## p - ApplDerivees II Q2

Name

**1.** A sphere is expanding in such a way that the area of any circular cross section through the sphere's center is increasing at a constant rate of $2\,\mathrm{cm}^2 / \mathrm{sec}$. At the instant when the radius of the sphere is 4 centimeters, what is the rate of change of the sphere's volume? (The volume $V$ of a sphere with radius $r$ is given by $V = \frac{4}{3}\pi r^3$. )

(A) $8\,\mathrm{cm}^3 / \mathrm{sec}$

(B) $16\,\mathrm{cm}^3 / \mathrm{sec}$

(C) $8\pi\,\mathrm{cm}^3 / \mathrm{sec}$

(D) $64\pi\,\mathrm{cm}^3 / \mathrm{sec}$

(E) $128\pi\,\mathrm{cm}^3 / \mathrm{sec}$

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**2.** The fuel consumption of a car, in miles per gallon (mpg), is modeled by $F(s) = 6e^{\left(\frac{s}{20} - \frac{s^2}{2400}\right)}$, where $s$ is the speed of the car, in miles per hour. If the car is traveling at 50 miles per hour and its speed is changing at the rate of 20 miles/hour$^2$ what is the rate at which its fuel consumption is changing?

(A) 0.215 mpg per hour

(B) 4.299 mpg per hour

(C) 19.793 mpg per hour

(D) 25.793 mpg per hour

(E) 515.855 mpg per hour

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**3.** When $x$=8, the rate at which $\sqrt[3]{x}$ is increasing is $\frac{1}{k}$ times the rate at which $x$ is increasing. What is the value of $k$ ?

(A) 3

(B) 4

(C) 6

(D) 8

(E) 12

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**4.** A cube with edges of length $x$ centimeters has volume $V(x) = x^3$ cubic centimeters. The volume is increasing at a constant rate of 40 cubic centimeters per minute. At the instant when $x = 2$, what is the rate of change of $x$, in centimeters per minute, with respect to time?

(A) 10/3

(B) $\sqrt{\frac{40}{3}}$

(C) 5

(D) 10

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**5.** The volume of a sphere is increasing at a rate of 6π cubic centimeters per hour. At what rate, in centimeters per hour, is its diameter increasing with respect to time at the instant the radius of the sphere is 3 centimeters?

(Note: The volume of a sphere with radius $r$ is given by $V = \frac{4}{3}p\pi^3$

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(A) 1/3

(B) 1

(C) $\sqrt{6}$

(D) 6

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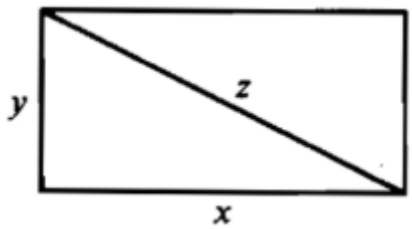
**6.**




The sides of the rectangle above increase in such a way that $\frac{dz}{dt} = 1$ and $\frac{dx}{dt} = 3\frac{dy}{dt}$ . At the instant when $x$ = 4 and $y$ = 3 , what is the value of $\frac{dx}{dt}$ ?

(A) $\frac{1}{3}$

(B) 1

(C) 2

(D) $\sqrt{5}$

(E) 5

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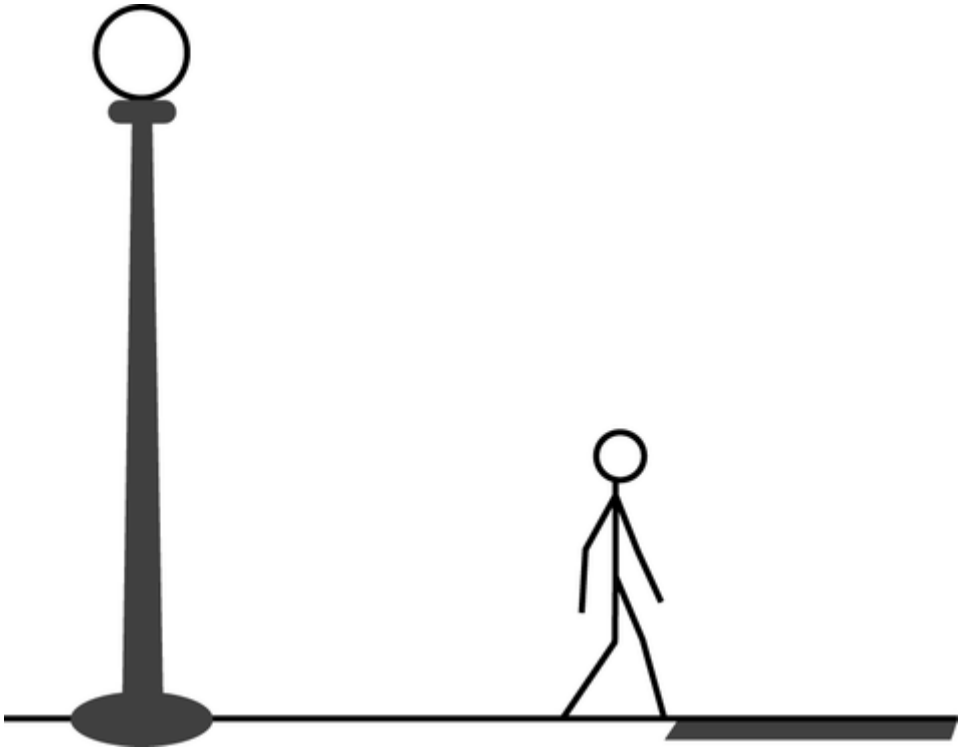
**7.**



A person whose height is 6 feet is walking away from the base of a streetlight along a straight path at a rate of 4 feet per second. If the height of the streetlight is 15 feet, what is the rate at which the person's shadow is lengthening?

(A) 1.5 ft/sec

(B) 2.667 ft/sec

(C) 3.75 ft/sec

(D) 6 ft/sec

(E) 10 ft/sec

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**8.** The radius of a circle is increasing. At a certain instant, the rate of increase in the area of the circle is numerically equal to twice the rate of increase in its circumference. What is the radius of the circle at that instant?

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(A) $\frac{1}{2}$

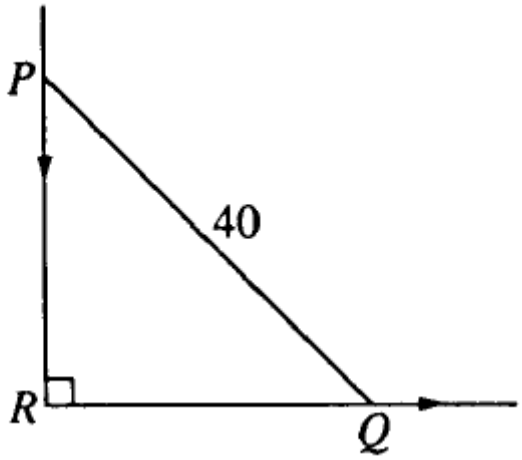
(B) 1

(C) $\sqrt{2}$

(D) 2

(E) 4

**9.**




In the figure above, *PQ* represents a 40-foot ladder with end *P* against a vertical wall and end *Q* on level ground. If the ladder is slipping down the wall, what is the distance *RQ* at the instant when *Q* is moving along the ground $\frac{3}{4}$ as fast as *P* is moving down the wall?

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(A) $\frac{6}{5}\sqrt{10}$

(B) $\frac{8}{5}\sqrt{10}$

(C) $\frac{80}{\sqrt{7}}$

(D) 24

(E) 32

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**10.**

The top of a 15-foot-long ladder rests against a vertical wall with the bottom of the ladder on level ground, as shown above. The ladder is sliding down the wall at a constant rate of 2 feet per second. At what rate, in radians per second, is the acute angle between the bottom of the ladder and the ground changing at the instant the bottom of the ladder is 9 feet from the base of the wall?

(A) $-\frac{2}{9}$

(B) $-\frac{1}{6}$

(C) $-\frac{2}{25}$

(D) $\frac{2}{25}$

(E) $\frac{1}{9}$

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**11.** In a certain factory, assume that the number of workers is constant. The number of minutes $N$ that it takes to make a single unit of a product and the number of units $U$ of the product that are made per day satisfy the relationship $U = \frac{k}{N}$, where $k$ is a constant. Which of the following best describes the relationship between the rate of change, with respect to time $t$, of $U$ and the rate of change, with respect to time $t$, of $N$ ?

(A) $\frac{dU}{dt} = \frac{k}{\left(\frac{dN}{dt}\right)}$

(B) $\frac{dU}{dt} = \frac{-k}{\left(\frac{dN}{dt}\right)}$

(C) $\frac{dU}{dt} = \frac{k}{N^2}\left(\frac{dN}{dt}\right)$

(D) $\frac{dU}{dt} = \frac{-k}{N^2}\left(\frac{dN}{dt}\right)$

**12.** Boyle's law states that if the temperature of an ideal gas is held constant, then the pressure $P$ of the gas and its volume $V$ satisfy the relationship $P = \frac{k}{V}$, where $k$ is a constant. Which of the following best describes the relationship between the rate of change, with respect to time $t$, of the pressure and the rate of change, with respect to time $t$, of the volume?

(A) $\frac{dP}{dt} = \frac{k}{\left(\frac{dV}{dt}\right)}$

(B) $\frac{dP}{dt} = \frac{-k}{\left(\frac{dV}{dt}\right)}$

(C) $\frac{dP}{dt} = \frac{k}{V^2}\left(\frac{dV}{dt}\right)$

(D) $\frac{dP}{dt} = \frac{-k}{V^2}\left(\frac{dV}{dt}\right)$

**13.** A particle moves on the hyperbola $xy = 18$ for time $t \geq 0$ seconds. At a certain instant, $y = 6$ and $\frac{dy}{dt} = 8$. Which of the following is true about $x$ at this instant?

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(A) $x$ is decreasing by 4 units per second.

(B) $x$ is increasing by 4 units per second.

(C) $x$ is decreasing by 1 unit per second.

(D) $x$ is increasing by 1 unit per second.

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**14.** A particle moves on the hyperbola $xy = 15$ for time $t \geq 0$ seconds. At a certain instant, $x = 3$ and $\frac{dx}{dt} = 6$. Which of the following is true about $y$ at this instant?

(A) $y$ is decreasing by 10 units per second.

(B) $y$ is increasing by 10 units per second.

(C) $y$ is decreasing by 5 units per second.

(D) $y$ is increasing by 5 units per second.

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