

Objective – Students will quickly find the vertex of a parabola by using a formula.

Finding the Vertex of Quadratic Equations

The vertex (x, y) of an equation in the form $y = ax^2 + bx + c$ can be found by letting $x = \frac{-b}{2a}$, and y will be whatever you get when you plug x into the equation.

Example: $y = 3x^2 + 12x - 5$

1. Find the x-coordinate of the vertex.

2. Plug the x-coordinate into the equation to find y .

1. $a = 3$ and $b = 12$

so, $\frac{-b}{2a}$ would be $\frac{-12}{2(3)} = \frac{-12}{6} = -2$

2. $y = 3(-2)^2 + 12(-2) - 5$

$y = 3(4) + 12(-2) - 5$

$y = 12 - 24 - 5 = -17$

Therefore, the vertex is $(-2, -17)$

Practice: Find the vertex of the parabolas given by the equations below.

1. $y = 3x^2 - 24x - 7$

$a = 3$ $y = 3(4)^2 - 24(4) - 7$
 $b = -24$ $48 - 96 - 7$

$x = \frac{-(-24)}{2(3)} = \frac{24}{6} = 4$ $(4, -55)$

2. $y = x^2 + 6x + 3$

$a = 1$ $x = \frac{-6}{2(1)} = \frac{-6}{2}$
 $b = 6$ $= -3$

$y = (-3)^2 + 6(-3) + 3$
 $= 9 - 18 + 3$
 $= -9 + 3$
 $= -6$ $(-3, -6)$

3. $y = -2x^2 - 8x + 10$

$a = -2$
 $b = -8$

$(-2, 18)$

4. $y = 2x^2 - 16x + 1$

$a = 2$
 $b = -16$

$(4, -31)$

7. $y = -4x^2 + 8x - 1$

$a = -4$
 $b = 8$

$(1, 3)$

5. $y = 3 - 24x - 15$

$a = 3$
 $b = -24$

$(4, -63)$

8. $y = 6x^2 + 12x + 6$

$a = 6$
 $b = 12$

$(-1, 0)$

6. $y = -x^2 + 5x + 1$

$a = -1$
 $b = 5$

$(2.5, 7.25)$

9. $y = 2x^2 - 2x + 5$

$a = 2$
 $b = -2$

$(0.5, 4.5)$

10. A ball is dropped kicked with a velocity of 64 ft/sec from 2 feet off the ground. $f(t) = -16t^2 + 64t + 2$

a. What is the maximum height of the ball?
Vertex

66 ft

$$x = \frac{-64}{2(-16)} = \frac{-64}{-32} = 2$$

(2, 66)

$$y = -16(2)^2 + 64(2) + 2 \Rightarrow -16(4) + 64(2) + 2 \Rightarrow -64 + 128 + 2 = 66$$



b. How long does it take for the ball to reach the maximum height?

2 sec

c. How high will the ball be after 1 second?

$$-16(1)^2 + 64(1) + 2$$

$$-16(1) + 64(1) + 2$$

$$-16 + 64 + 2$$

50 feet

11. You are standing on your deck which is 4 feet off of the ground; from the deck you launch a Stomp Rocket. The height h (in feet) of the rocket after t seconds is given by the equation: $h = -16t^2 + 112t + 4$.

a. What is the maximum height that the rocket will reach?

200 ft

$$x = \frac{-112}{2(-16)} = \frac{-112}{-32} = 3.5$$

$$y = -16(3.5)^2 + 112(3.5) + 4 \Rightarrow -16(12.25) + 112(3.5) + 4 \Rightarrow -196 + 392 + 4 = 200$$

b. How long does it take for the rocket to reach the maximum height?

3.5 sec

c. How high will the rocket be after 5 seconds?

$$-16(5)^2 + 112(5) + 4$$

$$-16(25) + 112(5) + 4$$

$$-400 + 560 + 4$$

164

164 feet