

## Answers to Worksheet 11 - Related Rates

1)  $V =$  volume of sphere  $r =$  radius  $t =$  time

$$\text{Equation: } V = \frac{4}{3}\pi r^3 \quad \text{Given rate: } \frac{dV}{dt} = -\frac{256\pi}{3} \quad \text{Find: } \left. \frac{dr}{dt} \right|_{r=3}$$

$$\left. \frac{dr}{dt} \right|_{r=3} = \frac{1}{4\pi r^2} \cdot \frac{dV}{dt} = -\frac{64}{27} \text{ in/s}$$

2)  $V =$  volume of material in cone  $h =$  height  $t =$  time

$$\text{Equation: } V = \frac{\pi h^3}{3} \quad \text{Given rate: } \frac{dV}{dt} = -\frac{2\pi}{3} \quad \text{Find: } \left. \frac{dh}{dt} \right|_{h=5}$$

$$\left. \frac{dh}{dt} \right|_{h=5} = \frac{1}{\pi h^2} \cdot \frac{dV}{dt} = -\frac{2}{75} \text{ cm/sec}$$

3)  $A =$  area of circle  $r =$  radius  $t =$  time

$$\text{Equation: } A = \pi r^2 \quad \text{Given rate: } \frac{dr}{dt} = 5 \quad \text{Find: } \left. \frac{dA}{dt} \right|_{r=8}$$

$$\left. \frac{dA}{dt} \right|_{r=8} = 2\pi r \cdot \frac{dr}{dt} = 80\pi \text{ m}^2/\text{min}$$

4)  $a =$  altitude of rocket  $\theta =$  angle of elevation from observer to rocket  $t =$  time

$$\text{Equation: } \tan \theta = \frac{a}{500} \quad \text{Given rate: } \frac{da}{dt} = 500 \quad \text{Find: } \left. \frac{d\theta}{dt} \right|_{a=1200}$$

$$\left. \frac{d\theta}{dt} \right|_{a=1200} = \frac{1}{500 \cdot \sec^2 \theta} \cdot \frac{da}{dt} = \frac{25}{169} \text{ radians/sec}$$

5)  $x =$  distance from person to lamppost  $y =$  length of shadow  $t =$  time

$$\text{Equation: } \frac{x+y}{17} = \frac{y}{6} \quad \text{Given rate: } \frac{dx}{dt} = -\frac{3}{x} \quad \text{Find: } \left. \frac{dy}{dt} \right|_{x=10}$$

$$\left. \frac{dy}{dt} \right|_{x=10} = \frac{6}{11} \cdot \frac{dx}{dt} = -\frac{9}{55} \text{ ft/sec}$$