I. Lesson Overview

Lesson Title:	Quadratic Identities
Strand:	Numbers and Algebra
Sub-Strand:	Quadratic Expressions and Equations 1
Grade Level:	10
Estimated Duration:	40 minutes

Key Inquiry Question

How do we apply the concept of quadratic equations?

II. Learning Objectives & Standards

Learning Objectives

Upon completion of this lesson, students will be able to:

1. **Know (Conceptual Understanding):** Understand what quadratic identities are and recognize the three key identities: $(a+b)^2$, $(a-b)^2$, and $(a-b)(a+b)$.
2. **Do (Procedural Skill):** Derive and apply quadratic identities to expand and factor quadratic expressions.
3. **Apply (Application/Problem-Solving):** Use quadratic identities to simplify expressions and solve problems more efficiently.

Curriculum Alignment

Strand:	Numbers and Algebra
Sub-Strand:	Quadratic Expressions and Equations 1
Specific Learning Outcome:	Derive the quadratic identities from the concept of area.

III. Materials & Resources

Textbooks:	CBC Grade 10 Mathematics Learner's Book CBC Grade 10 Mathematics Teacher's Book

IV. Lesson Procedure

Phase 1: Problem-Solving and Discovery / Engage & Explore (15 minutes)

Objective: To explore quadratic identities through collaborative discussion and discovery.

Anchor Activity: Exploring Quadratic Identities

Form groups of at least 4 individuals.

Part 1: Define and Discuss

In your groups, define and discuss the following terms:

1. Quadratic identities

2. Difference of squares

3. Perfect squares

4. Factorization of quadratic expressions

Part 2: Observe and Discuss

Copy the following expressions and identities, observe and discuss:

(i) $(a + b)^2 = a^2 + 2ab + b^2$

(ii) $(a - b)^2 = a^2 - 2ab + b^2$

(iii) $(a - b)(a + b) = a^2 - b^2$ (Difference of squares)

Discussion Questions:

- Compare the different approaches groups used to solve similar problems.
- Discuss how quadratic identities can make simplification and factoring easier.
- Explore how these identities are useful in different contexts (e.g., solving quadratic equations, simplifying expressions in algebra).
- How do the identities help us solve quadratic expressions faster?
- What happens if we don't recognize the identity right away—how might that slow us down?
- Can you think of any real-world applications where you might use quadratic identities?

What is an Identity?

An equation P = Q is called an identity if:

1. Both sides of the equality contain some variables.

2. Both sides give the same value when the variable is substituted with a particular constant.

Teacher's Role: The teacher circulates among groups, asking probing questions (e.g., "Can you verify that $(a+b)^2 = a^2 + 2ab + b^2$ by expanding?", "What pattern do you see?", "How is the difference of squares different from perfect squares?"). The teacher uses student discoveries to bridge to formal instruction.

Phase 2: Structured Instruction / Explain (10 minutes)

Objective: To formalize the three key quadratic identities and their applications.

Key Takeaways:

What are Quadratic Identities?

Quadratic identities are special rules or formulas that help us work with quadratic expressions. They simplify calculations and make factoring easier.

The Three Essential Quadratic Identities:

Identity	Formula	Name
1	$(a + b)^2 = a^2 + 2ab + b^2$	Perfect Square (Sum)
2	$(a - b)^2 = a^2 - 2ab + b^2$	Perfect Square (Difference)
3	$(a + b)(a - b) = a^2 - b^2$	Difference of Squares

The Difference of Squares:

This identity applies when you have two terms that are perfect squares being subtracted:

$$\mathbf{a^2 - b^2 = (a - b)(a + b)}$$

The difference between two squares can be factored into the product of two binomials: one where the terms are subtracted $(a - b)$ and one where the terms are added $(a + b)$.

Perfect Square Identities:

When squaring a binomial:

- $(a + b)^2 = a^2 + 2ab + b^2$ (the middle term is POSITIVE)
- $(a - b)^2 = a^2 - 2ab + b^2$ (the middle term is NEGATIVE)

Addressing Misconceptions: "Remember: $(a + b)^2 \neq a^2 + b^2$. You MUST include the middle term 2ab! The middle term is twice the product of the two terms."

Phase 3: Practice and Application / Elaborate (15 minutes)

Objective: To apply quadratic identities to factor and simplify expressions.

Worked Example: Factoring Using Difference of Squares

Factor: $x^2 - 16$

Solution:

Step 1: Recognize this is a difference of squares $(a^2 - b^2)$

- $a^2 = x^2$, so $a = x$
- $b^2 = 16$, so $b = 4$

Step 2: Rewrite in the form $a^2 - b^2$

$x^2 - 16 = x^2 - 4^2$

Step 3: Apply the identity $a^2 - b^2 = (a - b)(a + b)$

$x^2 - 16 = (x - 4)(x + 4)$

More Examples:

1. Factor: $9y^2 - 25$

$= (3y)^2 - 5^2$

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

2. Expand: $(2x + 3)^2$

$= (2x)^2 + 2(2x)(3) + 3^2$

$= 4x^2 + 12x + 9$

3. Factor: $x^2 - 10x + 25$

$= x^2 - 2(x)(5) + 5^2$

$= (x - 5)^2$

Teacher's Role: The teacher monitors students, emphasizing pattern recognition: "Look for perfect squares!" and "Check: is the middle term twice the product?"

Phase 4: Assessment / Evaluate (Exit Ticket)

Objective: To formatively assess individual student understanding.

Exit Ticket Questions:

1. Factor the following using the difference of squares:

a) $x^2 - 49$

b) $4a^2 - 9$

c) $25m^2 - 36n^2$

2. Expand using the perfect square identity:

a) $(x + 7)^2$

b) $(3y - 2)^2$

3. Factor the perfect square trinomial:

a) $x^2 + 6x + 9$

b) $4y^2 - 20y + 25$

4. Which identity would you use to simplify $49 - x^2$? Explain.

5. A square garden has sides of length $(x + 5)$ meters. Write an expression for the area of the garden in expanded form.

Answer Key:

1. a) $x^2 - 49 = (x - 7)(x + 7)$

b) $4a^2 - 9 = (2a - 3)(2a + 3)$

c) $25m^2 - 36n^2 = (5m - 6n)(5m + 6n)$

2. a) $(x + 7)^2 = x^2 + 14x + 49$

b) $(3y - 2)^2 = 9y^2 - 12y + 4$

3. a) $x^2 + 6x + 9 = (x + 3)^2$

b) $4y^2 - 20y + 25 = (2y - 5)^2$

4. Difference of squares: $49 - x^2 = 7^2 - x^2 = (7 - x)(7 + x)$

5. Area = $(x + 5)^2 = x^2 + 10x + 25$ square meters

V. Differentiation

Student Group	**Strategy & Activity**
Struggling Learners (Support)	Scaffolding: Provide identity reference cards. Use color coding to highlight a, b, and the middle term. Start with numerical examples (e.g., $5^2 - 3^2 = 25 - 9 = 16 = (5-3)(5+3) = 2\times8 = 16$). Allow peer support.
On-Level Learners (Core)	The core lesson activities as described above.
Advanced Learners (Challenge)	Extension Activity: 1) Factor $x^4 - 16$ completely. 2) Prove that $(a+b)^2 - (a-b)^2 = 4ab$. 3) Use the difference of squares to

	calculate 51 × 49 mentally. 4) Derive the identity for $(a+b+c)^2$.

Extension Activity Solutions:

1. $x^4 - 16 = (x^2)^2 - 4^2 = (x^2 - 4)(x^2 + 4) = (x - 2)(x + 2)(x^2 + 4)$

2. $(a+b)^2 - (a-b)^2 = (a^2 + 2ab + b^2) - (a^2 - 2ab + b^2) = 4ab$

3. $51 \times 49 = (50 + 1)(50 - 1) = 50^2 - 1^2 = 2500 - 1 = 2499$

4. $(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ac$

VI. Assessment

Type	Method	Purpose
Formative (During Lesson)	- Observation during group discussion - Questioning during exploration - Exit Ticket	To monitor progress and adjust instruction.
Summative (After Lesson)	- Homework assignment - Future quiz/test questions	To evaluate mastery of learning objectives.

Teacher's Role: Collect and review the exit tickets to gauge student understanding and identify any common misconceptions that need to be addressed in the next lesson.

VII. Teacher Reflection

To be completed after the lesson.

1. What went well?

2. What would I change?

3. Student Understanding: What did the exit tickets reveal?

4. Next Steps: Based on assessment data, what is the plan for the next lesson?