Grade 10 Mathematics Lesson Plan

Area of Rhombuses

Strand:	Measurement and Geometry
Sub-Strand:	Area of Polygons: Area of Quadrilaterals
Specific Learning Outcome:	Determine the area of quadrilaterals in different situations. Explore the area of polygons as used in real-life situations.
Duration:	40 minutes
Key Inquiry Question:	How do we work out the area of polygons?
Learning Resources:	CBC Grade 10 textbooks, graph paper, rulers, protractors, pencils, scissors, string or thread, colored pencils

Lesson Structure Overview

Phase	Duration	Focus
Problem-Solving and Discovery	15 minutes	Anchor activity: Exploring properties of a rhombus through drawing and measurement
Structured Instruction	10 minutes	Formalizing the formula: Area = (1/2) x d1 x d2
Practice and Application	10 minutes	Worked examples using the formula
Assessment	5 minutes	Exit ticket to check understanding

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

Anchor Activity: Exploring Properties of a Rhombus

Students work in groups to draw a rhombus, measure its sides and angles, draw and measure its diagonals, and discover the properties of a rhombus including how the diagonals bisect each other at 90 degrees.

Materials Needed:

- Ruler
- Protractor

- Pencil
- Graph paper
- Scissors (optional)
- String or thread (optional)
- Colored pencils

Steps for the Activity:

1. Draw a Rhombus: Using a ruler, draw a quadrilateral with all sides equal in length. Make sure the opposite angles are equal. Label the vertices as A, B, C, D in order.
2. Measure the Sides: Using a ruler to confirm that all four sides are of equal length.
3. Measure the angles: Using a protractor to measure each of the interior angles. Observe: Opposite angles should be equal.
4. Draw the Diagonals: Draw diagonal AC and diagonal BD.
5. Measure their lengths and angles at the intersection point. Observe: Diagonals bisect each other at 90 degrees, and they are not equal.
6. Cut and Fold (Optional): Cut out the rhombus and fold it along both diagonals. Observe the symmetry and how the diagonals act as lines of symmetry.

Recording Table for Student Observations:

Side Length (cm)	Angle A (degrees)	Angle C (degrees)	Diagonal AC (cm)	Diagonal BD (cm)	Angle at Intersection (degrees)
____	___	___	___	___	___

Discussion Questions:

- What do you notice about the sides and angles of the rhombus?
- How do the diagonals interact with each other?
- What makes a rhombus different from a square or a general parallelogram?

Teacher Role During Discovery:

- Circulate among groups, ensuring students understand how to draw a rhombus with all sides equal.
- Ask probing questions: "What do you notice about the opposite angles?" "How do the diagonals intersect?"
- For struggling groups: "Let us draw the rhombus together. All four sides must be equal."

- For early finishers: "Can you find a formula for the area of a rhombus using the diagonals?"
- Guide students to articulate: "The diagonals bisect each other at 90 degrees."
- Identify 2-3 groups with clear observations to share with the class.

Discovery Table: Linking Observations to Mathematical Significance

Student Observation	Mathematical Significance
All four sides are equal in length	This is the defining property of a rhombus - it is an equilateral quadrilateral
Opposite angles are equal	This property is shared with parallelograms
Diagonals bisect each other at 90 degrees	This is a unique property of rhombuses - the diagonals are perpendicular
Diagonals are not equal	This distinguishes a rhombus from a square (where diagonals are equal)
Diagonals act as lines of symmetry	The rhombus has two lines of symmetry along its diagonals

Phase 2: Structured Instruction (10 minutes)

Formalizing the Formula: Area = (1/2) x d1 x d2

After students have completed the anchor activity and shared their findings, the teacher formalizes the area formula for rhombuses.

Key Takeaway:

A rhombus is an equilateral quadrilateral. All its sides are of equal length, but all its angles are not. All its sides are equal and the diagonals bisect at 90 degrees. Which other quadrilateral has all its sides equal?

Properties of a Rhombus:

- All sides are equal in length.
- Opposite angles are equal.
- Diagonals bisect each other at right angles.
- Diagonals bisect the interior angles.

Examples of a rhombus:

Tiles or patterns in flooring, or The shape of playing cards (diamonds suit).

Formula:

The area of a rhombus is given by:

Area = (1/2) x d1 x d2

where d1 and d2 are the lengths of the two diagonals.

Scaffolding Strategies to Address Misconceptions:

- Misconception: "I can use the side length to find the area directly." Clarification: "No, you need the diagonals to use the formula Area = (1/2) x d1 x d2."
- Misconception: "The diagonals are equal." Clarification: "No, in a rhombus the diagonals are not equal unless it is a square."
- Misconception: "I need to know all four sides to find the area." Clarification: "No, you only need the two diagonals."
- Misconception: "The area formula is the same as a parallelogram." Clarification: "No, for a rhombus we use the diagonals: Area = (1/2) x d1 x d2."

Phase 3: Practice and Application (10 minutes)

Worked Example (Textbook Example 2.5.7):

A rhombus has a diagonal of 10 cm and another diagonal of 24 cm. Find:

i) The area of the rhombus.

ii) The length of one side of the rhombus.

Solution:

i. One diagonal = 10 cm

Another diagonal = 24 cm

Area = (1/2) x d1 x d2

= (1/2) x 10 cm x 24 cm

= 120 cm^2

ii. Length of One Side of the Rhombus

In a rhombus, the diagonals bisect each other at 90 degrees. That means each side of the rhombus forms a right-angled triangle with half of each diagonal.

Let us find the length of one side using the Pythagorean Theorem.

Each side of the rhombus is the hypotenuse of a right triangle with legs:

- Half of AC = 10/2 = 5 cm

- Half of BD = 24/2 = 12 cm

Side = $\sqrt{[(5)^2 + (12)^2]}$

= √[25 + 144]

= √169

= 13 cm

The length of one side of the rhombus is 13 cm.

Phase 4: Assessment (5 minutes)

Exit Ticket:

Students complete the following questions individually.

1. A rhombus has diagonals measuring 16 cm and 30 cm. a) Find the area of the rhombus. b) Find the side length of the rhombus.

2. A diamond-shaped road sign is a rhombus with a diagonal of 40 cm and another diagonal of 60 cm. Find: (a) The area of the sign. (b) The length of one side of the sign.

3. The perimeter of a rhombus is 48 cm. Find the length of one side.

4. A car logo is shaped like a rhombus. The diagonals measure 14 cm and 10 cm. Find its area.

5. A rhombus has one of its angles measuring 60 degrees. Find the other three angles.

6. A tiling design on a floor is made of rhombus-shaped tiles. Each tile has diagonals of 18 cm and 24 cm. (a) Find the area of one tile. (b) If 20 such tiles cover a portion of the floor, what is the total area covered?

Answer Key:

1. a) Area = (1/2) x 16 x 30 = 240 cm^2. b) Half diagonals: 8 cm and 15 cm. Side = $\sqrt{(8^2 + 15^2)}$ = $\sqrt{(64 + 225)}$ = $\sqrt{289}$ = 17 cm.

2. (a) Area = (1/2) x 40 x 60 = 1200 cm^2. (b) Half diagonals: 20 cm and 30 cm. Side = $\sqrt{(20^2 + 30^2)}$ = $\sqrt{(400 + 900)}$ = $\sqrt{1300}$ = 36.06 cm.

3. Perimeter = 4 x side. Side = 48/4 = 12 cm.

4. Area = (1/2) x 14 x 10 = 70 cm^2.

5. In a rhombus, opposite angles are equal. If one angle is 60 degrees, the opposite angle is also 60 degrees. The other two angles are equal and sum to 360 - 120 = 240 degrees. Each is 240/2 = 120 degrees. Angles: 60°, 120°, 60°, 120°.

6. (a) Area = (1/2) x 18 x 24 = 216 cm^2. (b) Total area = 20 x 216 = 4320 cm^2.

Differentiation Strategies

For Struggling Learners:

- Provide pre-drawn rhombuses with diagonals already marked.
- Use simpler numbers for diagonal lengths.
- Pair struggling students with confident problem solvers.
- Provide step-by-step calculation templates.
- Allow use of calculators.

For On-Level Learners:

- Encourage students to draw their own rhombuses from word problems.
- Ask students to explain which formula they chose and why.
- Provide mixed practice with both finding area and finding side lengths.

For Advanced Learners:

- Challenge students to derive the formula themselves using the properties of diagonals.
- Explore real-world applications: architecture, design, tiling patterns.
- Investigate the relationship between the area of a rhombus and the area of a square.
- Apply the formula to find missing diagonal lengths when area is known.

Extension Activity

Real-World Application: Designing Rhombus-Shaped Patterns

Students work in groups to design a rhombus-shaped pattern (tiling, logo, playing card design) and calculate its area.

Materials: Graph paper, rulers, protractors, calculators, colored pencils

Tasks:

7. Choose a real-world application that uses rhombus shapes (floor tiles, logo, playing card, etc.).
8. Draw the rhombus on graph paper with appropriate dimensions.
9. Measure or specify the lengths of both diagonals.
10. Calculate the area using the formula Area = (1/2) x d1 x d2.
11. If needed, calculate the side length using the Pythagorean theorem.
12. Present your findings to the class, explaining your design choices and calculations.

Key Takeaway:

Students should understand how the area formula for rhombuses is used in real-world professions such as interior design, architecture, and graphic design to calculate areas of decorative patterns, tiles, and logos.

Teacher Reflection Prompts

- Did students successfully draw the rhombus and measure the diagonals in the anchor activity?
- Were students able to discover that the diagonals bisect each other at 90 degrees?
- What misconceptions emerged during the lesson, and how were they addressed?
- Did students understand when to use the diagonal formula versus the Pythagorean theorem?
- What adjustments would improve this lesson for future classes?