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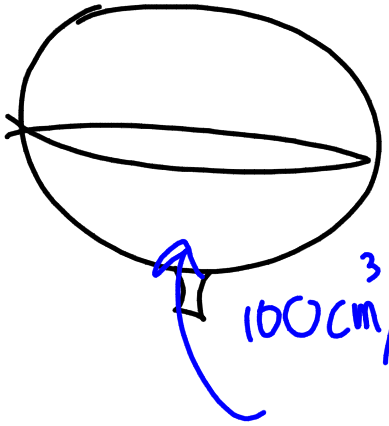
Ex1. Air is being pumped into a spherical balloon so that its volume increases at a rate of 100 cm^3/sec. How fast is the radius of the balloon increasing when the diameter is 50cm?

r = 25 cm



$\frac{dV}{dt} = 100\ cm^3/sec$

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

V of Sphere

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

$V(t) = \frac{4}{3}\pi [r(t)]^3$

$\frac{dV}{dt} = 4\pi [r(t)]^2 \cdot \frac{dr}{dt}$

$100 = 4\pi [25]^2 \cdot \frac{dr}{dt}$

$100 = 2500\pi \cdot \frac{dr}{dt}$

$\frac{100}{2500\pi} = \frac{2500\pi}{2500\pi} \cdot \frac{dr}{dt}$

$\frac{1}{25\pi}\ cm/sec = \frac{dr}{dt}$

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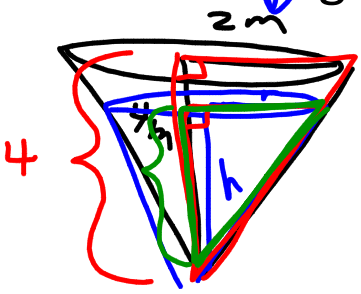
Ex2. A water tank has the shape of an inverted cone with a base radius of 2 m and a height of 4m. If water is being pumped into the tank at a rate of 2 m^3/min, find the rate at which the water level is rising when the water is 3m deep.



$2\ m^3/min$ $\frac{dV}{dt} = 2$ $\frac{dh}{dt} = ?$

Volume of Cone

$V = \frac{1}{3}\pi r^2 h$

$V = \frac{1}{3}\pi \left(\frac{h}{2}\right)^2 h$

$V = \frac{1}{3}\pi \frac{h^2}{4} \cdot h^1$

$V = \frac{1}{12}\pi h^3$

$V(t) = \frac{1}{12}\pi [h(t)]^3$

$\frac{2}{r} = \frac{4}{h}$

$2h = 4r$

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

$\frac{dV}{dt} = \frac{1}{4}\pi h^2 \frac{dh}{dt}$

$2 = \frac{1}{4}\pi 3^2 \frac{dh}{dt}$

$2 = \frac{9}{4}\pi \frac{dh}{t}$

$\frac{dh}{dt} = \frac{8}{9\pi}$ m/min

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Homework

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