3.1 Investigating Quadratic Functions in Vertex Form, pages 107–119

1. For each of the following, determine the number of x-intercepts, the equation of the axis of symmetry, and the domain and range.

a) $y = -2(x + 5)^2 + 6$

(a) 2 x-intercepts
(b) $x = -5$
(c) D: $\mathbb{R}$
R: $y \leq 6$

b) $y = 5(x - 8)^2$

(a) 1 x-intercept (vertex on x-axis)
(b) $x = 8$
(c) D: $\mathbb{R}$
R: $y \geq 0$

2. For each of the following, determine the coordinates of the vertex and whether the graph has a maximum or minimum value.

a) $y = -(x - 3)^2 - 7$

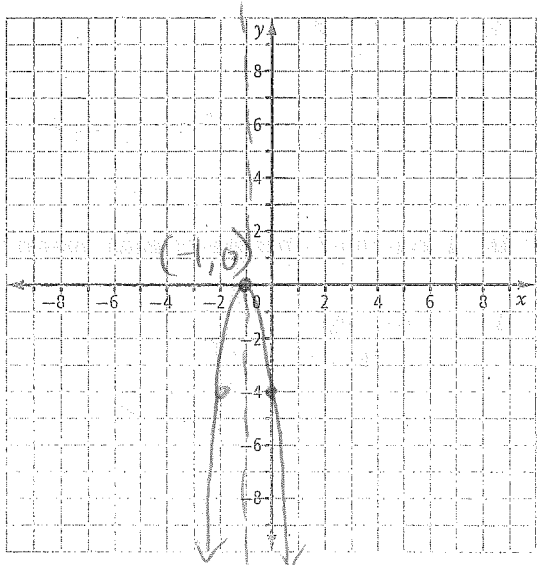
(a) Vertex (3, −7)
(b) max

b) $y = 0.5(x + 11)^2 + 8$

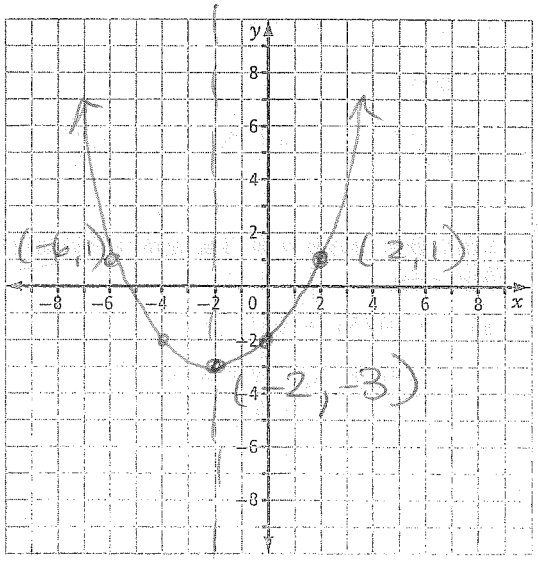
(a) (−11, 8)
(b) min

3. Sketch each of the following functions. Label the vertex and axis of symmetry.

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

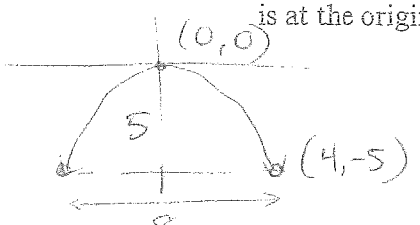


b) $y = \frac{1}{4}(x + 2)^2 - 3$



4. Suppose a sculptor wants to create a parabolic arch with a height of 5 m and a width at the base of 8 m.

a) Determine the quadratic function that represents the arch if the vertex of the parabola is at the origin.



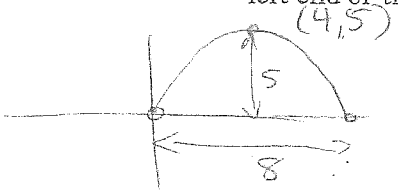
$y = a(x-p)^2+q$

$-5 = a(0-4)^2+0$

$-5 = 16a \qquad a = \frac{-5}{16}$

$y = -\frac{5}{16}x^2$

b) Determine the quadratic function that represents the arch if the origin is at the lower left end of the arch.



$y = -\frac{5}{16}(x-4)^2+5$

c) Explain the similarities and differences between your two functions.

same a, but p & q show the different vertexes

3.2 Investigating Quadratic Functions in Standard Form, pages 120–132

5. State the x-intercepts and y-intercept for each function.

a) $y = x^2 + 2x - 8$

y int = -8

x int: 2 and -4

b) $y = x^2 + 10x + 9$

y int = 9

x int: -9 and -1

6. Determine the x-coordinate of the vertex of each of the quadratic functions.

a) $y = 2x^2 + 6x - 5$

Vertex (-1.5, -9.5)

b) $y = -3x^2 - 5x + 9$

Vertex (-8.3, 11.08)

7. State the equation of the axis of symmetry and the direction of opening for each quadratic function.

a) $y = -0.5x^2 - 5x + 2$

OPENS DOWN

x = -5

b) $y = 6x^2 - 8x - 11$

OPENS UP

x = 0.667

3.3 Completing the Square, pages 133–141

8. Write each function in vertex form. State the domain and range.

a) $y = x^2 + 6x + 15$

$y = (x^2+6x+9) - 9 + 15$

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

D: $\mathbb{R}$
R: $y \geq 6$

b) $y = -3x^2 - 36x - 100$

$y = -3(x^2+12x+36) - 3(-3) - 100$

$y = -3(x+6)^2 + 8$

D: $\mathbb{R}$
R: $y \leq 8$

c) $y = 2x^2 - 16x + 22$

$y = 2(x^2-8x+16) - 16(2) + 22$

$y = 2(x-4)^2 - 10$

D: $\mathbb{R}$
R: $y \geq -10$

d) $y = \frac{1}{2}x^2 - x + 3$

$y = \frac{1}{2}(x^2-2x+1) - \frac{1}{2} + 3$

$y = \frac{1}{2}(x-1)^2 + \frac{5}{2}$

D: $\mathbb{R}$
R: $y \geq \frac{5}{2}$

9. The profit, p, earned from the sale of a particular product by a business is given by $p(d) = -0.25d^2 + 5d + 80$, where d is the number of days the product has been for sale.

a) Determine the vertex of the profit function.

$p(d) = -0.25(d^2 - 20d + 100) - 100(-0.25) + 80$

$p(d) = -0.25(d-10)^2 + 105$

b) Explain what the vertex means in the context of this problem.

It is the max. profit of $105 on the 10th day

10. A student club is planning a fundraising car wash. Last year they charged $10 per vehicle and washed 120 vehicles. They would like to earn more money this year. For every $1 increase in price, they know they will wash 5 fewer vehicles.

a) Write a quadratic function to model this situation using v as the number of vehicles and r as the revenue.

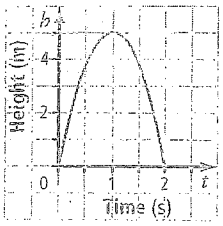
$r = (10+v)(120-5v)$

OMIT

b) Determine the best price to charge for the car wash and the revenue expected at that price.

Apply

6. The graph approximates the height of a soccer ball kicked by the goalkeeper. Use the graph to answer the following questions. Explain what property of the graph led to your answer.



a) From what height is the ball kicked?

Ground level since the "start" of the kick is at (0,0)

b) What is the maximum height of the ball? When does it occur?

5m at time = 1.0s (vertex)

c) How long is the ball in the air?

2 seconds (2^{nd} x-intercept)

d) What are the domain and range for this situation?

D: $0 \leq t \leq 2$ (ends at 2 since the ball hits the ground)

R: $0 \leq y \leq 5$ (max height → ground level)