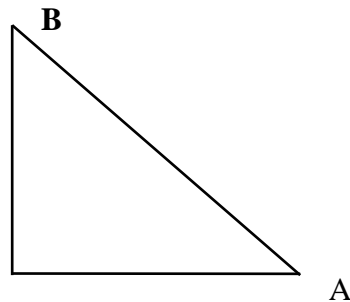


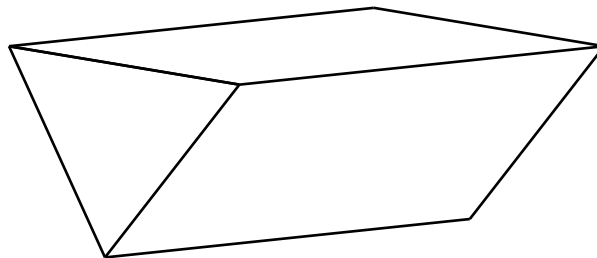
Practice Problems for Related Rates - AP Calculus BC

1. A circular plate of metal is heated in an oven, its radius increases at a rate of 0.01 cm/min. At what rate is the area of the plate increasing when the radius is 50 cm?
2. Two commercial jets at 40,000 ft are flying at 520 mi/hr along straight line courses that cross at right angles. How fast is the distance between them closing when the airplane A is 5 mi from the intersection point and airplane B is 12 mi from the intersection point? How fast is the distance closing at any time t ?



3. A spherical tootsie roll pop that you are enjoying is giving up volume at a steady rate of 0.08 ml/min. How fast will the radius of the pop be decreasing when the tootsie pop is 20mm across?
4. The mechanics at Lincoln Automotive are reboring a 6-in. deep cylinder to fit a new piston. The machine that they are using increases the cylinder's radius one-thousandth of an inch every 3 minutes. How rapidly is the volume of the cylinder increasing when the bore (diameter) is 3.80 inches?
5. Water is flowing out at the rate of 50 cubic meters/min from a shallow conical reservoir (vertex downward) of base radius 45 m and height 6m.
 - a) How fast is the water level falling when the water is 5m deep?
 - b) How fast is the radius of the water's surface changing then?
6. [1977 AB 6] A rectangle has a constant area of 200 square meters and its length L is increasing at the rate of 4 meters per second.
 - a) Find the width W at the instant the width is decreasing at the rate of 0.5 meters per second.
 - b) At what rate is the diagonal D of the rectangle changing at the instant when the width W is 10 meters?

7. [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. X is moved away from the building at the constant rate of 0.5 foot per second.
- Find the rate in feet per second at which the height of the ladder above the ground is changing when X is 9 feet from the building.
 - find the rate of change in square feet per second of the area of the triangle formed by the building, the ground, and the ladder when X is 9 feet from the building.
8. [1984 AB5, BC2] A balloon is in the shape of a cylinder and has hemispherical ends of the same radius as that of the cylinder. (i.e., it looks like a medicine capsule). The balloon is being inflated at the rate of 261π cubic centimeters per minute. At the instant that the radius of the cylinder is 3 cm, the volume of the balloon is 144π cubic centimeters and the radius of the cylinder is increasing at the rate of 2 centimeters per minute.
- At this instant, what is the height of the cylinder?
 - At this instant, how fast is the height of the cylinder changing?
9. [1987 AB5] The trough has an inverted isosceles triangle as a base. This isosceles triangle has a base of 2 feet and a height of 3 feet. The trough is 5 feet long. Water is being siphoned out of the trough at the rate of 2 cubic feet per minute. At any time t , let H be the depth and V be the volume of water in the trough.
- Find the volume of water in the trough when it is full.
 - What is the rate of change in H at the instant when the trough is $\frac{1}{4}$ full by volume?
 - What is the rate of change in the area of the surface of the water, at the instant when the trough is $\frac{1}{4}$ full by volume?



10. [1990 AB 4] The radius r of a sphere is increasing at the constant rate of 0.04 centimeters per second.
- At the time when the radius of the sphere is 10 cm., what is the rate of increase of its volume?
 - At the time when the volume of the sphere is 36π cubic centimeters, what is the rate of increase of the area of a cross section through the center of the sphere?
 - At the time when the volume and the radius of the sphere are increasing at the same numerical rate, what is the radius?