

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]:

$$3x(x + 2) = 3x^2 + 6x$$

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

$$\text{Combined: } 3x^2 + 6x - 4x^2 + 4$$

$$\text{Simplified: } -x^2 + 6x + 4$$

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)

Checkpoint exploration (5 minutes)

[DO] Project the digital textbook on the screen. Navigate to the "Checkpoint" section.

[SAY] "This is our digital mathematics textbook. It has something special called checkpoints. Watch what happens when I click this button..."

[DO] Click "Show new example question" on Checkpoint

[SAY] "See? A new number appeared! And if I click again..."

[DO] Click the button again to show randomization

[SAY] "A different number! This means you can practice with hundreds of different examples. The computer never runs out of problems to give you."

[SAY] "Now it's your turn. With your partner, open the digital textbook and find the checkpoint.

[SAY] Click "Show new example question" to load the problem

[SAY] Solve the displayed question

[SAY] Click "submit" to check your answer

[SAY] If incorrect, carefully read the feedback and analyse the error before trying a new question. The immediate feedback from checkpoint submissions allows students to identify and correct errors in real-time.

[SAY] Complete at least 5 questions

[DO] Circulate among pairs. Ask probing questions, for example, what patterns do you notice?

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?