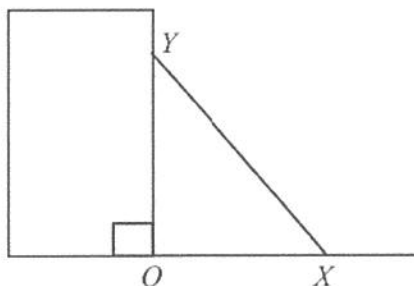


Name: \_\_\_\_\_  
AP Calc AB: Related Rated AP Questions  
Ms. Loughran

1982 AB 4



A ladder 15 feet long is leaning against a building so that end  $X$  is on level ground and end  $Y$  is on the wall as shown in the figure.  $X$  is moved away from the building at the constant rate of  $\frac{1}{2}$  foot per second.

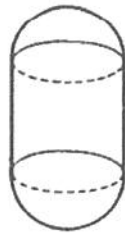
- Find the rate in feet per second at which the length  $OY$  is changing when  $X$  is 9 feet from the building.
- Find the rate of change in square feet per second of the area of triangle  $XOY$  when  $X$  is 9 feet from the building.

1984 AB 5

The volume  $V$  of a cone  $\left(V = \frac{1}{3}\pi r^2 h\right)$  is increasing at the rate of  $28\pi$  cubic units per second. At the instant when the radius  $r$  of the cone is 3 units, its volume is  $12\pi$  cubic units and the radius is increasing at  $\frac{1}{2}$  unit per second.

- At the instant when the radius of the cone is 3 units, what is the rate of change of the area of its base?
- At the instant when the radius of the cone is 3 units, what is the rate of change of its height  $h$ ?
- At the instant when the radius of the cone is 3 units, what is the instantaneous rate of change of the area of its base with respect to its height  $h$ ?

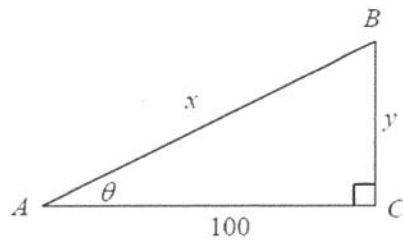
1985 AB 5, BC 2



The balloon shown is in the shape of a cylinder with hemispherical ends of the same radius as that of the cylinder. The balloon is being inflated at the rate of  $261\pi$  cubic centimeters per minute. At the instant the radius of the cylinder is 3 centimeters, the volume of the balloon is  $144\pi$  cubic centimeters and the radius of the cylinder is increasing at the rate of 2 centimeters per minute. (The volume of a cylinder is  $\pi r^2 h$  and the volume of a sphere is  $\frac{4}{3}\pi r^3$ ).

- (a) At this instant, what is the height of the cylinder?
- (b) At this instant, how fast is the height of the cylinder increasing?

1988 BC 3



The figure above represents an observer at point  $A$  watching balloon  $B$  as it rises from point  $C$ . The balloon is rising at a constant rate of 3 meters per second and the observer is 100 meters from point  $C$ .

- (a) Find the rate of change in  $x$  at the instant when  $y = 50$ .
- (b) Find the rate of change in the area of right triangle  $BCA$  at the instant when  $y = 50$ .
- (c) Find the rate of change in  $\theta$  at the instant when  $y = 50$ .

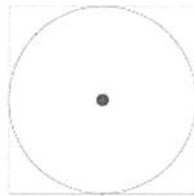
1990 AB4

The radius  $r$  of a sphere is increasing at a constant rate of 0.04 centimeters per second.

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

- (a) At the time when the radius of the sphere is 10 centimeters, what is the rate of increase of its volume?
- (b) At the time when the volume of the sphere is  $36\pi$  cubic centimeters, what is the rate of increase of the area of a cross section through the center of the sphere?
- (c) At the time when the volume and the radius of the sphere are increasing at the same numerical rate, what is the radius?

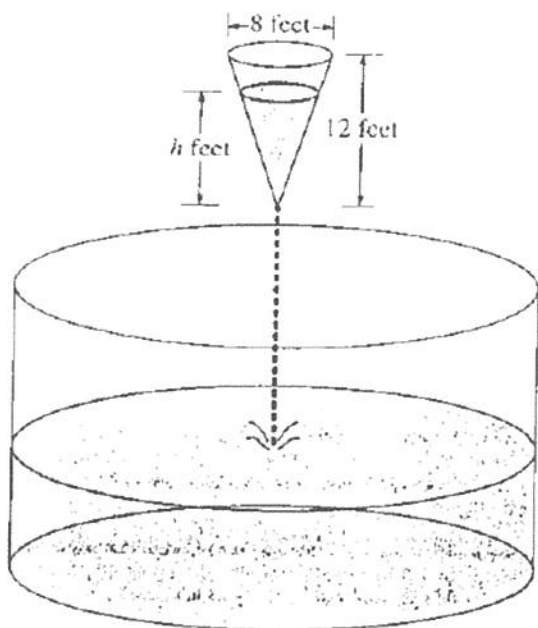
1994 AB 4, BC 2



A circle is inscribed in a square as shown in the figure above. The circumference of the circle is increasing at a constant rate of 6 inches per second. As the circle expands, the square expands to maintain the condition of tangency. (Note: A circle with radius  $r$  has circumference  $C = 2\pi r$  and area  $A = \pi r^2$ .)

- (a) Find the rate at which the perimeter of the square is increasing. Indicate units of measure.
- (b) At the instant when the area of the circle is  $25\pi$  square inches, find the rate of increase in the area enclosed between the circle and the square. Indicate units of measure.

1995 AB 5, BC 3



As shown in the figure above, water is draining from a conical tank with height 12 feet and diameter 8 feet into a cylindrical tank that has a base with area  $400\pi$  square feet. The depth  $h$ , in feet, of the water in the conical tank is changing at the rate of  $(h-12)$  feet per minute. (The volume  $V$  of a cone with radius  $r$  and height  $h$  is  $V = \frac{1}{3}\pi r^2 h$ .)

- Write an expression for the volume of water in the conical tank as a function of  $h$ .
- At what rate is the volume of water in the conical tank changing when  $h = 3$ ? Indicate units of measure.
- Let  $y$  be the depth, in feet, of the water in the cylindrical tank. At what rate is  $y$  changing when  $h = 3$ ? Indicate units of measure.