LESSON 71 Applications of Quadratic Functions

☐ **REFRESH YOUR SKILLS**

(Lesson 63) Find the vertex by using the vertex formula or by rewriting in vertex form.

1. $f(x) = -16x^2 + 32x + 128$

2. $f(x) = -4.9x^2 + 19.6x + 24.5$

(Lesson 57) Solve.

3. $-4.9x^2 + 122.5 = 44.1$

Hint: Clear the decimals first by multiplying both sides by a power of 10.

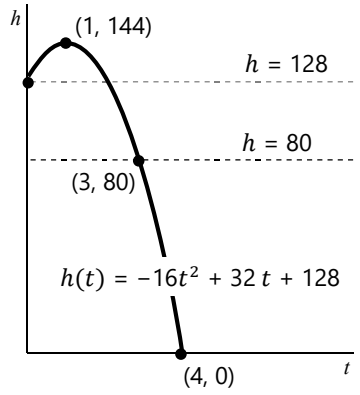
4. $-16x^2 + 32x + 128 = 80$

Hint: Write in standard form, then factors out −1 along with the GCF.

☐ **SOLVING WORD PROBLEMS INVOLVING QUADRATIC FUNCTIONS**

Quadratic functions can be used to model the motion of objects that are thrown straight up or dropped directly down. Understand that these functions are functions of time. When graphed with *time* as the x-axis and *height* as the y-axis, they form parabolas. Objects thrown straight up or dropped directly down move only vertically.

➔ **EXAMPLE** A ball is thrown straight up from a height of 128 feet with an initial speed of 32 feet per second. Its height h, in feet, after t seconds is given by $h(t) = -16t^2 + 32t + 128$. Determine a) what is the maximum height reached by the ball, b) when the ball hits the ground, and c) when the ball reaches a height of 80 feet.



a. We need to find the vertex of the parabola.
Convert $h(t)$ to vertex form, and you get $h(t) = -16(t-1)^2 + 144$.
So the ball reaches its maximum height of 144 feet after 1 second.

b. We need to find t when $h = 0$.
Solve $-16t^2 + 32t + 128 = 0$, and you get $t = -2$ or $t = 4$.
So the ball hits the ground after 4 seconds.

c. We need to find t when $h = 80$.
Solve $-16t^2 + 32t + 128 = 80$, and you get $t = -1$ or $t = 3$.
So the ball reaches a height of 80 feet after 3 seconds.

➔ **TRY IT 5.** A ball is thrown straight up from a height of 160 feet with an initial speed of 48 feet per second. Its height h, in feet, after t seconds is given by $h(t) = -16t^2 + 48t + 160$.

a. When does the ball reach its maximum height?

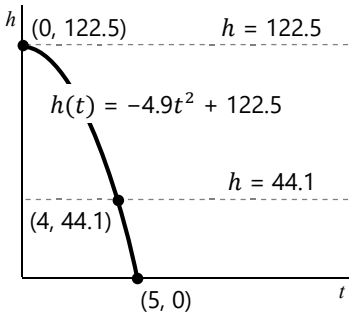
b. What is the maximum height reached by the ball?

c. When will the ball hit the ground?

d. When will the ball be at a height of 160 feet again?

e. When will the ball be at a height of 96 feet?

➔ **EXAMPLE** A ball is dropped from a height of 122.5 meters. Its height h, in meters, after t seconds is given by $h(t) = -4.9t^2 + 122.5$. Determine a) how long the ball takes to hit the ground and b) when the ball reaches a height of 44.1 meters.



a. We need to find t when $h = 0$.
Solve $-4.9t^2 + 122.5 = 0$, and you get $t = -5$ or $t = 5$.
So the ball hits the ground after 5 seconds.

b. We need to f find t when $h = 44.1$.
Solve $-4.9t^2 + 122.5 = 44.1$, and you get $t = -4$ or $t = 4$.
So the ball reaches a height of 44.1 meters after 4 seconds.

➔ **TRY IT 6.** A ball is dropped from a height of 64 feet. Its height h, in feet, after t seconds is given by $h(t) = -16t^2 + 64$.

a. When will the ball hit the ground?

b. When will the ball reach a height of 48 feet?

☐ **EXERCISE YOUR SKILLS**

Solve. Round your answer to the nearest tenth, if necessary.

7. A ball is thrown vertically upwards from the top of a building of height 24.5 meters with an initial speed of 19.6 meters per second. Its height h, in meters, after t seconds is given by $h(t) = -4.9t^2 + 19.6t + 24.5$.

a. When does the ball reach its maximum height?

b. How much higher does the ball rise above the top of the building?

c. How long will the ball be in the air before it hits the ground?

8. A golf ball is hit from ground level with an initial speed of 96 feet per second. Its height h, in feet, after t seconds is given by $h(t) = -16t^2 + 96t$.

a. When does the ball reach its maximum height?

b. How high will the ball rise before it starts falling?

c. How long will it take for the ball to hit the ground?

d. When will the ball reach a height of 80 feet?

9. A ball is dropped from the top of a building that is 256 feet high. Its height h, in feet, after t seconds is given by $h(t) = -16t^2 + 256$.

a. When will the ball hit the ground?

b. When will the ball reach a height of 112 feet?