4-6 day 1 Related Rates

Learning Objecves:

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 cm³/sec. How fast is the radius of the balloon increasing when the diameter is 50cm?

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

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

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

$r' = .013$ cm/sec

$\frac{dV}{dt} = V' = 100$ cm³/sec

$r = 25$

$\frac{dr}{dt} = r'$

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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?

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

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

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

$.00110\,5 = r'$

$SA = 4\pi r^2$

$V' = 2$ ft³/min

$r = 12$

$\frac{dSA}{dt} = ?$

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

$= 8\pi (12) \cdot .00110\,5$

$= .333$ ft²/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?

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

$x' = 1, x = 6$

$x^2 + h^2 = 10^2$

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

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

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

b. 8 feet from the house?

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

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

$h' = -\frac{4}{3}$ 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 m³/min, find the rate at which the water level is rising when the water is 3m deep.

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

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

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

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

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

$h' = .283$ m/min

$r = 2$ ~~$h = 4$~~

$V' = 2$

$h = 3$

$h' = ?$

$h = 2r$

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

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Homework

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