

Real Life Situations Modeled by Quadratic Equations – Algebra 8

You can solve most of the problems below with your knowledge of key features of parabolas! Each of the equations that model the situations can be factored. **Show all your work**, and don't forget units.

1. A relief package is released from a helicopter at 1600 feet. The height of the package can be modeled by the equation $h = -16t^2 + 1600$, where h is the height of the package in feet and t is the time in seconds.

a. What does the number 1600 in the equation represent?

The package is 1600 feet above the ground when it gets released.

b. How long it will take for the package to hit the ground?

* We need to find the second x-intercept

$$h = -16(t^2 - 100)$$

$$h = -16(t - 10)(t + 10)$$

$\begin{array}{r} 0 = t - 10 \\ +10 \quad +10 \\ \hline 10 = t \end{array}$	$\begin{array}{r} 0 = t + 10 \\ -10 \quad -10 \\ \hline -10 = t \end{array}$
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It will take 10 seconds.

2. The height of a flare fired from the deck of a ship in distress can be modeled by $h = -16t^2 + 104t + 56$, where h is the height of the flare above water and t is the time in seconds.

a. How high above the surface of the water is the deck of the ship?

The deck is 56 ft. above the surface of the water.

b. How long will the flare be in the air?

* We need to find the second x-intercept

$$h = -16t^2 + 104t + 56$$

$$h = -8(2t^2 - 13t - 7)$$

$$h = -8(2t^2 - 14t + t - 7)$$

$$h = -8(2t(t - 7) + 1(t - 7))$$

$$h = -8(2t + 1)(t - 7)$$

$$0 = -8(2t + 1)(t - 7)$$

$\begin{array}{r} 0 = 2t + 1 \\ -1 \quad -1 \\ \hline -1 = 2t \end{array}$	$\begin{array}{r} 0 = t - 7 \\ +7 \quad +7 \\ \hline 7 = t \end{array}$
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7 seconds in the air

3. Robert threw a rock off a bridge into the river. The distance from the rock to the river is modeled by the equation $h = -16t^2 - 16t + 60$, where h is the height in feet and t is the time in seconds.

a. How high above the river will the rock be 1 second after Robert throws it?

$$\begin{aligned} h &= -16(1)^2 - 16(1) + 60 \\ &= -16 - 16 + 60 \\ &= -32 + 60 \\ &= 28 \end{aligned}$$

The rock will be 28 feet off the ground after 1 second.

b. How long will it take for the rock to hit the surface of the water?

* Find the second x-intercept

$$\begin{aligned} h &= -16t^2 - 16t + 60 \\ h &= -4(4t^2 + 4t - 15) \\ h &= -4(4t^2 + 10t - 6t - 15) \\ h &= -4(2t(2t+5) - 3(2t+5)) \\ h &= -4(2t-3)(2t+5) \end{aligned}$$

The rock will hit the water after 1.5 seconds.

$$\begin{array}{r} 0 = 2t - 3 \\ +3 \quad +3 \\ \hline 3 = 2t \\ \frac{3}{2} = \frac{2t}{2} \end{array} \qquad \begin{array}{r} 0 = 2t + 5 \\ -5 \quad -5 \\ \hline -5 = 2t \\ \frac{-5}{2} = \frac{2t}{2} \end{array}$$

4. The height of a rocket launched upward from a 160-foot cliff is modeled by $h = -16t^2 + 48t + 160$, where h is the height in feet and t is the time in seconds.

a. How long will it take for the rocket to reach its maximum height?

* Find the L.O.S.

$$L.O.S. = \frac{5-2}{2} = \frac{3}{2} = 1.5 \text{ sec.}$$

$$\begin{aligned} h &= -16t^2 + 48t + 160 \\ h &= -16(t^2 - 3t - 10) \\ h &= -16(t-5)(t+2) \\ 0 &= -16(t-5)(t+2) \end{aligned}$$

The rocket will reach the maximum height after 1.5 seconds.

$$\begin{array}{r} 0 = t - 5 \\ +5 \quad +5 \\ \hline 5 = t \end{array} \qquad \begin{array}{r} 0 = t + 2 \\ -2 \quad -2 \\ \hline -2 = t \end{array}$$

b. How high will the rocket go?

* Use L.O.S. to find the vertex

$$h = -16(t-5)(t+2)$$

$$h = -16(1.5-5)(1.5+2)$$

$$h = -16(-3.5)(3.5)$$

$$h = 196$$

The highest the rocket will go is 196 feet.

5. The height of a rock thrown off a cliff can be modeled by the equation $h = -16t^2 - 8t + 120$, where h is the height in feet and t is the time in seconds.

a. How high above the ground is the rock 2 seconds after it is thrown?

$$h = -16(2)^2 - 8(2) + 120$$

$$h = -16(4) - 16 + 120$$

$$h = -64 - 16 + 120$$

$$h = -80 + 120$$

$$h = 40$$

After 2 seconds the rock will be 40 feet above the ground.

b. How long does it take the rock to reach the ground?

* Find the second x-intercept.

$$h = -16t^2 - 8t + 120$$

$$h = -8(2t^2 + t - 15)$$

$$h = -8(2t^2 + 6t - 5t - 15)$$

$$h = -8(2t(t+3) - 5(t+3))$$

$$h = -8(2t-5)(t+3)$$

$$0 = -8(2t-5)(t+3)$$

$$\begin{array}{r} 0 = 2t - 5 \\ +5 \quad +5 \\ \hline 5 = 2t \\ \frac{5}{2} = \frac{2t}{2} \end{array}$$

$$\begin{array}{r} 0 = t + 3 \\ -3 \quad -3 \\ \hline -3 = t \end{array}$$

The rock will reach the ground after 2.5 seconds.

