# Guideline for Solving Related Rate WP

1. Draw + Label a diagram.
2. Form algebraic expressions
3. Make a relationship between the two quantities involving the RATE to be determined.
4. TAKE the derivative of both sides with respect to time.
5. Solve for the desired RATE ↓ substitute in values

. **A pebble is dropped into a calm pond causing ripples in the form of concentric circles. The radius of the outer ripple is increasing at a rate of 1 ft/sec. When the radius is 4 feet, at what rate is the total area of the disturbed water increasing?**

$A = \pi r^2$

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

$\frac{dr}{dt} = 1 \text{ ft/sec}$

$r = 4 \text{ ft}$

Rate will be ft/sec in/sec m/min etc

$$\left.\frac{dA}{dt}\right|_{r=4} = 2\pi(4\text{ ft})\left(1\frac{\text{ft}}{\text{sec}}\right)$$

$$= 8\pi \text{ ft}^2/\text{sec}$$

**Air is being pumped into a spherical shaped balloon at a rate of 4.5 in3/min. Find the rate of change of radius when the radius = 2 in.**

$\frac{dV}{dt} = 4.5 in^3/min \quad r = 2 in$

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

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

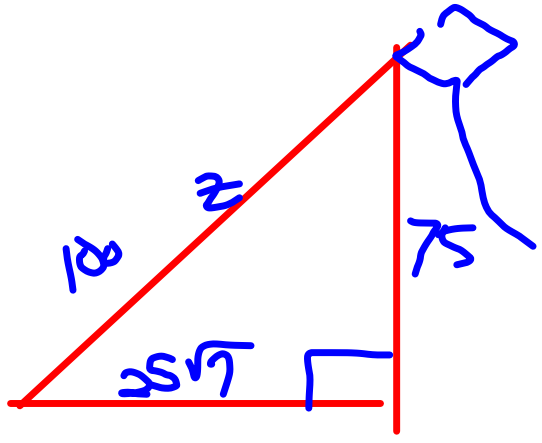
$4.5 = 4\pi (4)^{in^2} \frac{dr}{dt}$

$4.5 = 16\pi \frac{dr}{dt}$

$\frac{4.5}{16\pi} \frac{in}{min} = \frac{dr}{dt}$

$\frac{9}{32\pi} \frac{in}{min} = \frac{dr}{dt}$

**A kite is at an altitude of 75 feet and is moving horizontally at 12 ft/sec. The length of the kite string is 100 feet. How fast is the string being paid out by the person holding the kite?**




$z = 100$ @ some point

$\frac{dx}{dt} = 12$ ft/sec

$x^2 + 75^2 = 100^2$

$x^2 = 7500$

$x = \sqrt{7500} = 25\sqrt{7}$

$x^2 + y^2 = z^2$

$x^2 + 75^2 = z^2$

$2x\frac{dx}{dt} = 2z\frac{dz}{dt}$

$25\sqrt{7}(12) = 100\frac{dz}{dt}$

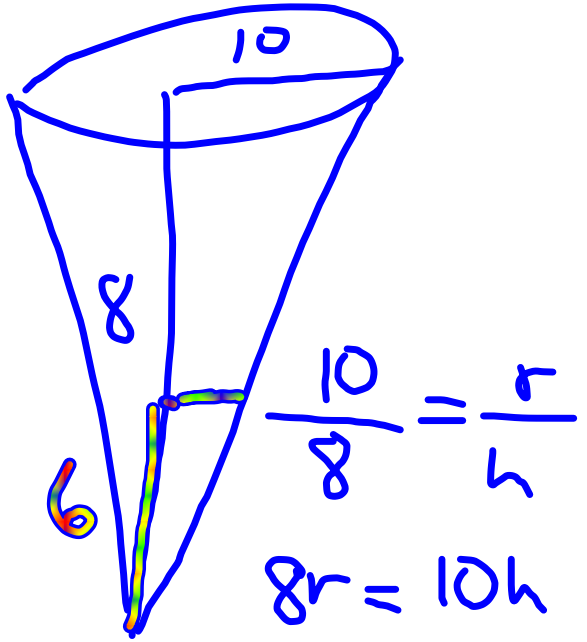
$3\sqrt{7} = \frac{25\sqrt{7}(12)}{100} = \frac{dz}{dt}$

A conical tank of diameter 20 feet has a dept of 8 feet. The point of the cone is poiting down. If the water is leaking out at a rate of 5 ft3 per minute, when the dept of the water is 6 feet determine:

a. the velocity at the top of the water

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

$\therefore$




$\frac{10}{8} = \frac{r}{h}$

$8r = 10h$

c. how fast the water is moving down the tanks side.

$\frac{10}{8} = \frac{r}{6}$ $r = 7.5$

c. how fast the water is moving down the tanks side.