

# Related Rate Problems 1

1. A police cruiser, approaching a right-angled intersection from the north, is chasing a speeding car that has turned the corner and is now moving straight east. When the cruiser is 0.6 miles north of the intersection and the car is 0.8 miles to the east, the police determine with radar that the distance between them and the car is increasing at 20 mph. If the cruiser is moving at 60 mph at the instant of measurement, what is the speed of the car?

2. *Changing Dimensions in a Rectangular Box.*

Suppose that the edge lengths  $x$ ,  $y$ , and  $z$  of a closed rectangular box are changing at the following rates:

$$\frac{dx}{dt} = 1 \text{ m/sec}, \quad \frac{dy}{dt} = -2 \text{ m/sec}, \quad \frac{dz}{dt} = 1 \text{ m/sec}$$

Find the rates of change of the following quantities at the instant when  $x = 4$ ,  $y = 3$ , and  $z = 2$ .

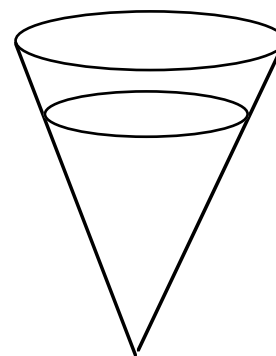
a) the volume

b) the surface area

c) the diagonal length

3. *Filling a Conical Tank*

Water runs into a conical tank at the rate of  $9 \text{ ft}^3/\text{min}$ . The tank stands point down and has a height of 10 ft and a base radius of 5 ft. How fast is the water level rising when the water is 6 ft. deep?



4. *Filling a Trough*

A trough is 15 ft. long and 4 ft across the top as shown in the figure. Its ends are isosceles triangles with height 3 ft. Water runs into the trough at the rate of  $2.5 \text{ ft}^3/\text{min}$ . How fast is the water level rising when it is 2 ft deep?

5. *A Haul of a problem*

A rope is attached to a pulley mount on a 15 foot tower. The end of the rope is attached to a heavily load cart. A worker can pull in the rope at a rate of 2 ft/sec. How fast is the cart approaching the tower when it is 8 ft. from the tower?

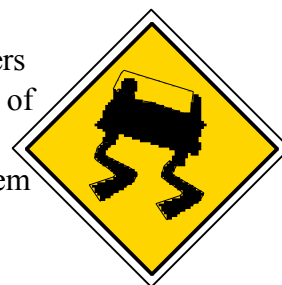
6. *Get him to the North Pole quick!!*

The body of a snowman is in the shape of a sphere and is melting at a rate of  $2 \text{ ft}^3/\text{hour}$ . How fast is the radius changing when the body is 3 ft. in diameter. Assume his body remains spherical.



7. *A slick problem*

An accident at an oil drilling platform is causing a circular oil slick. Engineers determine that when the radius is 750 feet, the slick is increasing at the rate of 0.5 feet per minute. At what rate is the oil flowing from the site of the accident? Note: We are ignoring the oil's thickness. How would the problem change if it is known that the oil is 0.08 feet thick?



8. Tweety is resting in a bird house 24 feet off the ground. Using a 26 foot ladder which he leaned against the pole holding the bird house, Sylvester tries to steal the small yellow bird. Tweety's bodyguard, Hector the dog, starts pulling the base of the ladder away from the pole at a rate of 2 ft/s. How fast is the ladder falling when it is 10 feet off the ground?

