# 5.2 Change Quadratic Relations From Vertex Form to Standard Form

**Student Text Pages**
242–247

**Suggested Timing**
80 min

**Tools**
- graphing calculators
- grid paper

**Related Resources**
BLM 5-4 Section 5.2 Change Quadratic Relations From Vertex Form to Standard Form
BLM 5-5 Section 5.2 Achievement Check Rubric
BLM G-3 Four Quadrant Grids

## Link to Prerequisite Skills

Students should complete questions 1 to 3 before proceeding with this section.

### Warm-Up

**1.** Expand.

**a)** $(3x + 4)(2x + 9)$ **b)** $(7x - 4)(5x - 1)$ **c)** $(4x + 3)^2$

**Warm-Up Answers**

**1. a)** $6x^2 + 35x + 36$ **b)** $35x^2 - 27x + 4$ **c)** $16x^2 + 24x + 9$

## Teaching Suggestions

### Warm-Up

- Write the Warm-Up questions on the board or on an overhead. Have students complete the questions independently. Then, discuss the solutions as a class.

### Investigate

- Have students work in pairs to complete the Investigate.
- Ensure students recognize that each pair of equations represent the same quadratic relation.
- Students should also recognize that the $a$-value is the same in equations that represent the same quadratic relation.

**Investigate Answers (page 242)**

**1.** The relations in each pair give the same parabola. The equations are different forms of the same quadratic relation.

**2.** The expanded form of the first relation is the same as the second relation in each pair.

**3. a)** vertex: (2, 1); $y$-intercept: 5 **b)** vertex: (–5, 3); $y$-intercept: 28

**c)** vertex: (–1, –4); $y$-intercept: –5 **d)** vertex: (4, 3); $y$-intercept: 11

In the first relation in each pair, the $x$-coordinate of the vertex is the opposite of the constant term in the brackets and the $y$-coordinate of the vertex is the constant term outside the brackets. In the second relation in each pair, the y-intercept is the constant term.

**4.** The first relation in each pair is written in vertex form. The second relation in each pair is written in standard form.

**5.** Given a quadratic relation in standard form, $y = ax^2 + bx + c$, the $y$-intercept is $c$. Given a quadratic relation in vertex form, $y = a(x - h)^2 + k$, the coordinates of the vertex are $(h, k)$.

### Examples

- Have students work through the Examples as a class before proceeding to the Discuss the Concepts. Alternatively, have students complete the Examples independently or in small groups before reviewing them as a class.

- For Example 1, you may wish to have graphing calculators or computers with graphing software available so students can see that the equations in standard form represent the same parabola as the equations in vertex form.
- In Example 2, remind students that the $a$-values are the same in both forms of the relation. You may also want to reassure students that it is not uncommon for real life problems to have decimals in them. Remind students that the initial height occurs when $x = 0$.
- Tell students that, in terms of changing forms, they should square the binomial first, then multiply the $a$-value, then simplify.

### Key Concepts

- Review the Key Concepts and suggest that the students write them in their notebooks and highlight the different forms of a quadratic relation.

### Discuss the Concepts

- Have students discuss these questions in small groups and take them up as a class before assigning the exercises.

**Discuss the Concepts Suggested Answers (page 244)**

**D1.** A quadratic relation written in standard form gives information about its $y$-intercept, while a quadratic relation written in vertex form gives information about its vertex and the minimum or maximum value.

**D2.** Square the binomial, multiply the result by –6, then add 15 and simplify to get $y = -6x^2 + 120x - 585$.

### Practise (A)

- Note that the equations become increasingly complex as you progress from **question 1** to **question 4**.
- For **question 5**, ask students to predict which relations they think will be the same before they graph them. Students may use technology to graph the relations or graph by hand. If they graph by hand, distribute copies of **BLM G-3 Four Quadrant Grids**.

### Apply (B)

- **Question 9** is a Literacy Connect. You may wish to assign this question as a journal entry or to discuss the question as a class. Literacy Connect questions offer the opportunity to explore literacy issues in the mathematics classroom and within the context of mathematics.
- **Question 11** links to the Chapter Problem. Remind students to keep the solution to this question handy as the methods they used may help them with the Chapter Problem Wrap-Up.
- **Question 12** is an Achievement Check question. It can be used as a diagnostic or formative assessment, or assigned as a small summative assessment piece. You may wish to use **BLM 5-5 Section 5.2 Achievement Check Rubric** to assist you in assessing your students. This question is based on a conversation between the physicist Richard Feynman and Hans Bethe while working on the Manhattan Project. It was chronicled it the book "Surely You're Joking Mr. Feynman".

## Common Errors

- Some students may multiply the $a$-value into the brackets of the vertex form before expanding.

$R_x$ Have student remember the order of operations when converting quadratic relations from vertex form to standard form.

## Accommodations

**Memory**—display standard form and vertex form on the word wall with examples of each

**Spatial**—help students prepare a set of numbered index cards with the steps for writing a quadratic equation in standard form

**Perceptual**—allow students to use software that graphs several relations in different colours

**Achievement Check Answers (page 247)**

**12. a)** $56^2 = (50 + 6)(50 + 6)$
$= 2500 + 600 + 36$
$= 3136$
$48^2 = (50 - 2)(50 - 2)$
$= 2500 - 200 + 4$
$= 2304$

**b)** Explanations may vary. $(50 - x)^2 = 2500 - 100x + x^2$

**c)** This pattern works for any whole number, $n$, because the square $(n - x)^2$ is the same as the expanded trinomial $n^2 - nx + x^2$.

## Extend (C)

- Assign the Extend question to students who are not being challenged by the Apply questions.
- In **question 13**, students might be intimidated by the apparent complexity of the equation. Encourage them to follow the instructions to help simplify the process. Another extension for this question would be to ask when the rider lands.

## Mathematical Process Expectations

| Process Expectation | Questions |
|---|---|
| Problem Solving | 8, 10, 11, 13 |
| Reasoning and Proving | 6, 10, 11, 12 |
| Reflecting | 8, 12, 14 |
| Selecting Tools and Computational Strategies | 1–4, 6–8, 10–14 |
| Connecting | 13, 14 |
| Representing | 5, 8, 10, 14 |
| Communicating | 9, 12, 14 |

## Ongoing Assessment

- You may wish to collect students' responses to the Discuss the Concepts questions to use as a formative assessment tool.

## Extra Practice

- You may wish to use **BLM 5-4 Section 5.2 Change Quadratic Relations From Vertex Form to Standard Form** for remediation or extra practice.