

Derivative Applications - AP Calculus

Solve each of the following:

1. (CALCULATOR) A rectangular plot of land is being expanded. At a particular moment, the length of the plot is 50 meters, and the width is 60 meters. The length is increasing at a rate of 3 meters per second, and the width is increasing at a rate of 2 meters per second. What is the rate of change of the area of the plot, in square meters, at that moment?

A) 230

B) 100

C) 360

D) 280

2. (CALCULATOR) Two cars start from the same location. One car drives east (along the positive x-axis) at a speed of 15 miles per hour, while the other car drives north (along the positive y-axis) at a speed of 20 miles per hour. At the moment when each car is exactly 100 miles away from the starting point, what is the rate at which the distance between the two cars is increasing?

- A) 24.749 mph
- B) 25 mph
- C) 30 mph
- D) 30.213 mph

3. (CALCULATOR) A 13-foot ladder is leaning against a vertical wall. The bottom of the ladder starts to slide away from the wall at a constant rate of 2 feet per second. At the moment when the bottom of the ladder is 5 feet away from the wall, how fast is the top of the ladder sliding down the wall?

A) $\frac{5}{6}$ feet per second

B) $-\frac{5}{6}$ feet per second

C) $\frac{3}{2}$ feet per second

D) $-\frac{3}{2}$ feet per second

4. A cylindrical water tank is being filled at a constant rate. The radius of the tank is increasing at a rate of 1 meter per minute. If the height of the tank remains constant at 10 meters, find the rate at which the volume of the tank is increasing when the radius is 5 meters.

A) 20π

B) 50π

C) 100π

D) 150π

5. An ice cube is melting in such a way that it maintains its cubic shape. The side length of the cube is decreasing at a rate of 0.1 cm per minute. What is the rate at which the volume of the ice cube is changing when the side length is 5 cm?
- A) -5 cubic centimeters per minute
 - B) -7.5 cubic centimeters per minute
 - C) -10 cubic centimeters per minute
 - D) -12.5 cubic centimeters per minute

6. A 6-foot-tall person is walking away from a streetlight at a rate of 3 feet per second. The streetlight is 18 feet tall. At what rate is the length of the person's shadow increasing when they are 12 feet away from the base of the streetlight?
- A) 1.5 feet per second
 - B) 2 feet per second
 - C) 2.5 feet per second
 - D) 3 feet per second

7. A swimming pool is shaped like a rectangular prism with a length of 20 meters, a width of 10 meters, and a height of 2 meters. Water is being drained from the pool at a rate of 1 cubic meter per minute. At what rate is the water level (height) decreasing when the water depth is 1.5 meters?
- A) 0.002 meters per minute
 - B) 0.005 meters per minute
 - C) 0.01 meters per minute
 - D) 0.02 meters per minute

8. A stone is dropped into a calm pond, causing circular ripples to spread out from the point of impact. If the radius of the ripple is increasing at a constant rate of 2 meters per second, how fast is the area of the ripple increasing when the radius is 4 meters?
- A) 8π square meters per second
 - B) 12π square meters per second
 - C) 16π square meters per second
 - D) 20π square meters per second

9. (CALCULATOR) A trough is being filled with water at a constant rate of 3 cubic meters per minute. The trough has a triangular cross-section with a base of 2 meters and a height of 1 meter, and it is 10 meters long. How fast is the water level rising when the water is 0.5 meters deep?
- A) 0.2 meters per minute
 - B) 0.3 meters per minute
 - C) 0.4 meters per minute
 - D) 0.5 meters per minute

10. A circular garden is being watered, causing its radius to expand at a rate of 0.4 meters per minute. When the radius of the garden is 7 meters, how fast is the area of the garden increasing?

A) 4.2π

B) 4π

C) 6π

D) 5.6π