SATPREP

Assignment- Related Rates

Solve each related rate problem.

1) Oil spilling from a ruptured tanker spreads in a circle on the surface of the ocean. The radius of the spill increases at a rate of 9 m/min. How fast is the area of the spill increasing when the radius is 4 m?

2) A spherical snowball is rolled in fresh snow, causing it to grow so that its radius increases at a rate of 2 in/sec. How fast is the volume of the snowball increasing when the radius is 8 in?

3) A conical paper cup is 10 cm tall with a radius of 30 cm. The cup is being filled with water so that the water level rises at a rate of 2 cm/sec. At what rate is water being poured into the cup when the water level is 3 cm?

4) A hypothetical square grows so that the length of its sides are increasing at a rate of 3 m/min. How fast is the area of the square increasing when the sides are 12 m each?

5) A hypothetical square grows so that the length of its diagonals are increasing at a rate of 8 m/min. How fast is the area of the square increasing when the diagonals are 8 m each?

6) A hypothetical cube grows so that the length of its sides are increasing at a rate of 3 m/min. How fast is the volume of the cube increasing when the sides are 3 m each?

7) A crowd gathers around a movie star, forming a circle. The radius of the crowd increases at a rate of 3 ft/sec. How fast is the area taken up by the crowd increasing when the radius is 2 ft?

8) A spherical balloon is inflated so that its radius increases at a rate of 4 cm/sec. How fast is the volume of the balloon increasing when the radius is 3 cm?

Answers to Assignment- Related Rates

1) A = area of circle r = radius t = time

Equation: $A = \pi r^2$ Given rate: $\frac{dr}{dt} = 9$ Find: $\left.\frac{dA}{dt}\right|_{r=4}$

$$\left.\frac{dA}{dt}\right|_{r=4} = 2\pi r \cdot \frac{dr}{dt} = 72\pi \text{ m}^2/\text{min}$$

2) V = volume of sphere r = radius t = time

Equation: $V = \frac{4}{3}\pi r^3$ Given rate: $\frac{dr}{dt} = 2$ Find: $\left.\frac{dV}{dt}\right|_{r=8}$

$$\left.\frac{dV}{dt}\right|_{r=8} = 4\pi r^2 \cdot \frac{dr}{dt} = 512\pi \text{ in}^3/\text{sec}$$

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

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

$$\left.\frac{dV}{dt}\right|_{h=3} = 9\pi h^2 \cdot \frac{dh}{dt} = 162\pi \text{ cm}^3/\text{sec}$$

4) A = area of square s = length of sides t = time

Equation: $A = s^2$ Given rate: $\frac{ds}{dt} = 3$ Find: $\left.\frac{dA}{dt}\right|_{s=12}$

$$\left.\frac{dA}{dt}\right|_{s=12} = 2s \cdot \frac{ds}{dt} = 72 \text{ m}^2/\text{min}$$

5) A = area of square x = length of diagonals t = time

Equation: $A = \frac{x^2}{2}$ Given rate: $\frac{dx}{dt} = 8$ Find: $\left.\frac{dA}{dt}\right|_{x=8}$

$$\left.\frac{dA}{dt}\right|_{x=8} = x \cdot \frac{dx}{dt} = 64 \text{ m}^2/\text{min}$$

6) V = volume of cube s = length of sides t = time

Equation: $V = s^3$ Given rate: $\frac{ds}{dt} = 3$ Find: $\left.\frac{dV}{dt}\right|_{s=3}$

$$\left.\frac{dV}{dt}\right|_{s=3} = 3s^2 \cdot \frac{ds}{dt} = 81 \text{ m}^3/\text{min}$$

7) A = area of circle r = radius t = time

Equation: $A = \pi r^2$ Given rate: $\frac{dr}{dt} = 3$ Find: $\left.\frac{dA}{dt}\right|_{r=2}$

$$\left.\frac{dA}{dt}\right|_{r=2} = 2\pi r \cdot \frac{dr}{dt} = 12\pi \text{ ft}^2/\text{sec}$$

8) V = volume of sphere r = radius t = time

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

$$\left.\frac{dV}{dt}\right|_{r=3} = 4\pi r^2 \cdot \frac{dr}{dt} = 144\pi \text{ cm}^3/\text{sec}$$