Step by step guide: Quadratic Expressions

Grade 10 Mathematics | 40-Minute Lesson

Before Class Begins

Preparation Checklist:

- Write example quadratic expressions on the board for each group
- Prepare exit tickets for distribution
- Set timer for phase transitions
- Have the standard form $ax^2 + bx + c$ ready to display
- Prepare worked example on a separate board section (covered until Phase 3)

PHASE 1: Problem-Solving and Discovery (15 Minutes)

Opening (2 minutes)

[SAY]:

"Good morning/afternoon, class! Today we're going to explore quadratic expressions—one of the most important types of algebraic expressions in mathematics. Quadratic expressions appear everywhere: in physics, engineering, economics, and even in the path of a thrown ball!"

[SAY]:

"Here's our key question: How do we apply the concept of quadratic equations? Let's start by exploring some examples."

Anchor Activity Introduction (2 minutes)

[ASSIGN groups and point to expressions on board]:

[SAY]:

"Each group has been assigned a quadratic expression:
• Group 1: $2x^2 + 5x - 3$
• Group 2: $3x^2 - 4x + 1$

• *Group 3: $x^2 + 6x + 9$*
• *Group 4: $4x^2 - 9$"*

Group Work Instructions (1 minute)

[SAY - Read slowly and clearly]:

"In your groups, I want you to:
1. Identify and label the terms: quadratic term, linear term, constant term
2. Identify the coefficients (the numbers in front of x^2 and x)
3. Discuss: Is the expression in standard form?
4. Prepare to present your findings to the class

You have 8 minutes. Begin!"

Circulation and Probing (6 minutes)

[DO]: Walk around the room, observing how students analyze the expressions.

[ASK probing questions as you circulate]:

- "Which term has x^2? What do we call that term?"
- "What is the coefficient of x^2? What letter represents it?"
- "What is the coefficient of x? What letter represents it?"
- "What is the constant term? What letter represents it?"
- "What would happen if the coefficient of x^2 was zero?"

[TIME CHECK]: At 6 minutes, announce: "Two more minutes to prepare your presentations!"

Group Presentations (4 minutes)

[SAY]:

"Time's up! Let's hear from each group. Keep it brief—tell us the three terms and their coefficients."

[CALL each group - about 1 minute each]:

[Expected answers]:

• Group 1 ($2x^2 + 5x - 3$): Quadratic term = $2x^2$, Linear term = $5x$, Constant = -3

• Group 2 ($3x^2 - 4x + 1$): Quadratic term = $3x^2$, Linear term = $-4x$, Constant = 1

• Group 3 ($x^2 + 6x + 9$): Quadratic term = x^2, Linear term = $6x$, Constant = 9

• Group 4 ($4x^2 - 9$): Quadratic term = $4x^2$, Linear term = $0x$, Constant = -9

[TRANSITION]:

"Excellent work! Now let me formalize what you've discovered and show you how to form quadratic expressions."

PHASE 2: Structured Instruction (10 Minutes)

Definition and Structure (5 minutes)

[WRITE on board]:

QUADRATIC EXPRESSION: $ax^2 + bx + c$

[SAY]:

"A quadratic expression has the form $ax^2 + bx + c$, where:
• a, b, and c are constants (real numbers)
• x is the variable
• $a \neq 0$ (IMPORTANT: if a = 0, it's not quadratic!)"

[WRITE and SAY]:

"The three parts are:
• ax^2 = Quadratic term (the term with x squared)
• bx = Linear term (the term with x to the first power)
• c = Constant term (the number without x)"

Types of Expressions (2 minutes)

[SAY]:

"Before we learn to form quadratic expressions, let's review some vocabulary:

• Monomial: An expression with ONE term (e.g., 3x, y^2, 5, 2a)
• Binomial: An expression with TWO terms (e.g., (a + b), (x − 3), (2x + 1))"

Forming Quadratic Expressions (3 minutes)

[SAY]:

"Quadratic expressions can be formed by:
1. Multiplying a monomial by a binomial
2. Multiplying two binomials

We use the DISTRIBUTIVE PROPERTY: a(b + c) = ab + ac"

[SAY - IMPORTANT]:

"When distributing a NEGATIVE sign, remember it changes the sign of EVERY term inside the bracket!

$-3(a^2 - 1) = (-3)(a^2) + (-3)(-1) = -3a^2 + 3$"

[TRANSITION]:

"Now let's practice forming quadratic expressions!"

PHASE 3: Practice and Application (15 Minutes)

Worked Example (5 minutes)

[SAY]:

"Let me show you how to form a quadratic expression step by step."

[WRITE on board]:

"Simplify: $2a(a - 1) - 3(a^2 - 1)$"

[SAY while writing each step]:

"Step 1: Identify the monomials and binomials
- *Monomials: $2a$ and -3*
- *Binomials: $(a - 1)$ and $(a^2 - 1)$*

Step 2: Apply the distributive property to each part
$2a(a - 1) = 2a(a) + 2a(-1) = 2a^2 - 2a$
$-3(a^2 - 1) = (-3)(a^2) + (-3)(-1) = -3a^2 + 3$

Step 3: Combine all terms
$= 2a^2 - 2a - 3a^2 + 3$

Step 4: Collect like terms
$= (2a^2 - 3a^2) + (-2a) + 3$
$= -a^2 - 2a + 3$"

[ASK]:

"Is this a quadratic expression? What are a, b, and c?"

[Expected answer]: "Yes! a = -1, b = -2, c = 3"

Guided Practice (5 minutes)

[SAY]:

"Now try this one with your partner: $3x(x + 2) - 4(x^2 - 1)$"

[GIVE 3 minutes, then solve together]:

"$3x(x + 2) = 3x^2 + 6x$
$-4(x^2 - 1) = -4x^2 + 4$
Combined: $3x^2 + 6x - 4x^2 + 4$
Simplified: $-x^2 + 6x + 4$"

Independent Practice (5 minutes)

[SAY]:

"Now try these on your own:
a) $8n(n + 5) - 3(n^2 - 6)$
b) $4p(p - 1) - 5(p^2 + 2)$"

[GIVE 4 minutes, then quickly check answers]:

"a) $8n^2 + 40n - 3n^2 + 18 = 5n^2 + 40n + 18$
b) $4p^2 - 4p - 5p^2 - 10 = -p^2 - 4p - 10$"

[TRANSITION]:

"Now I want to see what each of you has learned."

PHASE 4: Assessment / Checkpoint (8 Minutes)

Independent Work (5 minutes)

[DISPLAY questions]:

"Form a quadratic expression by simplifying:

1. $7a(a + 3) - 2(a^2 - 2)$

2. $5a(a - 3) - 2(a^2 + 4)$"

[SAY]:

"You have 5 minutes. Begin."

Collection and Closure (2 minutes)

[SAY]:

"Time's up. Please pass your exit tickets forward."

[COLLECT all tickets]

[SAY]:

"Today you learned:
• A quadratic expression has the form $ax^2 + bx + c$
• It has three parts: quadratic term, linear term, and constant
• We can form quadratic expressions by multiplying and collecting like terms
• Always be careful with negative signs when distributing!"

[SAY]:

"Great work today! For homework, complete the remaining problems from the assessment sheet."

Differentiation Notes

For Struggling Learners:

- Provide step-by-step templates showing the distribution process
- Start with simpler expressions (one monomial × one binomial)
- Use color coding to track positive and negative terms
- Allow peer support during practice

For Advanced Learners:

[GIVE these extensions]:

- Simplify: $2m - 2(m - 1)^2$
- Simplify: $(x + 2)(x - 3) + x(x + 1)$
- Create a real-world problem that results in a quadratic expression

Answer Key

Exit Ticket Answers:

1. $7a(a + 3) - 2(a^2 - 2)$:

$= 7a^2 + 21a - 2a^2 + 4$

$= 5a^2 + 21a + 4$

2. $5a(a - 3) - 2(a^2 + 4)$:

$= 5a^2 - 15a - 2a^2 - 8$

$= 3a^2 - 15a - 8$

Additional Assessment Answers:

$3m(m - 2) - 6(m^2 + 1) = 3m^2 - 6m - 6m^2 - 6 = -3m^2 - 6m - 6$

$9x(x + 3) - 4(x^2 - 4) = 9x^2 + 27x - 4x^2 + 16 = 5x^2 + 27x + 16$

$2y(y - 1) - 3(y^2 + 2) = 2y^2 - 2y - 3y^2 - 6 = -y^2 - 2y - 6$

$2b(b + 4) - 3(b^2 - 2) = 2b^2 + 8b - 3b^2 + 6 = -b^2 + 8b + 6$

$5q(q + 4) - 2(q^2 - 3) = 5q^2 + 20q - 2q^2 + 6 = 3q^2 + 20q + 6$

Post-Lesson Reflection Prompts

1. What went well? Did students correctly identify the parts of a quadratic expression?

2. What would I change? Was enough time given for the worked example?

3. Student Understanding: Did students struggle with distributing negative signs?

4. Next Steps: Which students need more practice with collecting like terms?