

$$1. \quad h(t) = -16t^2 + h_0$$

This represents the height of an object at time t when dropped from an initial height h_0 , the height at time $t = 0$.

$$2. \quad h(t) = -16t^2 + v_0t + h_0$$

This represents the height of an object at time t with initial velocity, v_0 , and initial height, h_0 , at time $t = 0$.

At an initial height of 4 feet, an object is launched upward at 30 feet per second. The object lands on a platform that is 3 feet high. How long is the object in the air?

Solution:

The initial height = 4. The initial velocity = 30. The final height = 3.

$$3 = -16t^2 + 30t + 4 \rightarrow 16t^2 - 30t - 1 = 0 \rightarrow t = \frac{30 \pm \sqrt{900 - 4(16)(-1)}}{32} = \frac{30 \pm \sqrt{964}}{32}$$

$t = 1.90776$ or $t = -0.032761$. Reject the 2nd answer because it is negative. $t = 1.90776$ Seconds.

A juggler tosses a ball into the air. It leaves the juggler's hand 3 feet above the ground and has an initial velocity of 20 feet per second. The juggler catches the ball when it falls back to a height of 4 feet. How long is the ball in the air?

Solution:

The initial height = 3. The initial velocity = 20. The final height = 4.

$$4 = -16t^2 + 20t + 3 \rightarrow 16t^2 - 20t + 1 = 0 \rightarrow t = \frac{20 \pm \sqrt{400 - 4(16)(1)}}{32} = \frac{20 \pm \sqrt{336}}{32}$$

$t = 1.19782$ or $t = 0.52178$. Reject the smaller number because that's when the height is 4 feet on the way up.

$t = 1.19782$ Seconds.

A rock is dropped from a bridge 22 feet above the ground. How long does it take for the rock to hit the ground?

Solution:

The initial height = 22. The final height = 0.

$$0 = -16t^2 + 22 \rightarrow 16t^2 = 22 \rightarrow t^2 = \frac{11}{8} \rightarrow t = \pm \sqrt{\frac{11}{8}} = \pm 0.353553. \text{ Reject the negative.}$$

$t = 0.353553$ Seconds.

1. In a volleyball game, a player on one team spikes the ball over the net when the ball is 10 feet above the court. The spike drives the ball downward with an initial velocity of 55 feet per second ($v_0 = -55$). How much time does the opposing team have to return the ball before it touches the court?
2. An archer is shooting at targets. The height of the arrow is 5 feet above the ground. Due to safety rules, the archer must aim the arrow parallel to the ground. How long does it take for the arrow to hit the target at a point 3 feet above the ground?
3. The number A of tablet computers sold (in millions) can be modeled by the function $A = 4.5t^2 + 43.5t + 17$, where t represents the year after 2010. At what year did the tablet computer reach 65 million?
4. A monthly teen magazine has 48,000 subscribers when it charges \$20 per annual subscription. For each \$1 increase in price, the magazine loses about 2000 subscribers. How much should the magazine charge to maximize annual revenue? What is the maximum annual revenue?