

### Station 4: Physics Applications (3E)

<b>3E</b>	I can <u>apply</u> a <b>quadratic model</b> (equations and inequalities) to <b>projectile motion</b> and <u>explain</u> the difference between solutions found theoretically versus within an applied context (includes inequalities).
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1. A ball is thrown straight upward at an initial speed of 40 ft/s.
  - a. When does the ball reach a height of 48 feet?
  - b. When does the ball reach its greatest height?
  - c. What is the ball's greatest height?
  - d. When does the ball hit the ground?
  
2. A bowling ball is dropped from a building that is 96 ft tall.
  - a. How long will it take the ball to fall half the distance to the ground?
  - b. When does the ball hit the ground?

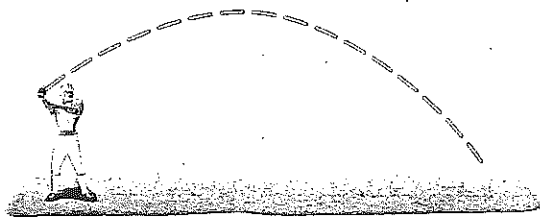
101-102 ■ **Falling-Body Problems** Use the formula  $h = -16t^2 + v_0t$  discussed in Example 9.

101. A ball is thrown straight upward at an initial speed of  $v_0 = 40$  ft/s.
- (a) When does the ball reach a height of 24 ft?
  - (b) When does it reach a height of 48 ft?
  - (c) What is the greatest height reached by the ball?
  - (d) When does the ball reach the highest point of its path?
  - (e) When does the ball hit the ground?
102. How fast would a ball have to be thrown upward to reach a maximum height of 100 ft? [Hint: Use the discriminant of the equation  $16t^2 - v_0t + h = 0$ .]

59. **Height of a Ball** If a ball is thrown directly upward with a velocity of 40 ft/s, its height (in feet) after  $t$  seconds is given by  $y = 40t - 16t^2$ . What is the maximum height attained by the ball?

60. **Path of a Ball** A ball is thrown across a playing field. Its path is given by the equation  $y = -0.005x^2 + x + 5$ , where  $x$  is the distance the ball has traveled horizontally, and  $y$  is its height above ground level, both measured in feet.

- (a) What is the maximum height attained by the ball?
- (b) How far has it traveled horizontally when it hits the ground?



### Applications

99-100 ■ **Falling-Body Problems** Suppose an object is dropped from a height  $h_0$  above the ground. Then its height after  $t$  seconds is given by  $h = -16t^2 + h_0$ , where  $h$  is measured in feet. Use this information to solve the problem.

99. If a ball is dropped from 288 ft above the ground, how long does it take to reach ground level?
100. A ball is dropped from the top of a building 96 ft tall.
- (a) How long will it take to fall half the distance to ground level?
  - (b) How long will it take to fall to ground level?

11. **Analyzing the Motion of a Projectile** A projectile is fired from a cliff 200 feet above the water at an inclination of  $45^\circ$  to the horizontal, with a muzzle velocity of 50 feet per second. The height  $h$  of the projectile above the water is modeled by

$$h(x) = \frac{-32x^2}{(50)^2} + x + 200$$

where  $x$  is the horizontal distance of the projectile from the face of the cliff.

- (a) At what horizontal distance from the face of the cliff is the height of the projectile a maximum?
- (b) Find the maximum height of the projectile.
- (c) At what horizontal distance from the face of the cliff will the projectile strike the water?
- (d) Using a graphing utility, graph the function  $h$ ,  $0 \leq x \leq 200$ .
- (e) Use a graphing utility to verify the solutions found in parts (b) and (c).
- (f) When the height of the projectile is 100 feet above the water, how far is it from the cliff?