B + C + D &= 360° \\ 110° + B + 80° + 70° &= 360° \\ B + 260° &= 360° \\ B &= 360° - 260° \\ B &= 100° \end{aligned}$$

4. Draw parallelogram WXYZ on the board:

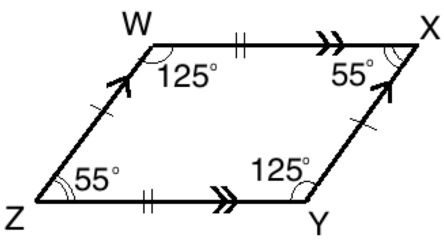


5. Discuss: Only 1 angle is given. How can we find the missing angles?
6. Allow pupils to share their ideas, then explain:
    - The opposite angles in a parallelogram are equal. Therefore, if $Z = 55°$, then X is also $55°$.
    - The other 2 missing angles, W and Y, are also equal. Subtract the total of X and Z from $360°$, then divide the result by 2 to find W and Y.
7. Solve on the board:

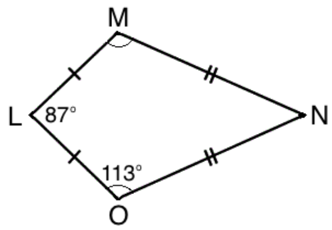
$$\begin{aligned} W + X + Y + Z &= 360° \\ W + 55° + Y + 55° &= 360° \\ W + Y + 110° &= 360° \\ W + Y &= 360° - 110° \\ W + Y &= 250° \end{aligned}$$

Since $W = Y$, divide $250°$ by 2 to find the measure.
$W = Y = 250° \div 2 = 125°$

8. Label the angles of $WXYZ$ with their measures:



9. Explain:
    - Notice that angles that are next to each other in this parallelogram add up to 180. $(125° + 55° = 180°)$
    - These are called co-interior angles. In this parallelogram, the following are co-interior: W and X, X and Y, Y and Z, Z and W.
    - This is true for any parallelogram. Recall that rhombus, square and rectangle are also parallelograms.
10. Draw kite LMNO on the board:

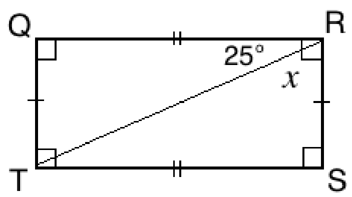


11. Discuss: How can we find the missing angles?
12. Allow pupils to share their ideas, then explain:
    - Angles M and O are equal, so we know the measure of M is 113°.
    - Once we know the measures of 3 angles, we can solve for the last missing angle by subtracting from 360°.
13. Ask pupils to solve for angles M and N with seatmates.

14. Invite a volunteer to write the solutions on the board and explain.
Solutions:
$M = O = 113°$.
Solve for angle N:

$$\begin{aligned} L + M + N + O &= 360° \\ 87° + 113° + N + 113° &= 360° \\ N + 313° &= 360° \\ N &= 360° - 313° \\ N &= 47° \end{aligned}$$

15. Draw rectangle $QRST$ on the board:

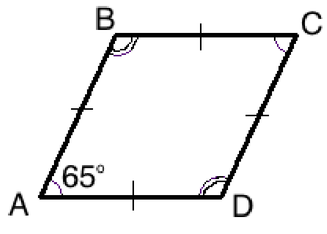


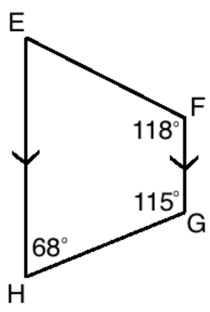
16. Discuss: Angle R is divided by the diagonal of the rectangle. How can we solve for angle x?
17. Allow pupils to share their ideas, then explain:
    - We know that angle R is 90° because it is a right angle. It is split by the diagonal, and we know part of it is 25°.
    - Subtract 25° from 90° to find the measure of angle x.
    - Recall that angle x and 25° are complementary angles. Complementary angles sum to 90°.
18. Ask pupils to work with seatmates to find angle x.
19. Invite a volunteer to solve on the board:

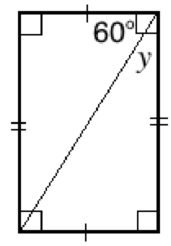
$$\begin{aligned} x + 25° &= 90° \\ x &= 90° - 25° \\ x &= 65° \end{aligned}$$

Practice *(12 minutes)*

1. Write on the board: Find the missing angles in each of the quadrilaterals:

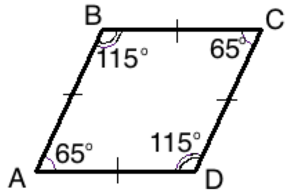
a.


b.


c.


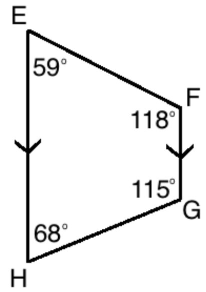
2. Ask pupils to work independently to find the missing angles.

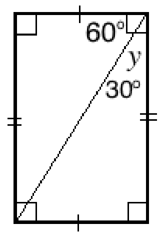
3. Invite 3 volunteers to write the solutions on the board, and label the missing angles in the shapes. They may come to the board at the same time.
   Solutions (and explanations):
   a. Shape $ABCD$ is a rhombus, and is therefore a parallelogram. Its opposite angles are equal, and co-interior angles sum to 180°.
      Angle $C = A = 65°$
      Angle $B = 180° - 65° = 115°$
      Angle $D = B = 115°$



   b. Subtract the 3 known angles from 360°.

$$
\begin{aligned}
E + F + G + H &= 360° \\
E + 118° + 115° + 68° &= 360° \\
E + 301° &= 360° \\
E &= 360° - 301° \\
E &= 59°
\end{aligned}
$$





   c. Subtract 60° from 90° to find y.

$$
\begin{aligned}
y + 60° &= 90° \\
y &= 90° - 60° \\
x &= 30°
\end{aligned}
$$

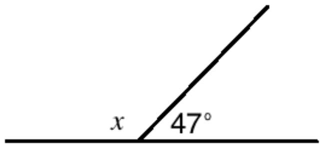
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L058 in the Pupil Handbook.

Lesson Title: Exterior angles of quadrilaterals	**Theme:** Geometry	
Lesson Number: M2-L059	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the measurement of exterior angles of quadrilaterals.	**Preparation** Draw the diagram in Opening on the board.	

Opening *(4 minutes)*

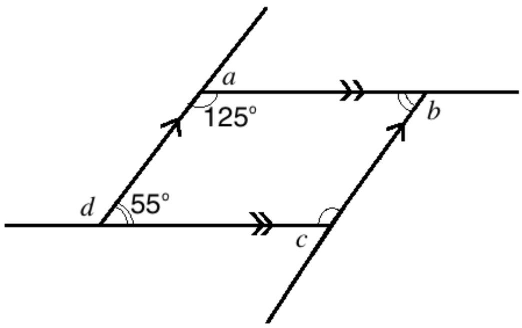
1. Review supplementary angles. Draw on the board:



2. Ask volunteers to describe how to find the measure of angle x. Allow them to share their ideas, then explain:
    a. Angles x and 47 make a straight line. We know that together their measures make 180°.
    b. Subtract 47° from 180° to find the measure of x.
3. Ask pupils to work with seatmates to find x.
4. Invite a volunteer to write the solution on the board. (Answer: $180° - 47° = 133°$)
5. Explain that today's lesson is on finding the exterior angles of quadrilaterals.

Teaching and Learning *(20 minutes)*

1. Draw the parallelogram with exterior angles on the board:

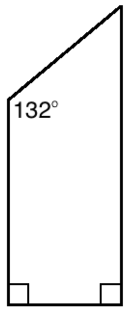


2. Explain:
    - The angles a, b, c, and d are called **exterior angles.**
    - Exterior angles are adjacent to interior angles. Together they form a straight line.
    - We can find the measure of an exterior angle by subtracting the interior angle from 180°.

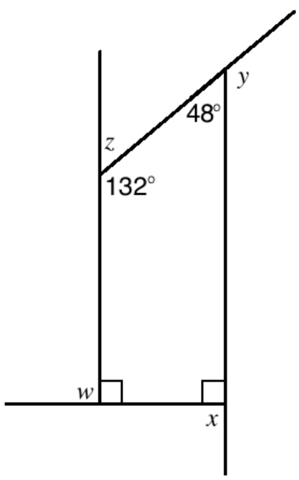
3. Solve for each exterior angle on the board:

Angle a:	$a = 180° - 125° = 55°$
Angle b:	Note that the interior angle is $55°$.
	$b = 180° - 55° = 125°$
Angle c:	Note that the interior angle is $125°$.
	$c = 180° - 125° = 55°$
Angle d:	$d = 180° - 55° = 125°$

4. Explain:
   - The sum of the exterior angles of any polygon is 360°. We can use this fact to calculate exterior angles, or to check our work after we find all of the exterior angles.
   - For squares and rectangles, the exterior angles are always right angles, the same as the interior angles.
5. Add the exterior angles of the parallelogram on the board to confirm that they sum to 360°: $55° + 125° + 55° + 125° = 360°$.
6. Draw the trapezium on the board:



7. Ask pupils to work with seatmates to draw the external angles on the rectangle.
8. Draw the external angles on the board, and label them w, x, y, and z (as shown below).
9. Ask a volunteer to explain how to find the missing interior angle. Write the calculation on the board: $360° - 90° - 90° - 132° = 48°$
10. Label the missing interior angle of the trapezium:

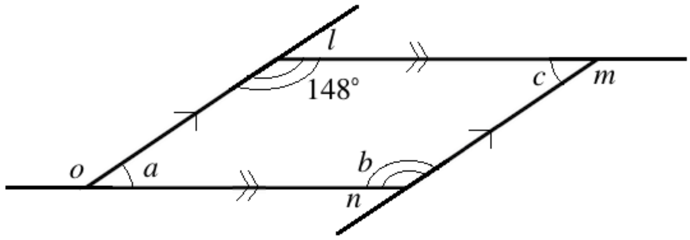


11. Ask pupils to work with seatmates to find the measures of the external angles.
12. Invite 4 volunteers to write the solutions on the board.

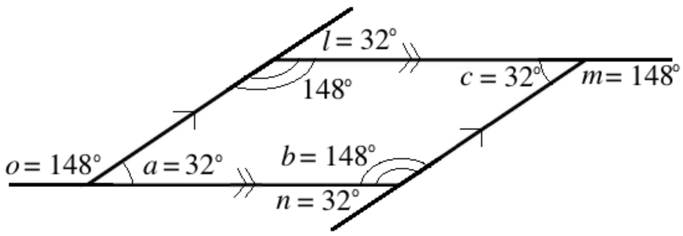
Solutions:

Angle w: $w = 180° - 90° = 90°$
Angle x: $b = 180° - 90° = 90°$
Angle y: $c = 180° - 48° = 132°$
Angle z: $d = 180° - 132° = 48°$

13. Label the exterior angles in the diagram with their measures, and make sure pupils understand.
14. Draw on the board:



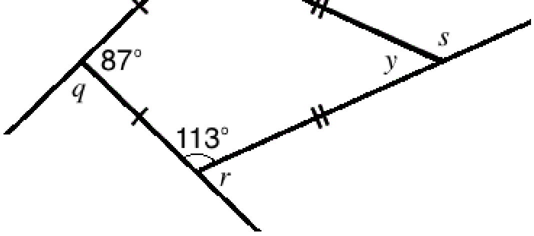
15. Explain: With the information from the previous lesson and this one, we can solve for all of the missing angles.
16. Ask pupils to work with seatmates to solve for all 7 of the missing angles.
17. Invite volunteers to label the missing angles on the board and explain.
Solution:
$l = 180° - 148° = 32°$ (supplementary angles); $b = 148°$ (opposite, equal angles); $a = c = \frac{360°-(2\times148°)}{2} = 32°$ (using angles in a quadrilateral); $o = 180° - 32° = 148°$ (supplementary angles); $m = 180° - 32° = 148°$ (supplementary angles).



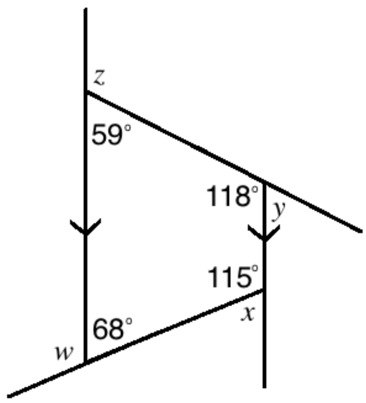
Practice *(15 minutes)*

1. Write on the board: Find the missing angles in each diagram:

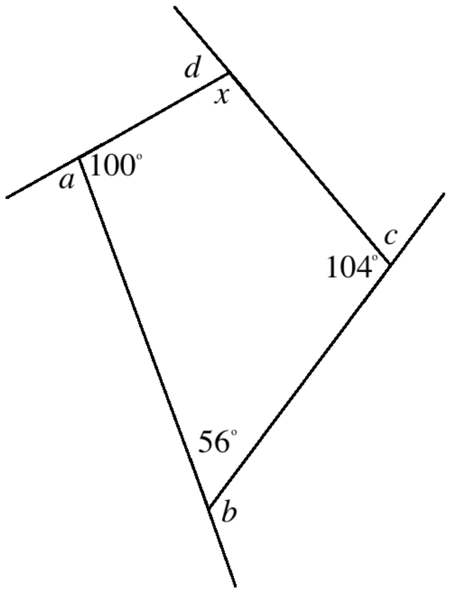
a.



b.



c.



2. Ask pupils to work independently to find the missing angles.
3. Invite 3 volunteers to write the solutions on the board, and label the missing angles in the shapes. They may come to the board at the same time.
   Solutions:

   a. $x = 113°$
      $y = 360° - 113° - 113° - 87° = 47°$
      $q = 180° - 87° = 93°$
      $r = 180° - 113° = 67°$
      $s = 180° - 47° = 133°$
      $t = 180° - 113° = 67°$
   b. $w = 180° - 68° = 112°$
      $x = 180° - 115° = 65°$
      $y = 180° - 118° = 62°$
      $z = 180° - 59° = 121°$
   c. $x = 360° - 100° - 104° - 56° = 100°$
      $a = 180° - 100° = 80°$
      $b = 180° - 56° = 124°$
      $c = 180° - 104° = 76°$
      $d = 180° - 100° = 80°$

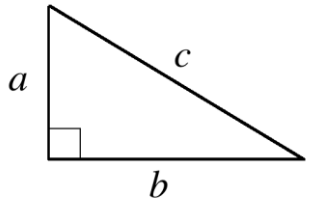
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L059 in the Pupil Handbook.

Lesson Title: Solving triangles	Theme: Geometry	
Lesson Number: M2-L060	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to identify how to solve various types of triangles by finding side and angle measures (review).	**Preparation** Draw the triangle in Opening on the board.	

Opening *(4 minutes)*

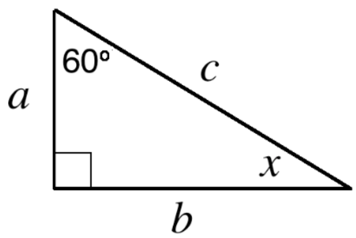
1. Draw on the board:



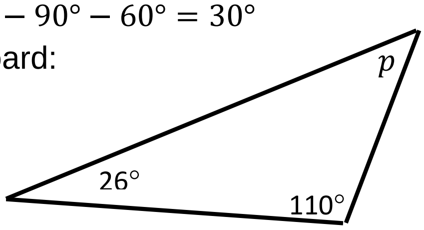
2. Discuss:
    a. What is this shape? (Answer: right-angled triangle)
    b. What do you know about right-angled triangles? (Example answers: two sides form a 90° angle; the 3 angles sum to 180°; Pythagoras' theorem can be used to find the lengths of the sides.)
3. Explain that today's lesson is on solving triangles. This means that pupils will be finding the measures of missing sides and angles.

Teaching and Learning *(23 minutes)*

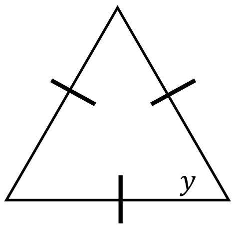
1. Label the angles in the triangle on the board as shown:

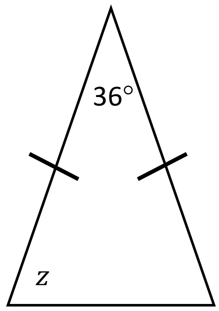


2. Discuss: How can you find the measure of x?
3. Allow pupils to share their ideas, then explain:
    - The angles of a triangle add up to 180°. Missing angles are found by subtracting known angles from 180°.
4. Solve for x on the board: $x = 180° - 90° - 60° = 30°$
5. Draw the triangle at right on the board:

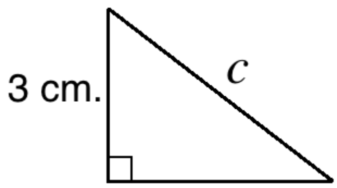


6. Ask pupils to work with seatmates to find the measure of p.
7. Invite a volunteer to write the solution on the board. (Answer: $x = 180° - 110° - 26° = 44°$)
8. Draw the following triangles on the board:

a. 

b. 

9. Discuss: What types of triangles are these? What do you know about them?
10. Allow pupils to share their answers, then explain:
    - Triangle a. is an equilateral triangle. All 3 of the angle measures are the same.
    - Triangle b. is an isosceles triangle. The bottom 2 angles (the angles adjacent to the equal sides and the third side) are equal to each other.
11. Ask pupils to discuss with seatmates how to solve for angles y and z. Allow them a moment to share ideas.
12. Ask volunteers to explain to the class how to solve for y and z. Guide the discussion and explain:
    - For the equilateral triangle, divide the total 180° by 3 to give the measure of each angle, including y.
    - For the isosceles triangle, subtract 36° from 180°, and divide the result by 2 to give the measure of the other 2 angles, including z
13. Ask pupils to solve the problems with seatmates.
14. Invite volunteers to write the solutions on the board. (Answers: a. $y = 180° \div 3 = 60°$; b. $180° - 36° = 144° \rightarrow z = 144° \div 2 = 72°$)
15. Draw the right-angled triangle on the board:

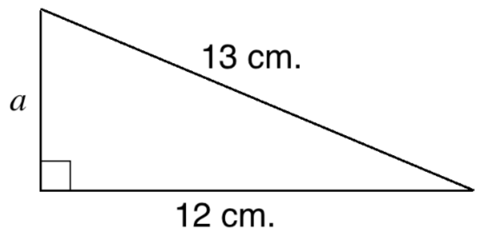


16. Discuss: How can we find the measure of the missing side, c?
17. Allow pupils to share ideas, then explain:
    - We use Pythagoras' theorem to find the missing side of a right-angled triangle.
    - This theorem only works for right-angled triangles. It does not work for other types of triangles.

18. Write Pythagoras' theorem on the board: $a^2 + b^2 = c^2$, where c is the hypotenuse, and a and b are the other 2 sides.
19. Explain: Recall that the hypotenuse is the longest side. It is across from the right angle.
20. Solve the problem on the board, explaining each step:

$3^2 + 4^2$	$=$	c^2	Substitute 3 and 4 into the formula
$9 + 16$	$=$	c^2	Simplify
25	$=$	c^2	
$\sqrt{25}$	$=$	$\sqrt{c^2}$	Take the square root of both sides
c	$=$	5	

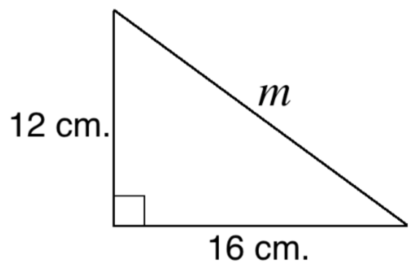
21. Draw the triangle shown below on the board:



22. Ask pupils to give each step to solve for a. As they give the steps, solve on the board:

$a^2 + 12^2$	$=$	13^2	Substitute 12 and 13 into the formula
$a^2 + 144$	$=$	169	Simplify
a^2	$=$	$169 - 144$	
a^2	$=$	25	Take the square root of both sides
$\sqrt{a^2}$	$=$	$\sqrt{25}$	
a	$=$	5	

23. Draw the triangle shown below on the board:



24. Ask pupils to work with seatmates to find the measure of side m.
25. Invite a volunteer to write the solution on the board.

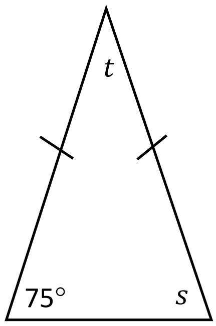
Solution:

$12^2 + 16^2$	$=$	m^2	Substitute 12 and 16 into the formula
$144 + 256$	$=$	m^2	Simplify
400	$=$	m^2	
$\sqrt{400}$	$=$	$\sqrt{m^2}$	Take the square root of both sides
m	$=$	20	

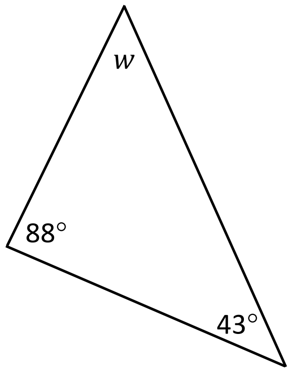
Practice *(12 minutes)*

1. Write on the board: Find the missing sides and angles marked with a letter in each diagram:

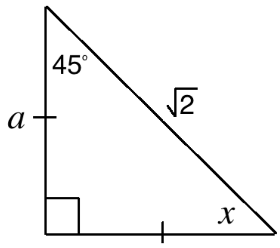
a.



b.



c.



2. Ask pupils to work independently to find the missing angles.
3. Invite 3 volunteers to write the solutions on the board. They may come to the board at the same time.

   Solutions:

   a. $s = 75°$ because the triangle is isosceles; $t = 180° - 75° - 75° = 30°$

   b. $w = 180° - 88° - 43° = 49°$

   c. $x = 45°$ because the triangle is isosceles;

   To find a, apply Pythagoras' theorem. Notice that 2 sides are the length of a.

$a^2 + a^2$	$=$	$(\sqrt{2})^2$	Substitute a and $\sqrt{2}$ into the formula
$2a^2$	$=$	2	Simplify
a^2	$=$	1	Divide throughout by 2
$\sqrt{a^2}$	$=$	$\sqrt{1}$	Take the square root of both sides
a	$=$	1	

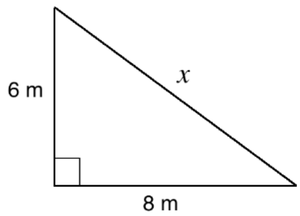
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L060 in the Pupil Handbook.

Lesson Title: Proportional division of the side of a triangle	**Theme:** Geometry	
Lesson Number: M2-L061	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcomes By the end of the lesson, pupils will be able to: 1. Apply ratios to find missing lengths when a line parallel to one side divides a triangle. 2. Apply the midpoint theorem.	**Preparation** Write the problem in Opening on the board.	

Opening *(4 minutes)*

1. Review the previous lesson. Write on the board: Find the missing angle x:



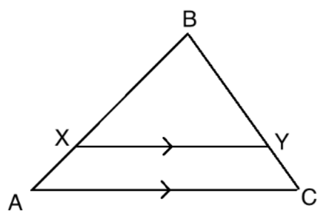
2. Ask pupils to work with seatmates to find x.
3. Invite a volunteer to write the solution on the board.
   Solution:

$$\begin{aligned} 6^2 + 8^2 &= x^2 && \text{Substitute 6 and 8 into the formula} \\ 36 + 64 &= x^2 && \text{Simplify} \\ 100 &= x^2 && \\ \sqrt{100} &= \sqrt{x^2} && \text{Take the square root of both sides} \\ x &= 10 && \end{aligned}$$

4. Explain that today's lesson is also on finding the missing sides in a triangle. Today pupils will be using proportions.

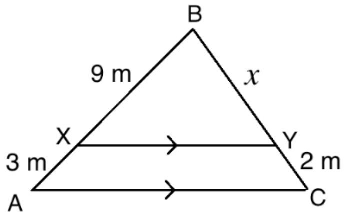
Teaching and Learning *(25 minutes)*

1. Draw the diagram as shown:



2. Explain:
   - The line XY divides triangle ABC. It is parallel to side AC.
   - When a line is drawn parallel to one side of a triangle, it divides the other 2 sides in the same ratio.
3. Write the ratios on the board: $\frac{BX}{XA} = \frac{BY}{YC}$

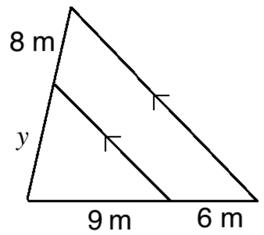
4. Explain: These are the ratios formed by the sides. We can use them to solve for unknown side lengths.
5. Point out each side from the ratio in the diagram on the board. Make sure pupils understand which are proportional.
6. Label the triangle on the board as shown:



7. Explain: We can find the missing side x using the ratios.
8. Solve for x on the board, explaining each step:

$$\begin{aligned} \frac{BX}{XA} &= \frac{BY}{YC} \\ \frac{9}{3} &= \frac{x}{2} && \text{Substitute known sides} \\ 3 &= \frac{x}{2} && \text{Cross multiply} \\ 3 \times 2 &= x && \text{Solve for } x \\ x &= 6 \end{aligned}$$

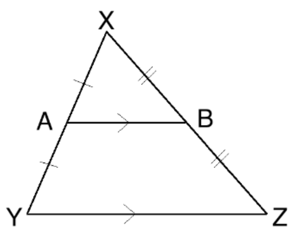
9. Write the following problem on the board:



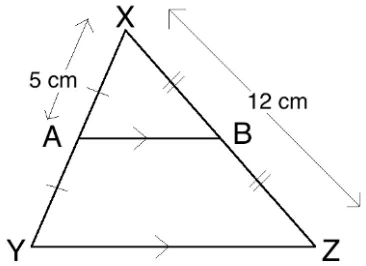
10. Ask volunteers to give the steps to solve for y. As they give the steps, solve on the board:

$$\begin{aligned} \frac{6}{9} &= \frac{8}{y} && \text{Set up the ratios} \\ \frac{2}{3} &= \frac{8}{y} && \text{Simplify the fraction} \\ 2y &= 8 \times 3 && \text{Cross multiply} \\ 2y &= 24 && \text{Solve for } y \\ y &= 12 \end{aligned}$$

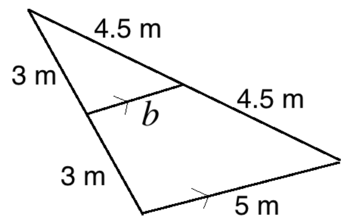
11. Draw the diagram as shown:



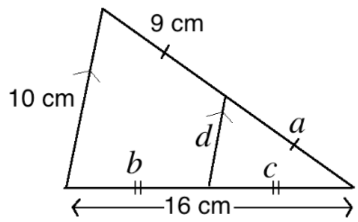
12. Explain:
    - In triangle XYZ, line AB joins the midpoints of two of its sides, XY and XZ.
    - The line AB has exactly half the length of the line YZ.
    - The lines AB and YZ are also parallel to each other.
13. Write on the board: $|AB| = \frac{1}{2}|YZ|$
14. Write the following problem for the triangle on the board: If $|AX| = 5$ cm and $|XZ| = 12$ cm., find the measure of: a. $\overline{XY}$ b. $\overline{AY}$ c. $\overline{XB}$ d. $\overline{BZ}$
15. Label the known sides of the triangle:



16. Discuss: How can we find the measure of $\overline{XY}$? (Answer: Multiply the length of $\overline{AX}$ by 2, since it is exactly half of $\overline{XY}$.)
17. Solve on the board: $|XY| = 2 \times |AX| = 2 \times 5 \text{ cm} = 10 \text{ cm}$
18. Discuss: How can we find the measure of $\overline{AY}$? (Answer: It is equal to $\overline{AX}$, which is 5 cm.)
19. Solve on the board: $|AY| = |AX| = 5 \text{ cm}$
20. Follow the same process for parts c and d, solving them on the board:
    c. $|XB| = \frac{1}{2} \times |XZ| = \frac{1}{2} \times 12 \text{ cm} = 6 \text{ cm}$
    d. $|BZ| = |XB| = 6 \text{ cm}$
21. Write another problem on the board: Find the length of b in the triangle:



22. Discuss: How can we find b? How do you know?
23. Allow pupils to share their ideas, then explain: b connects the midpoints of 2 sides. That means that it is parallel to the third side. It also means that it measures half of the third side.
24. Solve on the board: $b = \frac{1}{2}5 = \frac{5}{2} = 2.5 \text{ m}$
25. Write another problem on the board: Find a, b, c, and d in the triangle:

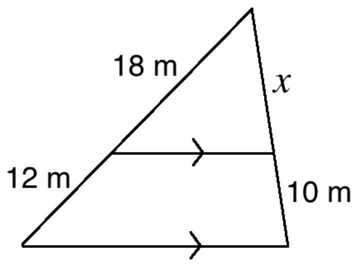


26. Ask pupils to work with seatmates to find the missing lengths.
27. Invite 4 volunteers to each give one of the lengths and explain their answer. (Answers: $a = 9$ cm., $b = 16 \div 2 = 8$ cm., $c = b = 8$ cm, $d = \frac{1}{2}(10) = 5$ cm)

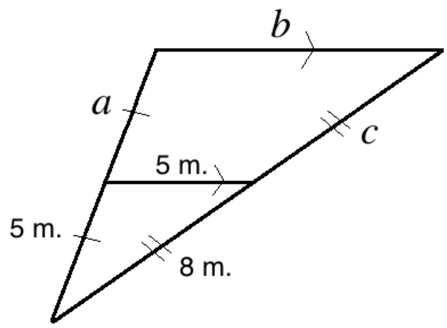
Practice *(10 minutes)*

1. Write on the board: Find the missing sides marked with a letter in each diagram:

a.



b.



2. Ask pupils to work independently to find the missing sides.
3. Invite 2 volunteers to write the solutions on the board. They may come to the board at the same time.

Solutions:

a.

$\frac{18}{12}$	$=$	$\frac{x}{10}$	Set up the ratios
$\frac{3}{2}$	$=$	$\frac{x}{10}$	Simplify the fraction
3×10	$=$	$2x$	Cross multiply
30	$=$	$2x$	Solve for x
x	$=$	15	

b. $a = 5$ m., $b = 2 \times 5 \text{ m} = 10$ m, $c = 8$ m

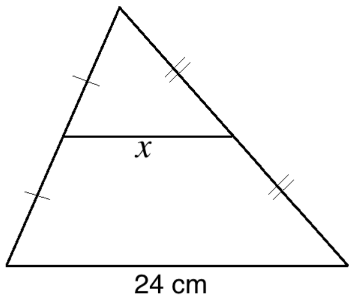
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L061 in the Pupil Handbook.

Lesson Title: Bisector of an angle in a triangle	Theme: Geometry	
Lesson Number: M2-L062	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to apply the angle bisector theorem.	**Preparation** Write the problem in Opening on the board.	

Opening *(3 minutes)*

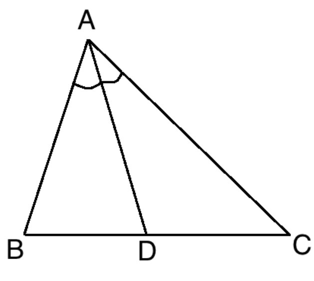
1. Review the previous lesson. Write on the board: Find the measure of x:



2. Ask pupils to find x in their exercise books.
3. Ask a volunteer to give the answer. (Answer: x is half the length of 24 cm; $x = \frac{1}{2}24 = 12$ cm)
4. Explain that today's lesson is on the angle bisector theorem, another theorem that is related to triangles.

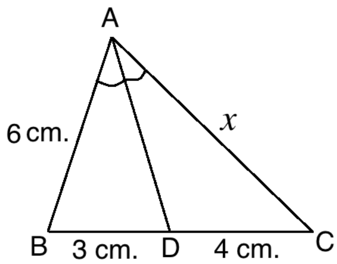
Teaching and Learning *(26 minutes)*

1. Draw the diagram as shown:



2. Explain:
   - We will consider the entire triangle ABC.
   - The line AD bisects angle A. If a line bisects an angle, it divides it into 2 equal parts.
   - The angle bisector theorem states that an angle bisector of a triangle divides the opposite side into two segments that are proportional to the other 2 sides of the triangle.
   - In this case, AD divides BC into two segments (BD and DC) that are proportional to the other sides, AC and AB.

3. Write on the board: $\frac{|BD|}{|DC|} = \frac{|AB|}{|AC|}$
4. Identify each of the 4 lines in this formula by pointing them out on the board. Make sure pupils understand which lines are proportional.
5. Label the triangle on the board with lengths, as shown:



6. Explain:
   - We want to find the length of x.
   - Problems involving the angle bisector theorem will often have a missing side or segment of a side.
   - We must apply the formula with proportions to solve the problem.
7. Solve the problem on the board, explaining each step:

$$\frac{|BD|}{|DC|} = \frac{|AB|}{|AC|}$$

$$\frac{3}{4} = \frac{6}{x} \quad \text{Substitute known sides}$$

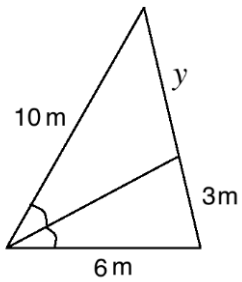
$$3x = 4 \times 6 \quad \text{Cross multiply}$$

$$3x = 24 \quad \text{Simplify}$$

$$x = \frac{24}{3}$$

$$x = 8 \text{ cm.}$$

8. Write the following problem on the board:



9. Ask volunteers to explain how to solve for y. (Answer: Substitute the known values into the formula, cross multiply, and simplify.)
10. Solve the problem on the board, explaining each step:

$$\frac{|BD|}{|DC|} = \frac{|AB|}{|AC|}$$

$$\frac{3}{y} = \frac{6}{10} \quad \text{Substitute known sides}$$

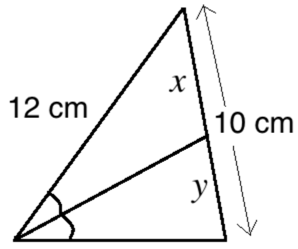
$$3 \times 10 = 6y \quad \text{Cross multiply}$$

$$30 = 6y \quad \text{Simplify}$$

$$\frac{30}{6} = y$$

$$y = 5 \text{ m}$$

11. Write another problem on the board: Solve for x and y:



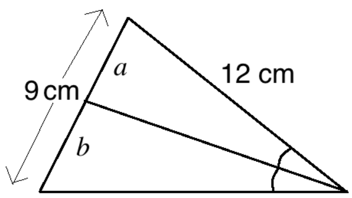
12. Explain:
    - This problem is different because there are 2 missing sides. However, we know that their sum is 10 cm.
    - We can use the ratios to find what fraction of the full length x and y are. We can use that fraction to find their lengths.
13. Solve the **first part** of the problem on the board:

    Write the ratios: $\frac{y}{x} = \frac{8}{12} = \mathbf{\frac{2}{3}}$

    Therefore, $y = \frac{2}{\mathbf{5}}$ of 10 cm
14. Explain:
    - We know the ratio of y to x is $\frac{2}{3}$. To find the ratio of either part to the whole length of 10, add the individual parts (the numerator and denominator, $2 + 3$).
    - y is $\frac{2}{5}$ of the whole side, and x is $\frac{3}{5}$ of the whole side.
    - We only need to use the fraction to find x or y. We can find the other by subtracting from 10.
15. Finish solving the problem on the board:

$$\begin{aligned} y &= \tfrac{2}{5} \text{ of } 10 \text{ cm} \\ &= \tfrac{2}{5} \times 10 \text{ cm} \\ &= 2 \times 2 \text{ cm} \\ &= 4 \text{ cm} \end{aligned}$$

    Find x by subtracting y from 10: $x = 10 - y = 10 - 4 = 6 \text{ cm}$
16. Write the following problem on the board: Solve for a and b:



17. Ask pupils to solve with seatmates.
18. Walk around to check for understanding and clear misconceptions.
19. Invite a volunteer to write the solution on the board.

    Solution:

Write the ratios: $\frac{a}{b} = \frac{12}{15} = \frac{\mathbf{4}}{\mathbf{5}}$

Therefore, $a = \frac{4}{\mathbf{9}}$ of 9 cm

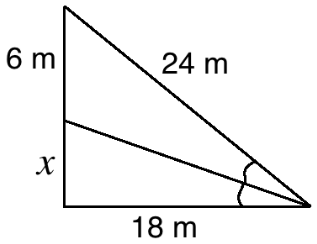
Calculate a: $a = \frac{4}{9} \times 9 = 4 \text{ cm}$

Subtract to find b: $9 \text{ cm} - 4 \text{ cm} = 5 \text{ cm}$

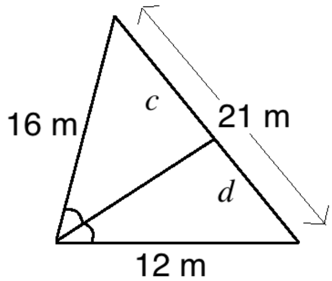
Practice *(10 minutes)*

1. Write on the board: Find the missing sides marked with a letter in each diagram:

a.



b.



2. Ask pupils to work independently to find the missing sides. Allow discussion with seatmates if needed.
3. Invite 2 volunteers to write the solutions on the board. They may come to the board simultaneously.

Solutions:

a.

$\frac{x}{6}$	$=$	$\frac{18}{24}$	Ratios
$\frac{x}{6}$	$=$	$\frac{3}{4}$	Simplify
$4x$	$=$	6×3	Cross multiply
$4x$	$=$	18	Simplify
x	$=$	$\frac{18}{4}$	
x	$=$	$4\frac{1}{2}$ m.	

b.

Write the ratios: $\frac{d}{c} = \frac{12}{16} = \frac{\mathbf{3}}{\mathbf{4}}$

Therefore, $d = \frac{3}{\mathbf{7}}$ of 21 m

Calculate a: $d = \frac{3}{7} \times 21 = 3 \times 3 = 9 \text{ m}$

Subtract to find c: $21 \text{ m} - 9 \text{ m} = 12 \text{ m}$

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L062 in the Pupil Handbook.

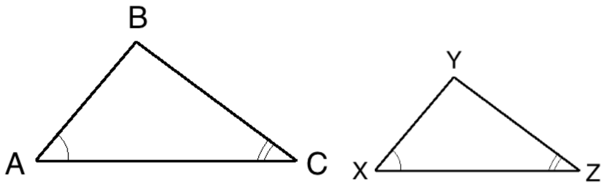
Lesson Title: Similar triangles	Theme: Geometry	
Lesson Number: M2-L063	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to use the properties of similar triangles to deduce lengths in similar shapes.	**Preparation** None	

Opening *(2 minutes)*

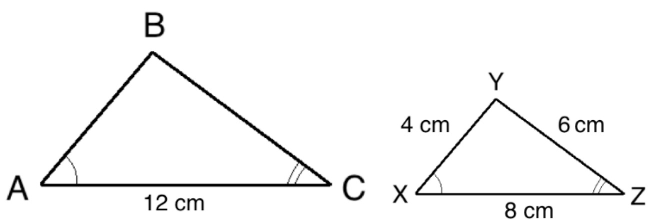
1. Discuss: What do you think it means for two shapes to be "similar"?
2. Allow pupils to share ideas, then explain: Similar shapes have the same angles but are different sizes.
3. Explain that today's lesson is on similar triangles. Pupils will be solving for the lengths of sides using ratio.

Teaching and Learning *(23 minutes)*

1. Draw the similar triangles as shown:



2. Explain:
    - Similar triangles have the same shape but are different sizes.
    - Triangles are similar if their respective angles are equal.
    - In the diagram, triangle ABC is similar to triangle XYZ.
    - If two triangles are similar, their corresponding sides are in the same ratio.
3. Write on the board: $\frac{|AB|}{|XY|} = \frac{|BC|}{|YZ|} = \frac{|CA|}{|ZX|}$
4. Label the sides of the triangles on the board as shown:



5. Allow pupils to share ideas, then explain:
    - To find the unknown side lengths (AB and BC), we can substitute the known sides into the ratio formula and solve.
    - We do not need to use all 3 ratios at once. We can choose 2 convenient ratios from among the 3.

- There should only be 1 unknown in the ratios we choose.

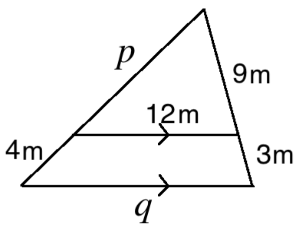
6. Solve the problem on the board, explaining each step:
   Find side AB:

$\frac{\lvert AB\rvert}{\lvert XY\rvert}$	$=$	$\frac{\lvert CA\rvert}{\lvert ZX\rvert}$	Choose 2 ratios
$\frac{\lvert AB\rvert}{4\text{ cm}}$	$=$	$\frac{12\text{ cm}}{8\text{ cm}}$	Substitute known sides
$8\lvert AB\rvert$	$=$	4×12	Cross multiply
$8\lvert AB\rvert$	$=$	48	Simplify
$\lvert AB\rvert$	$=$	$\frac{48}{8}$	Divide throughout by 8
$\lvert AB\rvert$	$=$	6 cm	

   Find side BC:

$\frac{\lvert BC\rvert}{\lvert YZ\rvert}$	$=$	$\frac{\lvert CA\rvert}{\lvert ZX\rvert}$	Choose 2 ratios
$\frac{\lvert BC\rvert}{6\text{ cm}}$	$=$	$\frac{12\text{ cm}}{8\text{ cm}}$	Substitute known sides
$8\lvert AB\rvert$	$=$	6×12	Cross multiply
$8\lvert AB\rvert$	$=$	72	Simplify
$\lvert AB\rvert$	$=$	$\frac{72}{8}$	Divide throughout by 8
$\lvert AB\rvert$	$=$	9 cm	

7. Label the triangles with the side lengths, and make sure pupils understand.
8. Write the following problem on the board: Solve for p and q:



9. Explain:
   - When a line that is parallel to one of the sides is drawn through a triangle, it forms a second triangle.
   - The 2 triangles are similar, because all 3 of their angles are the same. This means that ratios can be applied to find missing sides.
   - Recall that we solved for sides such as p during lesson 61, using ratios of the sides that are not parallel. Today we will solve for all of the sides, including the parallel ones.
10. Write the ratios on the board: $\frac{9}{9+3}=\frac{9}{12}=\frac{12}{q}=\frac{p}{p+4}$
11. Explain:
    - Remember to include the entire side in your ratio. The left side of the big triangle is the 2 smaller lengths combined, so we have $p+4$.
    - When working with larger numbers, it is easier if you simplify fractions when possible. Therefore, we will use $\frac{3}{4}$ in place of $\frac{9}{12}$.

12. Solve the problem on the board, explaining each step:

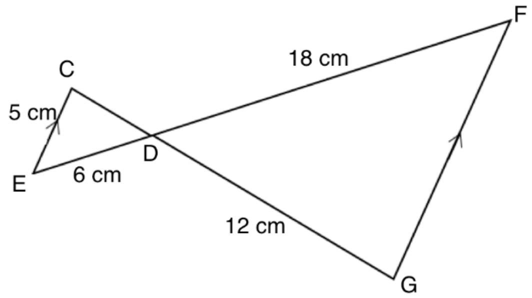
Find side q:

$$\begin{aligned} \tfrac{3}{4} &= \tfrac{12}{q} \\ 3q &= 4 \times 12 \\ 3q &= 48 \\ q &= \tfrac{48}{3} \\ q &= 16\text{ m} \end{aligned}$$

Find side p:

$$\begin{aligned} \tfrac{3}{4} &= \tfrac{p}{p+4} \\ 3(p+4) &= 4p \\ 3p+12 &= 4p \\ 12 &= 4p-3p \\ 12 &= p \\ p &= 12\text{ m} \end{aligned}$$

13. Write the following problem on the board: Find the measures of sides CD and FG:



14. Explain:
    - When two lines intersect between parallel lines, they form 2 similar triangles.
    - Triangle CDE is similar to triangle GDF.
    - The triangle sides that share a line are in the same ratio. For example, DE and DF.
15. Write the ratios on the board: $\frac{|CD|}{|DG|} = \frac{|DE|}{|DF|} = \frac{|CE|}{|FG|}$ or $\frac{|CD|}{12\text{ cm}} = \frac{6\text{ cm}}{18\text{ cm}} = \frac{5\text{ cm}}{|FG|}$
16. Explain: We will simplify $\frac{6\text{ cm}}{18\text{ cm}}$ and use $\frac{1\text{ cm}}{3\text{ cm}}$.
17. Solve the problem on the board, explaining each step:

Find side CD:

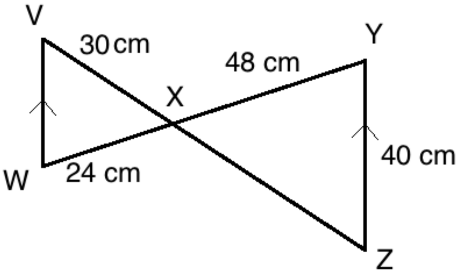
$$\begin{aligned} \frac{|CD|}{|DG|} &= \frac{|DE|}{|DF|} \\ \frac{|CD|}{12\text{ cm}} &= \frac{1\text{ cm}}{3\text{ cm}} \\ 3|CD| &= 12 \times 1 \\ |CD| &= \frac{12}{3} \\ |CD| &= 4\text{ cm} \end{aligned}$$

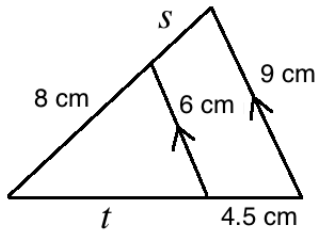
Find side FG:

$$\begin{aligned} \frac{|CE|}{|FG|} &= \frac{|DE|}{|DF|} \\ \frac{5\text{ cm}}{|FG|} &= \frac{1\text{ cm}}{3\text{ cm}} \\ 5 \times 3 &= |FG| \\ 15\text{ cm} &= |FG| \end{aligned}$$

Practice *(14 minutes)*

1. Write on the board:
    a. Find the missing sides, VW and XZ: b. Find the missing sides, s and t:





2. Ask pupils to work with seatmates to find the missing sides.
3. Walk around to check for understanding and support pupils.
4. Invite 4 volunteers to write the solutions on the board. They may come to the board at the same time. Other pupils should check their work.
   Solutions:
   a. Use ratios: $\frac{24\text{ cm}}{48\text{ cm}} = \frac{1\text{ cm}}{2\text{ cm}} = \frac{|VW|}{40\text{ cm}} = \frac{30}{|XZ|}$

Find side VW:

$$\begin{aligned} \frac{|VW|}{40\text{ cm}} &= \frac{1\text{ cm}}{2\text{ cm}} \\ 2|VW| &= 40 \times 1 \\ 2|VW| &= 40 \\ |VW| &= \frac{40}{2} \\ |VW| &= 20\text{ cm} \end{aligned}$$

Find side XZ:

$$\begin{aligned} \frac{30}{|XZ|} &= \frac{1\text{ cm}}{2\text{ cm}} \\ 1|XZ| &= 30 \times 2 \\ |XZ| &= 60\text{ cm} \end{aligned}$$

b. Use ratios: $\frac{6}{9} = \frac{2}{3} = \frac{8}{8+s} = \frac{t}{t+4.5}$

Find s:

$$\begin{aligned} \frac{2}{3} &= \frac{8}{8+s} \\ 2(8+s) &= 8 \times 3 \\ 16 + 2s &= 24 \\ 2s &= 24 - 16 \\ 2s &= 8 \\ s &= \frac{8}{2} \\ &= 4\text{ cm} \end{aligned}$$

Find t:

$$\begin{aligned} \frac{2}{3} &= \frac{t}{t+4.5} \\ 2(t + 4.5) &= 3t \\ 2t + 9 &= 3t \\ 9 &= 3t - 2t \\ 9 &= t \\ t &= 9\text{ cm} \end{aligned}$$

Closing *(1 minute)*

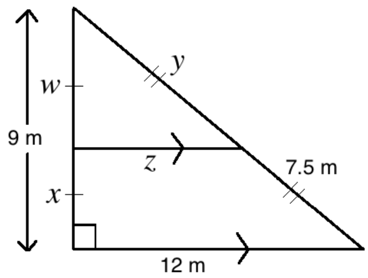
1. For homework, have pupils do the practice activity PHM2-L063 in the Pupil Handbook.

Lesson Title: Triangle problem solving	Theme: Geometry	
Lesson Number: M2-L064	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to apply various theorems and properties of triangles to solve for angles and lengths.	**Preparation** Write the problems in Opening on the board.	

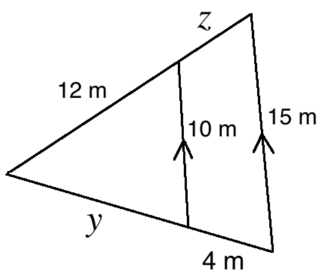
Opening *(5 minutes)*

1. Write the following 6 problems on the board:

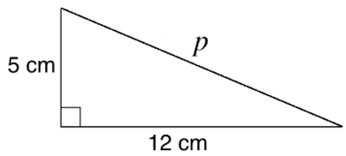
   a. Solve for w, x, y, and z:



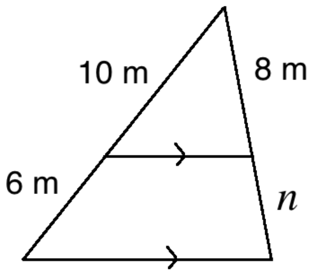
   b. Solve for y and z:



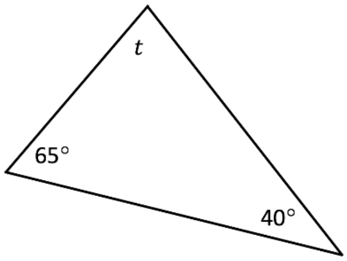
   c. Solve for p:



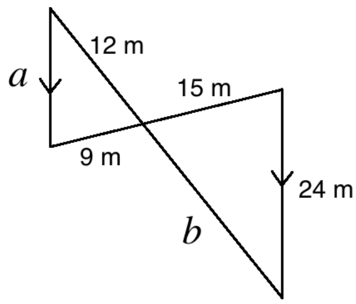
   d. Solve for n:



   e. Solve for t:



   f. Solve for a and b:



2. Discuss: How would you solve for the missing sides in each of these diagrams?
3. Have volunteers explain which theorem, property, or steps they would take to solve for the missing sides. Allow discussion and guide them to the correct answer for each.

   Answers:

   a. Midpoint theorem
   b. Similar triangles or proportional division of sides
   c. Pythagoras' theorem
   d. Similar triangles or proportional division of sides
   e. Subtract known angles from 180°
   f. Similar triangles
4. Explain that today's lesson is on solving triangles. Pupils will be applying various theorems and properties from the previous lessons.

Teaching and Learning *(20 minutes)*

1. Ask pupils to work with seatmates to solve problems a, b, and c. Encourage them to use their notes and Pupil Handbook as a guide.
2. Walk around to check for understanding and support pupils. Revise concepts as needed.
3. Invite 3 groups of seatmates to present their solutions on the board. Other pupils should check their work.

   Solutions:

   a. $w = \frac{1}{2} \times 9 = 4.5$, $x = w = 4.5$ m., $y = 7.5$ m., $z = \frac{1}{2} \times 12$ m. $= 6$ m.

   b. Use ratios: $\frac{10}{15} = \frac{2}{3} = \frac{12}{12+z} = \frac{y}{y+4}$

   Find z:

$$\begin{aligned} \frac{2}{3} &= \frac{12}{12+z} \\ 2(12+z) &= 3 \times 12 \\ 24 + 2z &= 36 \\ 2z &= 36 - 24 \\ 2z &= 12 \\ z &= \frac{12}{2} \\ &= 6 \text{ m} \end{aligned}$$

   Find y:

$$\begin{aligned} \frac{2}{3} &= \frac{y}{y+4} \\ 2(y+4) &= 3y \\ 2y + 8 &= 3y \\ 8 &= 3y - 2y \\ 8 \text{ m} &= y \end{aligned}$$

   c.

$$\begin{aligned} 5^2 + 12^2 &= p^2 \\ 25 + 144 &= p^2 \\ 169 &= p^2 \\ \sqrt{169} &= \sqrt{p^2} \\ 13 \text{ cm} &= p \end{aligned}$$

Practice *(14 minutes)*

1. Ask pupils to work independently to solve problems d., e., and f.
2. Walk around to check for understanding. Support pupils as needed.
3. Invite 2 volunteers to write the solutions on the board. They may come to the board at the same time. Other pupils should check their work.

   Solutions:

   a.

$$\begin{aligned} \frac{6}{10} &= \frac{n}{8} \\ 6 \times 8 &= 10n \\ 48 &= 10n \\ \frac{48}{10} &= n \\ n &= 4.8 \text{ m} \end{aligned}$$

b. $t = 180° - 65° - 40° = 75°$

c. Use ratios: $\frac{9}{15} = \frac{3}{5} = \frac{a}{24} = \frac{12}{b}$

Find a:

$$\begin{aligned} \frac{3}{5} &= \frac{a}{24} \\ 3 \times 24 &= 5a \\ 72 &= 5a \\ \frac{72}{5} &= a \\ 14\frac{2}{5} \text{ m} &= a \end{aligned}$$

Find b:

$$\begin{aligned} \frac{3}{5} &= \frac{12}{b} \\ 3b &= 5 \times 12 \\ 3b &= 60 \\ b &= \frac{60}{3} \\ b &= 20 \text{ m} \end{aligned}$$

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L064 in the Pupil Handbook.

Lesson Title: Conversion of units: smaller to larger	**Theme:** Mensuration	
Lesson Number: M2-L065	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to convert from smaller units to larger units using common units of measurement.	**Preparation** None	

Opening *(5 minutes)*

1. Discuss: Ask questions to review common measurements. Allow pupils to discuss each one. For example:
    a. Which is longer: 1 metre or 1 kilometre? (Answer: 1 kilometre)
    b. How many centimetres are in a metre? (Answer: 100 centimetres)
    c. Which is bigger: 1 gramme or 1 kilogramme? (Answer: 1 kilogramme)
    d. Which is bigger: 1 litre or 1 millilitre? (Answer: 1 litre)
2. Revise the types of measurement. Discuss:
    a. What are some units we use to measure length or distance? (Example answers: kilometres, metres)
    b. What are some units we use to measure mass or weight? (Example answers: grammes, kilogrammes)
    c. What are some units we use to measure volume or capacity? (Example answers: litres, millilitres)
3. Explain that today's lesson is on conversion of units from smaller to larger.

Teaching and Learning *(20 minutes)*

1. Write the following problem on the board: Fatu walked a total of 3000 metres in one day. How much did she walk in kilometres?
2. Discuss: How can we calculate the kilometres she walked?
3. Allow pupils to share ideas, then explain: Metres are smaller than kilometres. To convert from a smaller unit to a larger unit, **divide** by the conversion factor.
4. Write on the board: $1{,}000 \text{ m} = 1 \text{ km}$
5. Explain:
    - This is the factor that we use to convert between metres and kilometres.
    - To convert from metres to kilometres, **divide by 1,000**.
6. Solve the word problem on the board: $3{,}000 \div 1{,}000 = 3$ km
7. Explain:
    - We can often identify the conversion factor for common measurements.
    - For measurements that we are less familiar with, the prefix helps us to decide the conversion factor.
8. Write on the board:

    10 decimetres = 1 m

100 centimetres = 1 m
1,000 millimetres = 1 m
1 kilometre = 1,000 m

9. Explain:
    - Other units follow the same pattern. For example, 1,000 millilitres is equal to 1 litre.
    - A list of some common relationships between units of measurement can be found in the Pupil Handbook activity for this lesson.
10. Write the following problems on the board:
    a. Convert 5,200 ml to l
    b. Convert 7,625 mg to g
11. Ask volunteers to explain the steps to solve each problem. As they give the steps, solve on the board.
    Solutions:
    a. $5{,}200 \div 1{,}000 = 5.2$ litres
    b. $7{,}625 \div 1{,}000 = 7.625$ grammes
12. Write the following problem on the board: Convert 32,000 cm to km.
13. Discuss: We do not have a conversion factor for centimetres and kilometres. What can we do in this case?
14. Allow pupils to brainstorm, then explain:
    - When you do not have an easy conversion factor, it is possible to do 2 conversions.
    - We can convert centimetres to metres, then metres to kilometres.
15. Solve on the board, explaining each step:
    Step 1. Centimetres to metres:
    $32{,}000 \div 100 = 320$ metres
    Step 2. Metres to kilometres:
    $320 \div 1{,}000 = 0.32$ kilometres
16. Write the following problems on the board:
    a. Convert 95,200 milligrammes to grammes.
    b. Convert 2,500 decimetres to kilometres.
17. Ask pupils to work with their seatmates to solve the 2 problems.
18. Invite 2 volunteers to write the solutions on the board and explain.
    Solutions:
    a. $95{,}200 \div 1{,}000 = 95.2$ g.
    b. Decimetres to metres: $25{,}000 \div 10 = 2{,}500$ m
    Metres to kilometres: $2{,}500 \div 1{,}000 = 2.5$ km
19. Write the following problem on the board: Bintu wants to make a dress with some fabric she has. She has a piece that is 2 metres, and another piece that is 80 cm. How many metres does she have in total?
20. Discuss: What steps do we need to take to solve this problem? (Answer: We should **add** to find the **total**, but the **units should be the same** before adding.)
21. Ask pupils to work with seatmates to change the 80 cm in the problem to metres.

22. Invite a volunteer to write the solution on the board. (Solution: $80 \div 100 = 0.8$ m)
23. Ask pupils to work with seatmates to solve the problem.
24. Invite a volunteer to write the solution on the board. (Solution: $2 + 0.8 = 2.8$ m)
25. Explain:
    - Converting units is an important skill. To perform operations on measured amounts, they should always be in the same unit.
    - This has many real-world applications.

Practice *(12 minutes)*

1. Write on the board:
    a. Michael measured the distance between his house and his friend's house. It was 600 metres. Convert this to kilometres.
    b. Mohamed gained 6,500 grammes of weight this month. How much did he gain in kilogrammes?
    c. Ama drank 1,500 ml of water in the morning, and 2 litres in the evening. How much did she drink in total? Give your answer in litres.
2. Ask pupils to work independently to solve the problems.
3. Ask 3 volunteers to write the solutions on the board. They may come to the board simultaneously.
   Solutions:
    a. $600 \div 1{,}000 = 0.6$ km
    b. $6{,}500 \div 1{,}000 = 6.5$ kg
    c. Convert ml to l: $1{,}500 \div 1{,}000 = 1.5$ l; Add the measurements in l: $1.5 + 2 = 3.5$ l.

Closing *(3 minutes)*

1. Discuss: What are some real-life situations when you might need to know how to convert units? (Example answers: When building something; when deciding how much material to buy for a project.)
2. For homework, have pupils do the practice activity PHM2-L065 in the Pupil Handbook.

Lesson Title: Conversion of units: larger to smaller	**Theme:** Mensuration	
Lesson Number: M2-L066	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to convert from large units to smaller units using common units of measurement.	**Preparation** Write the problem in Opening on the board.	

Opening *(4 minutes)*

1. Review the previous lesson. Write a problem on the board: A carpenter has a piece of wood that is 75 cm long, and another piece of wood that is 2.2 metres long. How much wood does he have all together?
2. Ask volunteers to give the steps needed to solve the problem. (Answer: Convert 75 cm to metres, then add it to 2.2 m)
3. Ask pupils to solve the problem with seatmates.
4. Invite a volunteer to write the solution on the board.
   Solution:
   Convert 75 cm. to metres: $75 \div 100 = 0.75$ m
   Add to find the total: $0.75 + 2.2 = 2.95$ m
5. Explain that today's lesson is on conversion of units from larger to smaller.

Teaching and Learning *(20 minutes)*

1. Write a problem on the board: Foday travels 1.5 kilometres to school each day. How much is that in metres?
2. Discuss: How can we calculate the metres he walked?
3. Allow pupils to share ideas, then explain: Kilometres are larger than metres. To convert from a larger unit to a smaller unit, **multiply** by the conversion factor.
4. Write on the board: $1{,}000 \text{ m} = 1 \text{ km}$
5. Explain:
   - This is the factor that we use to convert between metres and kilometres.
   - To convert from kilometres to metres, **multiply by 1,000**.
   - Conversion factors between units are the same whether you are converting to larger or smaller units. The difference is whether multiplication or division is applied.
6. Solve the word problem on the board: $1.5 \times 1{,}000 = 1{,}500$ m
7. Write the following problems on the board:
   c. Convert 1.254 litres to ml
   d. Convert 8.65 g to mg
8. Ask volunteers to explain the steps to solve each problem. As they give the steps, solve on the board.

Solutions:

a. $1.254 \times 1{,}000 = 1{,}254$ ml
b. $8.65 \times 1{,}000 = 8{,}650$ mg

9. Write the following problem on the board: Convert 0.25 kg to mg
10. Discuss: We do not have a conversion factor for kg and mg. What can we do in this case?
11. Allow pupils to brainstorm, then explain:
    - Recall that it is possible to do 2 conversions.
    - We can convert kilogrammes to grammes, then grammes to milligrammes.
12. Solve on the board, explaining each step:

    Step 1. Kilogrammes to grammes:

    $0.25 \times 1{,}000 = 250$ g

    Step 2. Grammes to milligrammes:

    $250 \times 1{,}000 = 250{,}000$ mg
13. Write the following problems on the board:

    c. Convert 53 g to mg
    d. Convert 0.06 km to cm
14. Ask pupils to work with seatmates to solve the 2 problems.
15. Invite 2 volunteers to write the solutions on the board and explain.

    Solutions:

    c. $53 \times 1{,}000 = 53{,}000$ mg
    d. Kilometres to metres: $0.06 \times 1{,}000 = 60$ m
    Metres to centimetres: $60 \times 1{,}000 = 60{,}000$ cm
16. Write the following problem on the board: A tailor had 2.8 metres of fabric. If she used 150 cm to make a skirt, how much does she have left? Give your answer in centimetres.
17. Discuss: What steps do we need to take to solve this problem? (Answer: We should **subtract** to find what is **left**, but the **units should be the same** before adding.)
18. Ask pupils to work with seatmates to change the 2.8 m in the problem to centimetres.
19. Invite a volunteer to write the solution on the board. (Solution: $2.8 \times 100 = 280$ cm)
20. Ask pupils to work with seatmates to solve the problem.
21. Invite a volunteer to write the solution on the board. (Solution: $280 - 150 = 130$ cm)

Practice *(15 minutes)*

1. Write on the board:

   a. Aminata lives 0.5 kilometres from the hospital. How far from the hospital does she live in metres?

b. Aminata went to the hospital with malaria, and found that her weight reduced 1.24 kg. How much is this in milligrammes?
c. The doctor told Aminata to drink at least 3 litres of water each day. How much is this in millilitres?
d. The next day, Aminata drank 1.8 litres of water in the morning, and 1,500 ml of water in the evening. Did she drink enough water?

2. Ask pupils to work independently to solve the problems.
3. Invite 3 volunteers to write the solutions on the board. They may come to the board at the same time.

   Solutions:

   d. $0.5 \times 1{,}000 = 500$ m
   e. Convert to grammes: $1.24 \times 1{,}000 = 1{,}240$ g
      Convert to milligrammes: $1{,}240 \times 1{,}000 = 1{,}240{,}000$ mg
   f. $3 \times 1{,}000 = 3{,}000$ ml
   g. Convert l to ml: $1.8 \times 1000 = 1{,}800$ ml; Add the measurements: $1{,}800 + 1{,}500 = 3{,}300$ ml. This is more than 3,000 ml; therefore, she did drink enough water.

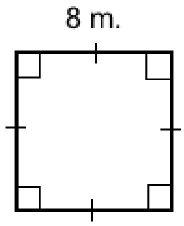
Closing *(1 minute)*

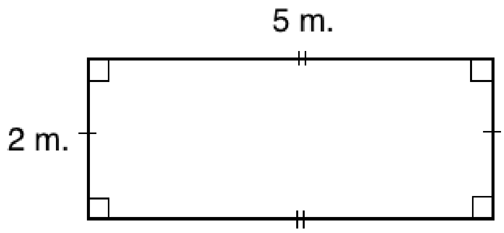
1. For homework, have pupils do the practice activity PHM2-L066 in the Pupil Handbook.

Lesson Title: Perimeter and area of a square and rectangle	**Theme:** Mensuration	
Lesson Number: M2-L067	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a square and rectangle.	**Preparation** Draw and label the shapes in Opening on the board.	

Opening *(3 minutes)*

1. Draw and label the square and rectangle on the board:



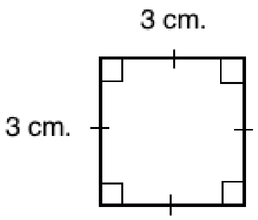


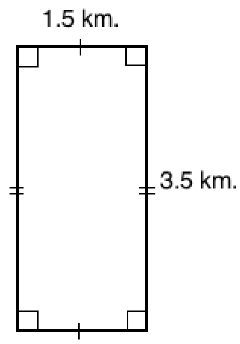
2. Ask volunteers to identify and label the length and width of the square and rectangle. (Answer: length and width of the square = 8 m; length of the rectangle = 5 m, width of the rectangle = 2 m)
3. Discuss**:** What are the similarities and differences between a square and a rectangle? (Example answer: Squares have four sides of equal length, while rectangles also have four sides but two are long and two are short. Both are quadrilaterals.)
4. Explain that this lesson is on calculating the perimeter and area of a square and rectangle. It is review of a JSS topic.

Teaching and Learning *(20 minutes)*

1. Discuss. Allow pupils to share their ideas:
   - What is perimeter? (Example answers: The length around a shape; it is like the fence around a farm or the walls around a room)
   - What is area? (Example answers: area is the size of the space inside a shape; a neighbourhood can be called an area)
2. Explain:
   - In Maths, "perimeter" is the total length or measure around a shape.
   - "Area" is the size of the space inside of a shape.
3. Explain how to calculate **perimeter:**
   - To find the perimeter of a rectangle or square, add the lengths of all 4 sides together.
   - For sides that are the same length, we can take a shortcut and multiply the length by the number of sides. For square, multiply the length by 4. For rectangle, multiply the length and the width each by 2.

4. Write the formulae for perimeter of a square and rectangle on the board:
   Square: $P = l + l + l + l = 4l$
   Rectangle: $P = l + l + w + w = 2l + 2w$
5. Calculate the perimeter of the square and rectangle on the board using the formulae. (Answers: Square: $\mathrm{P} = 4l = 4 \times 8\text{ m} = 32\text{ m}$; Rectangle: $\mathrm{P} = 2l + 2w = 2 \times 5\text{ m} + 2 \times 2\text{ m} = 10\text{ m.} + 4\text{ m.} = 14\text{ m}$)
6. Explain how to calculate **area:**
   - To find the area of a square or rectangle, multiply the measurements of the two sides, length and width. For square the sides are the same length, so the area will be length squared.
   - The area is always given in units squared. For example, if the lengths are given in metres, the area should be given in square metres. Note that perimeter is **not** given in units squared.
7. Write the formulae for the area of a square and rectangle on the board:
   Square: $A = l \times l = l^2$
   Rectangle: $A = l \times w$
8. Calculate the area of the square and rectangle on the board using the formulae. (Answers: Square: $\mathrm{A} = l^2 = 8\text{ m} \times 8\text{ m} = 64\text{ m}^2$; Rectangle: $\mathrm{A} = l \times w = 5\text{ m} \times 2\text{ m} = 10\text{ m}^2$)
9. Draw the following shapes on the board:





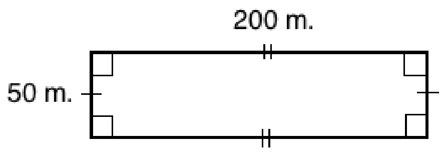
10. Ask pupils to work with seatmates to calculate the perimeter and area of the shapes.
11. Invite 2 volunteers to come to the board at the same time and show the calculations for the perimeter and area. (Answers: Square: $\mathrm{P} = 4l = 4 \times 3\text{ cm} = 12\text{ cm}$; $\mathrm{A} = l^2 = 3\text{ cm} \times 3\text{ cm} = 9\text{ cm}^2$; Rectangle: $\mathrm{P} = 2l + 2w = 2 \times 3.5\text{ km} + 2 \times 1.5\text{ km} = 7\text{ km.} + 3\text{ km.} = 10\text{ km}$; $\mathrm{A} = l \times w = 3.5\text{ km} \times 1.5\text{ km} = 5.25\text{ km}^2$.)
12. Write the following word problem on the board: Mr. Bah has a rectangular farm. It is 200 metres on one side, and 50 metres on the other side.
    a. Draw the shape of Mr. Bah's farm.
    b. If he wants to fence his farm, how long will his fence be?
    c. He wants to find the area of his farm to know how much fertiliser to buy. What is the area?
    d. If he needs 1 bottle of fertiliser for each 100 m^2, how many bottles should he buy?

e. If he plants half of his farm with corn, what is the area of the corn?

13. Ask pupils to work with seatmates to solve the word problem. Support pupils as needed.
14. Invite 5 volunteers to write the solution on the board and explain.

Solutions:

a.



b. Calculate the perimeter: $\text{P} = 2l + 2w = 2 \times 200 \text{ m} + 2 \times 50 \text{ m} = 400 \text{ m.} + 100 \text{ m.} = 500 \text{ m}$

c. Calculate the area: $\text{A} = l \times w = 200 \text{ m} \times 50 \text{ m} = 10{,}000 \text{ m}^2$

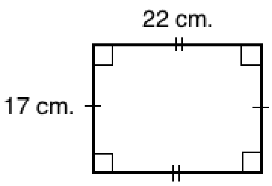
d. Divide the area by 100 to find the number of bottles needed: $10{,}000 \text{ m}^2 \div 100 \text{ m}^2 = 100$ bottles

e. Calculate half of the area: $\frac{1}{2}\text{A} = \frac{1}{2}(10{,}000 \text{ m}^2) = 5{,}000 \text{ m}^2$

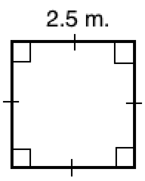
Practice *(16 minutes)*

1. Write on the board:
   Find the perimeter and area of shapes a. and b.:

a.



b.



c. Mrs. Jalloh has a perfectly square farm that measures 120 metres on each side. She will plant $\frac{1}{4}$ of the farm with cassava.

   i. Draw the shape of Mrs. Jalloh's farm.
   ii. What is the total area of Mrs. Jalloh's farm?
   iii. What is the area that she will plant with cassava?
   iv. If each square metre produces 2 pieces of cassava, how many pieces of cassava will she have in total?

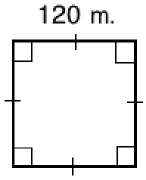
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

Solutions:

a. $\text{P} = 2l + 2w = 2 \times 22 \text{ cm} + 2 \times 17 \text{ cm} = 44 \text{ cm} + 34 \text{ cm} = 78 \text{ cm};$
$\text{A} = l \times w = 22 \text{ cm} \times 17 \text{ cm} = 374 \text{ cm}^2$

b. $\text{P} = 4l = 4 \times 2.5 \text{ m} = 10 \text{ m};$
$\text{A} = l^2 = 2.5 \text{ m} \times 2.5 \text{ m} = 6.25 \text{ m}^2$

c. i.



ii. $\mathrm{A} = l^2 = 120\text{ m} \times 120\text{ m} = 14{,}400\text{ m}^2$

iii. Calculate $\frac{1}{4}$ of the area: $\frac{1}{4}A = \frac{1}{4}(14{,}400\text{ m}^2) = 3{,}600\text{ m}^2$

iv. Multiply the area for cassava by the number of cassava per square metre: $3{,}600\text{ m}^2 \times 2\,\frac{\text{pieces}}{\text{m}^2} = 7{,}200$ pieces of cassava total.

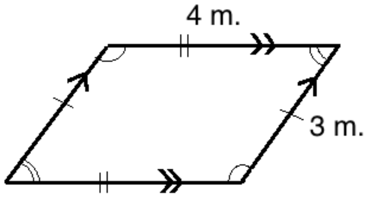
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L067 in the Pupil Handbook.

Lesson Title: Perimeter and area of a parallelogram	Theme: Mensuration	
Lesson Number: M2-L068	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a parallelogram.	**Preparation** Draw and label the shape in Opening on the board.	

Opening *(3 minutes)*

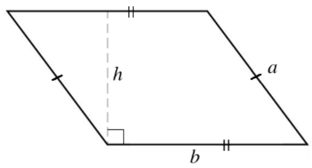
1. Draw and label the parallelogram on the board:



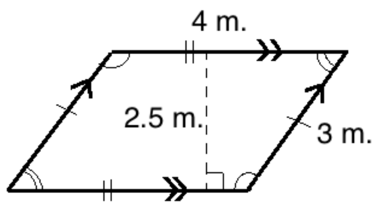
2. Discuss**:** What are the characteristics of a parallelogram? (Example answer: Opposite sides are parallel; opposite sides have an equal length; opposite angles are equal.)
3. Explain that this lesson is on calculating the perimeter and area of a parallelogram. It is review of a JSS topic.

Teaching and Learning *(20 minutes)*

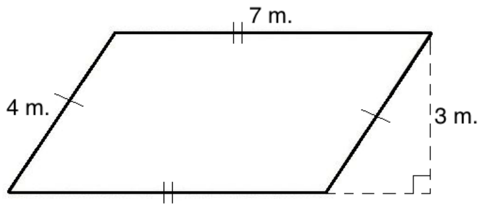
1. Discuss. Allow pupils to share their ideas:
   - How do you think we can find the perimeter of a parallelogram?
   - How do you think we can find the area of a parallelogram?
2. Explain:
   - We calculate the perimeter in the same way for any shape: by adding all of the sides. We use the same formula for a parallelogram that we used for a rectangle.
   - The area involves different formulae and calculations for different shapes.
3. Draw another parallelogram on the board, labeled only with a, b, and h:



4. Calculate the perimeter of the parallelogram on the board: $P = 2a + 2b = 2 \times 4\text{ m} + 2 \times 3\text{ m} = 14\text{ m}$
5. Write the formulae for the area of a parallelogram on the board:
$$A = base \times height = b \times h$$
6. Explain: The height of a parallelogram forms a right angle with its base.
7. Draw and label the height of the first parallelogram on the board, as shown:

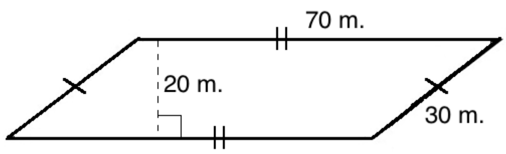


8. Calculate the area of the parallelogram using the formula. (Answers: $A = b \times h = 4 \text{ m.} \times 2.5 \text{ m.} = 10 \text{ m.}^2$)
9. Draw another parallelogram on the board:

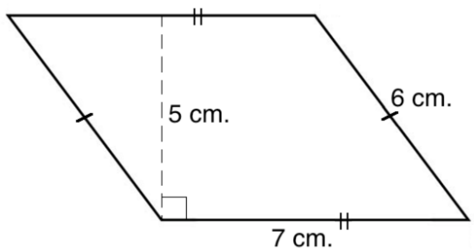


10. Ask volunteers to explain how to calculate perimeter and area of the parallelogram. As they explain, do the calculations on the board:
    $P = 2a + 2b = 2 \times 7 \text{ m.} + 2 \times 4 \text{ m.} = 22 \text{ m.}$
    $A = b \times h = 7 \text{ m.} \times 3 \text{ m.} = 21 \text{ m.}^2$
11. Draw the following shapes on the board:

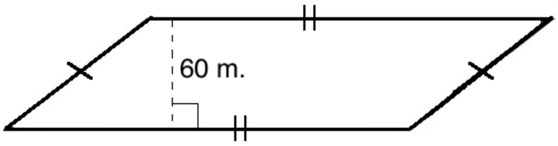
a.



b.



12. Ask pupils to work with seatmates to calculate the perimeter and area of the shapes.
13. Invite volunteers to come to the board at the same time and show the calculations for perimeter and area. (Answers: Parallelogram a: $P = 2 \times 70 \text{ m.} + 2 \times 30 \text{ m.} = 200 \text{ m.}$; $A = 70 \text{ m.} \times 20 \text{ m.} = 1{,}400 \text{ m.}^2$; Parallelogram b: $P = 2 \times 7 \text{ cm.} + 2 \times 6 \text{ cm.} = 26 \text{ cm.}$; $A = 7 \text{ cm.} \times 5 \text{ cm.} = 35 \text{ cm.}^2$;
14. Write the following word problem on the board: The yard of a school is in the shape of a parallelogram. The principal knows that the area is 12,000 square metres and the height is 60 metres.
    a. Draw and label the shape.
    b. Help him by calculating the length of the base.
15. Ask pupils to work with seatmates to solve the problem.
16. Invite a volunteer to come the board to draw the shape, and another to do the calculation.
    Solutions:
    a. (Note that a parallelogram may be drawn differently; it is only important that the height is labeled as 60 metres.):



b. Use the formula $A = b \times h$, and solve for b:

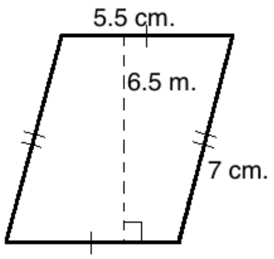
$$12{,}000 \text{ m.}^2 = b \times 60 \text{ m.}$$

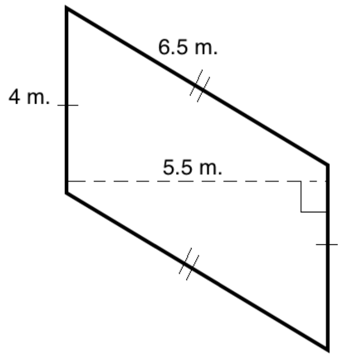
$$\frac{12{,}000 \text{ m.}^2}{60 \text{ m.}} = b \qquad \text{Divide throughout by 60 m.}$$

$$200 \text{ m} = b$$

Practice *(16 minutes)*

1. Write the following on the board:
   Find the perimeter and area of shapes a and b:

   a. 

   b. 

   c. A parallelogram has base 14 km. and area 280 km.^{2}. What is the height of the parallelogram?

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.
   Solutions:
   a. $\text{P} = 2a + 2b = 2 \times 5.5 \text{ cm} + 2 \times 7 \text{ cm} = 11 \text{ cm} + 14 \text{ cm} = 25 \text{ cm}$;
   $\text{A} = b \times h = 5.5 \text{ cm} \times 6.5 \text{ cm} = 35.75 \text{ cm}^2$
   b. $\text{P} = 2a + 2b = 2 \times 4 \text{ m} + 2 \times 6.5 \text{ m} = 8 \text{ m} + 13 \text{ m} = 21 \text{ m}$;
   $\text{A} = b \times h = 4 \text{ cm} \times 5.5 \text{ cm} = 22 \text{ cm}^2$
   c.
$$A = b \times h$$
$$280 \text{ km}^2 = 14 \text{ km.} \times h$$
$$\frac{280 \text{ km}^2}{14 \text{ km}} = h \qquad \text{Divide throughout by 14 km}$$
$$20 \text{ km} = h$$

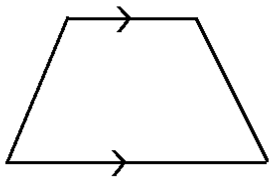
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L068 in the Pupil Handbook.

Lesson Title: Perimeter and area of a trapezium	**Theme:** Mensuration	
Lesson Number: M2-L069	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a trapezium.	**Preparation** Draw the shape in Opening on the board.	

Opening *(3 minutes)*

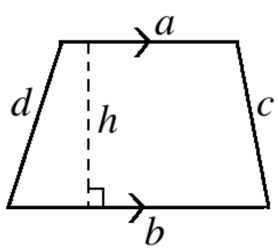
1. Draw the following trapezium on the board:



2. Discuss**:** What are the characteristics of a trapezium? (Example answer: 2 opposite sides are parallel, while the other set of opposite sides are not.)
3. Explain that this lesson is on calculating the perimeter and area of a trapezium. It is review of a JSS topic.

Teaching and Learning *(20 minutes)*

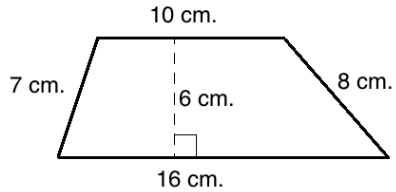
1. Discuss. Allow pupils to share their ideas:
   - How do you think we can find the perimeter of a trapezium?
   - How do you think we can find the area of a trapezium?
2. Explain:
   - We calculate the perimeter in the same way for any shape: by adding all of the sides.
   - The area involves a formula that is specifically for a trapezium.
3. Label the trapezium on the board as shown:



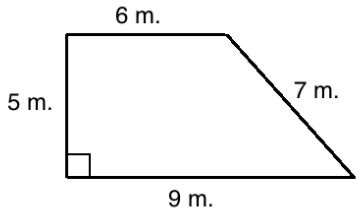
4. Write the formulae for the perimeter and area of a trapezium on the board:

$$P = a + b + c + d$$
$$A = \frac{1}{2}(a + b)h$$

5. Explain: As with parallelogram, the height of a trapezium forms a right angle with its base.
6. Draw and label a trapezium on the board, as shown:

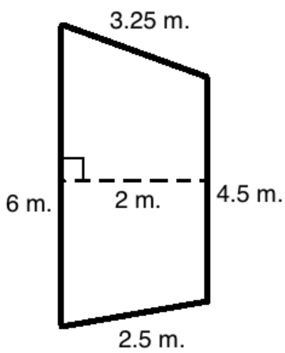


7. Calculate the perimeter of the trapezium on the board using the formula. (Answers: $P = a + b + c + d = 10 + 16 + 8 + 7 = 41$ cm.)
8. Calculate the area of the trapezium on the board using the formula. (Answers: $A = \frac{1}{2}(a + b)h = \frac{1}{2}(10 + 16)6 = \frac{1}{2}(26)6 = 78 \text{ cm.}^2$)
9. Draw another trapezium on the board:

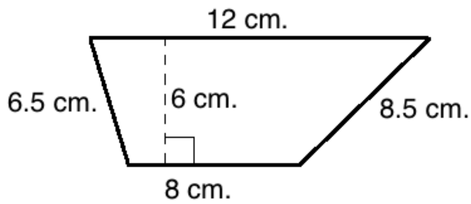


10. Discuss: What is the height?
11. Allow pupils to share their ideas, then explain that the left side of the trapezium is also its height.
12. Ask volunteers to explain the steps to calculate the perimeter and area of the trapezium. As they give the steps, solve on the board.
    Solutions:
    $P = a + b + c + d = 6 + 9 + 7 + 5 = 27$ m.
    $A = \frac{1}{2}(a + b)h = \frac{1}{2}(6 + 9)5 = \frac{1}{2}(15)5 = 7.5 \times 5 = 37.5 \text{ m.}^2$
13. Draw the following shapes on the board:

a.



b.

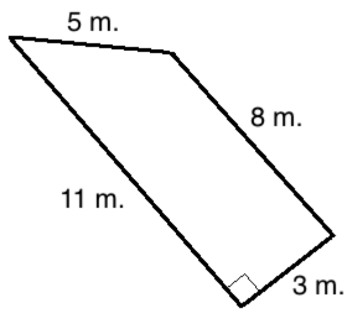


14. Ask pupils to work with seatmates to calculate the perimeter and area of the shapes.
15. Invite volunteers to come to the board at the same time and show the calculations for the perimeter and area. (Answers: Trapezium a: $P = 3.25 + 4.5 + 2.5 + 6 = 16.25$ m.; $A = \frac{1}{2}(6 + 4.5)2 = \frac{1}{2}(10.5)2 = 10.5 \text{ m.}^2$; Trapezium b: $P = 12 + 8.5 + 8 + 6.5 = 35$ cm.; $A = \frac{1}{2}(12 + 8)6 = \frac{1}{2}(20)6 = 10 \times 6 = 60 \text{ cm.}^2$)

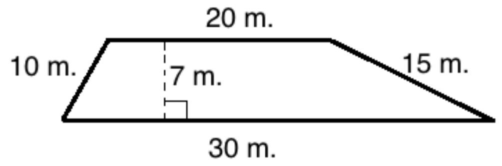
Practice *(16 minutes)*

1. Write on the board:
   Find the perimeter and area of shapes a. and b.:

   a.



   b.



   c. A trapezium has parallel lines that are 10 m and 15 m. If its area is 100 m^2, what is its height?

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.
   Solutions:
   a. $\text{P} = 5 + 8 + 3 + 11 = 27 \text{ m.};$
   $\text{A} = \frac{1}{2}(11 + 8)3 = \frac{1}{2}(19)3 = 9.5 \times 3 = 28.5 \text{ cm}^2$
   b. $\text{P} = 10 + 20 + 15 + 30 = 75 \text{ m.};$
   $\text{A} = \frac{1}{2}(30 + 20)7 = \frac{1}{2}(50)7 = 25 \times 7 = 175 \text{ m}^2$
   c.

A	$=$	$\frac{1}{2}(a + b)h$	
100 m.^2	$=$	$\frac{1}{2}(10 \text{ m.} + 15 \text{ m.})h$	Substitute values
$2 \times 100 \text{ m.}^2$	$=$	$(25\, m.)h$	Multiply throughout by 2
$\frac{200 \text{ m.}^2}{25 \text{ m.}}$	$=$	h	Divide throughout by 25
8 m.	$=$	h	

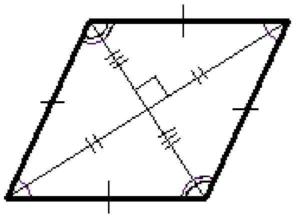
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L069 in the Pupil Handbook.

Lesson Title: Perimeter and area of a rhombus	**Theme:** Mensuration	
Lesson Number: M2-L070	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a rhombus.	**Preparation** Draw the shape in Opening on the board.	

Opening *(3 minutes)*

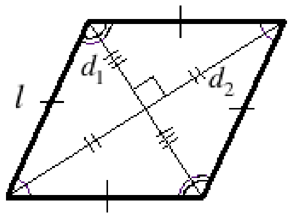
1. Draw the following rhombus on the board:



2. Discuss**:** What are the characteristics of a rhombus? (Example answers: All 4 sides are equal; opposite angles are equal; opposite sides are parallel; its diagonals bisect each other at a right angle.)
3. Explain that this lesson is on calculating the perimeter and area of a rhombus. It is review of a JSS topic.

Teaching and Learning *(20 minutes)*

1. Discuss. Allow pupils to share their ideas:
   - How do you think we can find the perimeter of a rhombus?
   - How do you think we can find the area of a rhombus?
2. Explain:
   - We calculate the perimeter in the same way for any shape: by adding all of the sides.
   - The area involves a formula that is specifically for rhombus.
3. Label the rhombus on the board as shown:



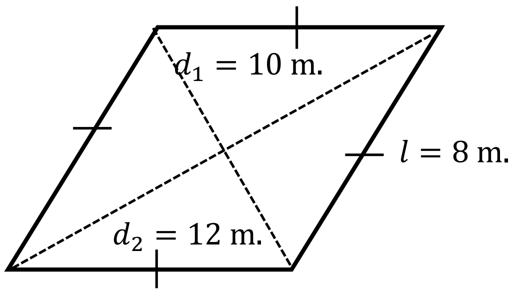
4. Write the formulae for the perimeter and area of a rhombus on the board:

$$P = l + l + l + l = 4l$$
$$A = \frac{1}{2}d_1 \times d_2$$

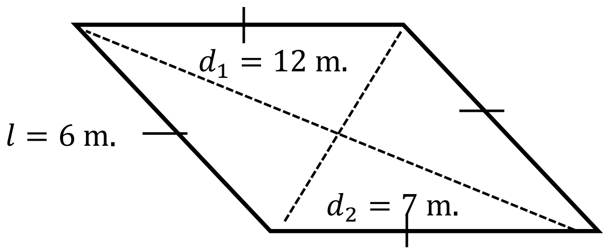
5. Explain:
   - As with a square, we can calculate the perimeter by multiplying the length of one side by 4. This is because all sides are the same length.

- To calculate the area, we must know the measures of the diagonals.

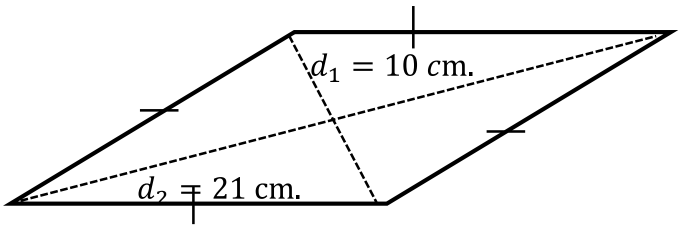
6. Draw and label the rhombus as shown below on the board:



7. Calculate the perimeter of the rhombus on the board using the formula. (Answers: $P = 4l = 4(8) = 32$ m)
8. Calculate the area of the rhombus on the board using the formula. (Answers: $A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(10 \times 12) = \frac{1}{2}(120) = 60 \text{ m}^2$)
9. Draw the rhombus shown below on the board:



10. Ask volunteers to explain the steps to calculate the perimeter and area of the rhombus. As they give the steps, solve on the board.
    Solutions:
    $P = 4l = 4(6) = 24$ m
    $A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(12 \times 7) = \frac{1}{2}(84) = 42\text{m}^2$
11. Write the following problem on the board: The rhombus below has a perimeter of 28 cm, and diagonals measuring 21cm and 10 cm. Find:
    a. The length of the sides.
    b. The area of the rhombus.



12. Discuss: How can we find the length of the sides?
13. Allow pupils to share ideas until they arrive at the answer. (Answer: Substitute the given perimeter into the formula $P = 4l$, and solve for l.)
14. Ask pupils to work with seatmates to calculate the length and area.
15. Invite 2 volunteers to come to the board and write the solutions.

Solutions:

a.

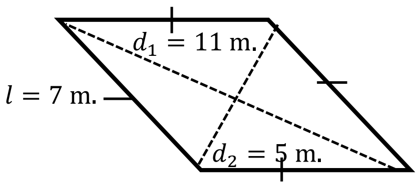
$$\begin{aligned} P &= 4l \\ 28 \text{ cm} &= 4l \\ \frac{28 \text{ cm}}{4} &= \frac{4l}{4} \quad \text{Divide throughout by 4} \\ 7 \text{ cm} &= l \end{aligned}$$

b. $A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(21 \times 10) = \frac{1}{2}(210) = 105 \text{ cm}^2$

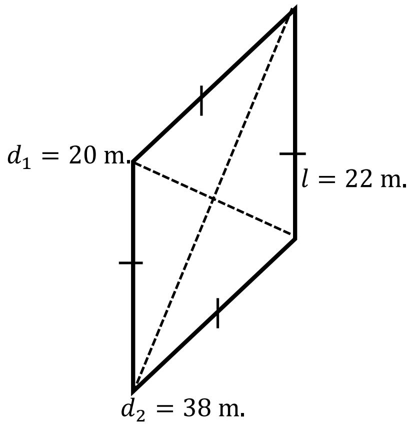
Practice *(16 minutes)*

1. Write the following problems on the board:
   Find the perimeter and area of shapes a. and b.:

   a.



   b.



   c. A rhombus has one diagonal that is 7 m. If its area is 84 m^2, what is its other diagonal?

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

   Solutions:

   a. $\text{P} = 4(7) = 28 \text{ m};$

   $\text{A} = \frac{1}{2}(11 \times 5) = \frac{1}{2}(55) = 27.5 \text{ m}^2$

   b. $\text{P} = 4(22) = 88 \text{ m};$

   $\text{A} = \frac{1}{2} \times 20 \times 38 = 10 \times 38 = 380 \text{ m}^2$

   c.

$$\begin{aligned} A &= \frac{1}{2}d_1 \times d_2 \\ 84 \text{ m}^2 &= \frac{1}{2}(7 \text{ m}) \times d_2 \quad \text{Substitute values} \\ 2 \times 84 \text{ m}^2 &= (7 \text{ m}) \times d_2 \quad \text{Multiply throughout by 2} \\ \frac{168 \text{ m}^2}{7 \text{ m}} &= d_2 \quad \text{Divide throughout by 7} \\ 24 \text{ m} &= d_2 \end{aligned}$$

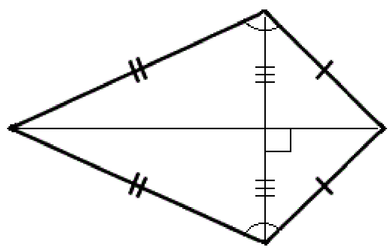
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L070 in the Pupil Handbook.

Lesson Title: Perimeter and area of a kite	**Theme:** Mensuration	
Lesson Number: M2-L071	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a kite.	**Preparation** Draw the shape in Opening on the board.	

Opening *(3 minutes)*

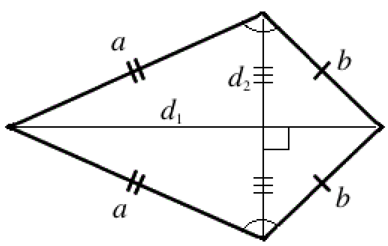
1. Draw the kite shown at right on the board:



2. Discuss: What are the characteristics of a kite? (Example answers: It has two pairs of sides with equal lengths, which meet each other; the angles where the two pairs of sides meet are equal; one diagonal is bisected by the other.)
3. Explain that this lesson is on calculating the perimeter and area of a kite.

Teaching and Learning *(20 minutes)*

1. Discuss. Allow pupils to share their ideas:
   - How do you think we can find the perimeter of a kite?
   - How do you think we can find the area of a kite?
2. Explain:
   - We calculate the perimeter in the same way for any shape: by adding all of the sides. We will take a shortcut since some of the sides are the same length.
   - Calculating the area of a kite, we use the same formula as for a rhombus.
3. Label the kite on the board as shown:



4. Write the formulae for the perimeter and area of a kite on the board:

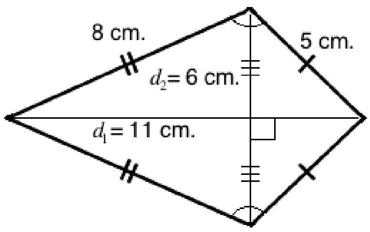
$$P = a + a + b + b = 2a + 2b$$

$$A = \frac{1}{2} d_1 \times d_2$$

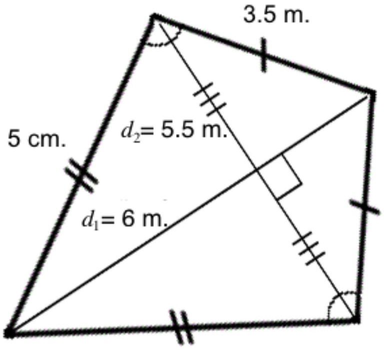
5. Explain:

- As with a rectangle, we can calculate the perimeter by multiplying sides a and b each by 2 before adding them. This is for sides that are the same length.
- To calculate the area, we must know the measurements of the diagonals.

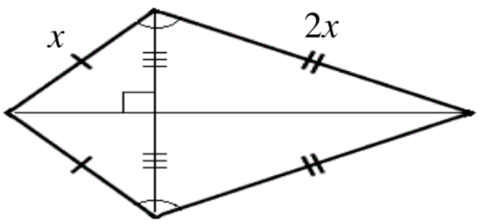
6. Draw and label the kite shown below on the board:



7. Calculate the perimeter of the kite on the board using the formula. (Answers: $P = 2a + 2b = 2(8) + 2(5) = 16 + 10 = 26$ cm.)
8. Calculate the area of the kite on the board using the formula. (Answers: $A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(11 \times 6) = \frac{1}{2}(66) = 33$ cm.^{2})
9. Draw and label the kite shown below on the board:



10. Ask volunteers to explain the steps to calculate the perimeter and area of the kite. As they give the steps, solve on the board.
Solutions:
$P = 2a + 2b = 2(5) + 2(3.5) = 10 + 7 = 17$ m.
$A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(6 \times 5.5) = \frac{1}{2}(33) = 16.5$ m.^{2}
11. Write the following problem on the board: The kite below has a perimeter of 24 cm. Find the lengths of the sides.



12. Discuss: How can we find the value of x?
13. Allow pupils to share ideas until they arrive at the answer. Guide them as needed. (Answer: Substitute the given sides (x and $2x$) into the formula for

perimeter. Set it equal to 24 cm. and solve for x. With x we can find the lengths of the 2 sides.)

14. Ask volunteers to describe each step. As they give the steps, solve the problem on the board:

    Solutions:

    Step 1. Find the value of x.

P	$=$	$2a + 2b$	Use the perimeter formula
24 cm	$=$	$2(x) + 2(2x)$	Substitute $P = 24$ cm., $a = x$, and $b = 2x$
24 cm	$=$	$2x + 4x$	Simplify
24 cm	$=$	$6x$	
$\frac{24 \text{ cm}}{6}$	$=$	$\frac{6x}{6}$	Divide throughout by 6
4 cm	$=$	x	

    Step 2. Find the lengths of the sides. Call them a and b.

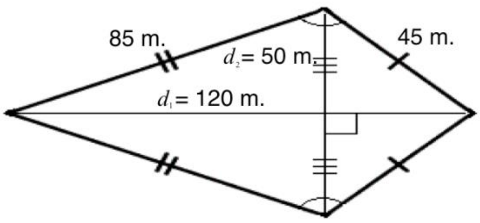
$$a = x = 4 \text{ cm}$$
$$b = 2x = 2(4 \text{ cm}) = 8 \text{ cm}$$

15. Write the following problem on the board: Mr. Bah's farm is in the shape of a kite. The diagonals are 25 m. and 38 m. Help him find the area.
16. Ask pupils to work with seatmates to find the area of Mr. Bah's farm.
17. Invite a volunteer from one set of seatmates to write their solution on the board. All other pupils should check their work. (Answer: $A = \frac{1}{2}d_1 \times d_2 = \frac{1}{2}(25 \times 38) = \frac{1}{2}(950) = 475 \text{ m}^2$)

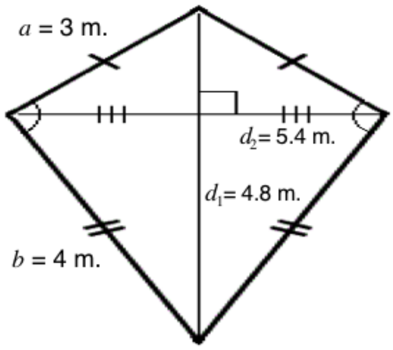
Practice *(16 minutes)*

1. Write the following problems on the board:
   Find the perimeter and area of shapes a. and b.:

   a.



   b.



   c. A kite has one diagonal that is 8 cm. If its area is 120 cm^2, what is its other diagonal?

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

Solutions:

a. $\text{P} = 2(85) + 2(45) = 170 + 90 = 260 \text{ m};$

$\text{A} = \frac{1}{2}(120 \times 50) = 60 \times 50 = 3{,}000 \text{ m}^2$

b. $\text{P} = 2(3) + 2(4) = 6 + 8 = 14 \text{ m};$

$\text{A} = \frac{1}{2} \times 4.8 \times 5.4 = 2.4 \times 5.4 = 12.96 \text{ m}^2$

c.

A	$=$	$\frac{1}{2}d_1 \times d_2$	
120 cm^2	$=$	$\frac{1}{2}(8 \text{ cm}) \times d_2$	Substitute values
120 cm^2	$=$	$4\ cm \times d_2$	Simplify
$\frac{120 \text{ cm}^2}{4\ cm}$	$=$	d_2	Divide throughout by 4
30 cm	$=$	d_2	

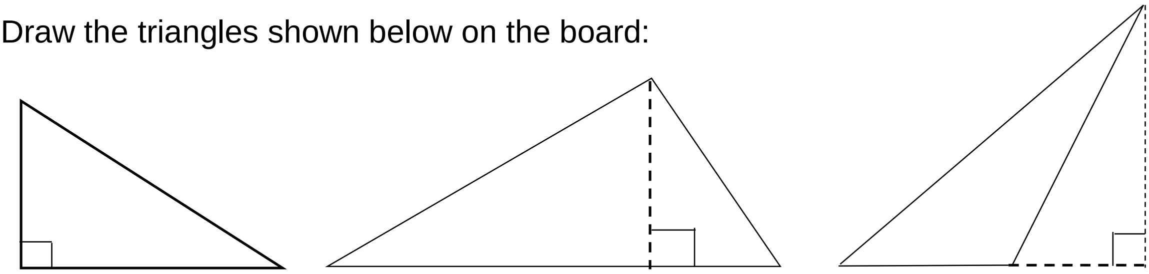
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L071 in the Pupil Handbook.

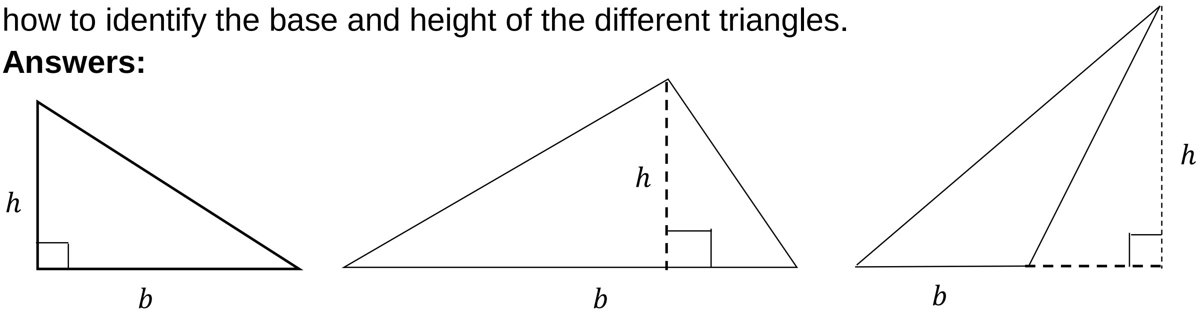
Lesson Title: Perimeter and area of a triangle	**Theme:** Mensuration	
Lesson Number: M2-L072	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a triangle.	**Preparation** Draw the shapes in Opening on the board.	

Opening *(3 minutes)*

1. Draw the triangles shown below on the board:



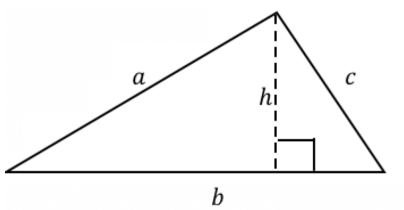
2. Invite volunteers to come to the board and label the **base** and **height** of each triangle, using the letters b and h.
3. Allow other pupils to support them and discuss. Make sure pupils understand how to identify the base and height of the different triangles.
   Answers:



4. Explain that this lesson is on calculating the perimeter and area of a triangle. This is review from JSS.

Teaching and Learning *(20 minutes)*

1. Discuss the following. Allow pupils to share their ideas:
   - How do you think we can find the perimeter of a triangle?
   - How do you think we can find the area of a triangle?
2. Explain:
   - We calculate the perimeter in the same way for any shape: by adding all of the sides.
   - Calculating the area of a triangle uses a specific formula.
3. Label the triangle on the board as shown:

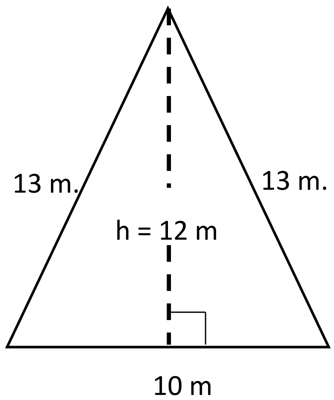


4. Write the formulae for the perimeter and area of a triangle on the board:

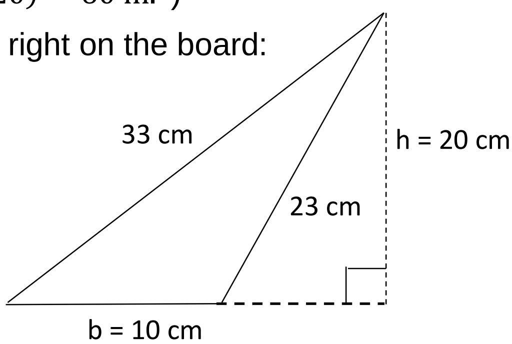
$$P = a + b + c$$

$$A = \frac{1}{2} b \times h$$

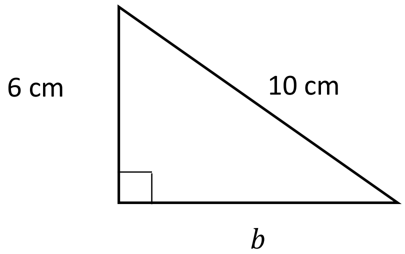
5. Explain:
    - To calculate the perimeter, add all 3 sides.
    - To calculate the area, multiply the base and height by one half.
    - Sometimes the height of the triangle is also a side. Other times it is not.
6. Draw and label a triangle on the board, as shown:



7. Discuss: What type of triangle is this? How do you know? (Answer: It is an isosceles triangle, because 2 sides are equal.)
8. Calculate the perimeter of the triangle on the board using the formula. (Answers: $P = 13 + 13 + 10 = 36$ m.)
9. Calculate the area of the triangle on the board using the formula. (Answers: $A = \frac{1}{2} b \times h = \frac{1}{2}(10 \times 12) = \frac{1}{2}(120) = 60 \text{ m.}^2$)
10. Draw the triangle shown at right on the board:



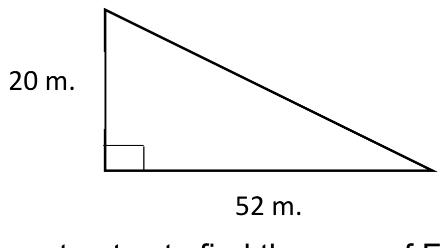
11. Ask volunteers to explain the steps to calculate the perimeter and area of the triangle. As they give the steps, solve on the board.
    Solutions:
    $P = a + b + c = 33 + 10 + 23 = 66$ cm.
    $A = \frac{1}{2} b \times h = \frac{1}{2}(10 \times 20) = \frac{1}{2}(200) = 100 \text{ cm.}^2$
12. Write the following problem on the board: The triangle below has a perimeter of 24 cm.
    a. Use the perimeter to find the length of b.
    b. Find the area.



13. Discuss: How can we find the value of b?
14. Allow pupils to share ideas until they arrive at the answer. Guide them as needed. (Answer: Substitute the known sides (6 cm. and 10 cm.) and the perimeter into the formula, and solve for b.)
15. Ask volunteers to describe each step. As they give the steps, solve a. on the board:

P	$=$	$a+b+c$	Use the perimeter formula
24	$=$	$6\ +\ b+10$	Substitute $P=24, a=6$, and $c=10$
24	$=$	$16+b$	Simplify
$24-16$	$=$	b	Transpose 16
b	$=$	8	

16. Discuss: How can we find the area?
17. Allow pupils to share ideas until they arrive at the answer. Guide them as needed. (Answer: Two sides of the triangle ($a=6$ and $b=8$) are the base and height. Substitute these in the area formula and solve.)
18. Ask volunteers to describe each step. As they give the steps, solve b on the board: $A=\frac{1}{2}b\times h=\frac{1}{2}(8\times 6)=\frac{1}{2}(48)=24\text{ cm.}^2$
19. Write the following problem on the board: Fatu's land is in the shape of a right-angled triangle. She measures the 2 sides that intersect at a right angle. They are 20 metres and 52 metres. Help her find the area.
20. Ask pupils to work with seatmates to draw a sketch of Fatu's land.
21. Invite a volunteer to draw the shape of the land on the board.
    Answer:

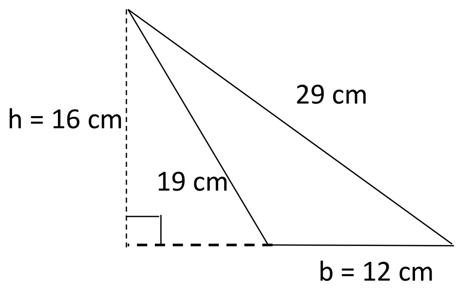


22. Ask pupils to work with seatmates to find the area of Fatu's land.
23. Invite a volunteer from one set of seatmates to write their solution on the board. All other pupils should check their work. (Answer: $A=\frac{1}{2}b\times h=\frac{1}{2}(52\times 20)=52\times 10=520\text{ m.}^2$)

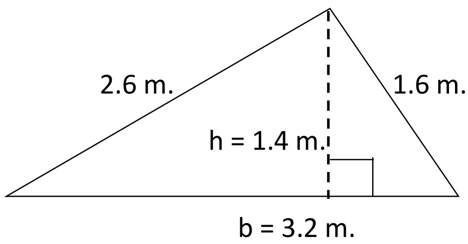
Practice *(16 minutes)*

1. Write the following problems on the board:
   Find the perimeter and area of shapes a. and b.:

a.



b.



c. A triangle has base 7 m., and area 21 m.^{2}. What is its height?

2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

Solutions:

a. $\text{P} = 19 + 12 + 29 = 60 \text{ cm};$

$\text{A} = \frac{1}{2}(12 \times 16) = 6 \times 16 = 96 \text{ cm}^2$

b. $\text{P} = 2.6 + 3.2 + 1.6 = 7.4 \text{ m};$

$\text{A} = \frac{1}{2} \times 3.2 \times 1.4 = 1.6 \times 1.4 = 2.24 \text{ m}^2$

c.

A	$=$	$\frac{1}{2}b \times h$	
21	$=$	$\frac{1}{2}(7) \times h$	Substitute values
42	$=$	$7h$	Multiply throughout by 2
$\frac{42}{7}$	$=$	$\frac{7h}{7}$	Divide throughout by 7
6 m	$=$	h	

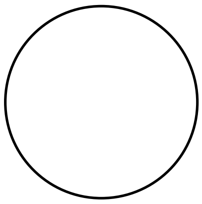
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L072 in the Pupil Handbook.

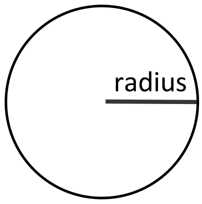
Lesson Title: Circumference and area of a circle	**Theme:** Mensuration	
Lesson Number: M2-L073	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the circumference and area of a circle.	**Preparation** None	

Opening *(3 minutes)*

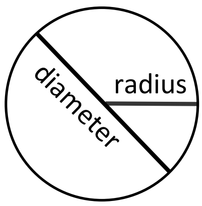
1. Draw a circle on the board:



2. Invite a volunteer to come draw and label a radius on the circle.
   Example:



3. Invite another volunteer to come draw a diameter on the circle:
   Example**:**



4. Explain that this lesson is on calculating the circumference and area of a circle. This is a review from JSS.

Teaching and Learning *(24 minutes)*

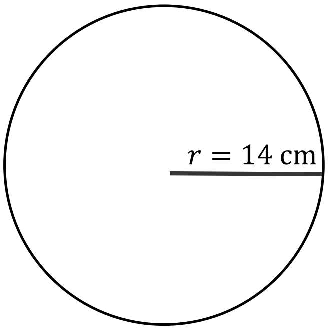
1. Discuss: What do you know about the diameter and radius of a circle? What is their relationship? (Answer: The diameter is twice the radius ($d = 2r$), or the radius is half of the diameter ($r = \frac{1}{2}d$).)
2. Discuss:
   - What is the circumference of a circle? (Answer: It is the distance around a circle, or the perimeter of a circle.)
   - How do we calculate the circumference and area?
3. Allow pupils to share ideas, then explain:
   - We calculate the circumference and area of a circle using specific formulae.
   - These formulae involve the number pi (π).

- Pi is a decimal number that stretches on forever. It can be estimated with numbers such as 3.14 and $\frac{22}{7}$. We will use these numbers in our calculations.

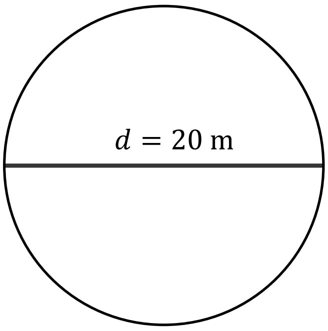
4. Write the formulae for circumference and area of a circle on the board:

$$C = 2\pi r$$
$$A = \pi r^2$$

5. Write the approximate values of pi on the board: 3.14 and $\frac{22}{7}$
6. Write the following problem on the board: Find the circumference and area of the circle. Use $\pi = \frac{22}{7}$.



7. Calculate the circumference of the circle on the board using the formula. (Answers: $C = 2\pi r = 2\left(\frac{22}{7}\right)(14\text{ cm}) = 2(22)(2\text{ cm}) = 88\text{ cm}$)
8. Calculate the area of the circle on the board using the formula. (Answers: $A = \pi r^2 = \left(\frac{22}{7}\right)14^2 = \left(\frac{22}{7}\right)196 = 22 \times 28 = 616\text{ cm}^2$)
9. Write the following problem on the board: Find the circumference and area of the circle. Use $\pi = 3.14$.



10. Ask volunteers to explain the steps to calculate circumference and area of the circle. As they give the steps, solve on the board.

Solutions:

Step 1. Find the radius. Divide diameter by 2:

$$r = \frac{1}{2}d = \frac{1}{2}(20\text{ m}) = 10\text{ m}$$

Step 2. Find the circumference:

$$C = 2\pi r = 2(3.14)(10) = 2(31.4) = 62.8\text{ m}$$

Step 3. Find the area:

$$A = \pi r^2 = (3.14)(10^2) = (3.14)(100) = 314\text{ m}^2$$

11. Write the following problem on the board: The circumference of a circle is 44 metres. Find its radius and area. Use $\pi = \frac{22}{7}$.
12. Discuss: How can we find the radius of a circle from its circumference? (Answer: Substitute the circumference in the formula and solve for radius.)
13. Solve on the board:

$$\begin{aligned} C &= 2\pi r \\ 44 &= 2\left(\frac{22}{7}\right)r \\ 22 &= \left(\frac{22}{7}\right)r && \text{Divide throughout by 2} \\ 7(22) &= 22r && \text{Multiply throughout by 7} \\ 7 &= r && \text{Divide throughout by 22} \end{aligned}$$

14. Ask pupils to find the area of the circle with seatmates.
15. Invite a volunteer to write the solution on the board. (Answer: $A = \pi r^2 = \left(\frac{22}{7}\right)7^2 = 22 \times 7 = 154 \text{ m}^2$)
16. Write another problem on the board: Ama wants to build a fence for her goats. She will make it a perfect circle with radius $3\frac{1}{2}$ m.
    a. What will the length of her fence be? Take $\pi = \frac{22}{7}$.
    b. If the fence costs Le 20,000.00 per metre, how much will she pay in total?
17. Discuss:
    - How can we find the length of the fence? (Answer: By calculating the circumference, which is the distance around the goat pen.)
    - How can we calculate the cost? (Answer: By multiplying the length in metres by the cost of each metre.)
18. Ask volunteers to give the steps needed to solve the problem. As they give the steps, solve it on the board:
    a. Calculate circumference: $C = 2\pi r = 2\left(\frac{22}{7}\right)\left(3\frac{1}{2}\right) = 2\left(\frac{22}{7}\right)\left(\frac{7}{2}\right) = 22 \text{ m}$
    b. Calculate cost: $22 \text{ m} \times \text{Le } 20{,}000.00 = \text{Le } 440{,}000.00$
19. Write another problem on the board: A farmer has a circular piece of land. He knows that it has a diameter of 40 metres.
    a. What is the area of his land? Use $\pi = 3.14$.
    b. If he grows 2 pieces of cassava for every square metre, how many pieces of cassava can he grow in total?
20. Discuss:
    - How can we calculate the area? (Answer: Divide the diameter by 2 to find the radius, then use the area formula.)
    - How can we calculate the number of cassava he can grow? (Answer: Multiply the area of his land in square metres by the number of cassava per square metre, 2.)
21. Ask pupils to work with seatmates to solve the problem.

22. Invite 2 volunteers to write the solutions on the board.

Solutions:

a. Calculate radius $r = \frac{1}{2}d = \frac{1}{2}(40 \text{ m}) = 20 \text{ m}$

Calculate area: $A = \pi r^2 = (3.14)(20^2) = (3.14)(400) = 1{,}256 \text{ m}^2$

b. Calculate number of cassava: $1{,}256 \text{ m}^2 \times 2\frac{\text{cassava}}{\text{m}^2} = 2{,}512 \text{ cassava}$

Practice *(12 minutes)*

1. Write the following problems on the board:
   a. If a circle has diameter 30 m, what is its circumference and area? Use $\pi = 3.14$.
   b. If the circumference of a circle is 132 cm, find its radius and area. Use $\pi = \frac{22}{7}$.
2. Ask pupils to work independently to solve the problems. Allow them to discuss with seatmates as needed.
3. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

Solutions:

a. Find radius: $r = \frac{1}{2}d = \frac{1}{2}(30) = 15 \text{ m}$

$\text{C} = 2\pi r = 2(3.14)(15) \text{ m} = 30(3.14) = 94.2 \text{ m}$

$\text{A} = \pi r^2 = (3.14)(15^2) = (3.14)(225) = 706.5 \text{ m}^2$

b. Find radius:

$$
\begin{aligned}
\text{C} &= 2\pi r \\
132 \text{ cm} &= 2\left(\frac{22}{7}\right)r \\
66 \text{ cm} &= \left(\frac{22}{7}\right)r \\
7(66 \text{ cm}) &= 22r \\
7 \times 3 \text{ cm} &= r \\
21 \text{ cm} &= r
\end{aligned}
$$

$\text{A} = \pi r^2 = \left(\frac{22}{7}\right)(21^2) = \left(\frac{22}{7}\right)(441) = 22 \times 63 = 1{,}386 \text{ cm}^2$

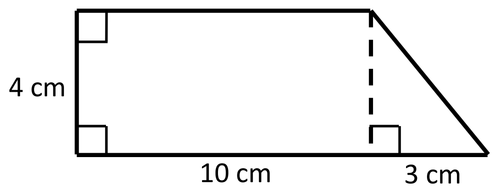
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L073 in the Pupil Handbook.

Lesson Title: Perimeter and area of compound shapes	Theme: Mensuration	
Lesson Number: M2-L074	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the perimeter and area of a compound shape.	**Preparation** Draw the shape in Opening on the board.	

Opening *(3 minutes)*

1. Draw the shape at right on the board:



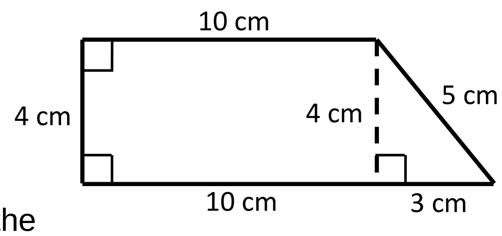
2. Discuss:
   a. What are the shapes that this shape is made up of? (Answer: A rectangle and a triangle.)
   b. How do you think we can find the perimeter of this shape?
   c. How can we find the area?
3. Allow pupils to discuss and share ideas.
4. Explain that this lesson is on calculating the perimeter and area of compound shapes. Compound shapes are ones that contain 2 or more different shapes.

Teaching and Learning *(21 minutes)*

1. Explain:
   - To find the area or perimeter of a compound shape, first divide it into its individual parts.
   - Find any missing lengths of sides.
   - To find the **perimeter**, add together the sides of the shape.
     - Notice that the triangle and rectangle share a side. Do not count shared sides toward perimeter.
   - Find the **area** of the compound shape by finding the area of all of the shapes and adding them together.
2. On the board, label the rectangle as A, and the triangle as B.
3. Find and label the unknown sides on the board.
   - Label the top length of the rectangle 10 cm. Label the shared side 4 cm.
   - Calculate the missing side of the triangle using Pythagoras' theorem:

$3^2 + 4^2 = c^2$	Substitute 3 and 4 into the formula
$9 + 16 = c^2$	Simplify
$25 = c^2$	
$\sqrt{25} = \sqrt{c^2}$	Take the square root of both sides
$c = 5$	

- Label the side of the triangle:



4. Find the **perimeter** of the shape on the board:

   $P = 4 + 10 + 5 + 3 + 10 = 32 \text{ cm}$

5. Find the **area** of the shape on the board, explaining each step:

   Step 1. Find the area of the rectangle:

   $$\begin{aligned} \text{area of A} &= l \times w \\ &= 10 \times 4 \\ &= 40 \text{ cm}^2 \end{aligned}$$

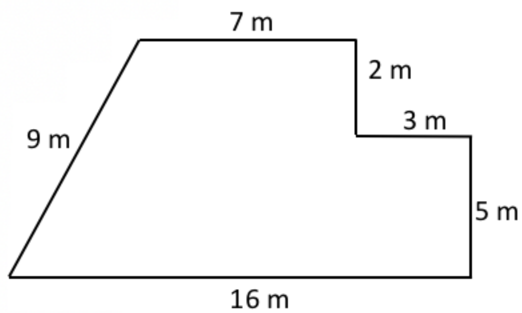
   Step 2. Find the area of the triangle:

   $$\begin{aligned} \text{area of } B &= \frac{1}{2} b \times h \\ &= \frac{1}{2}(3)(4) \\ &= 3 \times 2 \\ &= 6 \text{ cm}^2 \end{aligned}$$

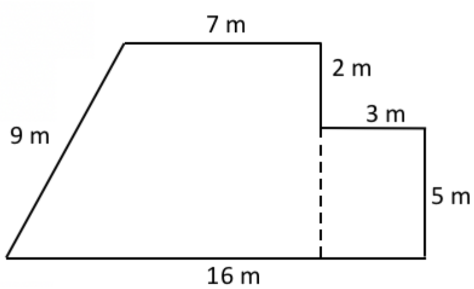
   Step 3. Add the areas:

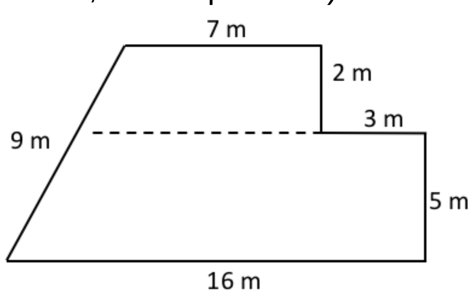
   $$\begin{aligned} \text{area of shape} &= \text{area of } A + \text{area of } B \\ &= 40 + 6 \\ &= 46 \text{ cm}^2 \end{aligned}$$

6. Draw the compound shape shown below on the board:



7. Invite a volunteer to draw a dotted line on the board to show the shapes. Possible answers (a rectangle and trapezium, or 2 trapeziums):

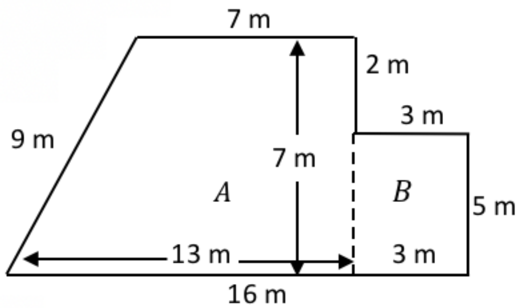




8. Explain:

- There are often different ways to divide a compound shape. Look for the way that will be the easiest to solve.
- It is easier to find the area of a rectangle than a trapezium, so we will take the shape with one trapezium and one rectangle.

9. Discuss and determine each unknown length. Label them on the board (see below).
    a. Base of rectangle: 3 m
    b. Height of trapezium: $2 + 5 = 7 \text{ m}$
    c. Base of trapezium: $16 - 3 = 13 \text{ m}$



10. Ask volunteers to explain the steps to calculate perimeter and area of the compound shape. As they give the steps, solve on the board.

Perimeter:

Add the sides: $P = 9 + 7 + 2 + 3 + 5 + 16 = 42 \text{ m}$

Area:

Step 1. Find the area of the trapezium:

$$\begin{aligned} \text{area of A} &= \tfrac{1}{2}(a+b)h \\ &= \tfrac{1}{2}(7+13)7 \\ &= \tfrac{1}{2}(20)7 \\ &= 10 \times 7 = 70 \text{ m}^2 \end{aligned}$$

Step 2. Find the area of the rectangle:

$$\begin{aligned} \text{area of } B &= l \times w \\ &= 5 \times 3 \\ &= 15 \text{ m}^2 \end{aligned}$$

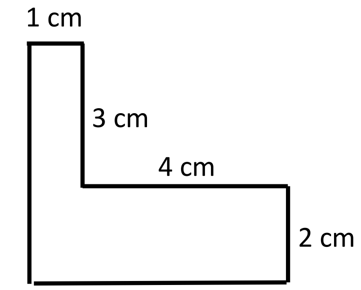
Step 3. Add the areas:

$$\begin{aligned} \text{area of shape} &= \text{area of } A + \text{area of } B \\ &= 70 + 15 \\ &= 85 \text{ m}^2 \end{aligned}$$

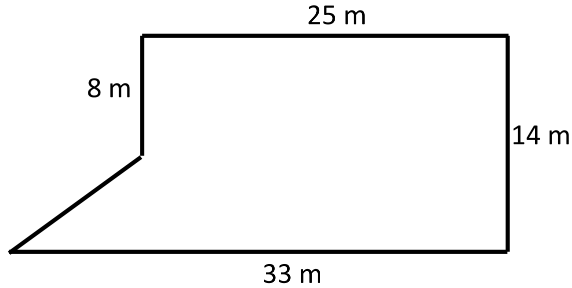
Practice *(15 minutes)*

1. Write the following problems on the board: Find the area and perimeter of each shape:

   a.



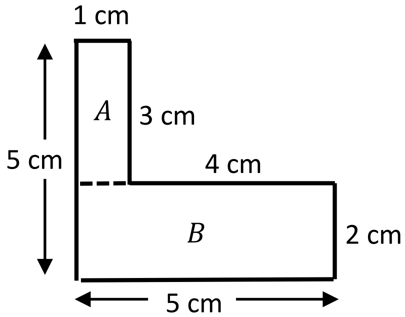
   b.



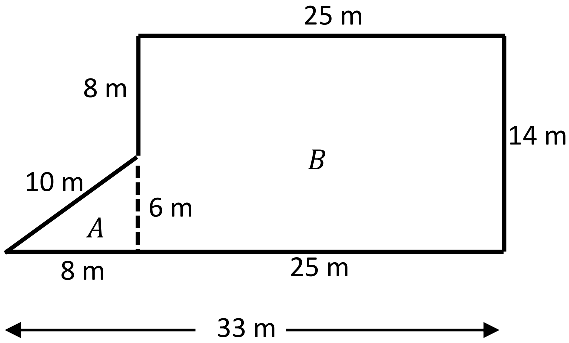
2. Ask pupils to work with seatmates to solve the problems.
3. Invite 2 volunteer to come to the board to draw the inside shapes and label the missing sides.

   Example answers (shapes could have been divided differently):

   a.



   b.



4. Invite volunteers to write the solutions on the board. They may come to the board at the same time.

   Solutions:

   a. **Perimeter:**

   $P = 1 + 3 + 4 + 2 + 5 + 5$
   $= 20 \text{ cm}$

   Area:

   Area of $A = 1 \times 3 = 3 \text{ cm}^2$

   Area of $B = 5 \times 2 = 10 \text{ cm}^2$

   Area of shape: $3 + 10 = 13 \text{ cm}^2$

   b. **Perimeter:**

   $P = 10 + 8 + 25 + 14 + 33 = 90 \text{ m}$

   Area:

   Area of $A = \frac{1}{2}(8)(6) = 24 \text{ m}^2$

   Area of $B = 25 \times 14 = 350 \text{ m}^2$

   Area of shape: $24 + 350 = 374 \text{ m}^2$

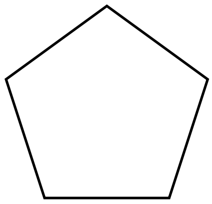
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L074 in the Pupil Handbook.

Lesson Title: Properties of polygons	**Theme:** Geometry	
Lesson Number: M2-L075	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to identify and describe properties of polygons (pentagon to decagon).	**Preparation** Draw the pentagon in Opening on the board. Draw the table in Teaching and Learning on the board.	

Opening *(3 minutes)*

1. Draw the shape shown below on the board:



2. Discuss:
   a. How many sides and angles does this shape have? (Answer: 5)
   b. What is the name of this shape? (Answer: pentagon)
3. Explain that this lesson is on the properties of polygons. “Poly” means “many”, so polygons are shapes with many sides. Pentagon is one example.

Teaching and Learning *(20 minutes)*

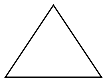
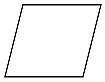
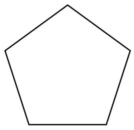
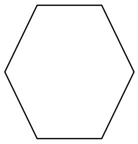
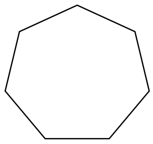
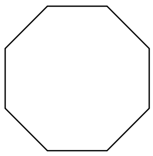
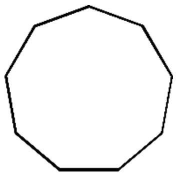
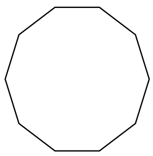
1. Draw the following table on the board (with taller rows and more space for the drawings):

Sides	Name	Drawing
3	Triangle	
4	Quadrilateral	
5		
6		
7		
8		
9		
10		

2. Invite a volunteer to come to the board to draw any triangle in the first row. Invite another volunteer to draw any quadrilateral. (See below for examples.)
3. Explain:
   - “Tri” means 3, which is the number of sides and angles in a triangle.
   - “Quad” means 4, which is the number of sides and angles in a quadrilateral.

- The name of each shape tells us how many sides and angles it has.

4. Ask volunteers to give the names of any other shapes they know. Write the names they share in the table.
5. After volunteers share all of the names they know, fill the table with the remaining names of the shapes (see below).
6. Explain: “Penta” means 5, “hexa” means 6, “hepta” means 7, and so on.
7. Draw the remaining shapes in the table on the board. While you are doing this, ask pupils to copy the table and draw 1 of each shape in their exercise books.

Sides	Name	Drawing
3	Triangle	
4	Quadrilateral	
5	Pentagon	
6	Hexagon	
7	Heptagon	
8	Octagon	
9	Nonagon	
10	Decagon	

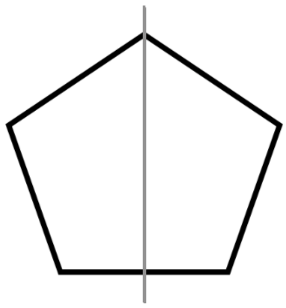
8. Explain:
    - A “regular” polygon is one with equal angles and equal sides.

- For example, an equilateral triangle is a regular polygon. A square is also a regular polygon.

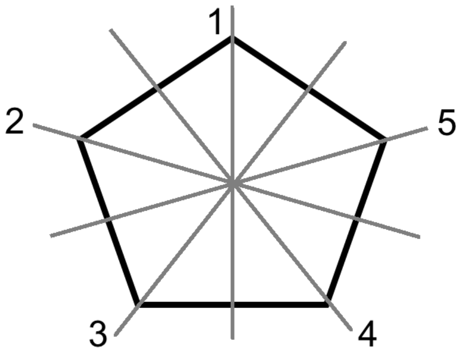
9. Draw the two pentagons shown below on the board.

regular pentagon pentagon

10. Explain:
    - A regular polygon with a given number of sides has the same number of **lines of symmetry**.
    - Recall that a line of symmetry is like a mirror. The polygon is exactly the same shape on both sides of the line of symmetry.
11. Draw one line of symmetry on the regular pentagon on the board:



12. Make sure pupils understand that the shape looks the same on both sides of the line. The lines and angles are all equal.
13. Draw the other 4 lines of symmetry:



Practice *(16 minutes)*

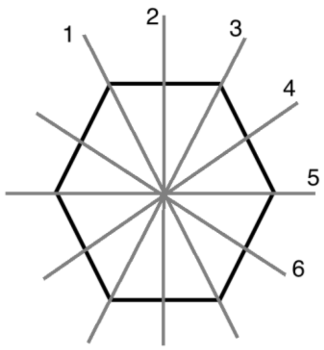
1. Write the following 2 problems on the board:
    a. Sketch a regular hexagon. Sketch its lines of symmetry. How many are there?

b. Sketch a heptagon with sides and angles of any measure. Are there any lines of symmetry?

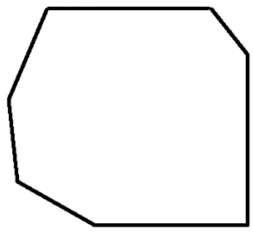
2. Explain: It is difficult to draw a regular polygon by hand, without a ruler and protractor. The word “sketch” means to draw an approximate shape. Draw the regular hexagon as accurately as you can.
3. Ask pupils to work independently.
4. Ask pupils to exchange papers with a partner when they are finished and check their partner’s work.
5. Invite volunteers to share their drawings with the class and explain how they constructed their polygon and identified lines of symmetry.

Example answers:

a. There are 6 lines of symmetry:



b. The heptagon could take any shape, as long as it has 7 sides. The heptagon below has no lines of symmetry:



Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L075 in the Pupil Handbook.

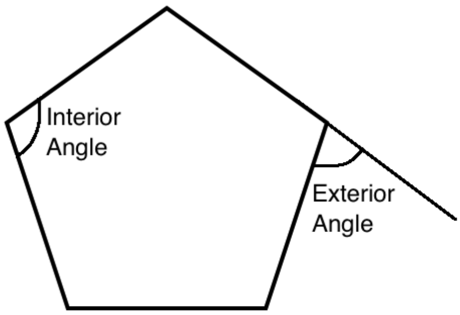
Lesson Title: Sum of interior angles of polygons	**Theme:** Geometry	
Lesson Number: M2-L076	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the sum of the interior angles of polygons.	**Preparation** Draw table from Teaching and Learning section on the board	

Opening *(3 minutes)*

1. Revise the previous lesson by asking questions and allowing for discussion. Example questions:
    a. What is a shape with 9 sides called? (Answer: nonagon)
    b. How many sides does a heptagon have? (Answer: 7)
    c. How many lines of symmetry does a hexagon have? (Answer: 6)
2. Explain that this lesson is on the sum of the interior angles of polygons.

Teaching and Learning *(20 minutes)*

1. Draw the pentagon on the board:



2. Explain:
    - **Interior angles are** the angles that are on the inside of a polygon.
    - **Exterior angles** are on the outside. They are formed by extending the sides of the polygon.
    - Every polygon has the same number of interior and exterior angles as it has sides. For example, a pentagon has 5 interior angles and 5 exterior angles.
    - Note that each exterior angle forms a straight line with an interior angle. This means that the exterior and interior angles sum to 180°.
    - The next lesson will include exterior angles. Today we will focus on interior angles.
3. Explain: There is a formula for finding the sum of the interior angles in a polygon.
4. Write the formula on the board: $(n-2) \times 180°$ where n is the number of sides.
5. Refer to the following table on the board:

Sides	Name	Sum of Interior Angles
3	Triangle	
4	Quadrilateral	
5	Pentagon	
6	Hexagon	
7	Heptagon	
8	Octagon	
9	Nonagon	
10	Decagon	

6. Ask volunteers if they know the sum of the angles of any shapes. (Example answers: a triangle's angles sum to 180°; a quadrilateral's angles sum to 360°.)
7. Calculate the sum of the angles of the first 3 shapes (triangle, quadrilateral, and pentagon) on the board using the formula. Explain each step to pupils. After solving, write the results in the table.
   Solutions:

   Triangle
   Sum of angles $= (3-2)\times 180° = 1\times 180° = 180°$

   Quadrilateral
   Sum of angles $= (4-2)\times 180° = 2\times 180° = 360°$

   Pentagon
   Sum of angles $= (5-2)\times 180° = 3\times 180° = 540°$
8. Ask pupils to copy the table on the board. They are then to work with seatmates and use the formula to find the sum of the angles for the other shapes (hexagon through decagon).
9. Walk around to check for understanding.
10. Invite volunteers to write the solutions on the board, and fill the table.
   Solutions:

   Hexagon
   Sum of angles $= (6-2)\times 180° = 4\times 180° = 720°$

   Heptagon
   Sum of angles $= (7-2)\times 180° = 5\times 180° = 900°$

   Octagon
   Sum of angles $= (8-2)\times 180° = 6\times 180° = 1080°$

   Nonagon
   Sum of angles $= (9-2)\times 180° = 7\times 180° = 1260°$

   Decagon
   Sum of angles $= (10-2)\times 180° = 8\times 180° = 1440°$

Filled table:

Sides	Name	Sum of Interior Angles
3	Triangle	180°
4	Quadrilateral	360°
5	Pentagon	540°
6	Hexagon	720°
7	Heptagon	900°
8	Octagon	1,080°
9	Nonagon	1,260°
10	Decagon	1,440°

11. Write the following problem on the board: The sum of the interior angles of a polygon is 1,800°. Calculate the number of sides.
12. Discuss: How can we solve this?
13. Allow pupils to share their ideas, then explain: This can be solved by substituting 1,800° into the interior angle formula, then solving for n.
14. Solve on the board, explaining each step:

$$\begin{aligned} \text{Sum of angles} &= (n-2)\times 180^\circ \\ 1{,}800^\circ &= (n-2)\times 180^\circ && \text{Substitute the sum} \\ 10 &= n-2 && \text{Divide throughout by } 180^\circ \\ 10+2 &= n && \text{Transpose } -2 \\ n &= 12 \end{aligned}$$

15. Explain: A polygon with 12 sides has interior angles that sum to 1,800°.

Practice *(16 minutes)*

1. Write the following problems on the board:
   a. Find the sum of the interior angles of a polygon with 14 sides.
   b. The sum of the angles of a polygon is 3,600°. Calculate the number of sides of the polygon. Show your work.
2. Ask pupils to work independently. Allow them to discuss with seatmates if needed.
3. Invite volunteers to write the solutions on the board.
   Solutions:
   a.

$$\begin{aligned} \text{Sum of angles} &= (14-2)\times 180^\circ \\ &= 12\times 180^\circ \\ &= 2{,}160^\circ \end{aligned}$$

   b.

$$\text{Sum of angles} = (n-2)\times 180^\circ$$

$$
\begin{aligned}
3{,}600° &= (n-2) \times 180° && \text{Substitute the sum} \\
20 &= n-2 && \text{Divide throughout by } 180° \\
20+2 &= n && \text{Transpose } -2 \\
n &= 22
\end{aligned}
$$

The polygon has 22 sides.

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L076 in the Pupil Handbook.

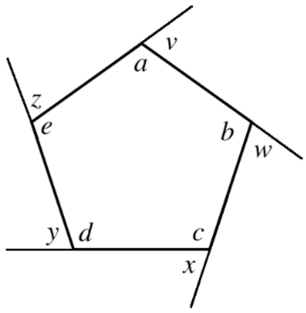
Lesson Title: Interior and exterior angles of polygons	**Theme:** Geometry	
Lesson Number: M2-L077	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to calculate the measurement of interior and exterior angles of polygons.	**Preparation** None	

Opening *(3 minutes)*

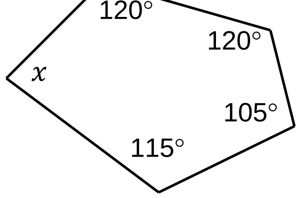
1. Review the previous lesson by asking questions and allowing discussion. Encourage pupils to look at their notes. Some example questions to ask are:
   a. What is a polygon with 10 sides called? (Answer: Decagon)
   b. What is the sum of the interior angles of a decagon? (Answer: 1,440°)
3. Explain that this lesson is on calculating the measurement of interior and exterior angles of polygons.

Teaching and Learning *(20 minutes)*

1. Draw a pentagon on the board and label it as shown:



2. Ask volunteers to identify the interior and exterior angles. (Answers: interior angles: a, b, c, d, e; exterior angles: v, w, x, y, z)
3. Explain:
   - The interior angles in a polygon must add up to the sums we found yesterday.
   - One way to calculate unknown angles is to subtract known angles from the total.
4. Write a question on the board: Find the missing angle x:

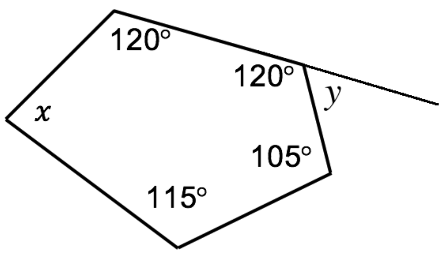


5. Write on the board: $x = 540° - (120° + 120° + 105° + 115°) =$
6. Ask pupils to work with seatmates to find the answer.
7. Invite a volunteer to share the answer with the class. (Answer: $x = 80°$)

8. Explain: For regular polygons, all of the angles are equal. There is a formula for finding the measure of interior angles of a regular polygon.
9. Write the formula on the board: $\frac{(n-2)\times 180°}{n}$ where n is the number of sides.
10. Explain: This is simply the formula from the previous lesson, divided by n, the number of sides.
11. Write the following problem on the board: Find the interior angle of a regular hexagon.
12. Solve on the board, explaining each step:

$$\begin{aligned}\text{Interior angle} &= \frac{(n-2)\times 180°}{n} \\ &= \frac{(6-2)\times 180°}{6} \\ &= \frac{4\times 180°}{6} \\ &= \frac{4\times 180°}{6} \\ &= \frac{720°}{6} \\ &= 120°\end{aligned}$$

13. Explain: Each interior angle of a regular hexagon is 120. Remember that they all have the same measure.
14. Explain:
    - Now we will solve exterior angles. Recall that exterior angles form a straight line with interior angles.
    - This means that each exterior angle and the adjacent interior angle sum to 180°.
    - Additionally, all of the exterior angles of a polygon sum to 360°. Note that 360° is the same as the degrees in a full revolution, or a circle.
15. Extend 1 side of the pentagon on the board to show the exterior angle y:

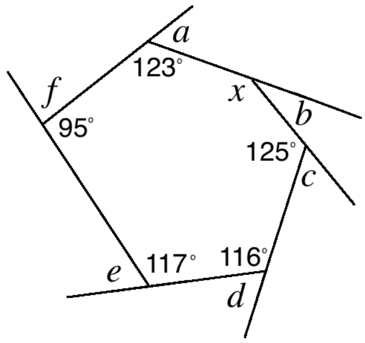


16. Ask pupils to work with seatmates to find the measure of angle y.
17. Invite a volunteer to write the solution on the board. (Answer: $y = 180° - 120° = 60°$)
18. Explain: For regular polygons, there is a formula for finding the measure of exterior angles. We use the fact that the sum of the exterior angles is 360°.
19. Write the formula on the board: $\frac{360°}{n}$ where n is the number of sides.
20. Write the following problem on the board: Find the exterior angle of a regular hexagon.

21. Solve on the board, explaining each step:

$$\text{Exterior angle} = \frac{360°}{n} = \frac{360°}{6} = 60°$$

22. Write the following problem on the board: Find the missing interior and exterior angles in the hexagon below:



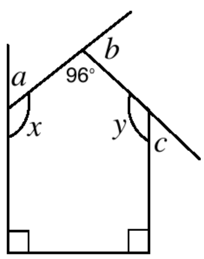
23. Ask pupils to work with seatmates to solve for all of the missing angles.
24. Invite volunteers to come to the board at the same time to write the solutions. Other pupils should check their work.

    Solutions:

    $x = 720° - (123° + 125° + 116° + 117° + 95°) = 144°$
    $a = 180° - 123° = 57°$
    $b = 180° - 144° = 36°$
    $c = 180° - 125° = 55°$
    $d = 180° - 116° = 64°$
    $e = 180° - 117° = 63°$
    $f = 180° - 95° = 85°$

Practice *(16 minutes)*

1. Write the following problems on the board:
   a. A regular polygon has 10 sides. Find using the formulae:
      i. The interior angle.
      ii. The exterior angle.
   b. Find the missing interior and exterior angles in the pentagon, where $x = y$:



2. Ask pupils to work independently. Allow them to discuss with seatmates if needed.
3. Walk around to check for understanding. Provide support if needed. (For example, for problem b., remind pupils to use the fact that $x = y$, and to solve for interior angles first.)
4. Invite volunteers to write the solutions on the board.

Solutions:

a.

iii. Interior angle
$$\begin{aligned} &= \frac{(n-2)\times 180°}{n} \\ &= \frac{(10-2)\times 180°}{10} \\ &= \frac{8\times 180°}{10} \\ &= \frac{1440°}{10} \\ &= 144° \end{aligned}$$

iv. Exterior angle
$$\begin{aligned} &= \frac{360°}{n} \\ &= \frac{360°}{10} \\ &= 36° \end{aligned}$$

or find using the interior angle:

Exterior angle $= 180° -$ interior angle
$$\begin{aligned} &= 180° - 144° \\ &= 36° \end{aligned}$$

b.

To find x and y, use the fact that the interior angles sum to 540°. Set up an equation and solve for x:

$540°$	$=$	$90° + 90° + 96° + x + y$	
$540°$	$=$	$90° + 90° + 96° + 2x$	Because $x = y$
$540°$	$=$	$276° + 2x$	Simplify
$540° - 276°$	$=$	$2x$	Subtract $276°$
$264°$	$=$	$2x$	
$\frac{264°}{2}$	$=$	$\frac{2x}{2}$	Divide by 2
$132°$	$=$	x	

We have $x = y = 132°$.

To find a, b, and c, subtract the interior angles from 180°:

$a = 180° - 132° = 48°$

$b = 180° - 96° = 84°$

$c = 180° - 132° = 48°$

Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L077 in the Pupil Handbook.

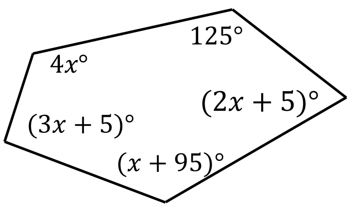
Lesson Title: Polygon problem solving	**Theme:** Geometry	
Lesson Number: M2-L078	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to solve problems involving polygons.	**Preparation** Write the problem in Opening on the board.	

Opening *(5 minutes)*

1. Review the previous lesson. Write the following problem on the board: For a regular nonagon, find:
   c. The interior angle.
   d. The exterior angle.
2. Ask pupils to work with seatmates to solve.
3. Invite volunteers to write the solutions on the board.
   Solutions:
   a. Interior angle $= \frac{(n-2)\times 180°}{n}$
   $= \frac{(9-2)\times 180°}{9}$
   $= \frac{7\times 180°}{9}$
   $= \frac{1260°}{9}$
   $= 140°$
   b. Exterior angle $= \frac{360°}{n}$
   $= \frac{360°}{9}$
   $= 40°$
   or find using the interior angle:
   Exterior angle $=$ $180°-$ interior angle
   $= 180° - 140°$
   $= 40°$
4. Explain that this lesson is on solving problems involving polygons. Pupils will use the information they learned in the previous lessons.

Teaching and Learning *(20 minutes)*

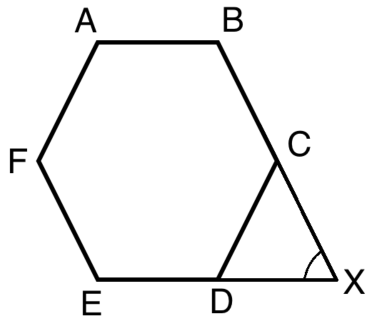
1. Write the following problem on the board and draw the pentagon shown below: In the pentagon below, solve for x:



2. Discuss:
   - The angles are labeled in this pentagon but there is an unknown variable. How can we find the value of that variable?
3. Allow pupils to share their ideas, then explain:
   - The interior angles in a polygon must add up to certain sums. The angles of a pentagon add up to 540°.
   - We can add the interior angles and set them equal to 540°. Then, solve for x.
4. Solve on the board, explaining each step:

$540°$	$=$	$125° + (2x+5)° + (x+95)° + (3x+5)° + 4x°$	Add the angles
	$=$	$(125° + 5° + 95° + 5°) + (2x + x + 3x + 4x)°$	Combine like terms
	$=$	$230° + 10x°$	
$540° - 230°$	$=$	$10x°$	
$310°$	$=$	$10x°$	Transpose $230°$
$31°$	$=$	x	Divide by $10°$

5. Explain:
   - The unknown value in this diagram is x.
   - Although the problem looked complicated at first, you had all of the information you needed to solve it.
   - When you see a difficult problem, first take a moment to think about how to solve it.
6. Write the following problem on the board: In the diagram, $ABCDEF$ is a regular polygon. When they are extended, sides BC and ED meet at point X. Find the measure of $\angle X$.



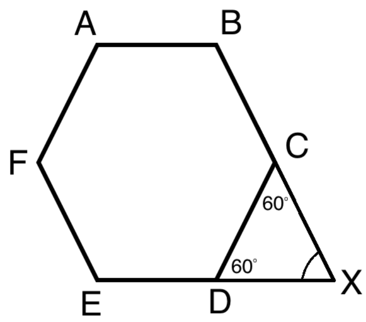
7. Discuss: How can we find the measure of angle X?
8. Allow pupils to share their ideas, then explain:
   - Because this is a regular hexagon, the interior angles are all the same, and the exterior angles are all the same.
   - The triangle with angle X is made of 2 exterior angles. If we find the measures of these angles, we can solve for X in the triangle.
9. Ask volunteers to explain how to find the exterior angles. As they explain, write the solution on the board:

Exterior angle of a hexagon $= \frac{360°}{n}$

$= \frac{360°}{6}$

$= 60°$

10. Label the exterior angles of C and D:



11. Ask pupils to work with seatmates to finish solving for angle X.
12. Invite a volunteer to write the solution on the board. (Answer: $X = 180° - (60° + 60°) = 60°$)
13. Write another problem on the board: The sum of the interior angles of a polygon is twice the sum of its exterior angles. How many sides does the polygon have?
14. Discuss: How can we find the number of sides?
15. Allow pupils to share their ideas, then explain:
    - We know that the sum of the exterior angles is always 360°.
    - We also know a formula for the sum of the interior angles. This formula has the number of sides (n) in it.
    - We can set up an equation with this information, and solve for n.
16. Write on the board: $(n - 2) \times 180° = 2(360°)$
17. Explain:
    - The left-hand side is the formula for sum of the interior angles.
    - The right-hand side is twice the sum of the exterior angles.
18. Ask pupils to work with seatmates to solve for n.
19. Invite a volunteer to write the solution on the board.

    Solution:

$(n - 2) \times 180°$	$=$	$2(360°)$	
$n(180°) - 2(180°)$	$=$	$2(360°)$	Distribute the left-hand side
$n(180°) - 360°$	$=$	$720°$	Simplify
$n(180°)$	$=$	$720° + 360°$	Transpose $-360°$
$n(180°)$	$=$	$1080°$	
$\frac{n(180°)}{180°}$	$=$	$\frac{1080°}{180°}$	Divide by 180°
n	$=$	6	

20. Explain: The polygon has 6 sides. It is a hexagon.

Practice *(14 minutes)*

1. Write the following problems on the board:

a. A pentagon has one exterior angle of $70°$. Two other angles are $(90-x)°$, while the remaining angles are each $(40+2x)°$. Find the value of x.
b. The interior angle of a regular polygon is $140°$. How many sides does it have?

2. Ask pupils to work with seatmates to solve the problems. Remind them to think about the process before they start working.
3. Walk around to check for understanding. Provide support if needed.
4. Invite volunteers to write the solutions on the board.

Solutions:

a.

Set the sum of the angles equal to $360°$, which is always the sum of the exterior angles. Solve for x.

$360°$	$=$	$70° + 2(90-x)° + 2(40+2x)°$	
	$=$	$70° + 180° - 2x° + 80° + 4x°$	Remove brackets
	$=$	$(70° + 180° + 80°) + (-2x° + 4x°)$	Combine like terms
	$=$	$330° + 2x°$	Simplify
$360° - 330°$	$=$	$2x°$	Transpose $330°$
$30°$	$=$	$2x°$	Divide by 2°
$15°$	$=$	x	

b.

Use the formula for the interior angle to find the number of sides, n:

Interior angle	$=$	$\frac{(n-2)\times 180°}{n}$	
$140°$	$=$	$\frac{(n-2)\times 180°}{n}$	
$140°n$	$=$	$(n-2)\times 180°$	Multiply throughout by n
$140°n$	$=$	$180°n - 360°$	Distribute the right-hand side
$140°n - 180°n$	$=$	$-360°$	Transpose $180°n$
$-40°n$	$=$	$-360°$	Divide throughout by $-40°$
n	$=$	9	

Answer: The polygon has 9 sides.

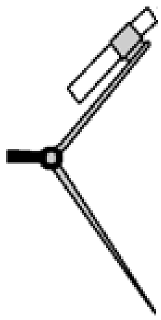
Closing *(1 minute)*

1. For homework, have pupils do the practice activity PHM2-L078 in the Pupil Handbook.

Lesson Title: Bisect a given line segment	**Theme:** Geometry	
Lesson Number: M2-L079	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to use a pair of compasses to construct a perpendicular bisection of a line.	**Preparation** 1. Read the note at the end of this lesson plan. 2. Bring a pair of compasses to class (purchased or handmade), and a ruler or any straight edge for drawing lines. Ask pupils to bring geometry sets if they already have them.	

Opening *(3 minutes)*

1. Hold up the pair of compasses if you have one. If you do not have one, sketch one on the board or show pupils this picture. →



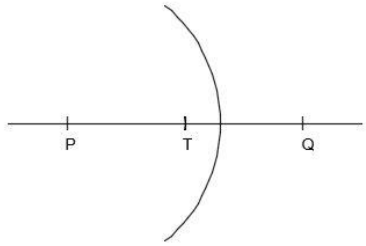
2. Discuss:
   - What is this tool called? (Answer: A pair of compasses)
   - What do we use this tool for? (Answer: It is used in geometry construction. For example, it is used to draw circles or to bisect lines or angles.)
3. Explain that today's lesson is on using a pair of compasses to construct a perpendicular bisection of a line.

Teaching and Learning *(22 minutes)*

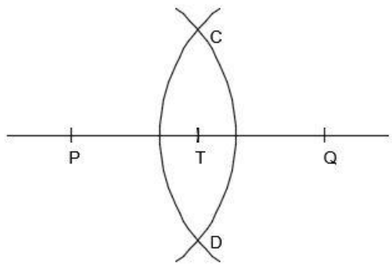
1. Explain:
   - There are problems on the WASSCE exam on geometry construction. If you can find a geometry set, bring it to class and practice with it at home.
   - If you do not have a geometry set, try to borrow one from a person in the community. We will be studying geometry construction for the next 18 lessons.
2. If you will be using a piece of string or paper as a pair of compasses for the lessons, explain this to pupils. Show them how to make one as well from the notes at the end of the lesson. Explain that they will be using this during this lesson and the following ones.
3. Draw a horizontal line segment across the board.
4. Ask a volunteer to choose any point around the middle of the line, and label it T.
5. Explain:
   - We will construct a perpendicular line at point T.
   - We will use T as a centre and choose any radius for our pair of compasses.
6. Perform the following steps on the board, explaining each one:
   - Open the compass all the way and using point T as the centre, mark point P on the line where the other side of the compass touches the line. Rotate

the compass around point *T*, keeping the compass fully open and mark point *Q* on the line where the other side of the compass touches the line. (It is important that $\overline{PT} = \overline{TQ}$). You should have a line with 2 points *P* and *Q* equidistant from point *T.*

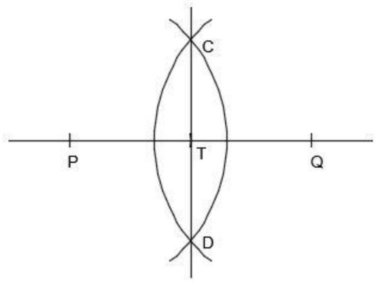
- With point P as the centre, open your compass more than half way to point Q. Then draw an arc that intersects $\overline{PQ}$.



- Using the same radius and point Q as a centre, draw an arc that intersects the first arc. Label the points where the 2 arcs intersect as C and D.



- Draw $\overline{CD}$.

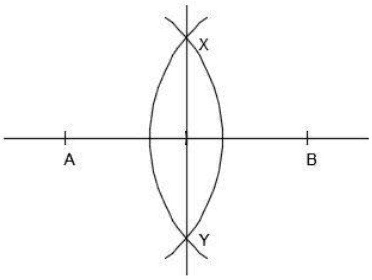


7. Explain the diagram:
   - $\overline{CD}$ is perpendicular to $\overline{PQ}$ at point T. Point T is the midpoint of $\overline{PQ}$.
   - $\overline{CD}$ is called the **perpendicular bisector** of line segment $\overline{PQ}$**.**
8. Explain bisection:
   - To **bisect** something means to divide it into 2 equal parts.
   - $\overline{CD}$ divides the line segment $\overline{PQ}$ into two parts that are equal. (If you have a ruler, demonstrate that $\overline{PT}$ and $\overline{TQ}$ are equal segments.)
   - A perpendicular bisector forms a 90° angle with the line.
9. Explain how to check perpendicular bisections: After drawing a perpendicular bisector, we can check it. We can use any item that has a right angle on it.
10. Demonstrate how to check the perpendicular bisection on the board:
    - Use any item with a right angle (for example, a book or piece of paper).

- Hold the item up so that two of its sides are along the lines $\overline{CD}$ and $\overline{PQ}$. The sides should line up perfectly with the two lines.

11. Discuss: What are some other items that have a right angle? How can you check a perpendicular bisection on your paper?
12. Write the following problem on the board: Draw line segment $\overline{AB}$. Construct its perpendicular bisector $\overline{XY}$.
13. Explain:
    - You can use any straight edge to draw a line. Try using the side of your exercise book, or a piece of paper.
    - Make a pair of compasses using a piece of paper or string (as described above).
14. Ask pupils to work with seatmates to draw the construction. Remind them that they will follow exactly the same steps as the ones demonstrated on the board.
15. Walk around to check for understanding. Show a step on the board if needed.
16. Invite volunteers from 1 group of seatmates to show the paper with their construction to the class. Ask the pupils to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

    Answer:



Practice *(12 minutes)*

1. Write on the board: Draw a line segment labelled with the initials of your name. Construct its perpendicular bisector and give it the initials of your best friend.
2. Ask pupils to work independently to do the construction.
3. Invite 2-3 volunteers to show their paper and explain how they did their construction. Allow discussion. (The solution should look the same as examples above, but with different letters.)

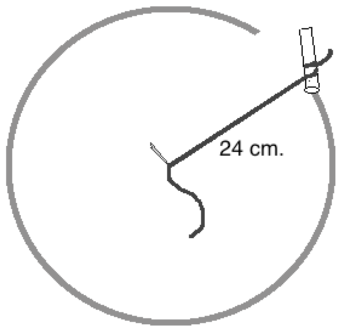
Closing *(3 minutes)*

1. Discuss:
    - What tools are used to construct a perpendicular line at a given point? (Answer: pair of compasses, ruler or any straight edge.)
    - How do you know that two lines are perpendicular? (Answer: when they are at right angles (90°) to each other).
2. For homework, have pupils do the practice activity PHM2-L079 in the Pupil Handbook.

[NOTE: MAKING A PAIR OF COMPASSES]
There are 18 lessons on geometry construction. You can do geometry construction without a pair of compasses. You can use material available in your community to draw circles. Follow the instructions below to make a circle using string or paper. Either of these methods can be used with chalk on the board, or with a pen/pencil on paper. In fact, they can be made large and are therefore better than a small pair of compasses for demonstrations on the board. Use these materials in your lessons as needed.

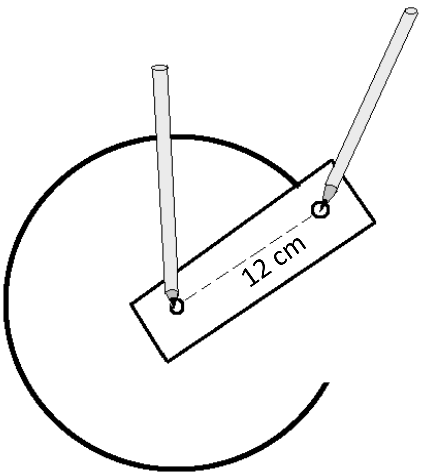
Using **string** to make a pair of compasses:

1. Cut a piece of string longer than the radius of the circle you will make.
2. Tie one end of the string to a piece of chalk (or pencil).
3. Hold the string to the board (or paper). The distance between the place you hold and the chalk will be the **radius** of the circle. In the diagram, the radius of the circle is 24 cm. The distance between the centre of the circle and the piece of chalk is 24 cm.
4. Use one hand to hold the string to the same place on the board. Use the other hand to move the chalk around and draw a circle.
5. Pupils can use string to make a pair of compasses with their pencil or pen. They can use it to construct circles in their exercise books.



Using **paper** to make a pair of compasses:

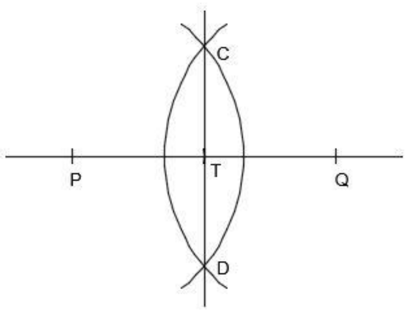
1. Cut or tear any piece of paper, longer than the radius of the circle you will make.
2. Make two small holes in the paper. The distance between the two holes will be the radius of your circle. In the diagram below, the radius of the circle is 12 cm
3. Put something sharp (a pen or pencil will work) through one hole. Place this in your exercise book, and you will draw at the centre of the circle.
4. Put your pen or pencil through the other hole, and move it in a circle on your paper.



Lesson Title: Bisect a given angle	Theme: Geometry	
Lesson Number: M2-L080	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcomes By the end of the lesson, pupils will be able to: 1. Use a pair of compasses to bisect an angle 2. Use a protractor to measure a given angle and its bisected parts	**Preparation** 1. Read the note at the end of this lesson plan. 2. Bring a pair of compasses and protractor to class (purchased or handmade), and a ruler or any straight edge for drawing lines. Ask pupils to bring geometry sets if they already have them.	

Opening *(3 minutes)*

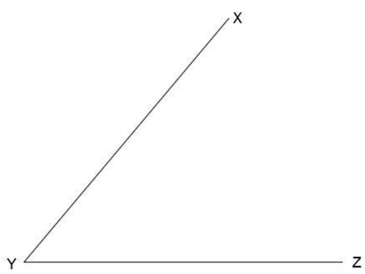
1. Review the previous topic, bisection of a given line.
2. Ask pupils to give each step to draw a perpendicular bisection of a line. As they describe the steps, show them on the board.
   Example:



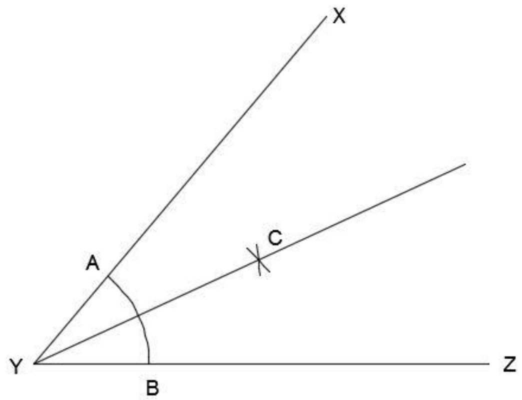
3. Explain that today's lesson is on using a pair of compasses to construct a perpendicular bisection of a line.

Teaching and Learning *(22 minutes)*

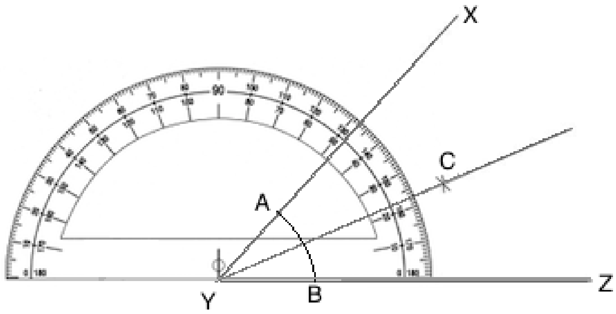
1. Discuss: We can also bisect an angle. What do you think it means to bisect an angle?
2. Allow discussion, then explain:
   - To bisect an angle means to divide it into 2 equal parts.
   - For example, if an angle is 60°, we can bisect it to find an angle of 30°.
3. Draw angle XYZ on the board (with any measure):



4. Explain: We will construct an angle bisector that divides XYZ into 2 equal parts.
5. Take the following steps on the board, explaining each one:
    - With point Y as the centre, open your pair of compasses to any convenient radius. Draw an arc AB to cut XY at A and YZ at B.
    - With point A as the centre, draw an arc using any convenient radius.
    - With the same radius as the step above, use point B as the centre and draw another arc to intersect the first one at C.
    - Label point C.
    - Join Y to C to get the angle bisector as shown.



6. Explain: $\overline{YC}$ is the angle bisector of $\angle XYZ$.
7. Explain: After drawing an angle bisector, we can check it. We will use a protractor to check the angles.
8. Demonstrate how to check the perpendicular bisection on the board:
    - Use a protractor (the one from the last page of this lesson, or another one). Hold the protractor to $\angle XYZ$, and measure the entire angle.

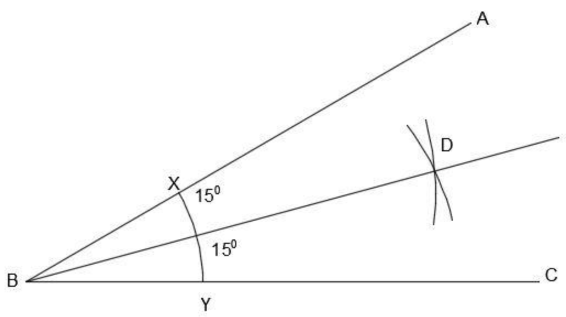


    - Write the angle measure on the board. (For example: $\angle XYZ = 48°$)
    - Hold the protractor up again, and measure angles CYZ and XYC.
    - Write the measure of each bisection on the board. (For example: $\angle CYZ = 24°$ and $\angle XYC = 24°$)
9. Explain: The bisection created two equal angles and they sum to the entire angle, $\angle XYZ$.
10. Write the following problem on the board:
    - Draw an angle ABC. Construct its bisector using the letter D.

- Check your bisection using a protractor. Label each angle with its measurement.

11. Ask pupils to work with seatmates to draw the construction. Remind them that they will follow exactly the same steps as the ones demonstrated on the board.
12. Walk around to check for understanding. If needed, show a step on the board again.
13. Invite volunteers from 1 group of seatmates to show the paper with their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

    Example Answer:



Practice *(12 minutes)*

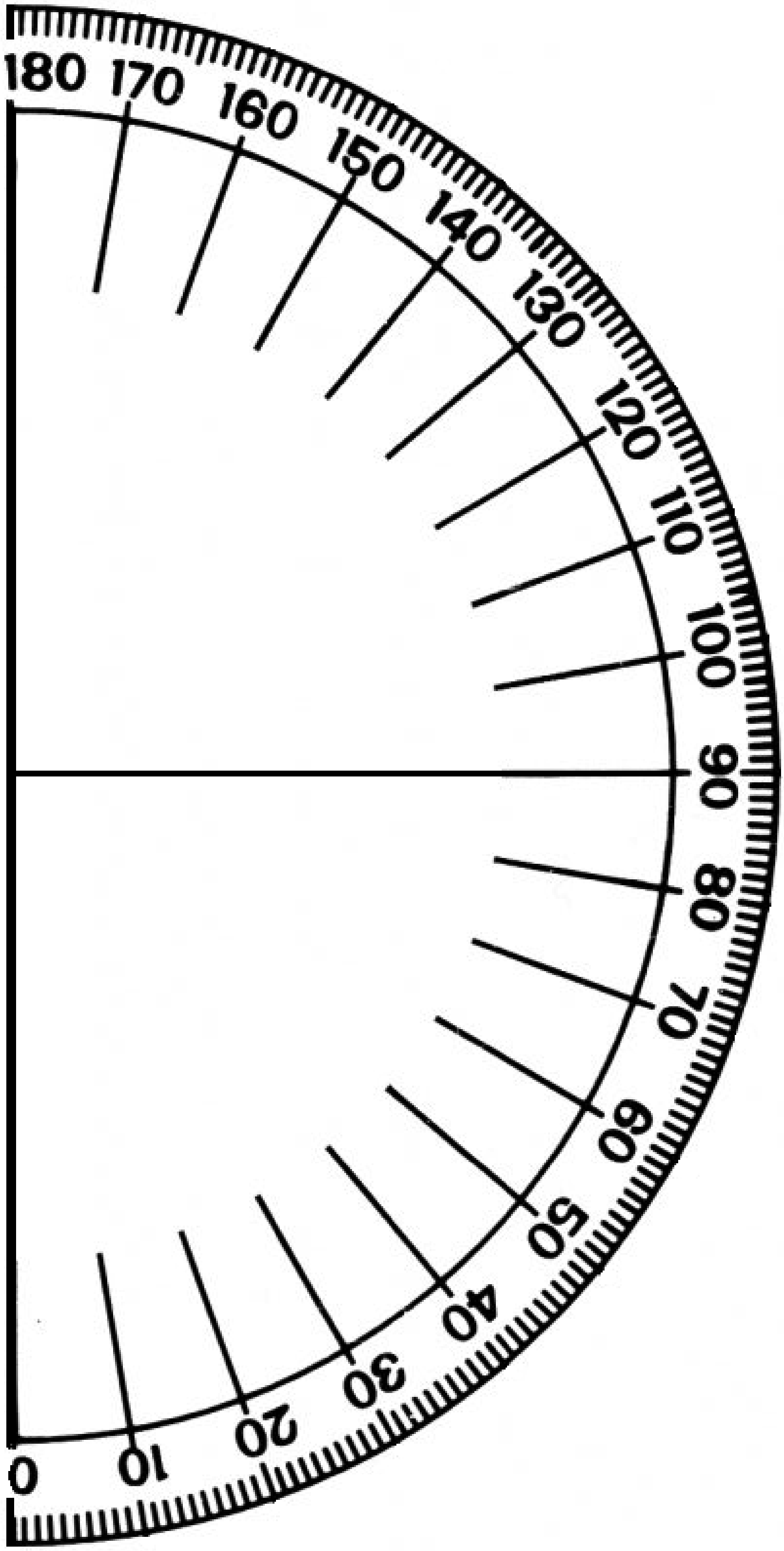
1. Write on the board:
    a. Draw an angle labelled with your favourite 3 letters. Bisect the angle.
    b. Check your bisection using a protractor. Label each angle with its measurement.
2. Ask pupils to work independently to do the construction.
3. Invite 2-3 volunteers to show their paper and explain how they did their construction. Allow discussion. (The solution should look the same as examples above, but with different letters.)

Closing *(3 minutes)*

1. Discuss:
    - What tools are used to bisect an angle? (Answer: pair of compasses, ruler or any straight edge.)
    - How can you check that your bisection is correct? (Answer: Use a protractor to measure each angle; the bisection should create 2 equal angles that are half of the original angle.)
2. For homework, have pupils do the practice activity PHM2-L080 in the Pupil Handbook.

[NOTE: MAKING A PROTRACTOR]

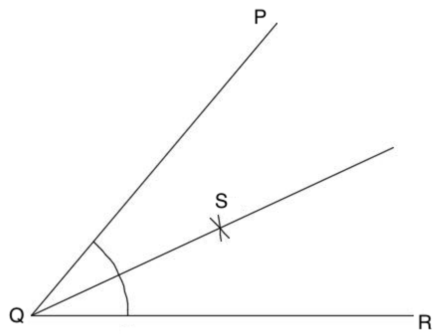
Teachers can use the large protractor below to show pupils how to measure angles on the board. This protractor can be traced with a pen onto a sheet of paper or photocopied. Then, cut it out with scissors. Pupils may do the same with the small protractors printed in their Pupil Handbooks.



Lesson Title: Construct 90°, 60°, and 120° angles	Theme: Geometry	
Lesson Number: M2-L081	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to use a pair of compasses to construct 90°, 60° and 120° angles.	**Preparation** Bring a pair of compasses and protractor to class (purchased or handmade), and a ruler or any straight edge for drawing lines. Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

1. Review the previous topic, bisection of an angle.
2. Draw an angle PQR on the board with any measure.
3. Ask pupils to give each step to bisect angle PQR. As they describe the steps, show them on the board.
   Example:

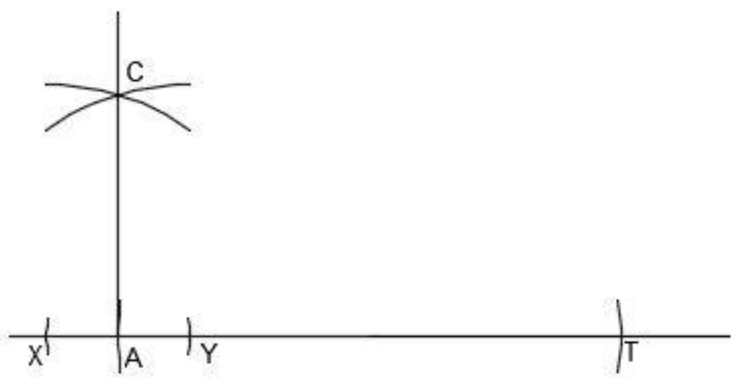


4. Ask pupils to explain how to check the bisection. (Answer: Use a protractor to measure the angles; each bisection should be equal to half of $\angle PQR$.)
5. Explain that today's lesson is on using a pair of compasses to construct specific angles: 90°, 60°, and 120°.

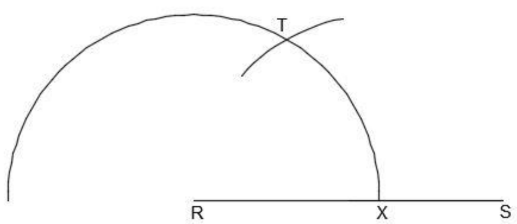
Teaching and Learning *(25 minutes)*

1. Explain:
   - There are some angles that can be constructed without using a protractor.
   - Today we will use **only** a straight edge and a pair of compasses to construct angles 90°, 60°, and 120°.
2. Ask pupils if they can think of a way to construct a 90° angle. Allow them to discuss.
3. Explain:
   - In a previous lesson, we constructed perpendicular bisectors. These formed a right angle with the line we were bisecting. Thus, you already know how to construct an angle of 90° when it bisects a segment.
   - Today we will learn another way that is very similar. We will not bisect a line, but will draw a perpendicular line from a specific point.

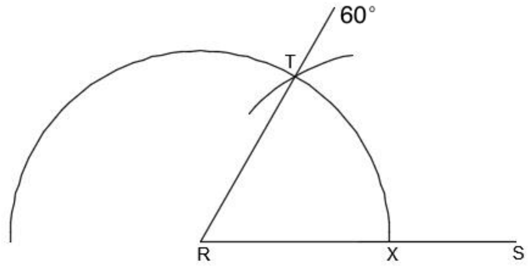
4. Draw a horizontal line on the board and label it AT.
5. Explain: I will draw a perpendicular line at A. I will make a 90-degree angle and call it CAT.
6. Take the following steps on the board, explaining each one:
    - Extend the straight line outwards from A.
    - With A as the centre, open your compass to a convenient radius and draw a semi-circle that intersects the line at X and Y.
    - Use X and Y as centres. Using any convenient radius, draw arcs to intersect at C.
    - Draw a line from A to C.



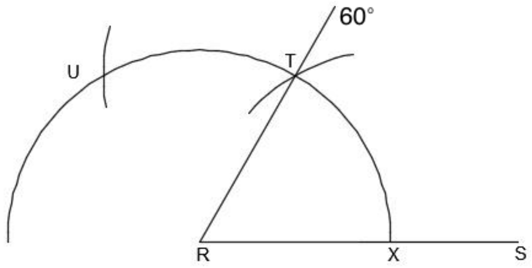
7. Explain: $\angle CAT$ is a right angle, which is 90°.
8. Use a protractor to check the measure of $\angle CAT$.
9. Leave $\angle CAT$ on the board for pupils to reference later. Follow the next steps and keep demonstrations of each angle (90°, 60°, and 120°) on the board if there is space.
10. Explain: Next, I will construct angles 60° and 120°.
11. Take the following steps on the board to construct 60°, explaining each one:
    - Draw the line RS.
    - With centre R, open your compass to any convenient radius and draw a semi-circle that cuts RS at X.
    - With centre X, use the **same radius** and mark another arc on the semi-circle. Label this point T.



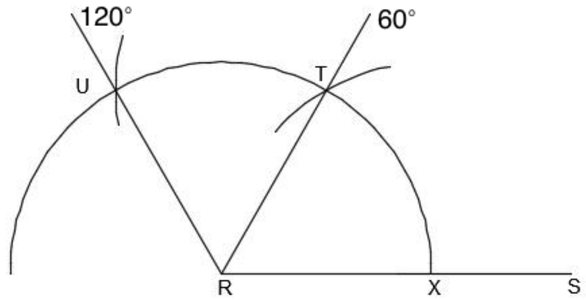
    - Draw a line from R to T. Label it 60°.



12. Explain: I have created the angle SRT, which is 60°.
13. Use a protractor to check the measure of $\angle SRT$.
14. Explain: We will follow the same process to make an angle of 120°. Remember that 120 is twice as much as 60. Therefore, two 60° angles make 120°.
15. Continue construction on the same angle SRT on the board.
16. Take the following steps on the board to construct 120°, explaining each one:
    - Use the same radius that we used to create the semi-circle.
    - Use T as the centre, and draw another arc on the semi-circle. Label this point U.

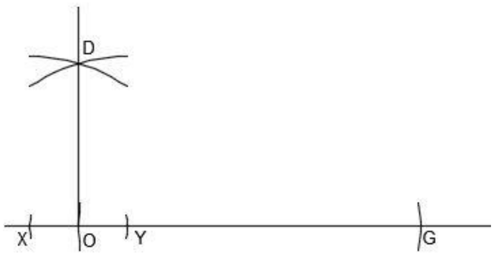


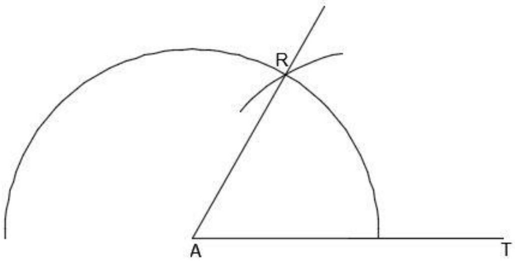
    - Draw a line from R to U. Label it 120°.



17. Write the following problems on the board:
    a. Construct an angle of 90°. Label it $\angle DOG$.
    b. Construct an angle of 60°. Label it $\angle RAT$.
    c. Check your angles using a protractor.
18. Ask pupils to work with seatmates to construct the angles. Remind the pupils that they will follow exactly the same steps as the ones demonstrated on the board.
19. Walk around to check for understanding. If needed, show a step on the board again.

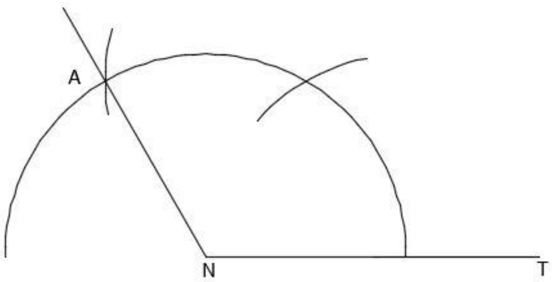
20. Invite volunteers from 2 groups of seatmates (1 for each construction) to show the paper with their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.
Answers:





Practice *(8 minutes)*

1. Write on the board: Construct a 120° angle. Label it $\angle ANT$.
2. Ask pupils to work independently to do the construction.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
Answer:



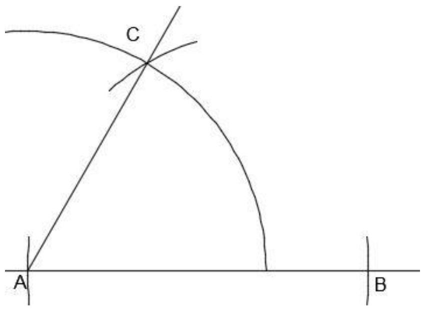
Closing *(3 minutes)*

1. Discuss:
   - What tools are used to draw a 60-degree angle? (Answer: pair of compasses, ruler or any straight edge.)
   - Are there any other ways you know of to draw a 60-degree angle? (Answer: A protractor can be used.)
2. For homework, have pupils do the practice activity PHM2-L081 in the Pupil Handbook.

Lesson Title: Construct 45°, 30° and 15° angles	Theme: Geometry	
Lesson Number: M2-L082	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to use a pair of compasses to construct 45°, 30°, and 15° angles using bisection of 90° and 60°.	**Preparation** Bring a pair of compasses and protractor to class (purchased or handmade), and a ruler or any straight edge for drawing lines. Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

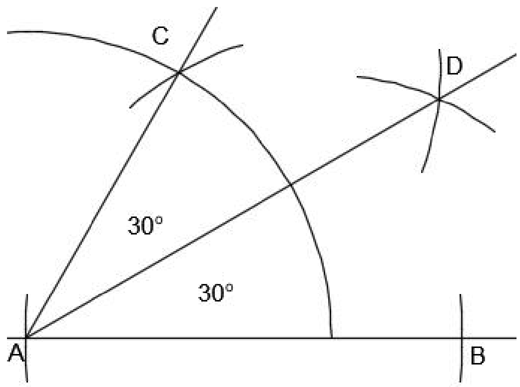
1. Review construction of a 60° angle.
2. Draw a line AB on the board.
3. Ask pupils to give each step to construct a 60° angle from AB. As they describe the steps, show them on the board.
   Solution:



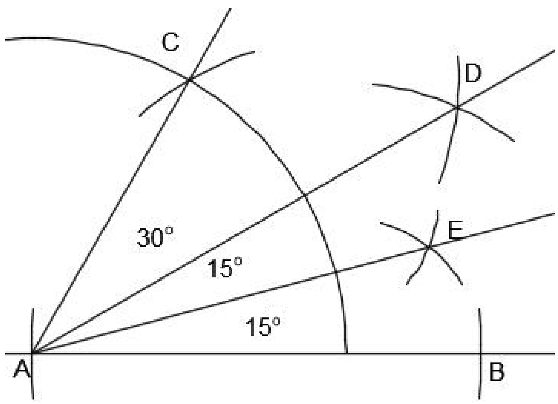
4. Explain that today's lesson is on using a pair of compasses to construct angles 45°, 30° and 15°.

Teaching and Learning *(25 minutes)*

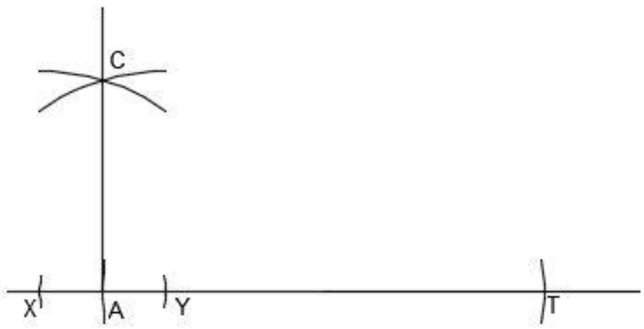
1. Discuss: Look at the 60° angle on the board. Can you think of a way to make a 30° angle from this?
2. Allow volunteers to share their ideas, then explain:
   - 30° is half of 60°. If we divide the 60° angle into 2 equal parts, we will have two 30° angles.
   - Recall that to divide an angle into equal parts, we bisect it.
3. Show the bisection of $\angle CAB$ on the board, explaining each step (see diagram below):
   - Centre your pair of compasses at the points where the semi-circle intersects CA and AB. Draw arcs from each point, using a convenient radius.
   - Label the point where the arcs intersect as D.
   - Join A to D to get the angle bisector as shown.



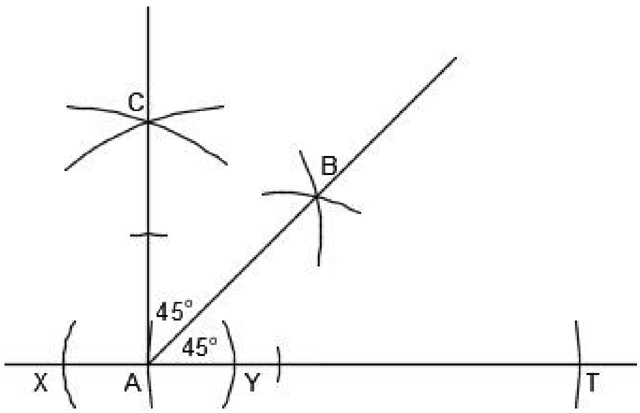
4. Explain: $\angle DAB$ is 30°. $\angle CAD$ is also 30°. We have constructed two 30° angles.
5. Use a protractor to check the measure of each 30° angle.
6. Discuss: Can you think of a way to make a 15° angle?
7. Allow volunteers to share their ideas, then explain: 15° is half of 30°. If we divide a 30° angle into 2 equal parts, we will have two 15° angles.
8. Show the bisection of $\angle DAB$ on the board, explaining each step:
   - Centre your pair of compasses at the points where the semi-circle intersects AD and AB. Draw arcs from each point, using a convenient radius.
   - Label the point where the arcs intersect as E.
   - Join A to E to get the angle bisector as shown.



9. Explain: $\angle DAE$ is 15°. $\angle EAB$ is also 15°. We have constructed two 15° angles.
10. Use a protractor to check the measure of each 15° angle.
11. Review construction of 90° angles. Ask pupils to give each step to construct a 90° angle. As they describe the steps, show them on the board.



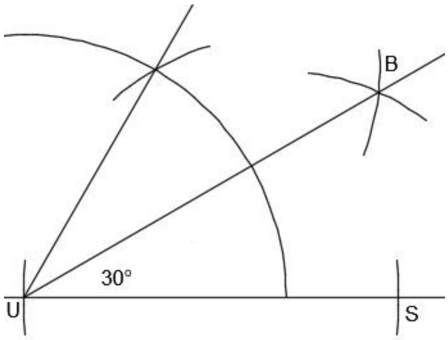
12. Discuss: Can you think of a way to make a 45° angle?
13. Allow volunteers to share their ideas, then explain: 45° is half of 90°. If we divide a 90° angle into 2 equal parts, we will have two 45° angles.
14. Show the bisection of $\angle CAT$ on the board, explaining each step:
    - With point A as the centre, open your pair of compasses to any convenient radius. Draw arcs to cut AC and AT.
    - Use the point where the arc intersects line *AC* and the point where the arc intersects line *AT* as centres. Draw arcs that intersect.
    - Label the point where the arcs intersect as B.
    - Join A to B to get the angle bisector as shown.



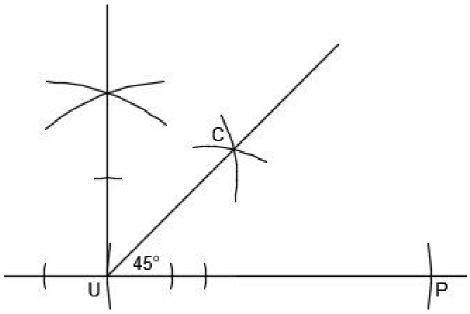
15. Explain: $\angle CAB$ is 45°. $\angle BAT$ is also 45°. We have constructed two 45° angles.
16. Use a protractor to check the measure of each 45° angle.
17. Write the following problems on the board:
    d. Construct an angle of 30°. Label it $\angle BUS$.
    e. Construct an angle of 45°. Label it $\angle CUP$.
    f. Check your angles using a protractor.
18. Ask pupils to work with seatmates to construct the angles. Remind pupils that they will follow exactly the same steps as the ones demonstrated on the board.
19. Walk around to check for understanding. If needed, show a step on the board again.
20. Invite volunteers from 2 groups of seatmates (1 for each construction) to show the paper with their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

Answers:

a.

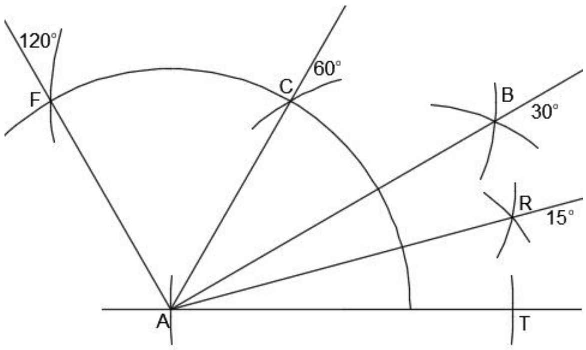


b.



Practice *(8 minutes)*

1. Write on the board: Create <u>one</u> construction that has all of the following angles:
    a. $\angle CAT = 60°$
    b. $\angle FAT = 120°$
    c. $\angle BAT = 30°$
    d. $\angle RAT = 15°$
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
   Answer:



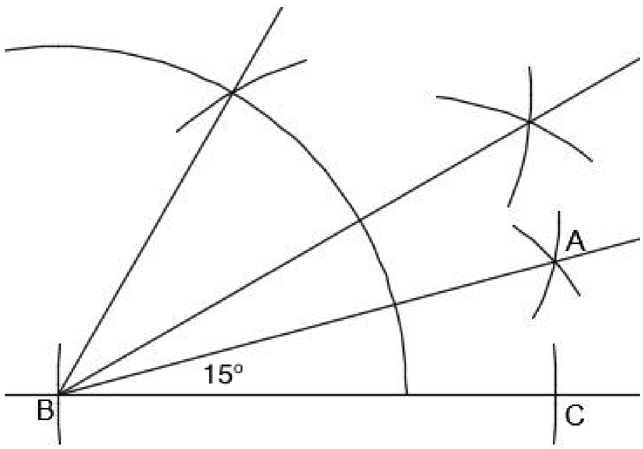
Closing *(3 minutes)*

1. Discuss:
    - How do you create a 15-degree angle? (Answer: Bisect a 60° angle, then bisect the resulting 30° angle.)
    - Are there any other angles you could create with the information you have? (Answer: We could continue to bisect the angles we know. If we bisect 45°, we have 22.5°. If we bisect 15°, we have 7.5°.)
2. For homework, have pupils do the practice activity PHM2-L082 in the Pupil Handbook.

Lesson Title: Construct 75°, 105° and 150° angles	**Theme:** Geometry	
Lesson Number: M2-L083	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to use a pair of compasses to construct 75°, 105°, and 150° angles.	**Preparation** Bring a pair of compasses and protractor to class (purchased or handmade), and a ruler or any straight edge for drawing lines. Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

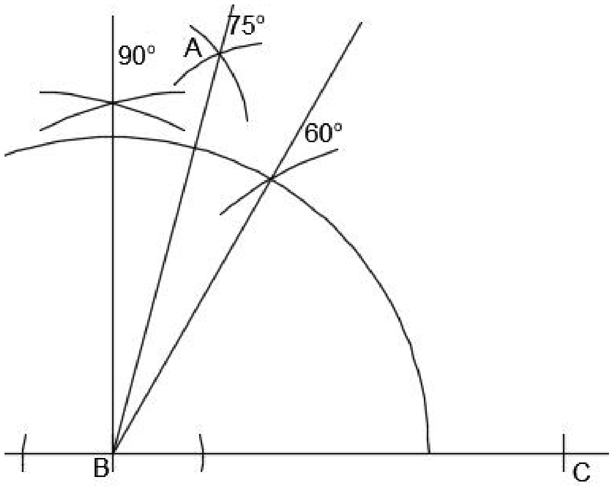
1. Review construction of a 15° angle.
2. Ask pupils to give each step to construct a 15° angle $\angle ABC$. As they describe the steps, show them on the board.
   Solution:



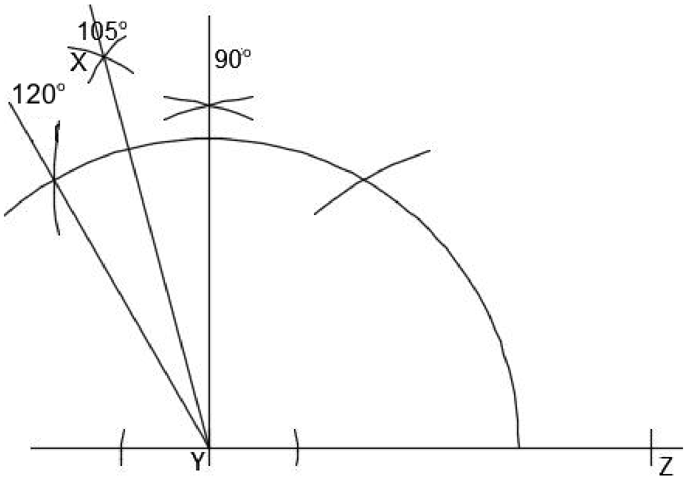
3. Explain that today's lesson is on using a pair of compasses to construct 75°, 105° and 150° angles.

Teaching and Learning *(25 minutes)*

1. Discuss: Can you think of any way to construct a 75 degree angle?
2. Allow volunteers to share their ideas, then explain:
   - 75° is halfway between 60° and 90°. It is 60° plus 15°.
   - To construct a 75° angle, we can draw 60° and 90° on the same construction, then bisect the angle between them.
3. Show the construction of a 75° angle $\angle ABC$ on the board, explaining each step (see diagram below):
   - Construct a 90-degree angle from base line BC.
   - Using the same base line BC, construct a 60-degree angle.
   - Bisect the angle between the 60 and 90 degree angles.
   - Label the bisection line as A.



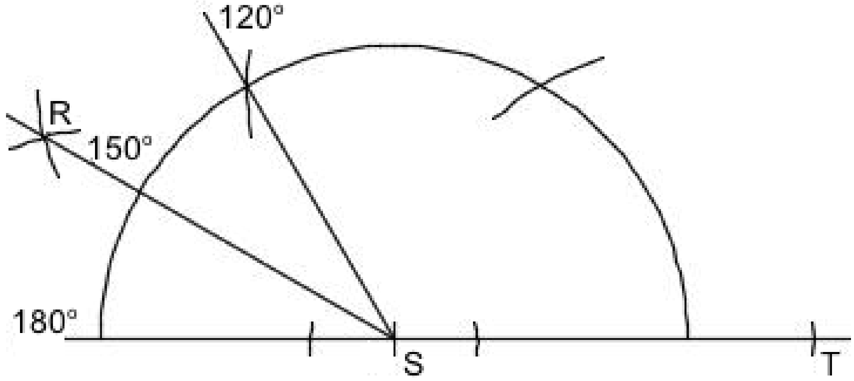
4. Explain: $\angle ABC$ is 75°.
5. Use a protractor to check the measure of the 75° angle.
6. Discuss: Can you think of a way to make a 105° angle?
7. Allow volunteers to share their ideas, then explain:
    - 105° is halfway between 90° and 120°. It is 90° plus 15°.
    - To construct a 105° angle, we can draw 90° and 120° on the same construction, then bisect the angle between them.
8. Show the construction of 105° angle $\angle XYZ$ on the board, explaining each step:
    - Construct a 90-degree angle from base line YZ.
    - Using the same base line YZ, construct a 120 degree angle.
    - Bisect the angle between the 90 and 120 degree angles.
    - Label the bisection line as X.



9. Explain: $\angle XYZ$ is 105°.
10. Use a protractor to check the measure the 105° angle.
11. Discuss: Can you think of a way to make a 150° angle?
12. Allow volunteers to share their ideas, then explain:
    - 150° is halfway between 120° and 180°. It is 120° plus 30°.
    - Recall that 180° is a straight line.

- To construct a 150° angle, we can draw 120° and extend the straight line on the same construction, then bisect the angle between them.

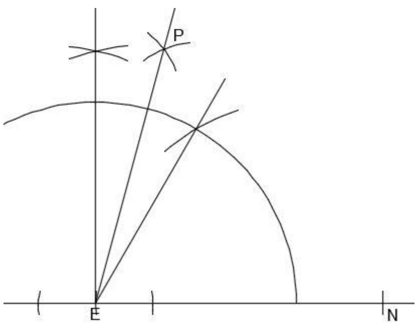
13. Show the construction of 150° angle $\angle RST$ on the board, explaining each step:
    - Construct a 120-degree angle from base line ST.
    - Extend the base line ST so that it shows 180°.
    - Bisect the angle between the 120 and 180 degree angles.
    - Label the bisection line as R.



14. Explain: $\angle RST$ is 150°.
15. Use a protractor to check the measure of the 150° angle.
16. Write the following problems on the board:
    g. Construct an angle at 75°. Label it $\angle PEN$.
    h. Construct an angle at 150°. Label it $\angle INK$.
    i. Check your angles using a protractor.
17. Ask pupils to work with seatmates to construct the angles. Remind them that they will follow exactly the same steps as the ones demonstrated on the board.
18. Walk around to check for understanding. If needed, show a step on the board again.
19. Invite volunteers from 2 groups of seatmates (1 for each construction) to show the paper with their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

    Answers:

a.



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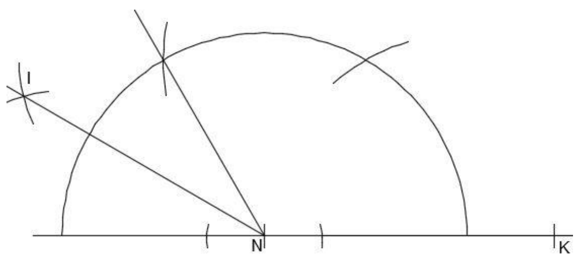
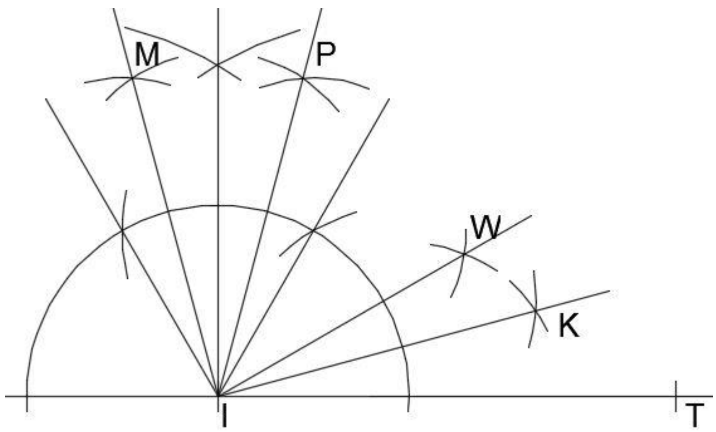


Practice *(8 minutes)*

1. Write on the board: Create one construction that has all of the following angles:
    a. $\angle KIT = 15°$
    b. $\angle WIT = 30°$
    c. $\angle PIT = 75°$
    d. $\angle MIT = 105°$
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
   Answer:



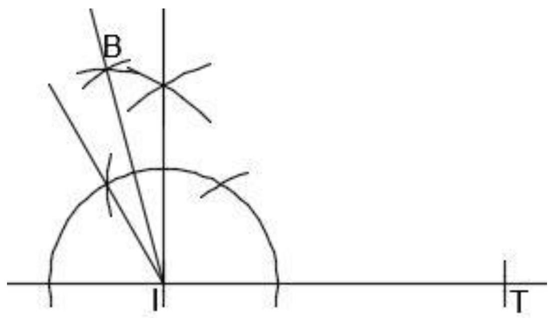
Closing *(3 minutes)*

1. Discuss:
    - How do you create a 105-degree angle? (Answer: Bisect the angle between 90° and 120°)
    - Are there any other angles you could create with the information you have? (Example answer: We could create 135° by bisecting the angle between 120° and 150°.)
2. For homework, have pupils do the practice activity PHM2-L083 in the Pupil Handbook.

Lesson Title: Construction of triangles – Part 1	Theme: Geometry	
Lesson Number: M2-L084	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct triangles using given lengths of three sides (SSS).	**Preparation** 1. Read the note at the end of this lesson. 2. Bring a pair of compasses and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

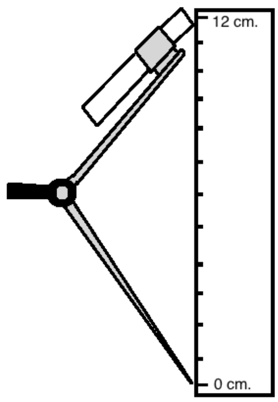
1. Review construction of a 105° angle.
2. Ask pupils to give each step to construct a 105° angle $\angle BIT$. As they describe the steps, show them on the board.
   Solution:

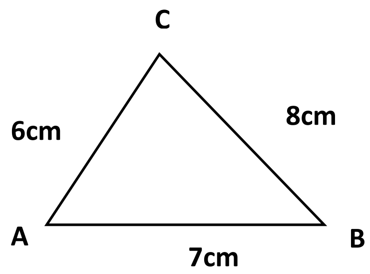


3. Explain that today's lesson is on constructing triangles. We will be constructing triangles from 3 given sides.

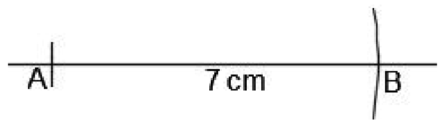
Teaching and Learning *(25 minutes)*

1. Write on the board: Construct triangle ABC with sides of 6 cm, 7 cm, and 8 cm.
2. Discuss: Can you think of any way to construct this triangle?
3. Allow volunteers to share their ideas, then explain:
   - We will set the radius of our compass equal to the lengths of the sides of the triangle.
   - The arcs we draw with our compass will tell us where the angles of the triangle are located.
4. Demonstrate how to open a pair of compasses to a given length (shown to the right).
5. Sketch a rough drawing of the triangle to be constructed on the board (do not use a ruler; just draw it quickly):

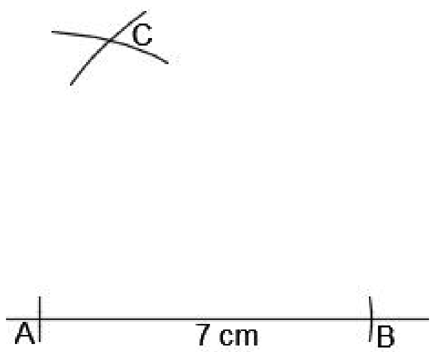




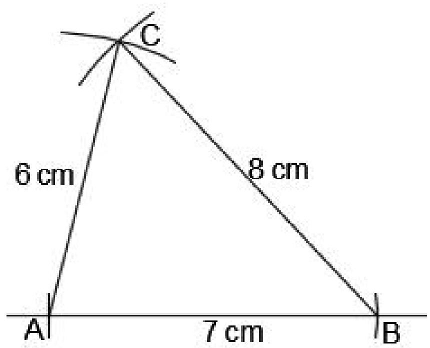
6. Explain: With shapes, it is helpful to create a rough drawing first. This helps to guide our construction.
7. Show the construction triangle ABC on the board, explaining each step:
   - Draw a line and label point A on one end.
   - Open your compass to the length of 7 cm. Use it to mark point B, 7 cm from point A. This gives line segment $\overline{AB} = 7\text{ cm}$.



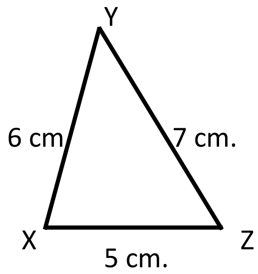
   - Open your compass to the length of 6 cm. Use A as the centre, and draw an arc of 6 cm above $\overline{AB}$.
   - Open your compass to the length of 8 cm. With the point B as the centre, draw an arc that intersects with the arc you drew from point A. Label the point of intersection C.



   - Join $\overline{AC}$ and $\overline{BC}$. This is the required triangle ABC.
   - Label the sides with the correct lengths:

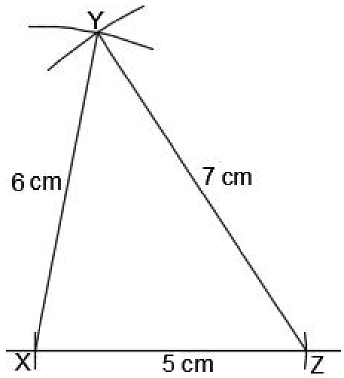


8. Write the following problem on the board: Construct a triangle with sides 5, 6, and 7 cm. Label the triangle XYZ.
9. Make a rough drawing of the triangle to be drawn on the board:



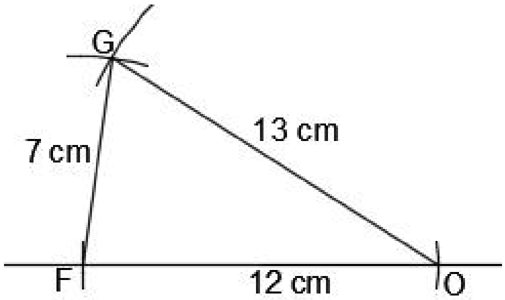
10. Ask pupils to describe each step to construct triangle XYZ. As they give each step, show it on the board.

Solution:



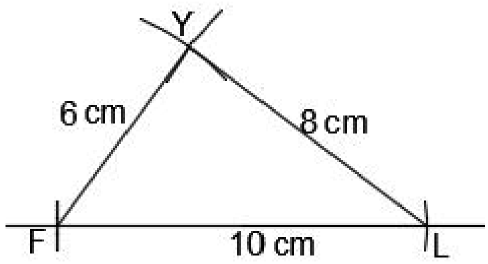
11. Write the following problem on the board: Construct triangle FOG with sides 7 cm, 12 cm, and 13 cm.
12. Ask pupils to work with seatmates to construct the triangle. Encourage them to share rulers if some pupils have them. If they do not have them, ask them to use the ruler in the Pupil Handbook.
13. Invite a set of seatmates to volunteer to show the paper with their construction to the class. Ask pupils to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.
    - Note that pupils may label the angles of their construction differently, or use a different side as the base. That is okay.

Solution (example):



Practice *(8 minutes)*

1. Write on the board: Construct triangle FLY where $\overline{FL}$ is 10 cm, $\overline{LY}$ is 8 cm, and $\overline{YF}$ is 6 cm.
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
   Answer:
   - Note that a different side may be used for the base; however, the angles should be labeled appropriately so that $\overline{FL}$ is 10 cm, $\overline{LY}$ is 8 cm., and $\overline{YF}$ is 6 cm.



Closing *(3 minutes)*

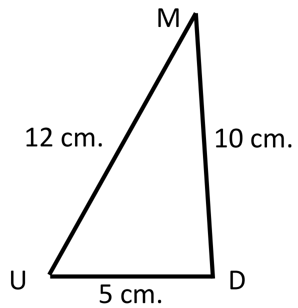
1. Discuss: What are the steps for constructing a triangle if you are given the lengths of the sides? (Answer: Draw one of the sides with a given length, and construct the other 2 sides by adjusting the radius of your pair of compasses.)
2. For homework, have pupils do the practice activity PHM2-L084 in the Pupil Handbook.

[NOTE]
Using rulers in class:
Constructing a triangle with sides of given lengths requires a ruler. The 2 legs of the compass are held against the ruler to set the radius at a given length. Encourage pupils to bring rulers to class for geometry construction lessons.
If pupils do not have rulers, they may use the rulers printed in their Pupil Handbook. Please note that this ruler is not printed to the exact scale. 1 centimetre may not be exactly 1 centimetre. However, for the purpose of practicing triangle construction, paper rulers can be used.
If you are demonstrating construction on the board with a larger compass that you made with string or paper, you will be able to construct larger triangles. These will be easier for pupils to see and understand. To construct a larger triangle, simply multiply the lengths given in this lesson by a factor. For example, for triangle ABC, multiply each side by a factor of 3. Construct ABC on the board with sides of 18 cm, 21 cm, and 24 cm.

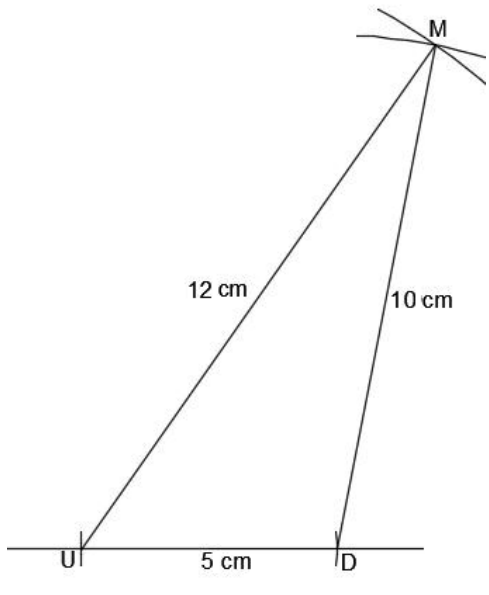
Lesson Title: Construction of triangles – Part 2	**Theme:** Geometry	
Lesson Number: M2-L085	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct triangles using two given sides and an angle (SAS).	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

1. Review construction of a triangle given the lengths of 3 sides. Write a problem on the board: Construct a triangle MUD with sides of length 5 cm, 12 cm, and 10 cm.
2. Draw a sketch of what the triangle would look like:



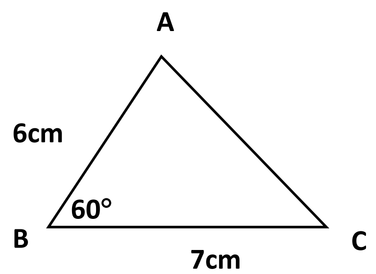
3. Ask pupils to give each step to construct the triangle. As they describe the steps, show them on the board.
Solution:



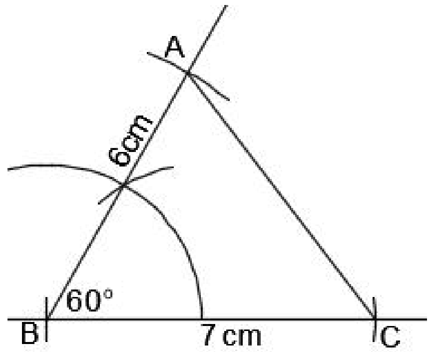
4. Explain that today's lesson is also on constructing triangles. We will be constructing triangles with 2 given sides and a given angle.

Teaching and Learning *(25 minutes)*

1. Explain: We will construct triangles given 2 sides and the angle between them. These are SAS (side-angle-side) triangles.
2. Write the following problem on the board: Construct triangle ABC where $\overline{AB}$ is 6 cm, $\overline{BC}$ is 7 cm, and B is 60°.
3. Discuss: Can you think of any way to construct this triangle?
4. Allow volunteers to share their ideas, then explain:
   - We will draw one side with the first known length. Then, construct the angle from this.
   - Extend the line we used to construct the angle so it is the second known length.
   - Connect the 2 known sides to make the third side.
5. Sketch a rough drawing of the triangle to be constructed on the board (do not use a ruler or pair of compasses; just draw it quickly):

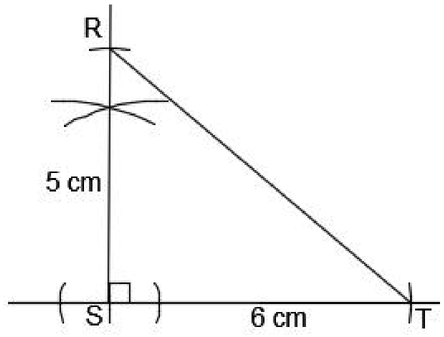


6. Show the construction of the triangle on the board, explaining each step:
   - Draw the side $\overline{BC} = 7\text{ cm}$ and label it 7 cm.
   - From $\overline{BC}$, construct an angle of 60° at B, and label it 60°.
   - Open your compass to the length of 6 cm. Use B as the centre and draw an arc of 6 cm on the 60° line. Label this point A.
   - Join $\overline{AB}$ and $\overline{BC}$. This is the required triangle ABC.



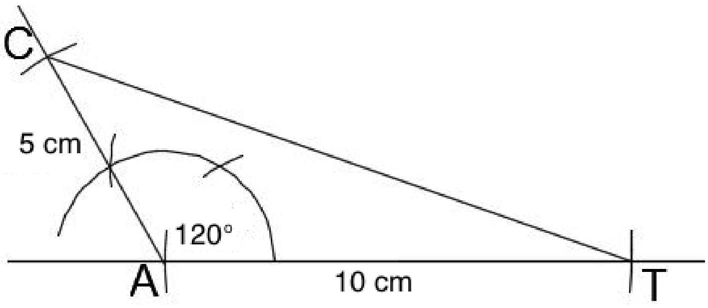
7. Write the following problem on the board: Construct triangle RST where $\overline{RS}$ is 5 cm, $\overline{ST}$ is 6 cm, and S is 90°.
8. Ask pupils to describe each step to construct triangle RST. As they give each step, show it on the board.

Solution:



9. Write the following problem on the board: Construct triangle CAT where $\overline{CA}$ is 5 cm, $\overline{AT}$ is 10 cm, and A is 120°.
10. Ask pupils to work with seatmates to construct the triangle.
11. Invite one set of seatmates to show the paper with their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

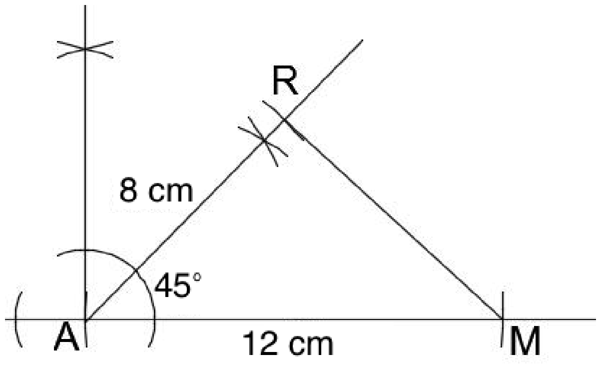
    Solution:



Practice *(8 minutes)*

1. Write on the board: Construct triangle RAM where $\overline{RA}$ is 8 cm, $\overline{AM}$ is 12 cm, and $\angle A = 45°$
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.

Answer:



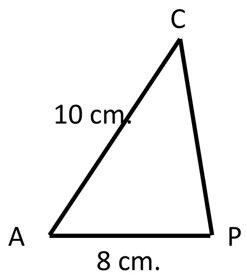
Closing *(3 minutes)*

1. Discuss: What are the steps for constructing a triangle if you are given the lengths of 2 sides and the angle between them? (Answer: Draw one of the sides with a given length, and construct the angle from that. Make the constructed line the length of the other given side. Connect the 2 known sides to make the third side.)
2. For homework, have pupils do the practice activity PHM2-L085 in the Pupil Handbook.

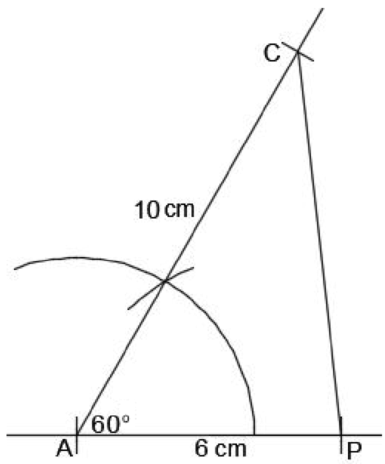
Lesson Title: Construction of triangles – Part 3	**Theme:** Geometry	
Lesson Number: M2-L086	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct triangles using two given angles and a side (ASA).	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

1. Review construction of an SAS triangle. Write on the board: Construct triangle CAP where $\overline{AP}$ is 8 cm, $\overline{CA}$ is 10 cm, and A is 60°.
2. Draw a sketch of what the triangle would look like:



3. Ask pupils to give each step to construct the triangle. As they describe the steps, show them on the board.
   Solution:

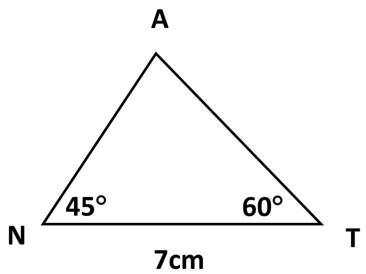


4. Explain that today's lesson is also on constructing triangles. We will be constructing triangles with 2 given angles and a given side.

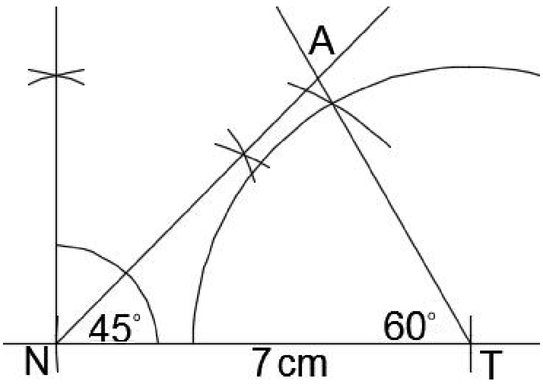
Teaching and Learning *(25 minutes)*

1. Explain: We will construct triangles given 2 angles and the sides between them. These are ASA (angle-side-angle) triangles.

2. Write on the board: Construct triangle ANT where $\angle N = 45°$, $\angle T = 60°$ and $\overline{NT} = 7$ cm.
3. Discuss: Can you think of any way to construct this triangle?
4. Allow volunteers to share their ideas, then explain: We will first construct the known side. Then, we will construct the 2 known angles on either side of it. These 2 angles connect to make a triangle.
5. Sketch a rough drawing of the triangle to be constructed on the board:

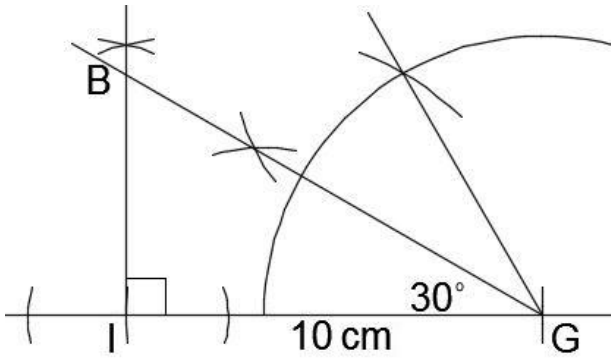


6. Show the construction of the triangle on the board, explaining each step:
    - Draw the side $\overline{NT} = 7$ cm and label it 7 cm.
    - From $\overline{NT}$, with N as the centre, construct an angle of 45° and label it 45°.
    - From $\overline{NT}$, with T as the centre, construct an angle of 60°, and label it 60°.
    - Extend the 2 angle constructions until they meet. Label this point A. This is the required triangle ANT.



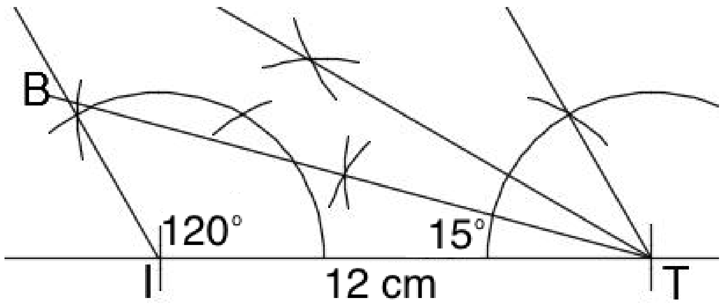
7. Write the following problem on the board: Construct triangle BIG where $\angle I = 90°$, $\angle G = 30°$ and $\overline{IG} = 10$ cm.
8. Ask pupils to describe each step to construct triangle BIG. As they give each step, show it on the board.

Solution:



9. Write the following problem on the board: Construct triangle BIT where $\angle I = 120°$, $\angle T = 15°$ and $\overline{IT} = 12$ cm.
10. Ask pupils to work with seatmates to construct the triangle.
11. Ask one set of seatmates to volunteer to show the paper with their construction to the class. Ask the pupils to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

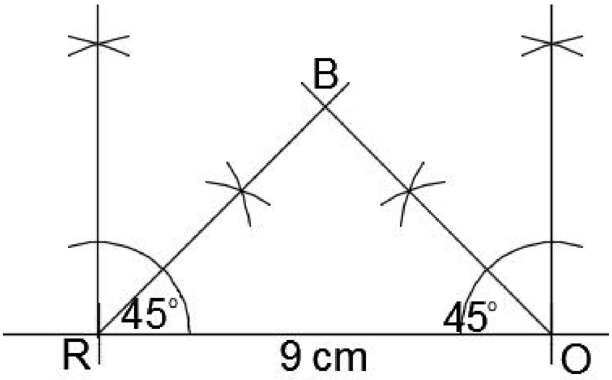
    Solution:



Practice *(8 minutes)*

1. Write on the board: Construct triangle BRO where $\angle R = \angle O = 45°$, and $\overline{RO} = 9$ cm.
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.

Answer:



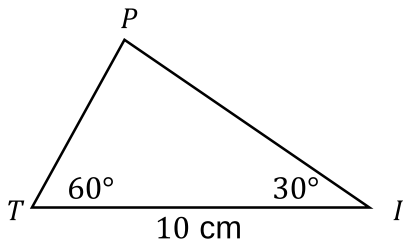
Closing *(3 minutes)*

1. Discuss: What are the steps for constructing a triangle if you are given the measures of 2 angles and the length of the side between them? (Answer: Draw the side with the given length, and construct the 2 angles on either side of it. Connect the constructed lines to give the desired triangle.)
2. For homework, have pupils do the practice activity PHM2-L086 in the Pupil Handbook.

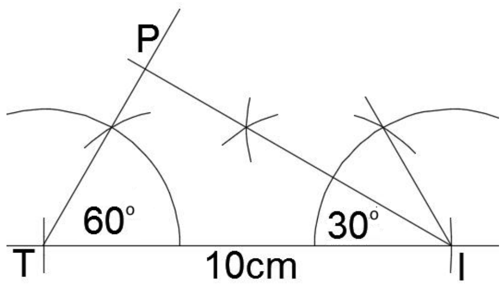
Lesson Title: Construction of quadrilaterals - Part 1	**Theme:** Geometry	
Lesson Number: M2-L087	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct squares and rectangles using given sides.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

1. Review construction of an ASA triangle. Write on the board: Construct triangle TIP where $\overline{TI}$ is 10 cm, $\angle T = 60°$ and $\angle I = 30°$.
2. Draw a sketch of what the triangle would look like:



3. Ask pupils to give each step to construct the triangle. As they describe the steps, show them on the board.
   Solution:



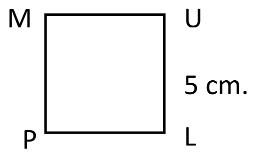
4. Explain that today's lesson is on constructing squares and rectangles.

Teaching and Learning *(25 minutes)*

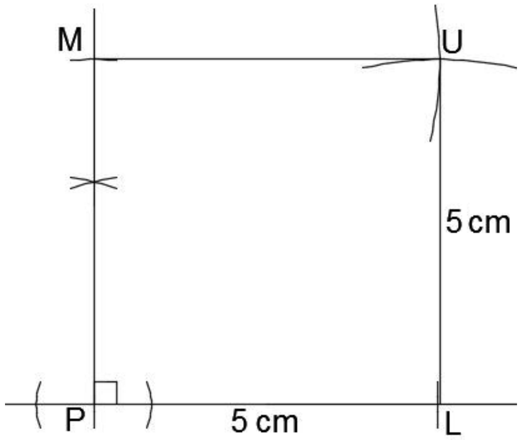
1. Discuss: How could we construct a square? Does anyone have an idea?
2. Allow volunteers to share their ideas, then explain:
   - We construct a square using its characteristics, which we know.
   - The angles are all right angles, but we only need to construct one of them.

- After constructing 1 right angle, we can complete the square using a pair of compasses to mark the lengths of the sides.

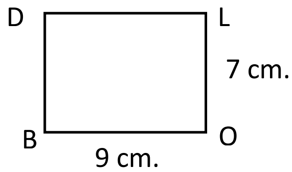
3. Write on the board: Construct square $PLUM$ with sides of 5 cm.
4. Draw a rough sketch of the square to be constructed:



5. Show the construction of the square on the board, explaining each step:
   - Draw the side $\overline{PL} = 5\ \text{cm}$ and label it 5 cm.
   - From $\overline{PL}$, construct an angle of 90° at P.
   - Open your pair of compasses to 5 cm. With P as the centre, draw an arc on the 90° line. Label the intersection M.
   - With L as the centre, draw an arc above the line PL. With M as the centre, draw an arc to the right, above L. Label the intersection of these 2 arcs U.
   - Draw lines to connect M with U, and U with L.

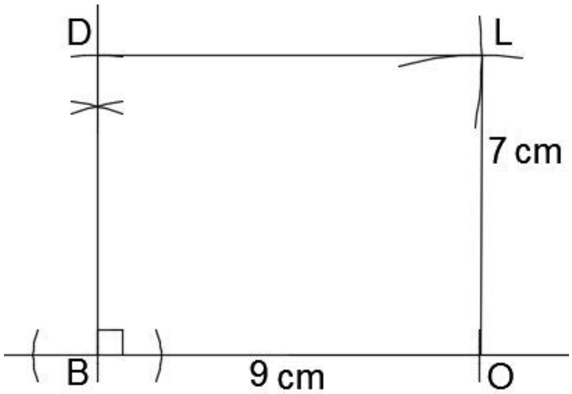


6. Write the following problem on the board: Construct rectangle $BOLD$ where $l = 9$ cm and $w = 7$ cm.
7. Draw a rough sketch of the rectangle to be constructed:



8. Discuss: How could we construct a rectangle? Does anyone have an idea?
9. Allow volunteers to share their ideas, then explain:
   - The process for constructing a rectangle is very similar to constructing a square.
   - Draw the base line, then construct a right angle from it. Adjust your compass to the given lengths to draw the other sides.
10. Show the construction of the rectangle on the board, explaining each step:
    - Draw the side $\overline{BO} = 9\ \text{cm}$ and label it 9 cm.

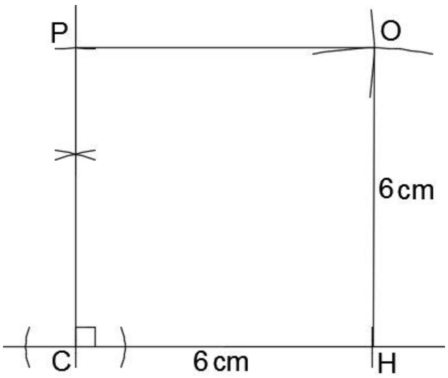
- From $\overline{BO}$, construct an angle of 90° at B.
- Open your pair of compasses to 7 cm. With B as the centre, draw an arc on the 90° line. Label the intersection D.
- Keep the radius of your pair of compasses at 7 cm. With O as the centre, draw an arc above the line BO.
- Change the radius of your pair of compasses to 9 cm. With D as the centre, draw an arc to the right, above O. Label the intersection of these 2 arcs L.
- Draw lines to connect D with L, and O with L.



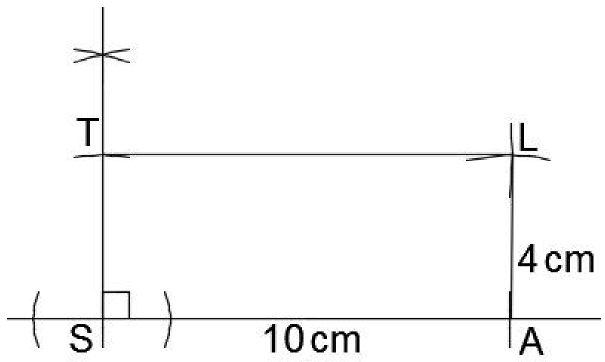
11. Write the following problems on the board:
    a. Construct square $CHOP$ with sides of length 6 cm.
    b. Construct rectangle $SALT$ where $SA = 10$ cm and $AL = 4$ cm.
12. Ask pupils to work with seatmates to construct the quadrilaterals.
13. Invite two sets of seatmates to volunteer to each show one construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

Solutions:

a.

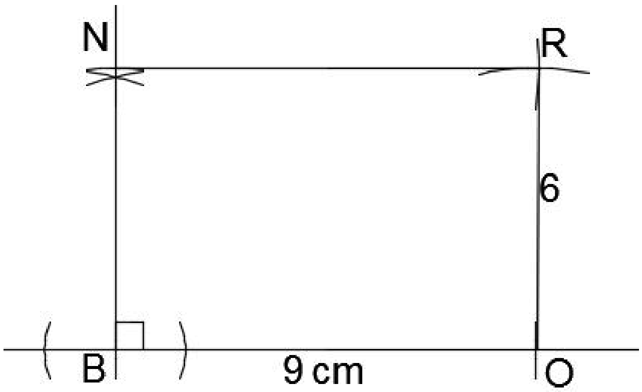


b.



Practice *(8 minutes)*

1. Write on the board: Construct rectangle $BORN$ where $\overline{BO} = 9$ cm and $\overline{OR} = 6$ cm.
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
   Solution:



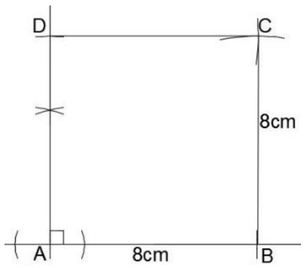
Closing *(3 minutes)*

1. Discuss: What are the steps for constructing a rectangle? (Answer: Draw the base line, then construct a 90-degree angle from it. Open your pair of compasses to the size of the length and width. Use arcs to mark the corners before connecting them to make a rectangle.)
2. For homework, have pupils do the practice activity PHM2-L087 in the Pupil Handbook.

Lesson Title: Construction of quadrilaterals - Part 2	**Theme:** Geometry	
Lesson Number: M2-L088	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct rhombi and parallelograms using two sides and an angle.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

1. Revise construction of a square. Write the following problem on the board: Construct square $ABCD$ with sides 8 cm.
2. Ask pupils to give each step to construct the square. As they describe the steps, show them on the board.
   Solution:

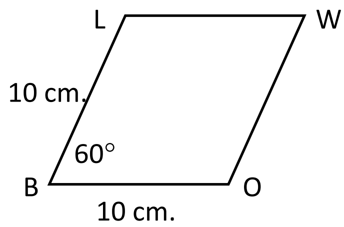


3. Explain that today's lesson is on constructing parallelograms and rhombi.

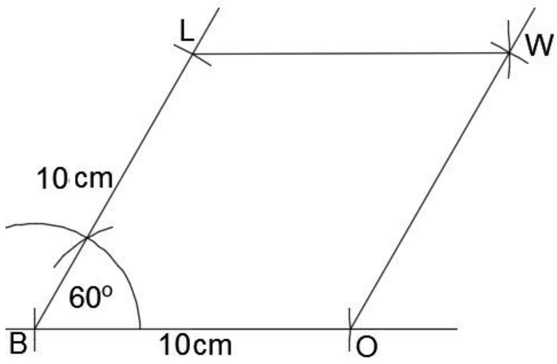
Teaching and Learning *(25 minutes)*

1. Discuss: How could we construct a parallelogram? Does anyone have an idea?
2. Allow volunteers to share their ideas, then explain:
   - We construct a parallelogram or a rhombus using their characteristics.
   - The constructions are carried out in the same way for parallelogram and rhombus. Remember that rhombus is a type of parallelogram.
   - In parallelogram construction problems, we are given the measure of an angle, and the lengths of 2 sides. We construct the given angle and extend the sides to the correct lengths.

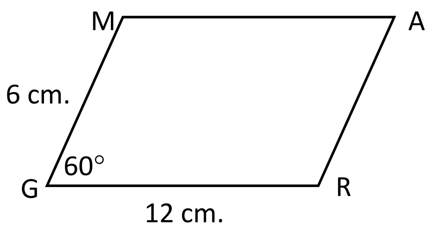
3. Write on the board: Construct a rhombus $BOWL$ with sides of length 10 cm, and angle $B = 60°$.
4. Draw a rough sketch of the rhombus to be constructed:



5. Show the construction of the rhombus on the board, explaining each step:
   - Draw the side $\overline{BO} = 10\text{ cm}$ and label it 10 cm.
   - From $\overline{BO}$, construct an angle of 60° at B.
   - Open your pair of compasses to 10 cm. With B as the centre, draw an arc on the 60° line. Label the intersection L.
   - With O as the centre, draw an arc above the line BO. With L as the centre, draw an arc to the right, above O. Label the intersection of these 2 arcs W.
   - Draw lines to connect L with W, and W with O.

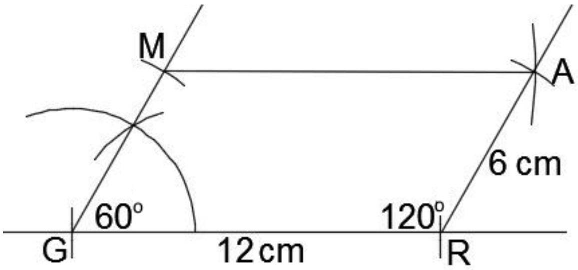


6. Write another problem on the board: Construct parallelogram $GRAM$ where $\overline{GR} = 12\text{ cm}$, $\overline{GM} = 6\text{ cm.}$, and angle $G = 60°$.
7. Draw a rough sketch of the parallelogram to be constructed:



8. Show the construction of the parallelogram on the board, explaining each step:
   - Draw the side $\overline{GR} = 12\text{ cm}$ and label it 12 cm.
   - From $\overline{GR}$, construct an angle of 60° at G.
   - Open your pair of compasses to 6 cm. With G as the centre, draw an arc on the 60° line. Label the intersection M.
   - Keep the radius of your pair of compasses at 6 cm. With R as the centre, draw an arc above the line GR.

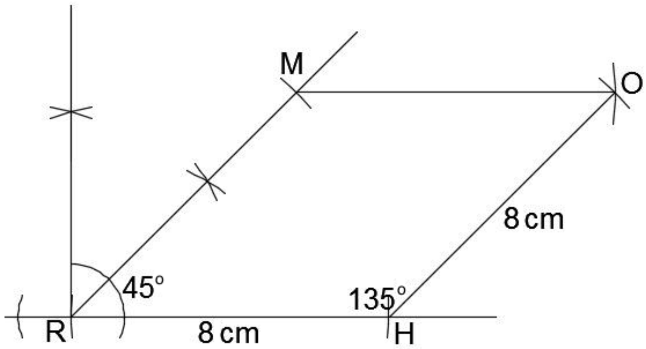
- Change the radius of your pair of compasses to 12 cm. With M as the centre, draw an arc to the right, above R. Label the intersection of these 2 arcs A.
- Draw lines to connect M with A, and A with R.



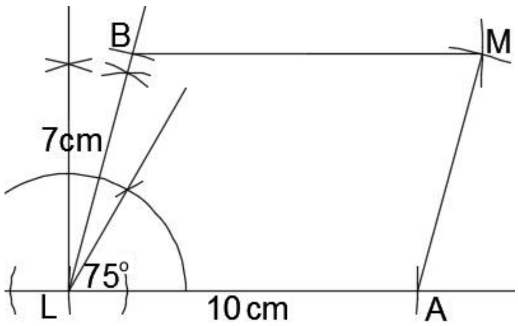
9. Write the following problems on the board:
    c. Construct a rhombus $RHOM$ with sides of length 8 cm, and angle $R = 45°$.
    d. Construct parallelogram $LAMB$ where $\overline{LA} = 10$ cm, $\overline{BL} = 7$ cm, and angle $L = 75°$.
10. Ask pupils to work with seatmates to construct the quadrilaterals.
11. Invite two sets of seatmates to each volunteer to show one construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

    Solutions:

a.



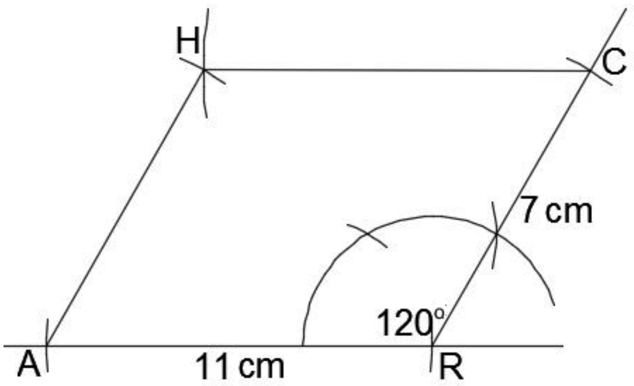
b.



Practice *(8 minutes)*

1. Write on the board: Construct parallelogram $ARCH$ where $\overline{AR} = 11$ cm, $\overline{RC} = 7$ cm, and angle $R = 120°$.

2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.
   Answer:



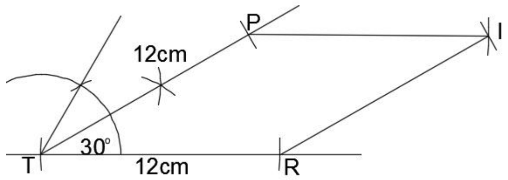
Closing *(3 minutes)*

1. Discuss: What are the steps for constructing a parallelogram? (Answer: Draw the base line, then construct the given angle from it. Open your pair of compasses to the lengths of the sides. Use arcs to mark the corners before connecting them to make a parallelogram.)
2. For homework, have pupils do the practice activity PHM2-L088 in the Pupil Handbook.

Lesson Title: Construction of quadrilaterals - Part 3	**Theme:** Geometry	
Lesson Number: M2-L089	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcomes By the end of the lesson, pupils will be able to: 1. Construct trapeziums using the lengths of 3 sides and an angle. 2. Construct other quadrilaterals given side and angle measures.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(4 minutes)*

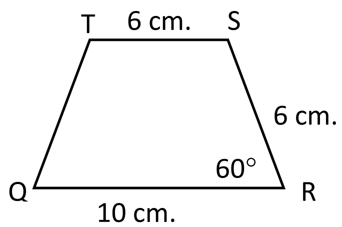
1. Review construction of a square. Write the following problem on the board: Construct rhombus $TRIP$ with sides 12 cm., and $\angle T = 30°$
2. Ask pupils to give each step to construct the rhombus. As they describe the steps, show them on the board.
   Solution:



3. Explain that today's lesson is on constructing trapeziums.

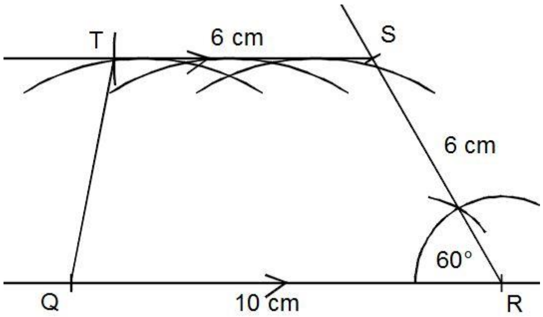
Teaching and Learning *(25 minutes)*

1. Discuss: How could we construct a trapezium? Does anyone have an idea?
2. Allow volunteers to share their ideas, then explain:
   - We construct a trapezium using its characteristics.
   - In trapezium construction problems, we are given the lengths of 3 sides and the measure of at least 1 angle. We are told which 2 sides are parallel.
3. Write on the board: Construct a trapezium $QRST$ such that $\overline{QR} = 10$ cm, $\overline{RS} = 6$ cm, $\overline{ST} = 6$ cm, and $\angle QRS = 60°$ and line $\overline{QR}$ is parallel to line $\overline{ST}$.
4. Draw a rough sketch of the trapezium to be constructed:

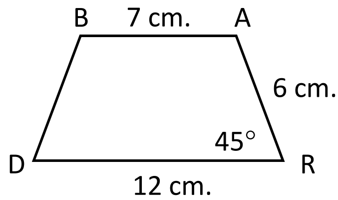


5. Show the construction of the trapezium on the board, explaining each step (see diagram below):
   - Draw the side $\overline{QR} = 10$ cm and label it 10 cm.
   - From $\overline{QR}$, construct an angle of 60° at R.

- Open your pair of compasses to 6 cm. With R as the centre, draw an arc on the 60° line. Label the intersection S.
- Construct a line parallel to QR:
  - Centre your pair of compasses at S, and open them to the distance between point S and the line QR.
  - Choose any 3 points on line QR. Keep your compass open to the distance between S and QR, and draw 3 arcs above QR.
  - Place your ruler on the highest points of these 3 arcs, and connect them to make a line parallel to QR.
- Open your compass to 6 cm. With S as the centre, draw an arc through the parallel line you constructed. Label the intersection T.
- Draw a line to connect T with Q.

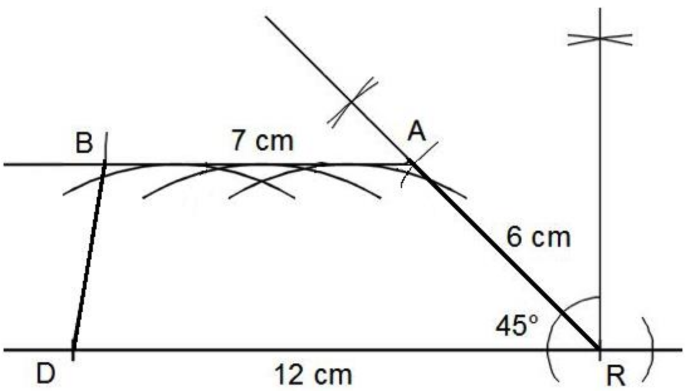


6. Write the following problem on the board: Construct trapezium $DRAB$ where $\overline{DR} = 12$ cm, $\overline{RA} = 6$ cm, $\overline{AB} = 7$ cm, and $\angle R = 45°$ and line $\overline{DR}$ is parallel to line $\overline{AB}$.
7. Draw a rough sketch of the trapezium to be constructed:

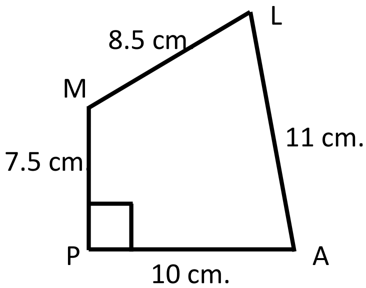


8. Ask pupils to work with seatmates to construct the trapezium. The steps are the same as trapezium $QRST$, but the angles and side lengths are different.
9. Walk around to check for understanding and support pupils as needed.
10. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

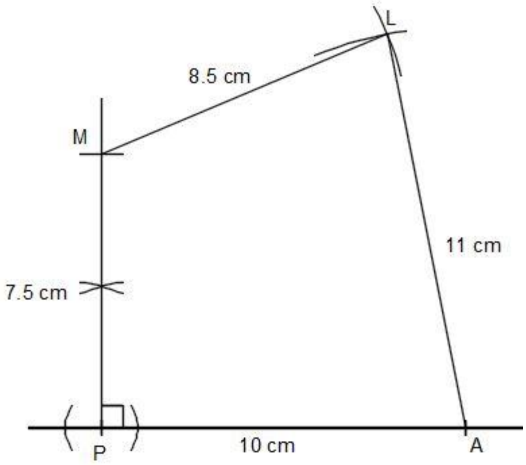
Solution:



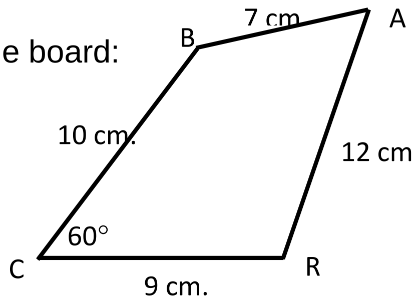
11. Draw the sketch of quadrilateral $PALM$ on the board:



12. Discuss:
    - What type of quadrilateral is this? (Answer: It is not a certain type; it does not have a name.)
    - How could we draw this quadrilateral?
13. Allow pupils to share ideas, then explain:
    - We can construct any quadrilateral if we have enough information.
    - In this drawing, we have the lengths of 4 sides and one angle, P. This is enough information to construct the quadrilateral.
14. Construct $PALM$ on the board, explaining each step (see diagram below):
    - Draw the side $\overline{PA} = 10 \text{ cm}$ and label it 10 cm.
    - From $\overline{PA}$, construct an angle of 90° at P.
    - Open your pair of compasses to 7.5 cm. With P as the centre, draw an arc on the 90° line. Label the intersection M.
    - Open your compass to 8.5 cm. With M as the centre, draw an arc to the right. Open your compass to 11 cm. With A as the centre, draw an arc above PA. Label the intersection of the two arcs L.
    - Draw a line to connect M with L, and a line to connect A with L.

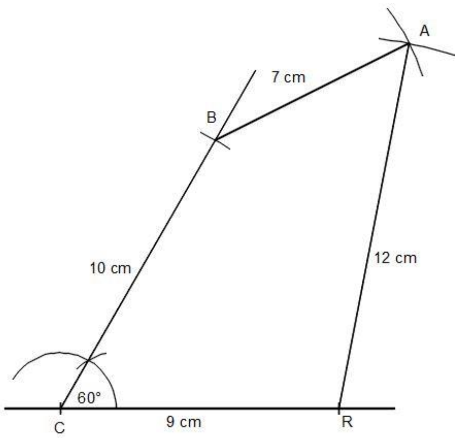


15. Write the following problem on the board: Construct quadrilateral $CRAB$ with $CR = 9 \text{ cm}$, $RA = 12 \text{ cm}$, $AB = 7 \text{ cm}$, $CB = 10 \text{ cm}$, and $\angle C = 60°$.
16. Ask pupils to work with seatmates to draw a rough sketch of the quadrilateral to be constructed.
17. Invite a volunteer to draw their sketch on the board:



18. Ask pupils to work with seatmates to construct the quadrilateral. The steps are the same as quadrilateral $PALM$, but the angles and side lengths are different.
19. Walk around to check for understanding and support pupils as needed.
20. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to ask questions and discuss.

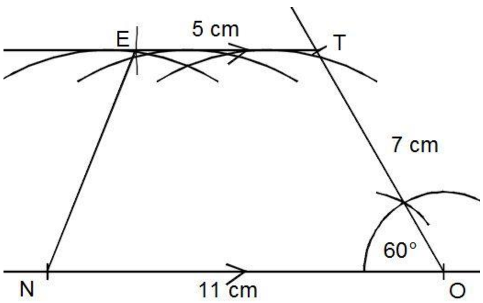
    Solution:



Practice *(8 minutes)*

1. Write on the board: Construct trapezium $NOTE$ where $\overline{NO} = 11 \text{ cm}$, $\overline{OT} = 7 \text{ cm}$, $\overline{TE} = 5 \text{ cm}$, and $\angle O = 60°$ and line $\overline{NO}$ is parallel to line $\overline{TE}$.
2. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
3. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.

   Solution:



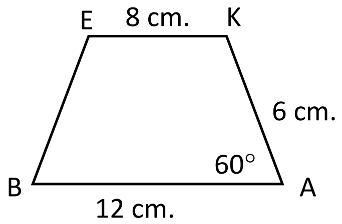
Closing *(3 minutes)*

1. Discuss: What are the steps for constructing a trapezium? (Answer: Draw the base line, then construct the given angle from it. Open your pair of compasses to the length of the side and use an arc to construct it. Use arcs to draw a line parallel to the base line, and draw it the given length. Connect the points to draw the final side of the trapezium.)
2. For homework, have pupils do the practice activity PHM2-L089 in the Pupil Handbook.

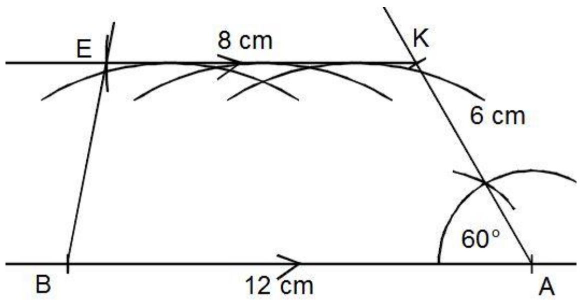
Lesson Title: Construction word problems – Part 1	Theme: Geometry	
Lesson Number: M2-L090	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct angles and triangles based on information in word problems.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(5 minutes)*

1. Review construction of a trapezium. Write the following problem on the board: Construct trapezium $BAKE$ such that $\overline{BA} = 12$ cm, $\overline{AK} = 6$ cm, $\overline{KE} = 8$ cm, and $\angle A = 60°$ and line $\overline{BA}$ is parallel to line $\overline{KE}$.
2. Draw a sketch of the trapezium on the board:



3. Ask pupils to give each step to construct the trapezium. As they describe the steps, show them on the board.
Solution:



4. Explain that today's lesson is on constructing angles and triangles from word problems.

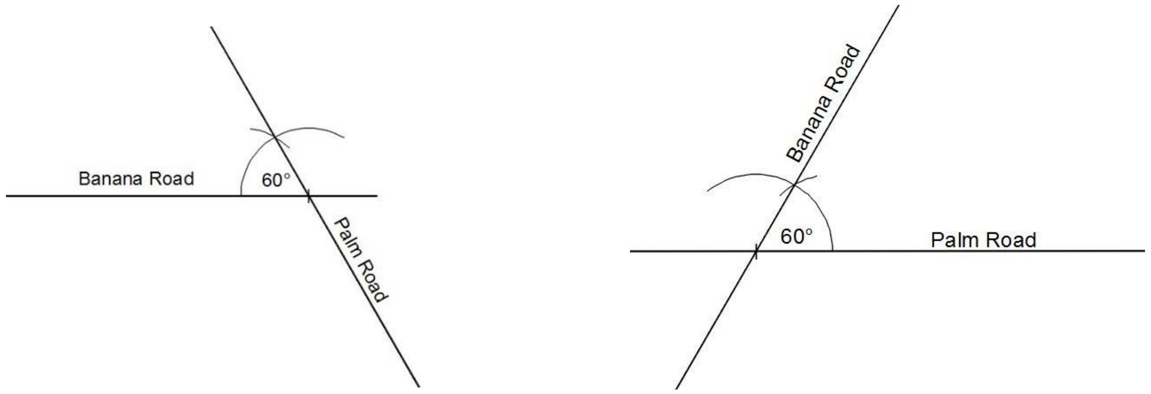
Teaching and Learning *(22 minutes)*

1. Write on the board: Hawa is drawing a map of her community. She knows that 2 roads intersect at a 60° angle, Banana Road and Palm Road. Draw the intersection of these 2 roads.
2. Discuss: How can we draw this intersection for Hawa?
3. Allow pupils to share their ideas, then explain: We can construct a 60° angle, and extend the 2 lines. Then, label the lines with the road names.
4. Ask pupils to work with seatmates to construct the intersection.

5. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it.
6. If another set of seatmates drew theirs differently, allow them to also share.

   Example solutions:

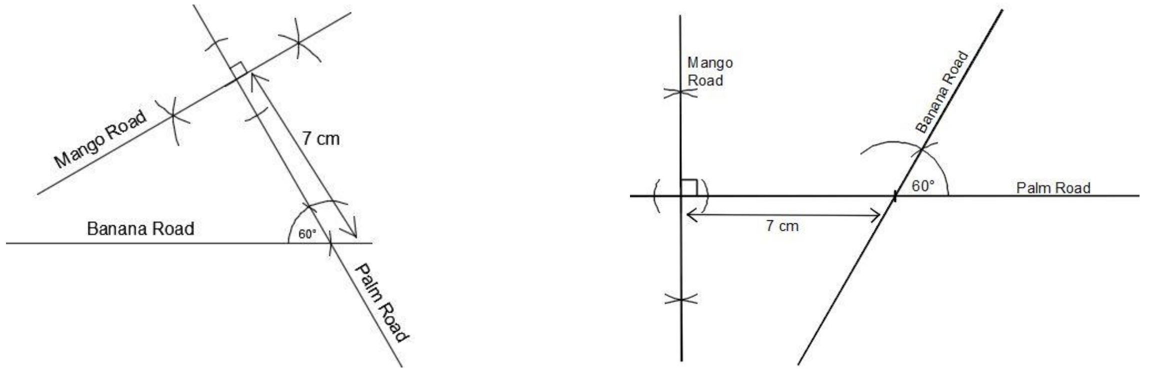
   Note that other answers may also be accurate. Check for the 60° angle and road labels.



7. Write on the board: Palm Road also intersects with Mango Road at a 90° angle. The intersection is 7 kilometres from the intersection with Banana Road. Construct Mango Road on your map. Use 1 cm to represent each kilometre.
8. Ask pupils to work with seatmates to draw the intersection on their existing map.
9. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it.
10. If another set of seatmates drew theirs differently, allow them to also share.

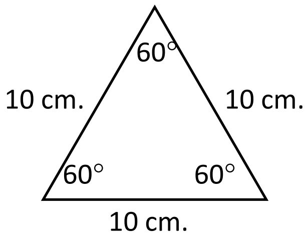
    Example solutions:

    Note that other answers may also be accurate. Check for the 90° angle, 7 cm distance, and road labels.

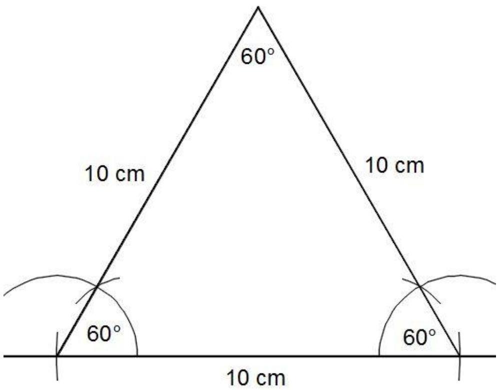


11. Write on the board: Mr. Bangura is a carpenter. He wants to construct a table with a triangular top. He wants each angle to be equal, and each side to be 1 metre. Construct a triangle that gives the shape of his table top. Construct it to a smaller scale, with sides of 10 cm.
12. Discuss: If each angle of a triangle is equal, what are their measures?
13. Allow pupils to share ideas, then explain: The triangle is equilateral. Equilateral triangles have angles of 60 degrees.

14. Ask pupils to draw a rough sketch of the triangle to be constructed in their exercise books. Remind them to label the angles and sides.
15. Invite a volunteer to draw their sketch on the board.
    Sketch:

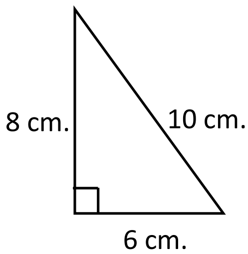


16. Explain:
    - Remember that we can construct a triangle given two angles and a side (ASA).
    - Use 3 measures from this triangle to construct it.
17. Ask pupils to work with seatmates to do the construction. Ask them to label all sides and angles.
18. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
    Solution:



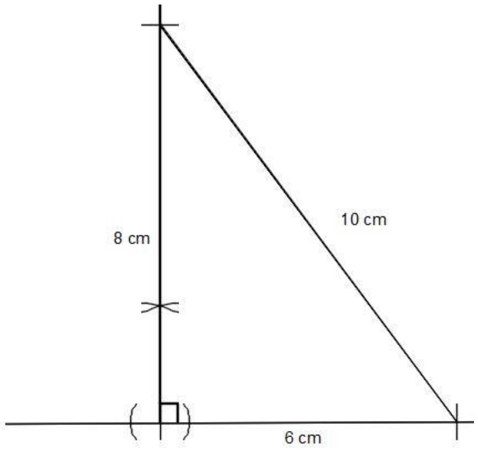
Practice *(10 minutes)*

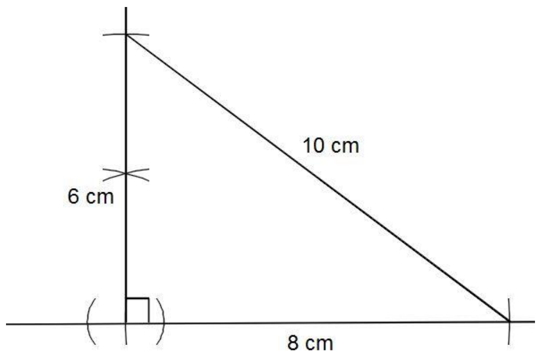
1. Write on the board: Fatu has saved her money and she will build an interesting house. The walls will be in the shape of a right-angled triangle. The outside walls will be 6 metres, 8 metres, and 10 metres. Draw the walls of her house using 1 cm for each metre.
2. Ask pupils to draw a sketch of the triangle in their exercise books.
3. Invite a volunteer to draw their sketch on the board.
   Example sketches (triangle may face any direction):



4. Explain:
    - Recall that the longest side of a right-angled triangle is the hypotenuse. It is opposite the right angle.
    - The walls next to the right angle are 6 metres and 8 metres.
    - Use 2 sides and an angle to construct the triangle (SAS).
5. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
6. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.

    Example answers:





Closing *(3 minutes)*

1. Discuss:
    a. In what other situations is geometry construction useful?
    b. What professionals could use geometry construction in their jobs? (Example: Carpenters, architects, builders, engineers, city planners)
2. For homework, have pupils do the practice activity PHM2-L090 in the Pupil Handbook.

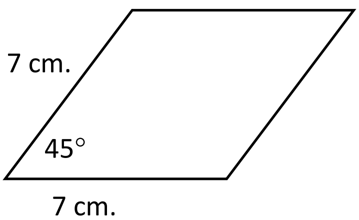
Lesson Title: Construction word problems – Part 2	**Theme:** Geometry	
Lesson Number: M2-L091	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct quadrilaterals and compound shapes based on information given in word problems.	**Preparation** Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(2 minutes)*

1. Discuss: What are some occasions in real life when it is useful to be able to construct angles and triangles? (Example answers: When building furniture or a house; tailors may use angles when sewing.)
2. Explain that today's lesson is on constructing quadrilaterals and compound shapes from word problems.

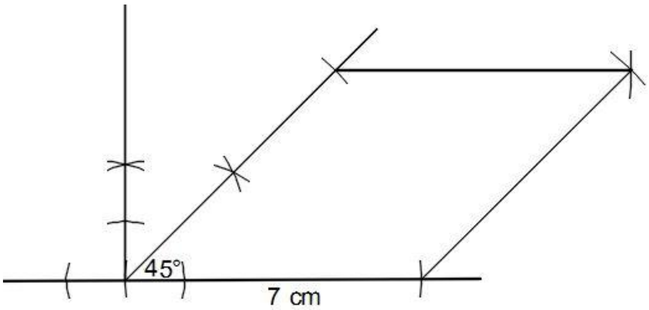
Teaching and Learning *(25 minutes)*

1. Write on the board: Foday wants to draw a map of his land, which is in the shape of a rhombus. It borders 2 roads that form a $45°$ angle in the corner. He knows that one side is 70 m long. Help him draw the map. Use 1 cm for each 10 m.
2. Discuss: How can we draw the map of Michael's land?
3. Allow pupils to share their ideas, then explain: We have enough information to construct a rhombus. We have the measures of the sides and 1 angle.
4. Discuss: How many centimetres will the sides of our rhombus be? (Answers: They will all be 7 cm.)
5. Ask pupils to work with seatmates to draw a rough sketch of the rhombus.
6. Invite a volunteer to draw their sketch on the board.
   Sketch:

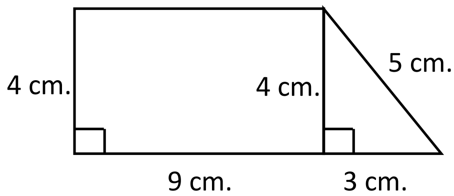


7. Ask pupils to construct the rhombus with seatmates.
8. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it.

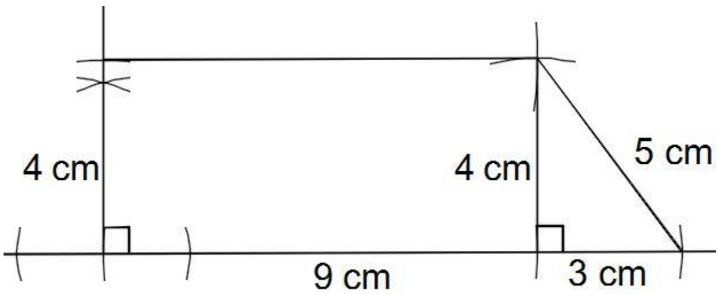
Solution:



9. Write the following problem on the board: Fatu and Hawa own land next to each other. They decided to make a farm on both pieces of land. Fatu's land is a rectangle that is 90 metres long by 40 metres wide. It shares one 40 metre side with Hawa's land. Hawa's land is a right triangle with sides of length 40 metres, 50 metres, and 30 metres. Construct the shape of the land using 1 cm for each 10 m.
10. Discuss: What will the shape of their farm be? (Answer: A rectangle and right-angled triangle attached to one another, which makes a trapezium)
11. Ask pupils to draw a rough sketch of the shape to be constructed in their exercise books. Remind them to label the angles and sides.
12. Ask a volunteer to draw their sketch on the board.
Sketch:



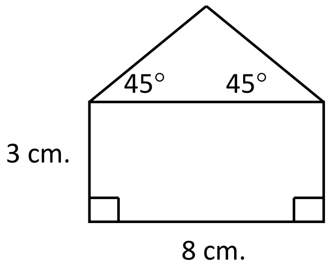
13. Explain:
    - We have enough information to construct this shape.
    - We can construct the rectangle given the lengths of the sides.
    - We can construct the triangle given two sides and an angle (SAS).
14. Ask pupils to work with seatmates to do the construction. Ask them to label all sides and angles.
15. Ask one set of seatmates to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
Solution:



Practice *(10 minutes)*

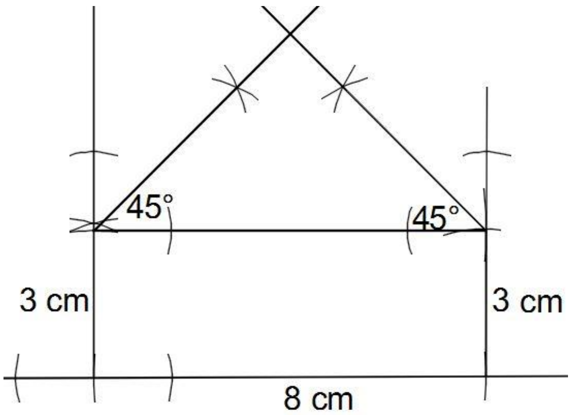
1. Write on the board: Aminata dreams of becoming an architect. She practices by drawing the front of her parents' house. The front wall forms a rectangle that is 8 metres long and 3 metres tall. The roof forms a 45° angle with each wall. Construct the front of her parents' house. Use 1 cm for each m.
2. Ask pupils to draw a sketch of the front of the house in their exercise books.
3. Invite a volunteer to draw their sketch on the board.

   Sketch:



4. Ask pupils to work independently to do the construction. They may discuss with seatmates if needed.
5. Invite a volunteer to show their paper and explain how they did their construction. Allow discussion.

   Solution:



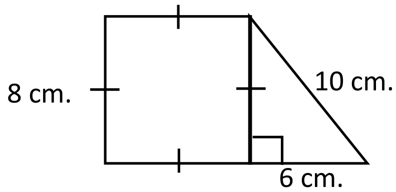
Closing *(3 minutes)*

1. Discuss:
   - Which shapes have you learned to construct during the last several lessons? (Answers: angles, triangles, quadrilaterals, compound shapes.)
   - Which shapes do you think are most useful and why? (Example: Rectangles and triangles are useful because these shapes are often used in building things.)
2. For homework, have pupils do the practice activity PHM2-L091 in the Pupil Handbook.

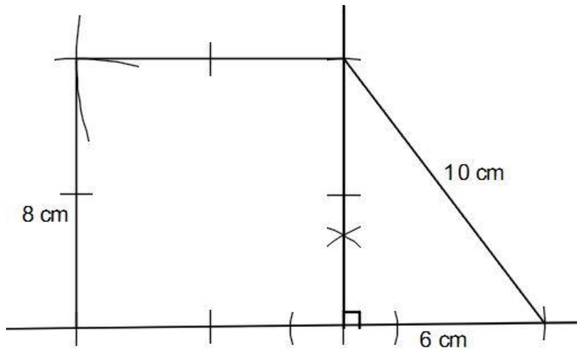
Lesson Title: Construction of loci – Part 1	Theme: Geometry	
Lesson Number: M2-L092	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct points at a given distance from a given point.	**Preparation** 1. Write the problem and draw the sketch in Opening. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(8 minutes)*

1. Review construction of composite shapes. Write on the board: Construct the shape that is sketched:



2. Ask pupils to work with seatmates to construct the composite shape using a pair of compasses.
3. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
   Solution:

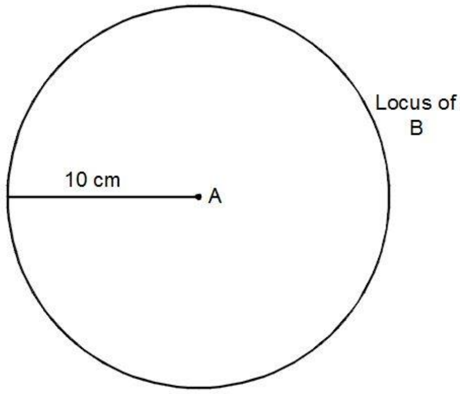


4. Explain that today's lesson is the first on constructing loci. Loci are different from the shapes that we have been constructing.

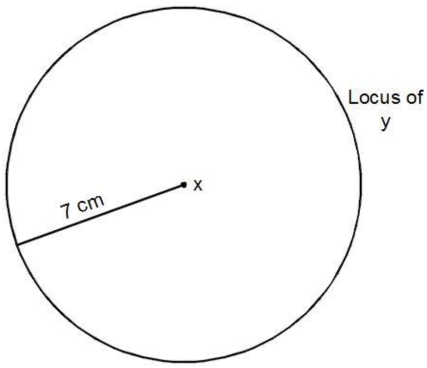
Teaching and Learning *(18 minutes)*

1. Write on the board: one locus, two loci
2. Explain:
   - A locus is a path. It is a specific path that a point moves through. The point obeys certain rules as it moves through the locus.
   - The plural of locus is loci.

3. Write on the board: Draw the locus of point B if it is 10 cm from point A.
4. Explain:
   - The locus of point B is all of the possible points where B could exist.
   - The only information that we know about point B is that it is 10 cm away from point A.
5. Construct the locus of B on the board, explaining each step:
   a. Mark point A anywhere.
   b. Open the compass to 10 cm.
   c. With A as the centre, construct a full circle.
   d. Label the circle "locus of B".

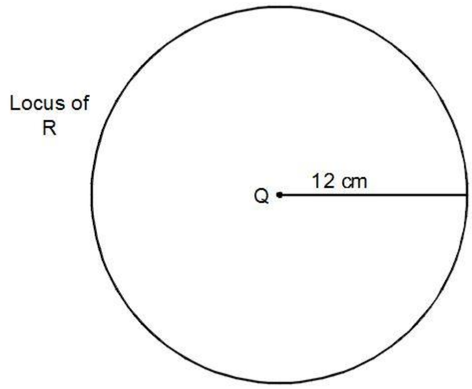


6. Write the following problem on the board: The locus of a point (y) moves so that it is 7 cm away from a fixed point (x). Draw the locus of y.
7. Ask volunteers to explain how to solve the problem. As they give the steps, construct the locus on the board:

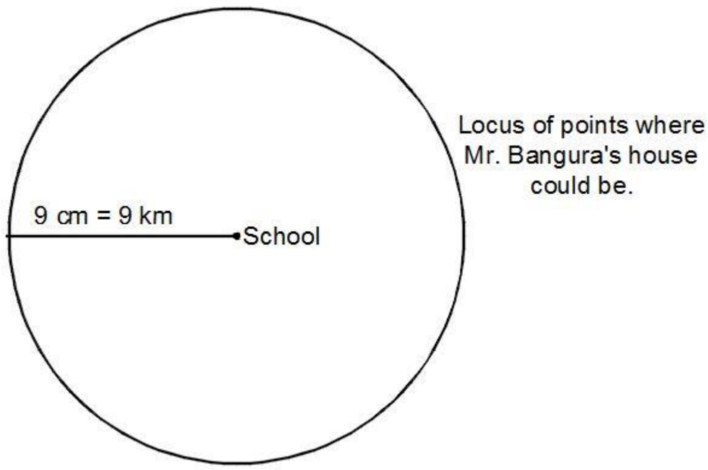


8. Write the following problem on the board: The locus of a point R is 12 cm away from point Q. Construct the locus of R.
9. Ask pupils to work with seatmates to construct the locus of R.
10. Invite one set of seatmates to volunteer to show their construction to the class. Ask the pupils to explain the steps they took to draw it. Allow other pupils to discuss.

Solution:



11. Write on the board: Mr. Bangura is a teacher who lives exactly 9 km from school. A group of pupils are looking for his house. Draw the locus of all possible locations of Mr. Bangura's house. Use 1 cm for each 1 km.
12. Discuss:
    - Do we have enough information to draw the locus? (Answer: Yes.)
    - What steps should we take? (Answer: Draw a point to represent the school. Adjust the compass to 9 cm and draw a circle to show the locus.)
13. Ask pupils to work with seatmates to construct the locus.
14. Ask one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
    Solution:



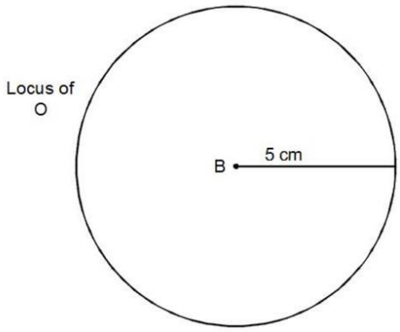
Practice *(12 minutes)*

1. Write the following problems on the board:
    a. O is a point 5 cm from B. Draw the locus of O.
    b. T is a point such that $\overline{ST} = 11$ cm. With S as the centre, draw the locus of T.
    c. A horse is tied to a pole with a rope that is 6 m in length. It has been running in circles all day, as far from the pole as it can be. Construct the path of the horse. Use 1 cm for each metre.

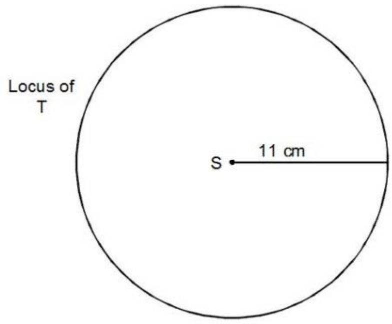
2. Ask pupils to construct the loci independently in their exercise books. They may discuss with seatmates if needed.
3. Invite 3 volunteers to show their papers and explain how they constructed the loci. Allow discussion.

   Solutions:

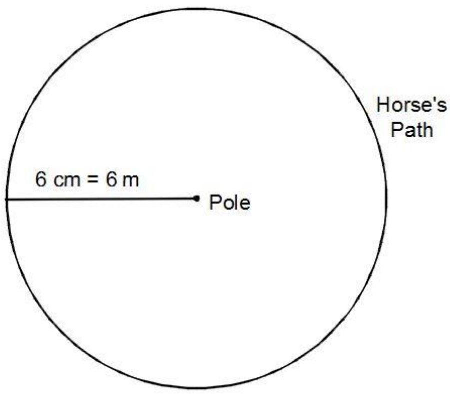
   a.



   b.



   c.



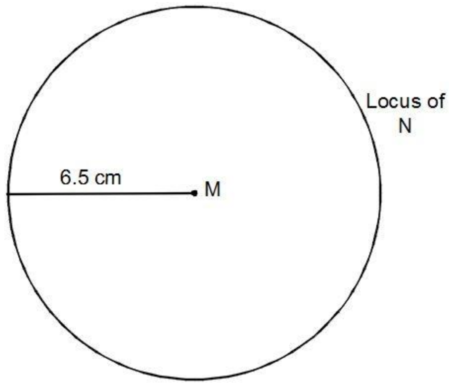
Closing *(2 minutes)*

1. Discuss: Ask pupils to explain in their own words what a locus is. Encourage all responses. Guide them to see that it is a path that a point traces as it follows a certain rule.
2. For homework, have pupils do the practice activity PHM2-L092 in the Pupil Handbook.

Lesson Title: Construction of loci – Part 2	Theme: Geometry	
Lesson Number: M2-L093	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct points equidistant from two given points.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and a ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(3 minutes)*

1. Review construction of loci from a given point. Write a problem on the board: If N is a point 6.5 cm from M, draw the locus of N.
2. Ask pupils to work with seatmates to draw the construction.
3. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
   Solution:



4. Explain that today's lesson is also on constructing loci. Today pupils will be constructing the set of points equidistant from 2 given points.

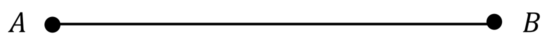
Teaching and Learning *(18 minutes)*

1. Draw 2 points A and B horizontally from one another on the board:

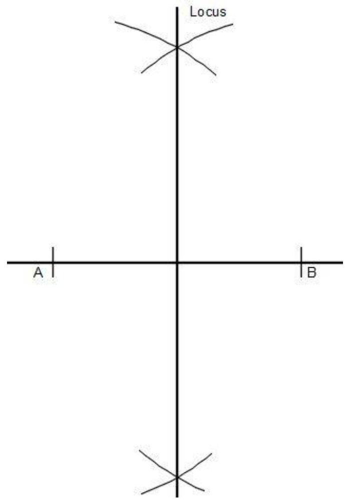
   A ● ● B

2. Explain:
   - We will construct the locus of points that is equidistant from A and B. That is, the points that are the same distance from A and B.
   - Remember that a locus is a path. It is a set of many points.
3. Discuss: Can anyone locate a point that is the same distance from A and B? How would we find such points?

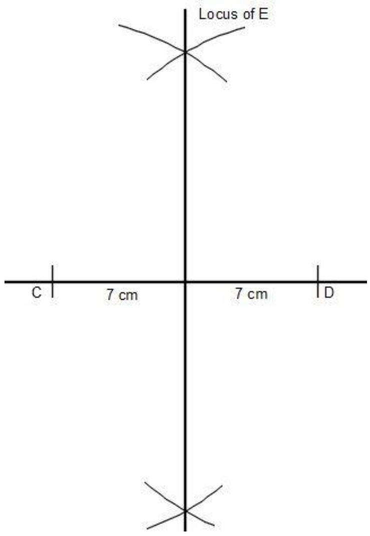
4. Allow pupils to mark points on the board, or to share their ideas through discussion.
5. Explain:
    - A and B can be connected in a line.
    - The points that are equidistant from A and B are all of the points on the perpendicular bisector of line AB.
    - Remember that a perpendicular bisector must be exactly in the middle of a given line.
6. Use a straight edge to connect points A and B:



7. Construct the perpendicular bisector of AB on the board, explaining each step:
    e. With A as the centre, draw arcs above and below line AB.
    f. With B as the centre, draw arcs above and below line AB.
    g. Draw the perpendicular bisector through the two points where the arcs intersect.
    h. Label the line "locus".

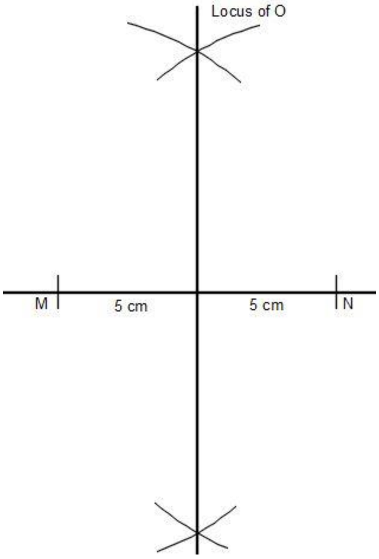


8. Explain: Any point on this line is the same distance from A and B.
9. Write the following problem on the board: Points C and D are 14 cm from one another. Point E is equidistant from C and D. Draw the locus of point E.
10. Ask volunteers to explain how to solve the problem. As they give the steps, construct the locus on the board:

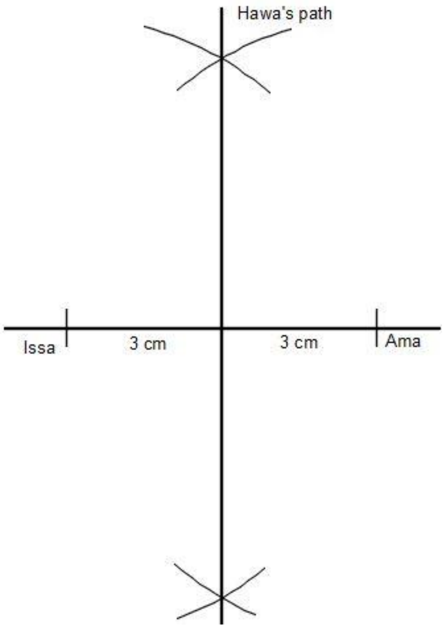


11. Write the following problem on the board: Point N is 10 cm from point M. Point O is equidistant from M and N. Draw the locus of point O.

12. Ask pupils to work with seatmates to construct the locus of O.
13. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
Solution:



14. Write on the board: Issa and Ama are standing 60 metres from one another. Their friend Hawa is running in a straight line. She maintains the same distance from Issa and Ama. Construct Hawa's path. Use 1 cm to represent 10 metres.
15. Discuss:
    - Do we have enough information to draw the locus? (Answer: Yes.)
    - What steps should we take? (Answer: Draw points to show Issa and Ama standing 60 metres (6 cm) from one another. Draw the perpendicular bisector to show Hawa's path.)
16. Ask pupils to work with seatmates to construct the locus.
17. Invite one set of seatmates to volunteer to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
Solution:



Practice *(17 minutes)*

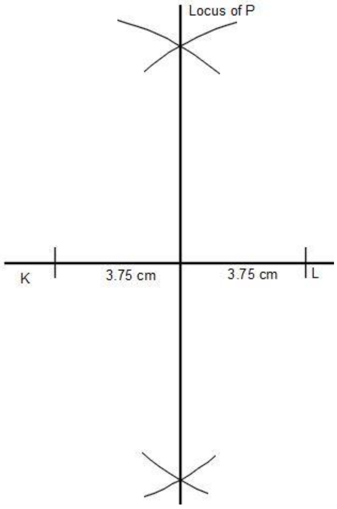
1. Write the following problems on the board:
    a. P is a point that is equidistant from 2 points K and L. Draw K and L a distance of 7.5 cm from each other, then construct the locus of P.
    b. Z is a point such that $\overline{XZ} = \overline{YZ}$. If points X and Y are 9 cm from one another, draw the locus of Z.

c. Two neighbours live 100 metres apart. They decide to buy a new water pump to share, and they want to put it equidistant from their 2 houses. Draw the locus of points where they could place the new pump. Use 1 cm to represent 10 m.

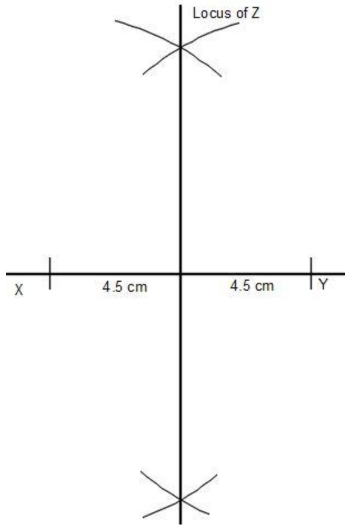
2. Ask pupils to construct the loci independently in their exercise books. They may discuss with seatmates if needed.
3. Invite 3 volunteers to show their papers and explain how they constructed the loci. Allow discussion.

Solutions:

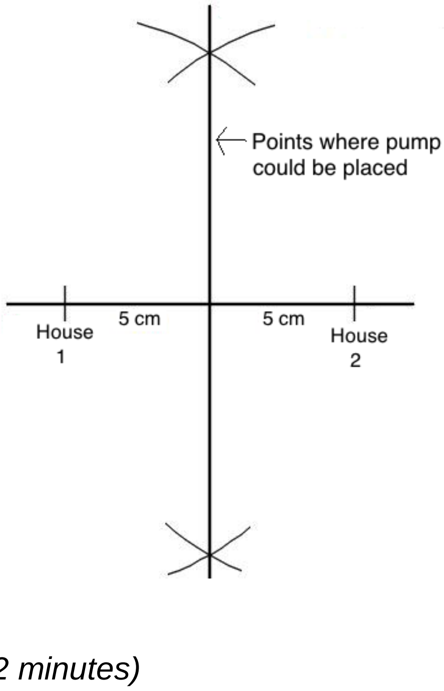
a.



b.



c.



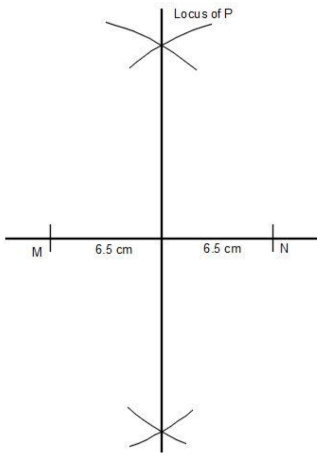
Closing *(2 minutes)*

1. Discuss: Ask pupils to explain in their own words how to construct the locus of points equidistant from 2 given points. (Example answer: Draw a line between the 2 points and construct the perpendicular bisector.)
2. For homework, have pupils do the practice activity PHM2-L093 in the Pupil Handbook.

Lesson Title: Construction of loci – Part 3	**Theme:** Geometry	
Lesson Number: M2-L094	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct points equidistant from two straight lines.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(5 minutes)*

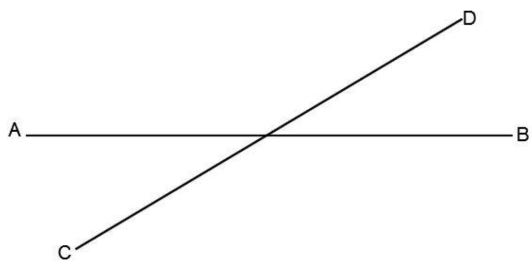
1. Review construction of loci equidistant to two given points. Write a problem on the board: If M and N are 2 points such that $\overline{MN} = 13$ and P is equidistant from M and N, draw the locus of P.
2. Ask pupils to work with seatmates to draw the construction.
3. Invite one set of seatmates to show their construction to the class. Ask them to explain the steps they took to draw it. Allow other pupils to discuss.
   Solution:



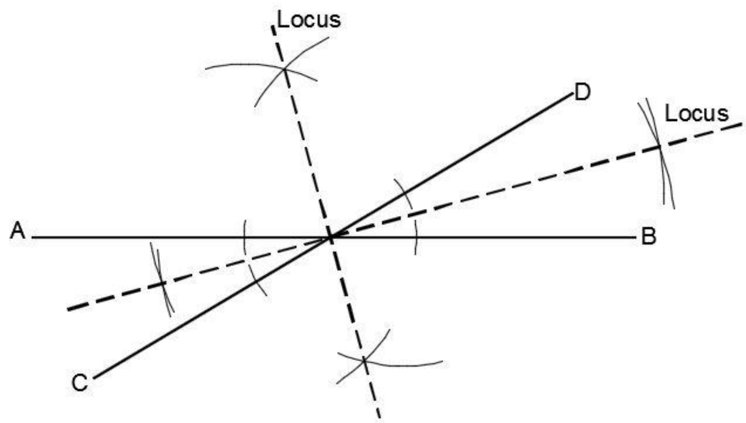
4. Explain that today's lesson is also on constructing loci. Today pupils will be constructing the set of points equidistant from 2 given lines.

Teaching and Learning *(20 minutes)*

1. Draw 2 intersecting lines on the board. Label them AB and CD, as shown:



2. Explain:
   - We will construct the locus of points that are equidistant from lines AB and CD. That is, the points that are the same distance from AB and CD.
   - Remember that a locus is a path. It is a set of many points.
3. Discuss: Can anyone locate a point that is the same distance from AB and CD? How would we find such points?
4. Allow pupils to mark points on the board, or to share their ideas through discussion.
5. Explain:
   - There are many points that are equidistant from AB and CD.
   - The points that are equidistant from 2 lines can be found by bisecting the angles formed by the lines.
   - The points that are equidistant from AB and CD are all of the points on the angle bisectors.
   - Note that there are 4 angles between these 2 lines. We want to bisect all of them.
6. Construct the angle bisectors on the board, explaining each step:
   i. With the intersection of the lines as the centre, draw an arc on each line. Use any radius, but use the same radius for each arc.
   j. Use the intersection of each arc with the lines as a centre. Adjust your compass to a convenient radius, and draw arcs on both sides of each line. The arcs should intersect within the angles between the lines.
   k. Connect the intersections of the arcs to create 2 new lines. These are the loci for the point that are equidistant from AB and CD.
   l. Label each new line “locus”.

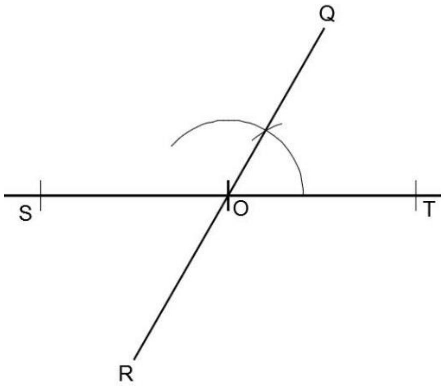


7. Explain: Any point on either of these 2 lines is the same distance from AB and CD.
8. Write the following problem on the board: Lines QR and ST intersect at point O such that $\angle COT = 60°$. Construct the lines, then construct the locus of a point P that is equidistant from the 2 lines.
9. Ask volunteers to describe what the construction will look like. Allow them to share ideas. (Example: The locus will be 2 lines that also pass through the point

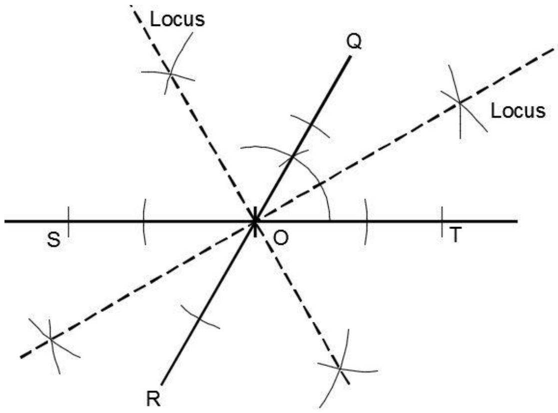
of intersection O. The locus will be the angle bisectors of the angles formed by QR and ST.)

10. Ask volunteers to explain how to solve the problem. As they give the steps, do the construction on the board:

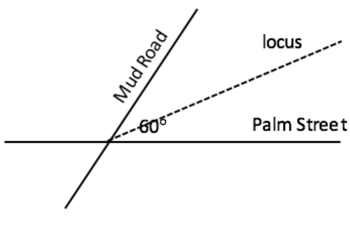
Step 1. Construct lines QR and ST with a 60° degree angle:



Step 2. Bisect each of the 4 angles to construct the locus:

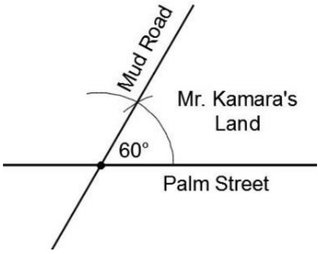


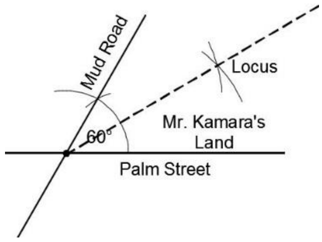
11. Write the following problem on the board: Mr. Koroma owns a very large piece of land on the corner of Mud Road and Palm Street. The intersection of the roads at the corner of his land is 60°.
    a. Draw the intersection of the two roads, and label Mr. Koroma's land.
    b. Mr. Koroma decides to build a house equidistant from Mud Road and Palm Street. On the same construction, construct the locus of points where he could build his house.
12. Ask volunteers to describe what the intersection of the 2 streets will look like. Draw a rough sketch on the board:



13. Ask pupils to work with seatmates to complete both parts of the problem.
14. Invite 2 different sets of seatmates to volunteer to share their drawing and explain how they did the construction. Ask one group to share part a., and one group to share part b.

Solutions:



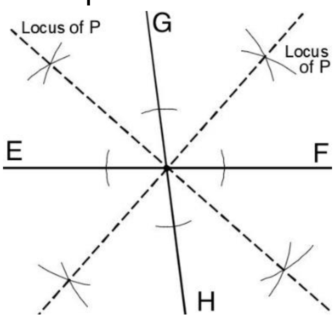


Practice *(12 minutes)*

1. Write the following 2 problems on the board:
    a. Draw any 2 intersecting lines and label them EF and GH. Construct the locus of a point P that is equidistant from the 2 lines.
    b. Two sides of a fence form a 90 angle. Bintu wants to plant a tree equidistant from the 2 fence sides.
        i. Construct the 2 sides of the fence (a right angle).
        ii. Construct the locus of points where she could plant the tree.
2. Ask pupils to construct the loci independently in their exercise books. They may discuss with seatmates if needed.
3. Invite 3 volunteers to show their papers and explain how they constructed the loci. Allow discussion.

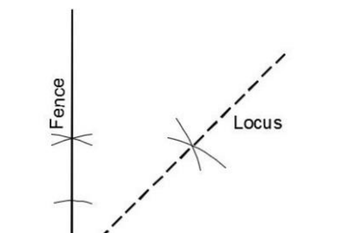
   Solutions:

   a. Example answer:



b. i.

ii.



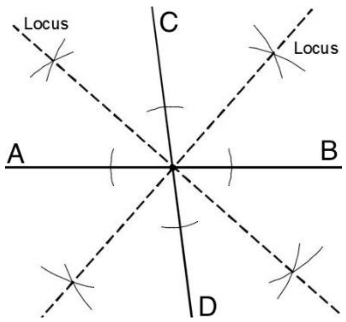
Closing *(3 minutes)*

1. Discuss: Ask pupils to explain in their own words how to construct the locus of points equidistant from 2 given lines. (Example answer: Bisect each angle between the 2 lines.)
2. For homework, have pupils do the practice activity PHM2-L094 in the Pupil Handbook.

Lesson Title: Construction of loci – Part 4	**Theme:** Geometry	
Lesson Number: M2-L095	**Class:** SSS 2	**Time:** 40 minutes
Learning Outcome By the end of the lesson, pupils will be able to construct points at a given distance from a given straight line.	**Preparation** 1. Write the problem in Opening on the board. 2. Bring a pair of compasses, a protractor, and ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.	

Opening *(5 minutes)*

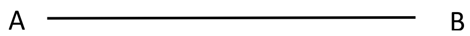
1. Review construction of loci equidistant to two intersecting lines. Draw 2 intersecting lines on the board, at any angle.
2. Ask volunteers to describe the steps to construct the locus of the points equidistant to the 2 lines. As they give the steps, construct the locus on the board:



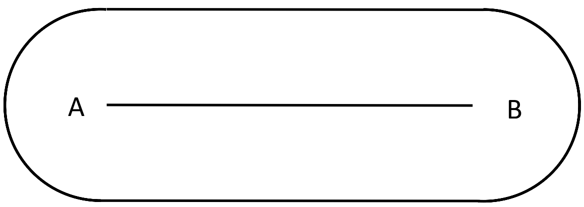
3. Explain that this is the last lesson on constructing loci. Today pupils will be constructing the set of points at a given distance from a given straight line.

Teaching and Learning *(20 minutes)*

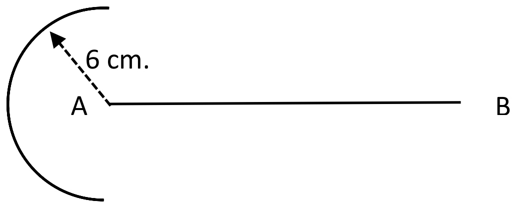
1. Draw a line of 15 cm on the board. Label the ends A and B, as shown:



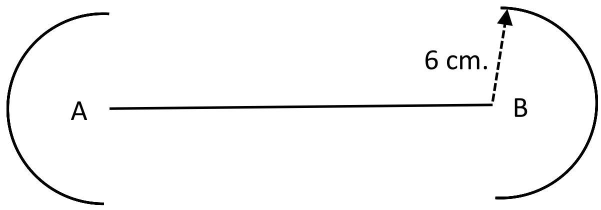
2. Explain:
   - We will construct the locus of points that is 6 cm from line segment AB.
   - A line segment is a line that has 2 ends. It does not stretch on forever, but has a specific length.
3. Discuss: How can we find points that are 6 cm away from this line?
4. Allow pupils to share their ideas, then explain: There are many points that are 6 cm from AB. These points are above the line, below the line, and to the right and left of it.
5. Draw a rough sketch around the line to show the **approximate** locus of points 6 cm from the line:



6. Explain: The locus of points equidistant to a line segment is a long shape that surrounds the line.
7. Erase the sketch of the locus, but leave the line. You will construct the locus on the same line.
8. Construct the locus on the board, explaining each step:
    m. Open your pair of compasses to a radius of 6 cm.
    n. With A as the centre, draw a semi-circle to the left of the line:

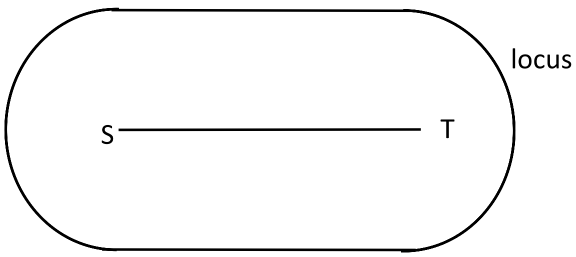


    o. With B as the centre, draw a semi-circle to the right of the line:

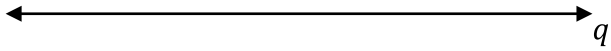


    p. Use a straight edge to connect the semi-circles above and below the line segment.

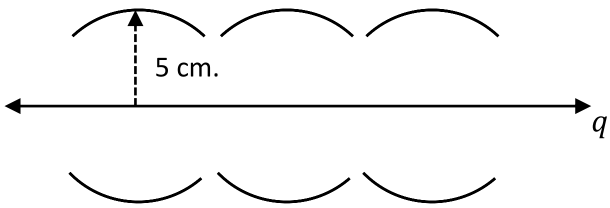
9. Explain:
    - This curved shape is 6 cm from line AB at every point.
    - Any point on either of these 2 lines is the same distance from AB and CD.
10. Write the following problem on the board: Draw line $\overline{ST} = 12$ cm. Construct the locus of a point P that is 8 cm from the line.
11. Ask volunteers to explain how to do the construction. As they explain each step, do the construction on the board:



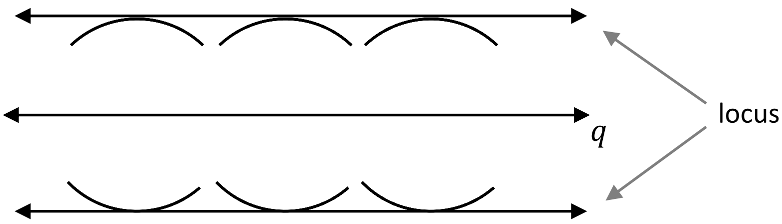
12. Write the following problem on the board: Construct the locus of point P if it is 5 cm from line q:



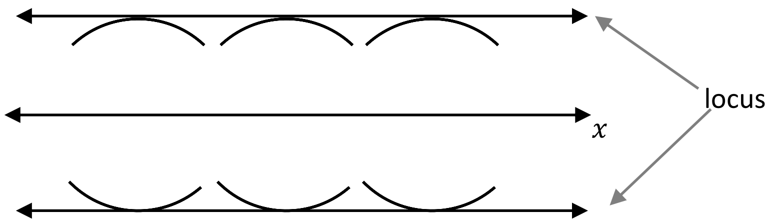
13. Discuss: Line q goes on forever in both directions. How do you think we can construct the locus?
14. Allow pupils to share their ideas, then explain:
    - We can construct the locus by drawing several arcs centred on line q with a radius of 5 cm. We simply need to open our pair of compasses to this radius.
    - We can construct a line above and a line below q.
    - The locus of points will be 2 lines that stretch on forever, because q is a line that stretches on forever.
15. Construct the locus of q on the board, explaining each step:
    a. Open your pair of compasses to a radius of 5 cm.
    b. Choose several points on q, and centre your compass at each. From each point, draw an arc directly above and below line q.



    c. Hold a straight edge along the points of the arcs farthest from line q. Connect these points.
    d. Draw arrows to show that the locus extends forever in both directions.



16. Write the following problem on the board: Draw a horizontal line x that extends forever in both directions. Construct the locus of points 4 cm from the line.
17. Ask pupils to work with seatmates to construct the locus.
18. Invite a group of seatmates to share their construction with the class and explain how they made it.
    Solution:

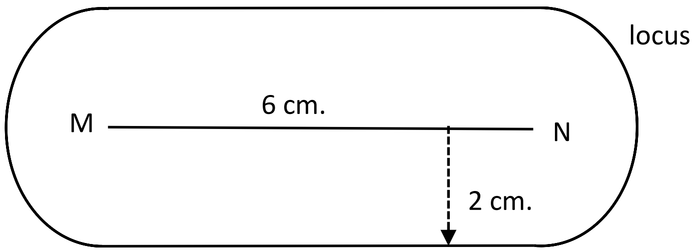


Practice *(12 minutes)*

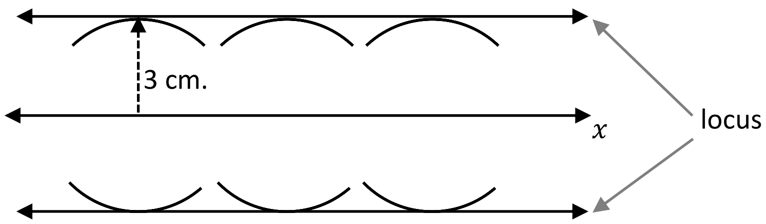
1. Write the following 2 problems on the board:
   a. Draw a line segment $\overline{MN} = 6\text{ cm}$. Construct the locus of points 2 cm from the line segment.
   b. Draw a horizontal line x that extends forever in both directions. Construct the locus of points 3 cm from the line.
2. Ask pupils to construct the loci independently in their exercise books. They may discuss with seatmates if needed.
3. Invite 2 volunteers to show their papers and explain how they constructed the loci. Allow discussion.

   Solutions:

   a.



   b.



Closing *(3 minutes)*

1. Discuss: Ask pupils to explain in their own words how to construct:
   a. The locus of points given a specified distance from a given line segment. (Answer: Open your compass to the given distance, center it on the ends of the segment, and draw semi-circles on either end. Connect the semi-circles with 2 lines.)
   b. The locus of points given a specified distance from a line that stretches on forever. (Answer: Open your compass to the given distance, and draw arcs above and below the line. Connect them to make the locus.)
2. For homework, have pupils do the practice activity PHM2-L095 in the Pupil Handbook.

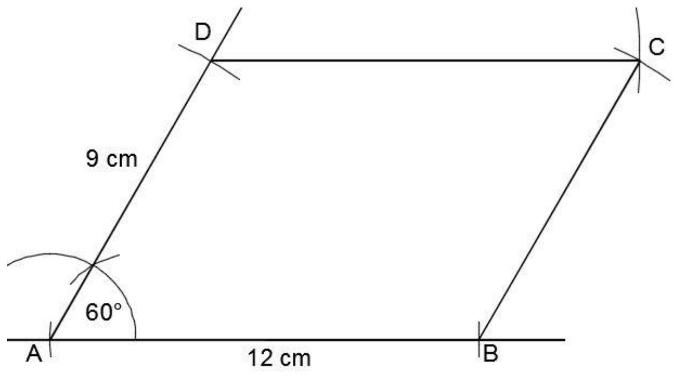
<table>
<tr><td>Lesson Title: Construction practice</td><td colspan="2">Theme: Geometry</td></tr>
<tr><td>Lesson Number: M2-L096</td><td>Class: SSS 2</td><td>Time: 40 minutes</td></tr>
<tr><td>Learning Outcome
By the end of the lesson, pupils will be able to apply construction techniques to construct various figures.</td><td colspan="2">Preparation
1. Write the problem in Opening on the board.
2. Bring a pair of compasses, a protractor, and ruler to class (purchased or handmade). Ask pupils to bring geometry sets if they already have them.</td></tr>
</table>

Opening *(2 minutes)*

1. Discuss: What are some things you know how to construct using a pair of compasses and a straight edge? (Example answers: angles, triangles, perpendicular lines, angle and line bisectors, quadrilaterals, loci.)
2. Explain that this is the last lesson on construction. Pupils will combine construction techniques from different lessons to construct various figures.

Teaching and Learning *(16 minutes)*

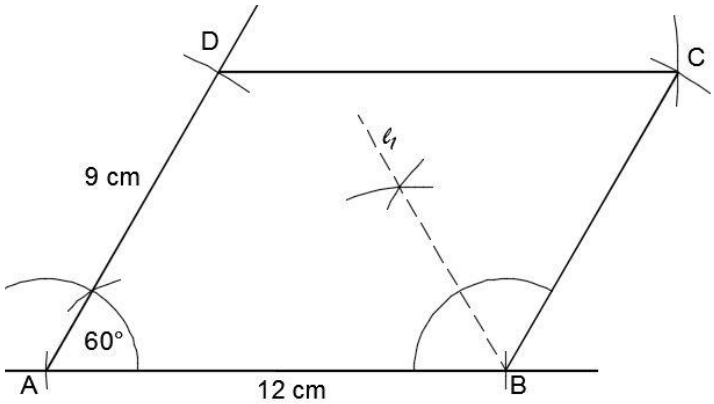
1. Write the following problem on the board: Using only a ruler and pair of compasses, construct:
   a. Parallelogram $ABCD$ such that $A = 60°$, $AB = 12$ cm, and $AD = 9$ cm.
   b. The locus l_1 of points equidistant from AB and BC.
   c. The locus l_2 of points equidistant from C and D.
2. Explain:
   - There are often questions of this style on the WASSCE exam. Pupils are asked to construct a shape such as a quadrilateral.
   - After constructing a shape, pupils are asked to construct loci. It is common that pupils are asked to construct the loci of points and lines on the same shape.
3. Ask pupils to work with seatmates to construct parallelogram $ABCD$. As they are working, construct the parallelogram shown below on the board (not shown to scale):



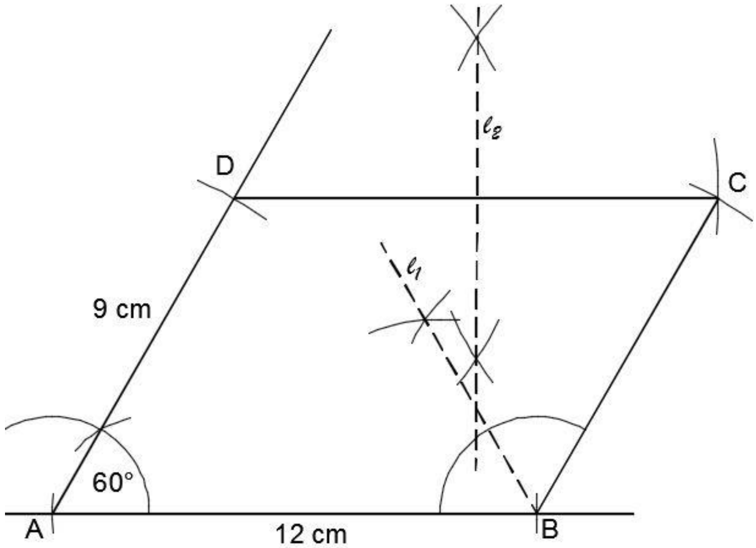
4. After pupils have drawn the parallelograms at their seats, discuss:

- How can we find locus l_1? (Answer: It is the locus of points equidistant from 2 **lines**, so we construct the **angle bisector**.)
- How can we find locus l_2? (Answer: It is the locus of points equidistant from 2 **points**, so we construct the **perpendicular bisector** of the line that connects them.)

5. Ask pupils to give the steps to construct l_1. As they give the steps, do the construction on the board:



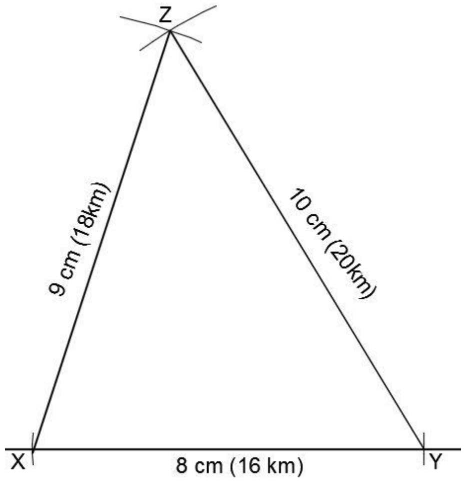
6. Ask pupils to give the steps to construct l_2. As they give the steps, do the construction on the board:



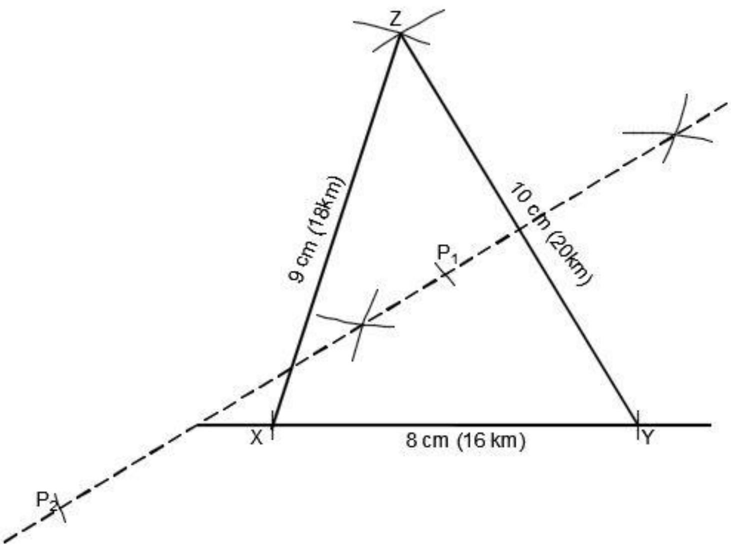
7. Ask pupils to work with seatmates to construct l_1 and l_2. Give them a few moments.
8. Write another problem on the board: Three towns, X, Y and Z are such that Y is 16 km from X and 20 km from Z. X is 18 km from Z. The government wants to build a secondary school so that pupils in towns Y and Z will travel the same distance to reach it, while pupils from town X will travel 10 km to reach it.
   a. Draw a map showing the 3 towns. Use a scale of 1 cm = 2 km.
   b. Identify the possible locations where the school could be built.
   c. Measure and record the distances of the possible locations from Z and Y.
   d. Which location would be most convenient for all 3 towns?
9. Discuss the problem with pupils:

- How will we draw a map of these villages? (Answer: They form a triangle, and we are given the 3 lengths.)
- How will we find the possible locations of the school? (Answer: It will be equidistant from points Y and Z, so we construct the loci of such points. We also know it's 10 km from X, so we open our compass to the correct radius and find the points on the locus that are 5 cm from X.)

10. Ask pupils to describe the triangle to be constructed. Draw a sketch on the board:
11. Ask pupils to construct the triangle with seatmates. As they are working, construct it on the board:



12. Ask pupils to work with seatmates to complete part b. of the question. Remind them of the steps:
    - Construct the locus of points equidistant from points Y and Z.
    - Find the points on the locus that are 5 cm (10 km) from town X.
13. As they are working, construct it on the board:



14. Label the 2 points on the locus that are 5 cm from X as P_1 and P_2.
15. Ask pupils to complete part c. with seatmates.
16. Invite volunteers to share the answers. (Answers: P_1 is around 5.5 cm from Y and Z, which is 11 km. P_2 is around 12.5 cm from Y and Z, which is 25 km.)

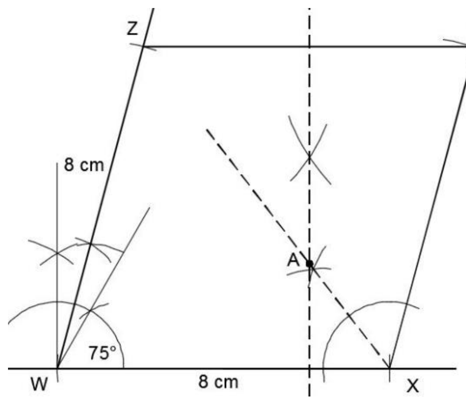
17. Discuss part d. of the question as a class: Which location is most convenient? (Answer: P_1 is most convenient because it is near all 3 towns. P_2 is only near town X.)

Practice *(20 minutes)*

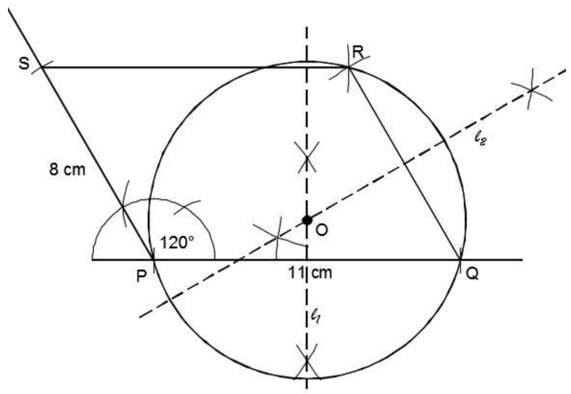
1. Write the following 2 problems on the board:
   - Using a ruler and pair of compasses only:
     i. Construct rhombus $WXYZ$ with sides 8 cm such that $W = 75°$.
     ii. Locate point A such that A lies on the locus of points equidistant from lines WX and XY, and is also equidistant from Z and Y.

   d. Using a ruler and pair of compasses only:
     i. Construct a parallelogram $PQRS$, such that $\angle P = 120°$, $\overline{PQ} = 11$ cm, and $\overline{PS} = 8$ cm.
     ii. Construct locus l_1 of points equidistant from P and Q.
     iii. Construct locus l_2 of points equidistant from Q and R.
     iv. Label the point where l_1 and l_2 intersect as O.
     v. With the centre at O and radius $\overline{OP}$, construct a circle.
2. Ask pupils to construct the loci independently in their exercise books. They may discuss with seatmates if needed.
3. Invite volunteers to show their papers and explain how they did the construction. Allow discussion.
4. Construct the solutions on the board if needed.
   Solutions:

a.



b.

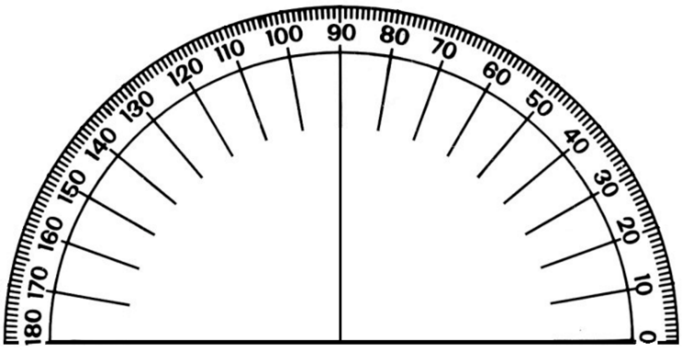


Closing *(2 minutes)*

1. Discuss: What are some real-life problems that could be solved with geometry construction? (Example answers: planning a town, deciding where to put resources such as a water pump or health clinic; planning and building a house.)
2. For homework, have pupils do the practice activity PHM2-L096 in the Pupil Handbook.

Appendix I: Protractor

You can use a protractor to measure angles. If you do not have a protractor, you can make one with paper. Trace this protractor with a pen onto another piece of paper. Then, cut out the semi-circle using scissors.



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