Grade 10 Mathematics Lesson Plan

Area of Segments

Strand:	**Measurement and Geometry**
Sub-Strand:	Area of a Part of a Circle: Area of a Segment of a Circle
Specific Learning Outcome:	Work out the area of a segment of a circle. Apply the area of a part of a circle in real-life situations. Explore the use of the area of a part of a circle in real-life situations.
Duration:	40 minutes
Key Inquiry Question:	How do we use the concept of the area of a part of a circle in real life?
Learning Resources:	CBC Grade 10 textbooks, compass, ruler, protractor, scientific calculator, worksheet with given radii and angles

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Discovering segments by drawing chords and measuring areas
Structured Instruction	10 minutes	Formalizing the segment formula and addressing misconceptions
Practice and Application	10 minutes	Worked examples and varied problems
Assessment	5 minutes	Exit ticket to check understanding

Phase 1: Problem-Solving and Discovery (15 minutes)

Anchor Activity: Discovering Segments

Objective: Students will discover the formula for finding the area of a segment by drawing circles with chords and exploring the relationship between sectors and triangles.

Materials Needed:

- A compass
- A ruler
- A protractor
- A scientific calculator
- A worksheet with given radii and angles

Steps for the Activity:

1. Step 1: Draw a Circle. Use a compass to draw a circle of radius r.
2. Step 2: Draw a Chord. Draw a chord across the circle using a ruler.
3. Step 3: Measure the Angle. Use a protractor to measure the angle subtended at the center by the chord. Shade the segment formed.
4. Step 4: Find the Area. Find the area of the segment part and record your results.
5. Step 5: Repeat with Different Angles. Perform the same process for different chords and angles (e.g., 70 degrees, 90 degrees, 120 degrees, 150 degrees).
6. Step 6: Discuss. Discuss your work with other learners in your class.

Discussion Questions:

7. What is a segment?
8. How is a segment different from a sector?
9. What shapes do you see in the segment?
10. How did you calculate the area of the segment?

Teacher Role During Discovery:

- Circulate among groups, ensuring students understand how to draw chords and measure angles accurately.
- Ask probing questions: What shapes do you see in the segment? How can we find the area of each shape?
- For struggling groups: Let us find the area of the sector first. Then find the area of the triangle. What do we do next?
- For early finishers: Can you write a general formula for finding the area of any segment?
- Guide students to articulate: The area of a segment equals the area of the sector minus the area of the triangle.
- Identify 2-3 groups with clear findings to share with the class.

Phase 2: Structured Instruction (10 minutes)

Formalizing the Segment Formula and Addressing Misconceptions

After students have completed the anchor activity and shared their findings, the teacher formalizes the formula for finding the area of a segment.

Key Takeaway: What is a Segment?

A segment is the region of a circle bounded by a chord and an arc.

Formula:

Area of a segment = Area of sector minus Area of triangle

Where:

- Area of sector = $(\theta / 360)$ times π r squared
- Area of triangle = $(1 / 2)$ a b sin θ
- θ is the angle subtended at the center in degrees
- r is the radius of the circle
- a and b are the two radii forming the triangle

Scaffolding Strategies to Address Misconceptions:

- Misconception: A segment is the same as a sector. Clarification: No, a segment is bounded by a chord and an arc, while a sector is bounded by two radii and an arc.
- Misconception: I add the area of the sector and the triangle. Clarification: No, you subtract the area of the triangle from the area of the sector.
- Misconception: I can use any triangle formula. Clarification: No, you must use the formula with sine because you know the two sides (radii) and the angle between them.
- Misconception: The angle in the triangle formula is different from the sector angle. Clarification: No, it is the same angle subtended at the center.

Phase 3: Practice and Application (10 minutes)

Worked Example 1:

A chord in a circle of radius 7 cm subtends an angle of 75 degrees at the center. Find the area of the segment.

Solution:

To find the area of the segment, find the area of the triangle and subtract from the area of the sector.

Area of sector:

A = (θ / 360) times π r squared

A = (75 / 360) times (22 / 7) times 7 squared

= (5 / 24) times (22 / 7) times 49

= 385 / 12

= 32.0833 cm squared

Area of triangle:

A = (1 / 2) a b sin θ

Where a = 7 cm and b = 7 cm

A = (1 / 2) times 7 times 7 times sin 75 degrees

= (1 / 2) times 49 times sin 75 degrees

= 23.6652 cm squared

Therefore:

A = 32.0833 cm squared minus 23.6652 cm squared

= 8.4181 cm squared

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually.

1. A circular table has a radius of 15 cm. A slice of cake is cut out, forming a 75 degree segment. Find the area of the cake slice not covered by the straight cut.

2. A wheel of a car has a radius of 30 cm. A mudguard covers a 60 degree segment of the wheel. Find the area of the covered segment.

Answer Key:

1. Area of sector = (75 / 360) times π times 15 squared = 147.26 cm squared. Area of triangle = (1 / 2) times 15 times 15 times sin 75 degrees = 108.72 cm squared. Area of segment = 147.26 minus 108.72 = 38.54 cm squared.

2. Area of sector = (60 / 360) times π times 30 squared = 471.24 cm squared. Area of triangle = (1 / 2) times 30 times 30 times sin 60 degrees = 389.71 cm squared. Area of segment = 471.24 minus 389.71 = 81.53 cm squared.

Differentiation Strategies

For Struggling Learners:

- Provide pre-drawn circles with chords already outlined.
- Use simpler angles for initial practice (e.g., 60 degrees, 90 degrees).
- Pair struggling students with confident problem solvers.
- Provide step-by-step calculation templates.
- Allow use of calculators for trigonometric functions.
- Break down the formula into steps: Find sector area, find triangle area, subtract.

For On-Level Learners:

- Encourage students to verify their formula with different angles.
- Ask students to explain the difference between a segment and a sector.
- Provide mixed practice with different types of segment problems.
- Challenge students to find both minor and major segments.

For Advanced Learners:

- Challenge students to derive the formula using coordinate geometry.
- Explore real-world applications: cake slices, mudguards, architectural designs.
- Investigate problems where the chord length is given instead of the angle.

- Apply the concept to find major segments using the circle area.
- Solve optimization problems involving segments.

Extension Activity

Real-World Application: Circular Park Walking Path Project

Work in groups

Situation: A circular park has a radius of 20 meters. A walking path cuts across the park, forming a chord that subtends an angle of 120 degrees at the center.

Tasks:

11. Draw a diagram of the circular park with the walking path.
12. Calculate the area of the segment formed by the walking path.
13. If the park authority wants to plant grass in the segment area, and grass costs Ksh 50 per square meter, calculate the total cost.
14. Calculate the area of the major segment (the rest of the park).
15. Present your findings with diagrams and calculations.

Key Takeaway:

Students should understand how the area of a segment is used in real-world contexts such as landscaping, architecture, food service (cake slices), automotive design (mudguards), and urban planning.

Teacher Reflection Prompts

- Did students successfully discover the segment formula through the anchor activity?
- Were students able to draw chords and measure angles accurately?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand the difference between a segment and a sector?
- What adjustments would improve this lesson for future classes?