

4.1 - Related Rates

↳ relation between 2 things (rates)
characterized by an eq.

Steps to follow

1. identify variables & givens (check units)
2. make a diagram
3. Write an equation to relate your variables (units)
4. Take the derivative of both sides
5. Sub back in known values to solve for rate.

6. $t=20, \frac{dx}{dt} = 5$ $x=150$ $y=80$ @ $t=20$ what is $\frac{ds}{dt}$?
 $\frac{dy}{dt} = 4$ $s^2 = x^2 + y^2$

$$2s \frac{ds}{dt} = 2x \frac{dx}{dt} + 2y \frac{dy}{dt} \quad \frac{ds}{dt} = \frac{x \frac{dx}{dt} + y \frac{dy}{dt}}{s}$$

$$s = \sqrt{150^2 + 80^2} = \pm 170$$

$$\frac{ds}{dt} = \frac{(150)(5) + (80)(4)}{\pm 170} = \pm \frac{1070}{170}$$

10. Volume of a Sphere

rad ↑ @ 1 cm/s

$\frac{dv}{dt}$ when $r=6$ cm?

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

$$\frac{dv}{dt} = \frac{4\pi}{3} 3r^2 \frac{dr}{dt}$$

$$\frac{dv}{dt} = 4\pi (6)^2 (1)$$

$$\frac{dv}{dt} = 144\pi$$

Right Triangle

$$A = \frac{bh}{2}$$

$$A^2 + B^2 = c^2$$

Cube

$$\text{Surface area} = 6(\text{edge})^2$$

$$V = (\text{edge})^3$$

Circle

$$A = \pi r^2$$

$$\text{Circumference} = 2\pi r$$

Sphere

$$\text{Surface area} = 4\pi r^2$$

$$\text{Volume} = \frac{4}{3}\pi r^3$$

Right Circular Cone

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

Rectangle

$$A = bh$$

12) $\frac{dr}{dt} = \frac{2 \text{ cm}}{\text{min}}$

$\frac{d}{dt}$ Surface Area when $r = 100 \text{ cm}$?

$$\frac{ds}{dt} = 4\pi 2r \left(\frac{dr}{dt}\right)$$

$$\frac{ds}{dt} = 8\pi (100) \left(2 \frac{\text{cm}}{\text{min}}\right) = 16000\pi \frac{\text{cm}^2}{\text{min}}$$