

constant will not change } $\frac{dV}{dt} = ?$
 variable will change

4. Let V be the volume of a sphere with radius r that is changing with respect to time. If $\frac{dr}{dt}$ is constant, is $\frac{dV}{dt}$ constant? Explain.

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

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

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

r is a constant

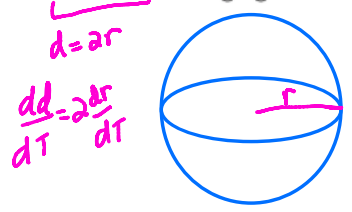
if $\frac{dr}{dt} = 0$ Then r is a constant

if $\frac{dr}{dt} \neq 0$ Then r changes

$\frac{dV}{dt}$ changes if $\frac{dr}{dt} \neq 0$

$\frac{dy}{dt}$ is a constant if $\frac{dr}{dt} = 0$

3. A spherical snowball ($V = \frac{4}{3}\pi r^3$) is melting at a rate of 3π cubic centimeters per hour. How fast is the diameter changing when the diameter is 25 cm?



$d = 2r$
 $\frac{dd}{dt} = 2 \frac{dr}{dt}$

$r = \frac{25}{2} = 12.5$
 $V = \frac{4}{3}\pi r^3$
 $\frac{dV}{dt} = \frac{4}{3}\pi \cdot 3r^2 \frac{dr}{dt} = 4\pi r^2 \frac{dr}{dt}$

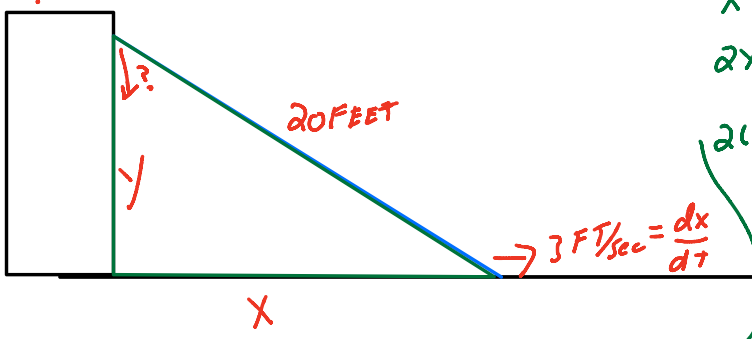
$\frac{dV}{dt} = -3\pi \text{ cm}^3/\text{hour}$

$\frac{dV}{dt} = 4\pi r^2 \frac{dr}{dt}$
 $-3\pi \text{ cm}^3/\text{h} = 4\pi \left(\frac{25}{2} \text{ cm}\right)^2 \frac{dr}{dt}$

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

2. A ladder is 20 feet long leans against the wall of a house. The base of the ladder is pulled away at a rate of 3 feet per second. How fast is the top of the ladder moving down the wall when the base is 12 feet from the wall? (Include Given, Want, and Picture in your answer)

$\frac{dy}{dt} = -$ (y is shrinking)



$x^2 + y^2 = (20 \text{ FT})^2 = 400 \text{ FT}^2$

$2x \frac{dx}{dt} + 2y \frac{dy}{dt} = 0$

$2(12) \cdot 3 + 2(16) \frac{dy}{dt} = 0$

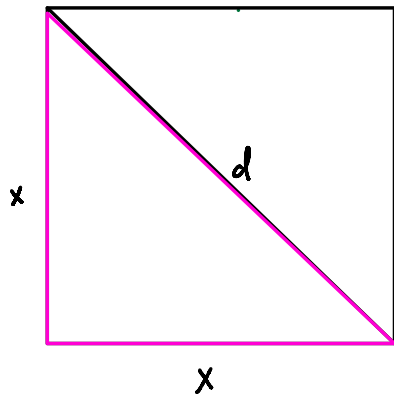
$12^2 + y^2 = 20^2$

$144 + y^2 = 400$

$y^2 = 256$

$y = 16$

$72 + 32 \frac{dy}{dt} = 0$



$$x^2 + x^2 = d^2$$

$$2x^2 = d^2$$

$$4x \cdot \frac{dx}{dt} = 2d \cdot \frac{dd}{dt}$$

$$\frac{dd}{dt} = 7 \text{ m/min}$$

$$d = 3 \text{ m}$$

$$x^2 + x^2 = 3^2$$

$$2x^2 = 9$$

$$x^2 = \frac{9}{2}$$

$$x = \frac{3}{\sqrt{2}} = \frac{3\sqrt{2}}{2}$$

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

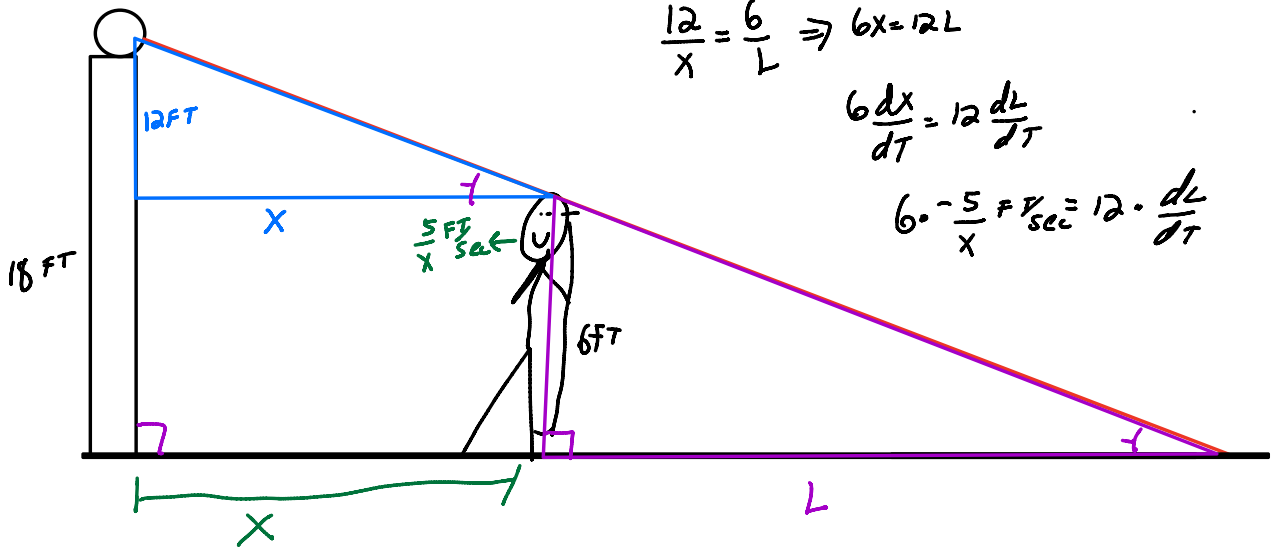
Find $\frac{dx}{dt}$

$$A = x^2$$

$$\frac{dA}{dt} = 2x \frac{dx}{dt}$$

and Plug in

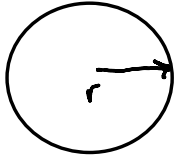
$$\frac{dx}{dt} = -\frac{5}{x} \text{ FT/sec}$$



$$\frac{12}{x} = \frac{6}{L} \Rightarrow 6x = 12L$$

$$6 \frac{dx}{dt} = 12 \frac{dL}{dt}$$

$$6 \cdot \frac{5}{x} \text{ FT/sec} = 12 \cdot \frac{dL}{dt}$$



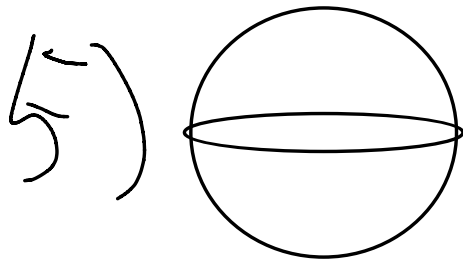
$$A = \pi r^2$$

$$\frac{dV}{dT} = 2\text{ m/min}$$

$$\frac{dA}{dT} = \pi 2r \frac{dr}{dT}$$

$$= \pi 2(12\text{ m})(2\text{ m/min})$$

$$\frac{dA}{dT} = 48\pi \text{ m}^2/\text{min}$$



$$\frac{dr}{dt} = -2 \text{ in/sec}$$

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

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

$$\frac{dV}{dt} = 4\pi (5\text{ in})^2 (-2 \text{ in/sec})$$

$$\frac{dV}{dt} = -200\pi \text{ in}^3/\text{sec}$$