

## Related Rates – DAY 1

- 1) The top of a 25-foot ladder, leaning against a vertical wall, is slipping down the wall at the rate of 1 foot per minute. How fast is the bottom of the ladder slipping along the ground when the bottom of the ladder is 7 feet away from the base of the wall?
- 2) A balloon is being inflated by pumping air in at the rate of 2 cubic inches per second. How fast is the diameter of the balloon increasing when the radius is one-half inch?
- 3) Oil from an uncapped oil well in the ocean is radiating outward in the form of a circular film on the surface of the water. If the radius of the circle is increasing at the rate of 2 meters per second, how fast is the area of the oil film growing when the radius is 100 meters?
- 4) ) If the radius of a sphere is increasing at the constant rate of  $3 \text{ mm/sec}$ , how fast is the volume changing when the surface area  $4\pi r^2$  is 10 square millimeters?
- 5) What is the radius of an expanding circle at a moment when the rate of change of its area is numerically twice as large as the rate of change of its radius?
- 6) A plane flying parallel to the ground at a height of 4 km passes over a radar station. A short time later, the radar equipment reveals that the plane is 5 km away and that the distance between the plane and the station is increasing at a rate of 300 km per hour. At that moment, how fast is the plane moving horizontally?
- 7) A spherical snowball is melting (symmetrically) at a rate of  $4\pi$  cubic cm per hour. How fast is the diameter changing when it 20 centimeters?

## Related Rates – DAY 2

- 1) A cylindrical tank of radius 10 feet is being filled with wheat at the rate of 314 cubic feet per minute. How fast is the depth of the wheat increasing? (The volume of a cylinder is  $\pi r^2 h$ , where  $r$  is its radius and  $h$  its height.)
- 2) A boat passes a fixed buoy at 9 A.M., heading due west at 3 mph. Another boat passes the same buoy at 10 A.M., heading due north at 5 mph. How fast is the distance between the boats changing at 11:30 A.M.?
- 3) Water is pouring into an inverted cone at the rate of 3.14 cubic meters per minute. The height of the cone is 10 m and the radius of its base is 5 m. How fast is the water level rising when the water stands 7.5 meters in the cone?
- 4) A boat is being pulled into a dock by a rope that passes through a ring on the bow of the boat. The dock is 8 feet higher than the bow ring. How fast is the boat approaching the dock when the length of rope between the dock and the boat is 10 feet, if the rope is being pulled in at the rate of 3 feet per second?
- 5) A trough is 10 feet long and has a cross section in the shape of an equilateral triangle 2 feet on each side. If water is being pumped in at a rate of  $20 \text{ ft}^3/\text{min}$ , how fast is the water level rising when the water is 1 ft deep?
- 6) Sand is being poured onto a conical pile at the constant rate of  $50 \text{ ft}^3/\text{min}$ . Frictional forces in the sand are such that the height of the pile is always equal to the radius of the base. How fast is the height of the pile increasing when the sand is 5 feet deep?

## Packet p.6

Related Rates - Day 1

1.  $\frac{dx}{dt} = +\frac{29}{7} \text{ ft/min}$  or  $\approx 3.429 \text{ ft/min}$

2.  $\frac{dr}{dt} = \frac{2}{\pi} \text{ in/sec}$   $\frac{d(\text{Diameter})}{dt} = \frac{4}{\pi} \text{ in/sec}$

3.  $\frac{dA}{dt} = 400\pi \frac{\text{m}^2}{\text{sec}}$

4.  $\frac{dV}{dt} = 30 \frac{\text{mm}^3}{\text{sec}}$

5.  $r = \frac{1}{\pi}$  units

6. 500 km/hr

7.  $\frac{1}{30} \text{ cm/hr}$  or  $-0.02 \text{ cm/hr}$

## Packet p.7

Related Rates - Day 2

1.  $\frac{dh}{dt} = 1 \text{ ft/min}$   $\left(\frac{314}{100\pi}\right) \times 1$

2.  $4\sqrt{2} \text{ mph}$  or  $5.657 \text{ mph}$

3.  $\frac{dh}{dt} = \frac{16}{225} \text{ m/min}$

4.  $\frac{dx}{dt} = -5 \text{ ft/sec}$

5.  $\frac{dh}{dt} = \sqrt{3} \text{ ft/min}$

6.  $\frac{dh}{dt} = \frac{2}{\pi} \text{ ft/min}$