

4-6 day 1 Related Rates

Learning Objectives:

I can use derivatives and the process of related rates to find rates in real world situations where I know another rate.

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Ex1: Air is being pumped into a spherical balloon so that its volume increases at a rate of $100 \text{ cm}^3/\text{sec}$. How fast is the radius of the balloon increasing when the diameter is 50 cm ?

$$V = \frac{4}{3} \pi r^3 \quad \left\{ \begin{array}{l} \frac{dV}{dt} = V' = 100 \text{ cm}^3/\text{sec} \\ r = 25 \\ \frac{dr}{dt} = r' \end{array} \right.$$

$$V' = 4\pi r^2 \cdot r'$$

$$100 = 4\pi (25)^2 \cdot r'$$

$$r' = .013 \text{ cm/sec}$$

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Ex. 2: Gas is escaping from a spherical balloon at the rate of 2 cubic feet per minute. How fast is the surface area shrinking when the radius is 12 feet?

$$V = \frac{4}{3} \pi r^3 \quad SA = 4\pi r^2$$

$$V' = 4\pi r^2 \cdot r' \quad V' = 2 \text{ ft}^3/\text{min}$$

$$2 = 4\pi (12)^2 \cdot r' \quad r = 12$$

$$.001105 = r' \quad \frac{dSA}{dt} = ?$$

$$\frac{dSA}{dt} = 8\pi r \cdot r'$$

$$= 8\pi (12) \cdot .001105$$

$$= .333 \text{ ft}^2/\text{min}$$

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Ex. 3: A ladder 10 feet long is leaning against a house. The base of the ladder slides away from the house at a constant rate of 1 foot per second. How fast is the top of the ladder moving down the house when the base of the ladder is

a. 6 feet from the house? $x^2 + h^2 = 10^2$

$$\frac{dh}{dt} = h'$$

$$2x \cdot x' + 2h \cdot h' = 0$$


$$2(6)(1) + 2(8) \cdot h' = 0$$

$$h' = -\frac{3}{4} \text{ ft/sec}$$

b. 8 feet from the house? $h' = \frac{3}{4} \text{ ft/sec}$

$$2x \cdot x' + 2h \cdot h' = 0$$

$$2(8)(1) + 2(6) \cdot h' = 0$$

$$h' = -\frac{4}{3} \text{ ft/sec}$$


c. 9 feet from the house?

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Ex4: A water tank has the shape of an inverted cone with a base radius of 2 m and a height of 4m. If water is being pumped into the tank at a rate of $2 \text{ m}^3/\text{min}$, find the rate at which the water level is rising when the water is 3m deep.

$$V = \frac{\pi}{3} r^2 h$$

$$V = \frac{\pi}{3} \left(\frac{h}{2}\right)^2 \cdot h = \frac{\pi}{12} h^3$$

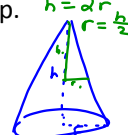
$$V = \frac{\pi}{12} h^3$$

$$V' = \frac{\pi}{4} \cdot h^2 \cdot h'$$

$$2 = \frac{\pi}{4} \cdot 3^2 \cdot h'$$

$$h' = .283 \text{ m/min}$$

$h = 2r$
 $r = \frac{h}{2}$



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Homework

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