7) A spherical balloon is inflated with helium at a rate of 110π ft^3/min. How fast is the balloon's radius increasing when the radius is 4 ft?

7) _____

$$7) \frac{d}{dt}\left(V = \frac{4}{3}\pi r^3\right)$$

$$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$$

$$110\pi = 4\pi (4)^2 \frac{dr}{dt}$$

$$110\pi = 64\pi \frac{dr}{dt}$$

$$\frac{110\pi}{64\pi} = \frac{64\pi \frac{dr}{dt}}{64\pi}$$

$$1.72 = \frac{dr}{dt}$$

8) The radius of a right circular cylinder is increasing at the rate of 6 in./s, while the height is decreasing at the rate of 3 in./s. At what rate is the volume of the cylinder changing when the radius is 5 in. and the height is 11 in.?

8) _____

$V = \pi r^2 h$

$r = 5 \qquad h = 11$

$\dfrac{dr}{dt} = 6$

$\dfrac{dh}{dt} = -3$

$V = \pi(r^2 h)$

$f = r^2 \qquad g = h$

$f' = 2r \dfrac{dr}{dt}$

$g' = \dfrac{dh}{dt}$

$\dfrac{dV}{dt} = \pi \left(2rh \dfrac{dr}{dt} + r^2 \dfrac{dh}{dt} \right)$

$\qquad\qquad\quad f' g \qquad + \quad f \ g'$

$= \pi \left(2(5)(11)(6) + 5^2(-3) \right)$

$= \pi (660 - 75) = 585\pi \ in^2/s$

1

9) A man flies a kite at a height of 120 m. The wind carries the kite horizontally away from him at a rate of 8 m/sec. How fast is the distance between the man and the kite changing when the kite is 130 m away from him?

9) _____

$d = 130$

$d = 130$

120 y

$\dfrac{dx}{dt} = 8$ $\dfrac{dd}{dt} = ?$

$x = 50$

$x^2 + 120^2 = d^2$

$120^2 + x^2 = 130^2$

$2x\dfrac{dx}{dt} = 2d\dfrac{dd}{dt}$

$2(50)(8) = 2(130)\dfrac{dd}{dt}$

$\dfrac{400}{130} = \dfrac{dd}{dt}$

10) A ladder is slipping down a vertical wall. If the ladder is 20 ft long and the top of it is slipping at the constant rate of 2 ft/s, how fast is the bottom of the ladder moving along the ground when the bottom is 16 ft from the wall?

10) _____

$$x^2 + y^2 = 20^2$$

$$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0$$

$$\frac{dy}{dt} = -2 \downarrow$$

$$y = 12$$

3

$$2(16) \frac{dx}{dt} + 2(12)(-2) = 0 \qquad \frac{dx}{dt} ?$$

$$32 \frac{dx}{dt} - 48 = 0$$

$$\frac{dx}{dt} = \frac{48}{32} = 1.5 \qquad x = 16$$

20

5'

$$16^2 + y^2 = 20^2$$

$$256 + y^2 = 400$$

$$y^2 = 144$$

$$y = 12$$

4