Related rates

Multiple Choice
Identify the choice that best completes the statement or answers the question.

_____ 1. A point is moving along the graph of the function $y = \sin 6x$ such that $\dfrac{dx}{dt} = 2$ centimeters per second.

Find $\dfrac{dy}{dt}$ when $x = \dfrac{\pi}{7}$.

- a. $\dfrac{dy}{dt} = 6\cos\dfrac{2\pi}{7}$
- b. $\dfrac{dy}{dt} = 12\cos\dfrac{6\pi}{7}$
- c. $\dfrac{dy}{dt} = 6\cos\dfrac{6\pi}{7}$
- d. $\dfrac{dy}{dt} = 12\cos\dfrac{2\pi}{7}$
- e. $\dfrac{dy}{dt} = 12\cos\dfrac{12\pi}{7}$

_____ 2. The radius, *r,* of a circle is decreasing at a rate of 5 centimeters per minute.

Find the rate of change of area, *A*, when the radius is 6.

- a. $\dfrac{dA}{dt} = -360\pi$ sq cm/min
- b. $\dfrac{dA}{dt} = 360\pi$ sq cm/min
- c. $\dfrac{dA}{dt} = -60\pi$ sq cm/min
- d. $\dfrac{dA}{dt} = 60\pi$ sq cm/min
- e. $\dfrac{dA}{dt} = -30\pi$ sq cm/min

____   3.   The radius r of a sphere is increasing at a rate of 6 inches per minute. Find the rate of change of the volume when $r = 11$ inches.

   a. $\dfrac{dV}{dt} = 3630\pi \text{ in}^3 \text{ / min}$

   b. $\dfrac{dV}{dt} = 1452\pi \text{ in}^3 \text{ / min}$

   c. $\dfrac{dV}{dt} = 2904\pi \text{ in}^3 \text{ / min}$

   d. $\dfrac{dV}{dt} = \dfrac{1}{1452\pi} \text{ in}^3 \text{ / min}$

   e. $\dfrac{dV}{dt} = \dfrac{1}{2904\pi} \text{ in}^3 \text{ / min}$

____   4.   All edges of a cube are expanding at a rate of 9 centimeters per second. How fast is the volume changing when each edge is 2 centimeters?

   a. $486 \text{ cm}^3 \text{ / sec}$

   b. $72 \text{ cm}^3 \text{ / sec}$

   c. $36 \text{ cm}^3 \text{ / sec}$

   d. $108 \text{ cm}^3 \text{ / sec}$

   e. $162 \text{ cm}^3 \text{ / sec}$

____   5.   A conical tank (with vertex down) is 12 feet across the top and 18 feet deep. If water is flowing into the tank at a rate of 18 cubic feet per minute, find the rate of change of the depth of the water when the water is 10 feet deep.

   a. $\dfrac{9}{40\pi} \text{ ft/min}$

   b. $\dfrac{9}{100\pi} \text{ ft/min}$

   c. $\dfrac{81}{20\pi} \text{ ft/min}$

   d. $\dfrac{81}{50\pi} \text{ ft/min}$

   e. $\dfrac{81}{200\pi} \text{ ft/min}$

_____ 6. A ladder 25 feet long is leaning against the wall of a house (see figure). The base of the ladder is pulled away from the wall at a rate of 2 feet per second. Consider the triangle formed by the side of the house, the ladder, and the ground. Find the rate at which the area of the triangle is changed when the base of the ladder is 11 feet from the wall. Round your answer to two decimal places.
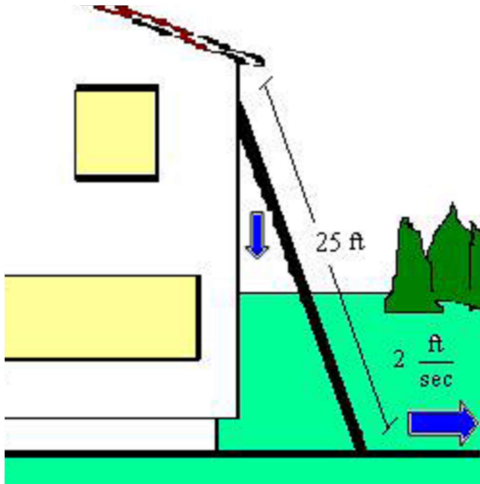

    a. $16.67\,\text{ft}^2/\text{sec}$

    b. $119.10\,\text{ft}^2/\text{sec}$

    c. $66.34\,\text{ft}^2/\text{sec}$

    d. $20.06\,\text{ft}^2/\text{sec}$

    e. $40.13\,\text{ft}^2/\text{sec}$

_____   7. A ladder 20 feet long is leaning against the wall of a house (see figure). The base of the ladder is pulled away
from the wall at a rate of 2 feet per second. Find the rate at which the angle between the ladder and the wall
of the house is changing when the base of the ladder is 19 feet from the wall. Round your answer to three
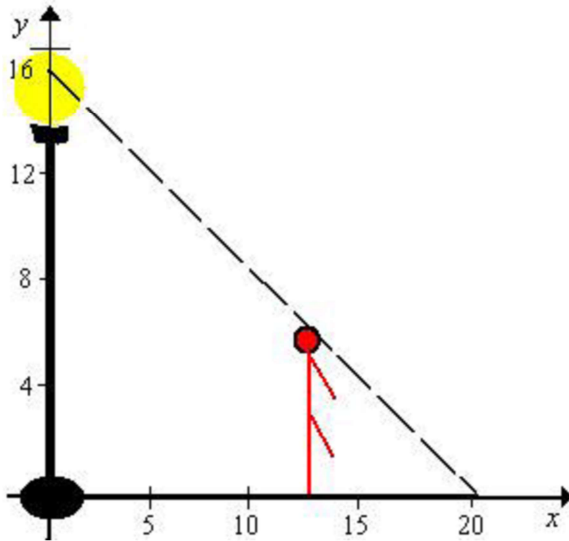decimal places.
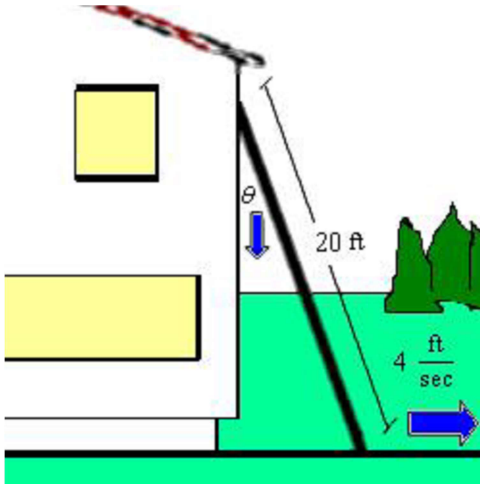
    a.   0.242 rad/sec
    b.   0.190 rad/sec
    c.   2.168 rad/sec
    d.   3.804 rad/sec
    e.   0.278 rad/sec

_____ 8. A man 6 feet tall walks at a rate of 10 feet per second away from a light that is 15 feet above the ground (see figure). When he is 13 feet from the base of the light, at what rate is the tip of his shadow moving?
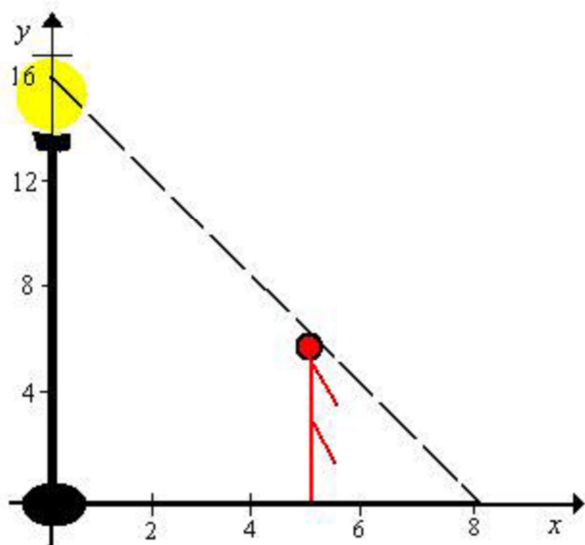

a. $\dfrac{1}{2}$ ft/sec

b. 50 ft/sec

c. $\dfrac{3}{50}$ ft/sec

d. $\dfrac{9}{2}$ ft/sec

e. $\dfrac{50}{3}$ ft/sec

_____ 9. A man 6 feet tall walks at a rate of 13 feet per second away from a light that is 15 feet above the ground (see figure). When he is 5 feet from the base of the light, at what rate is the length of his shadow changing?

a. $\dfrac{5}{2}$ ft/sec

b. $\dfrac{65}{3}$ ft/sec

c. $\dfrac{26}{3}$ ft/sec

d. $\dfrac{3}{65}$ ft/sec

e. $\dfrac{1}{2}$ ft/sec

_____ 10. A man 6 feet tall walks at a rate of 2 ft per second away from a light that is 16 ft above the ground (see figure). When he is 8 ft from the base of the light, find the rate.at which the tip of his shadow is moving.
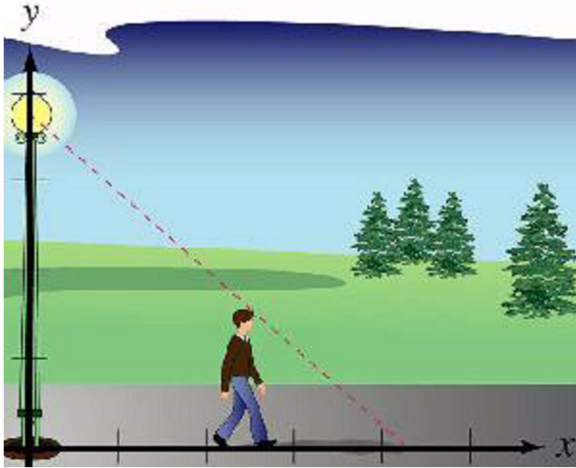
a. $\dfrac{8}{5}$ ft per minute

b. $\dfrac{4}{5}$ ft per minute

c. $\dfrac{64}{5}$ ft per minute

d. $\dfrac{32}{5}$ ft per minute

e. $\dfrac{16}{5}$ ft per minute

_____ 11. An airplane is flying in still air with an airspeed of 255 miles per hour. If it is climbing at an angle of $21°$, find the rate at which it is gaining altitude. Round your answer to four decimal places.

a. 103.7178 mi/hr
b. 78.7993 mi/hr
c. 111.7846 mi/hr
d. 92.4589 mi/hr
e. 91.3838 mi/hr

Related rates
Answer Section

MULTIPLE CHOICE

1. ANS: B   PTS: 1   DIF: Easy   REF: Section 2.6
   OBJ: Solve a related rate problem involving a point moving along a curve
   MSC: Skill
2. ANS: C   PTS: 1   DIF: Easy   REF: Section 2.6
   OBJ: Solve a related rate problem involving the area of a circle and its radius
   MSC: Application
3. ANS: C   PTS: 1   DIF: Easy   REF: Section 2.6
   OBJ: Solve a related rate problem involving the volume of a sphere and its
   MSC: Application
4. ANS: D   PTS: 1   DIF: Easy   REF: Section 2.6
   OBJ: Solve a related rate problem involving the volume of a cube and the length of a side
   MSC: Application
5. ANS: D   PTS: 1   DIF: Difficult   REF: Section 2.6
   OBJ: Solve a related rate problem involving a cone   MSC: Application
6. ANS: D   PTS: 1   DIF: Medium   REF: Section 2.6
   OBJ: Solve a related rate problem involving a moving ladder and the area it encloses
   MSC: Application
7. ANS: B   PTS: 1   DIF: Medium   REF: Section 2.6
   OBJ: Solve a related rate problem involving a moving ladder and its internal angle
   MSC: Application
8. ANS: E   PTS: 1   DIF: Difficult   REF: Section 2.6
   OBJ: Solve a related rate problem involving a man walking away from a light source
   MSC: Application
9. ANS: C   PTS: 1   DIF: Difficult   REF: Section 2.6
   OBJ: Solve a related rate problem involving a man walking away from a light source
   MSC: Application
10. ANS: E   PTS: 1   DIF: Difficult   REF: Section 2.6
    OBJ: Solve a related rate problem involving a man walking away from a light source
    MSC: Application
11. ANS: E   PTS: 1   DIF: Medium   REF: Section 2.6
    OBJ: Solve a related rate problem involving the altitude of an airplane
    MSC: Application