# 6.2 Quadratic Models

Warmup: Write the equation of each line using the given information.

a. Line with slope of 2 through the point (-3, -7)

$$y = 2x + b$$
$$(-3, -7) \quad -7 = 2(-3) + b$$
$$x \quad y \qquad -7 = -6 + b$$
$$-1 = b \qquad \boxed{y = 2x - 1}$$

b. Line with y-intercept of (0,4) through the point (5, 3)

$$y = mx + 4$$
$$(5, 3) \quad 3 = 5m + 4$$
$$x \quad y \quad -1 = 5m$$
$$-\tfrac{1}{5} = m \qquad \boxed{y = -\tfrac{1}{5}x + 4}$$

The equations you wrote above are linear models. Today we will be focusing on quadratic models. For each form, identify what information is given by each feature in the equation.

| Standard Form | Intercept Form | Vertex Form |
|---|---|---|
| $y = ax^2 + bx + c$ | $y = a(x - p)(x - q)$ | $y = a(x - h)^2 + k$ |
| Pattern ⟋ y-intercept | Pattern ⟋ x-intercepts | Pattern ⟋ Vertex |

Knowing this, try the following problems:

1) Write an equation that models the given information.

a. A quadratic with x-intercepts at (2,0) and (-2,0) that goes through the point (0,4)

$$x = 2 \qquad x = -2$$
$$y = a(x-2)(x+2)$$
$$(0, 4) \quad 4 = a(0-2)(0+2)$$
$$x \quad y$$
$$4 = a(-2)(2)$$
$$4 = -4a \qquad \boxed{y = -(x-2)(x+2)}$$
$$-1 = a$$

b. A quadratic with x-intercepts at (-2,0) and (4,0) that passes through the point (2,4)

$$x = -2 \quad x = 4$$
$$y = a(x+2)(x-4)$$
$$(2, 4) \quad 4 = a(2+2)(2-4)$$
$$x \quad y \quad 4 = a(4)(-2)$$
$$4 = -8a \qquad \boxed{y = -\tfrac{1}{2}(x+2)(x-4)}$$
$$-\tfrac{1}{2} = a$$

c. A quadratic with a vertex of (1,6) that passes through the point (2,4)

$$y = a(x-1)^2 + 6$$
$$(2, 4) \quad 4 = a(2-1)^2 + 6$$
$$x \quad y \quad 4 = a(1)^2 + 6$$
$$4 = a + 6$$
$$-2 = a \qquad \boxed{y = -2(x-1)^2 + 6}$$

d. A quadratic with vertex (-4, -8) that passes through the point (-2, -5)

$$y = a(x+4)^2 - 8$$
$$(-2, -5) \quad -5 = a(-2+4)^2 - 8$$
$$x \quad y \quad -5 = a(2)^2 - 8$$
$$-5 = 4a - 8$$
$$3 = 4a$$
$$\tfrac{3}{4} = a \qquad \boxed{y = \tfrac{3}{4}(x+4)^2 - 8}$$

Write yourself a list of steps to describe the process that you did on the previous page.

Writing Quadratic Models

1) Decide what form to use based on the info given
2) Plug information into equation
3) Plug in point for x & y in order to solve for a
4) Rewrite equation with a-value

**Application Problems**

1) Sean is kicking a soccer ball to his dad who is 10 meters away. if after <u>2 meters, the ball is 1 meter in the air</u>, write the equation the represents the path of the ball.

Picture:
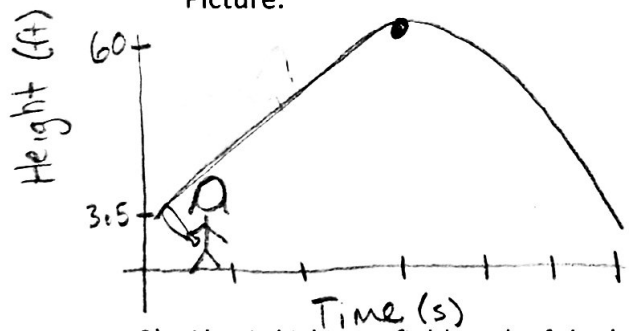


10m
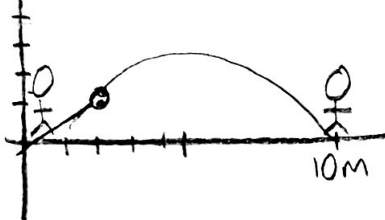
Zeros: $(0,0), (10,0)$
Vertex:
Point: $(2,1)$

$y = a(x-0)(x-10)$

$(2,1)$   $1 = a(2)(2-10)$
x   y   $1 = -16a$
$\frac{-1}{16} = a$

$\boxed{y = -\frac{1}{16}x(x-10)}$

2) Mae hit a softball so that it's ⟨maximum⟩ height was 60 ft at 3 seconds after she hit it. If she hit the ball 3.5 feet above the ground, what is the path of the ball in terms of seconds?

Height (ft)

60
3.5

Picture:



Time (s)

Zeros:
Vertex: $(3, 60)$
Point: $(0, 3.5)$

$\boxed{y = -6.23(x-3)^2 + 60}$

$y = a(x-3)^2 + 60$

$(0, 3.5)$   $3.5 = a(0-3)^2 + 60$
x   y   $3.5 = a(-3)^2 + 60$
  $3.5 = -9a + 60$
$-56.5 = -9a$   $a = -6.23$

3) Alex is kicking a field goal. If the ball landed 22 yards away, what is the equation for the path of the ball in terms of seconds if the maximum height the ball reaches is 15 yards?

Height (yds)

Picture:



15

11   22

Max height (vertex) is reached at Aos, halfway between x-int
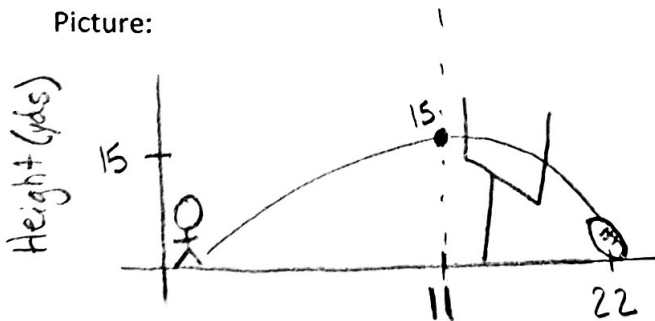
Zeros: $(0,0), (22,0)$
Vertex: $(11, 15)$
Point:

* Pick which form to use if you have both info

$y = a(x-0)(x-22)$

$(11, 15)$   $15 = a(11)(11-22)$
x   y   $15 = a(11)(-11)$
  $15 = -121a$
$\frac{-15}{121} = a$

$\boxed{y = \frac{-15}{121}x(x-22)}$