

### FREQUENTLY ASKED Questions

**Q:** What are the key properties of a quadratic relation?

**A:** The key properties are:

- In a table of values, the second differences are constant and not zero.
- The degree of the equation that represents the relation is 2.
- The graph has a U shape, which is called a parabola.
- Every parabola has a vertex that is the highest or lowest point on the curve.
- Every parabola has an axis of symmetry that passes through its vertex.

**Q:** What information can you easily determine from the factored and standard forms of a quadratic relation?

**A:** From the standard form  $y = ax^2 + bx + c$ , you can determine the  $y$ -intercept, which is  $c$ .

From the factored form  $y = a(x - r)(x - s)$ , you can determine

- the zeros, or  $x$ -intercepts, which are  $r$  and  $s$
- the equation of the axis of symmetry, which is  $x = \frac{r + s}{2}$
- the coordinates of the vertex, by substituting the value of the axis of symmetry for  $x$  in the relation
- the  $y$ -intercept, which is  $a \times r \times s$

From both forms, you can determine the direction in which the parabola opens: upward when  $a > 0$  and downward when  $a < 0$ .

**Q:** If you are given information about a quadratic relation, how can you determine the equation?

**A:** If the graph has zeros, these can be used to write the equation of the quadratic relation in factored form. Then you can use a different point on the parabola to determine the coefficient  $a$ .

#### EXAMPLE

The points  $(-2, 0)$  and  $(3, 0)$  are the zeros of a parabola that passes through  $(4, 12)$ . Determine an equation for the quadratic relation.

#### Solution

Use the zeros to write the equation  $y = a(x + 2)(x - 3)$ . Substitute the coordinates of the point  $(4, 12)$  into the equation to determine the coefficient  $a$ .

$$12 = a(4 + 2)(4 - 3)$$

$$12 = a(6)(1)$$

$$2 = a$$

An equation for the quadratic relation is  $y = 2(x + 2)(x - 3)$ .

#### Study Aid

- See Lesson 3.1 and Lesson 3.2, Examples 1 to 4.
- Try Mid-Chapter Review Questions 1 and 2.

#### Study Aid

- See Lesson 3.2, Example 2, and Lesson 3.3, Examples 1 to 3.
- Try Mid-Chapter Review Questions 3 to 7.

#### Study Aid

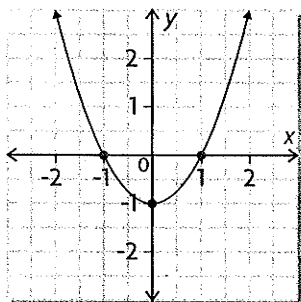
- See Lesson 3.3, Example 4.
- Try Mid-Chapter Review Questions 8 to 10.

## PRACTICE Questions

### Lesson 3.1

1. State whether each relation is quadratic. Justify your answer.

a)



b)  $y = 5x^2 + 3x - 1$

c)

$x$	0	1	2	3	4	5
$y$	3	2	1	0	1	2

2. Each table of values represents a quadratic relation. Decide, without graphing, whether the parabola opens upward or downward.

a)

$x$	-2	-1	0	1	2
$y$	0	-5	0	15	40

b)

$x$	-2	-1	0	1	2
$y$	-3	3	5	3	-3

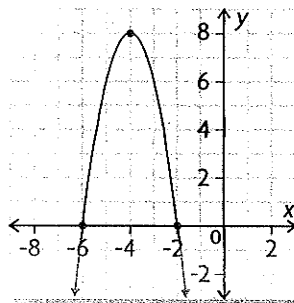
### Lesson 3.2

3. Graph  $y = -x^2 + 6x$  to determine
- the equation of the axis of symmetry
  - the coordinates of the vertex
  - the  $y$ -intercept
  - the zeros
4. The points  $(-3, 8)$  and  $(9, 8)$  lie on opposite sides of a parabola. Determine the equation of the axis of symmetry.
5. Use a graphing calculator to graph each relation. Determine the  $y$ -intercept, zeros, equation of the axis of symmetry, and vertex.
- $y = x^2 + 8x + 15$
  - $y = -2x^2 + 16x - 32$

6. A soccer ball is kicked into the air. Its height,  $h$ , in metres, is approximated by the equation  $h = -5t^2 + 15t + 0.5$ , where  $t$  is the time in seconds since the ball was kicked.
- From what height is the ball kicked?
  - When does the ball hit the ground?
  - When does the ball reach its maximum height?
  - What is the maximum height of the ball?
  - What is the height of the ball at  $t = 3$ ? Is the ball travelling upward or downward at this time? Explain.
  - When is the ball at a height of 10 m?

### Lesson 3.3

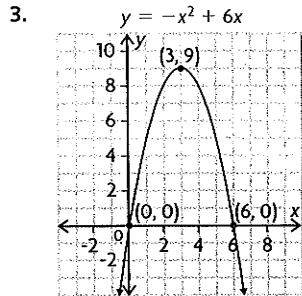
7. Determine the  $y$ -intercept, zeros, equation of the axis of symmetry, and vertex of each quadratic relation. Then sketch its graph.
- $y = (x - 5)(x + 5)$
  - $y = -(x - 6)(x - 2)$
  - $y = 2(x - 1)(x + 3)$
  - $y = -0.5(x + 4)^2$
8. The zeros of a parabola are  $-10$  and  $30$ . The parabola crosses the  $y$ -axis at  $50$ .
- Determine an equation for the parabola.
  - Determine the coordinates of the vertex.
9. Determine an equation for this quadratic relation.



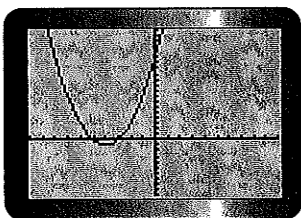
10. Give an example of an equation of a quadratic relation whose vertex and  $x$ -intercept occur at the same point.

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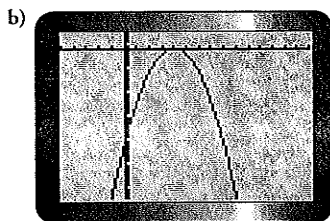
- Yes. The graph has a U shape.
  - Yes. The degree of the equation is 2.
  - No. The second differences are not a non-zero constant.
- upward
  - downward



4. a)  $x = 3$       b)  $(3, 9)$       c) 0      d) 0, 6
5. a)  $x = 3$



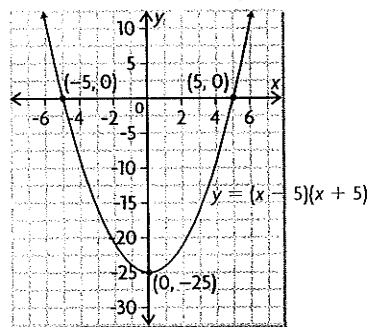
$y$ -intercept: 15;  
 zeros:  $-3, -5$ ;  
 equation of the axis of symmetry:  $x = -4$ ;  
 vertex:  $(-4, -1)$



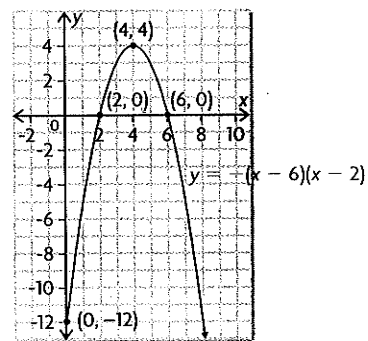
$y$ -intercept:  $-32$ ;  
 zero: 4;  
 equation of the axis of symmetry:  $x = 4$ ;  
 vertex:  $(4, 0)$

- 0.5 m
  - about 3 s
  - 1.5 s
  - 11.75 m
  - 0.5 m; the ball is travelling downward because this is after it has reached its maximum height.
  - about 0.9 s and 2.1 s

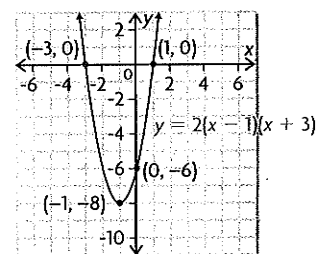
- $y$ -intercept:  $-25$ ; zeros:  $-5, 5$ ;  
 equation of the axis of symmetry:  $x = 0$ ; vertex:  $(0, -25)$



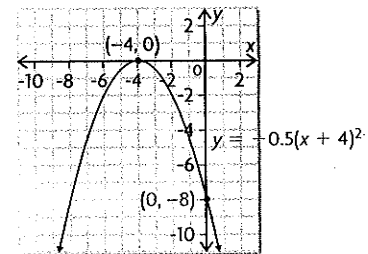
- $y$ -intercept:  $-12$ ; zeros: 2, 6;  
 equation of the axis of symmetry:  $x = 4$ ; vertex:  $(4, 4)$



- $y$ -intercept:  $-6$ ; zeros:  $-3, 1$ ;  
 equation of the axis of symmetry:  $x = -1$ ; vertex:  $(-1, -8)$



- $y$ -intercept:  $-8$ ; zero:  $-4$ ;  
 equation of the axis of symmetry:  $x = -4$ ; vertex:  $(-4, 0)$



- $y = -\frac{1}{6}(x - 30)(x + 10)$
  - $\left(10, \frac{200}{3}\right)$
- $y = -2(x + 2)(x + 6)$
- Answers may vary, e.g.,  $y = (x + 5)(x + 5)$