

## Related Rates

1. Oil spilled from a ruptured tanker spreads in a circle whose area increases at a constant rate of  $6\text{km}^2 / \text{hr}$ . How fast is the radius of the spill increasing when the area is  $9\text{km}^2$ . ( $1/\sqrt{\pi}$ )
2. A spherical balloon is to be deflated so that its radius decreases at a constant rate of 15 cm/min. At what rate must air be removed when the radius is 9cm? ( $4860\pi\text{ cm}^3 / \text{min}$ ).
3. A 13 foot ladder is leaning against a wall. If the top of the ladder slips down the wall at a rate of 2 ft/sec, how fast will the foot be moving away from the wall when the top is 5 feet above the ground. ( $5/6$  feet/sec)
4. At a certain instant each edge of a cube is 5 n. long and the volume is increasing at a rate of  $2\text{ in}^3 / \text{min}$ . How fast is the surface area of the cube increasing? ( $8/5\text{ in}^2 / \text{min}$ )
5. A rocket, rising vertically, is tracked by a radar station that is on the ground 5 miles from the launch pad. At what rate is the elevation angle changing when the rocket is 3000 feet up and rising vertically at 500 ft/sec? (0.0187 radian/sec or  $1.071^\circ / \text{sec}$ )
6. A conical water tank with vertex down has a radius of 10 ft at the top and is 24 ft high. If water flows into the tank at a rate of  $20\text{ ft}^3 / \text{min}$ , how fast is the depth of the water increasing when the water is 16 feet deep? ( $9/20\pi\text{ ft} / \text{min}$ )
7. Sand pouring from a chute forms a conical pile whose height is equal to the diameter. If the height increases at a constant rate of 5 ft/min, at what rate is the sand pouring from the chute when the pile is 10 ft high? ( $125\pi\text{ ft}^3 / \text{min}$ )
8. An aircraft is climbing at a 30 degree angle to the horizontal. How fast is the aircraft gaining altitude if its speed is 500 mi/hr? (250mi/hr)
9. A boat is pulled into a dock by means of a rope attached to a pulley on the dock. The rope is attached to the bow of the boat at a point 10 feet below the pulley. How fast must the rope be pulled if we want the boat to approach the dock at a rate of 12 ft/min at the instant when 125 ft of rope is out? ( $36/25\sqrt{69}\text{ ft} / \text{min}$ )
10. A particle is moving along the curve whose equation is  $\frac{xy^3}{1+y^2} = \frac{8}{5}$ . Assume that the x-coordinate is increasing at the rate of 6 units/sec when the particle is at the point (1, 2).
  - a) At what rate is the y-coordinate of the point changing at that instant? ( $-60/7$  units/sec)
  - b) Is the particle rising or falling at that instant? (falling)