Solution

a. $\Delta d = d_3 - d_0 = 144 - 0 = 144$ ft Using data from Table 1

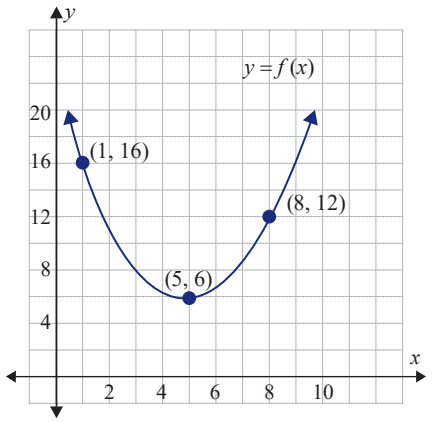
b. $\dfrac{\Delta d}{\Delta t} = \dfrac{144 \text{ ft}}{3 \text{ sec}} = 48 \dfrac{\text{ft}}{\text{sec}}$ Using $\Delta t = t_3 - t_0 = 3 - 0 = 3$ sec

c. We do not know how fast the ball is traveling when $t = 3$ seconds. This is a question of instantaneous velocity, which we will discuss later.

2.5 EXERCISES

PRACTICE

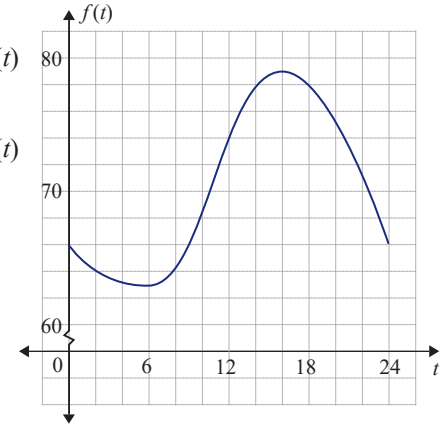
In Exercises 1–2, use the graph of $f(x)$ to answer the questions.



1. What is the average rate of change of $f(x)$ from $x_1 = 1$ to $x_2 = 5$?

2. What is the average rate of change of $f(x)$ from $x_1 = 5$ to $x_2 = 8$?

Use the graph to solve Exercises 3–4. The variable t is the number of hours since midnight and $f(t)$ is the temperature at time t.



3. What is the average rate of change of $f(t)$ from $t = 0$ to $t = 2$?

4. What is the average rate of change of $f(t)$ from $t = 6$ to $t = 12$?

In Exercises 5–14, find the average rate of change of the given functions between the given values of x_1 and x_2.

5. $f(x) = 5x + 3;\ x_1 = 1,\ x_2 = 3$

6. $f(x) = 3x + 8;\ x_1 = -2,\ x_2 = 1$

7. $f(x) = 2x^2 - x - 3;\ x_1 = 2,\ x_2 = 2.5$

8. $f(x) = 3x^2 - 2x - 1;\ x_1 = 1,\ x_2 = 1.5$

9. $f(x)=\dfrac{-2}{2x-1};\ x_1=3,\ x_2=3.5$

10. $f(x)=\dfrac{2}{3x+2};\ x_1=0.5,\ x_2=1$

11. $f(x)=\sqrt{x};\ x_1=1,\ x_2=2.5$

12. $f(x)=\sqrt{x-3};\ x_1=4,\ x_2=4.44$

13. $f(x)=2x-\sqrt{x};x_1=4,\ x_2=4+h$

14. $f(x)=\dfrac{3}{x+1};x_1=x,\ x_2=x+h$

APPLICATIONS

15. The population (in millions) for a country is modeled by

$$P(t)=250+0.8t-0.002t^2,$$

where t is the number of years since 2000.

a. Interpret the meaning of $P(0) = 250$.

b. What population was predicted for 2010?

c. What was the average rate of change of population from 2000 to 2010?

16. The electrical charge on a new cell phone declines according to the formula $f(t)=10-0.2t^2-0.5t,$ where t is the time in hours following a full charge and $f(t)$ is a measure of the charge. What is the average rate of change from $t = 0$ to $t = 5$?

17. When a factory operates from 6:00 a.m. to 6:00 p.m., its total fuel consumption varies according to the formula $f(t)=0.8t^2-0.1\sqrt{t}+10,$ where t is the time in hours after 6:00 a.m. and $f(t)$ is the number of barrels of fuel oil.

a. How much fuel oil is consumed by noon?

b. What is the average rate of consumption from 6:00 a.m. to 12:00 p.m.?

18. The population of bacteria in a lab experiment for a biology class is given by $f(t)=4.4\sqrt{t}-0.9t+3,$ where t is the time in hours after 2:00 p.m. and $f(t)$ is the population in suitable units.

a. What is the population at 2:00 p.m.?

b. The lab is over at 4:00 p.m. What is the new population of bacteria?

c. What is the average rate of change of bacteria from 2:00 p.m. to 4:00 p.m.?