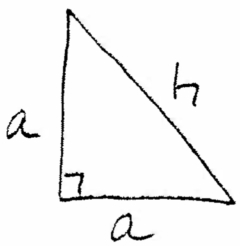
The legs of an isosceles right triangle are increasing in length at a rate of 1 mm/sec. How quickly is the size of the hypotenuse growing at the moment when its length is 5 cm? $= 50\text{ mm}$



$$a^2 + a^2 = h^2$$

$$2a^2 = h^2$$

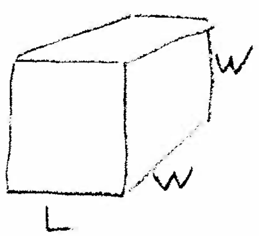
$$\cancel{4}^{2} a \frac{da}{dh} = \cancel{2} h \frac{dh}{dt}$$

$$2a^2 = h^2 \qquad a^2 = \frac{50^2}{2} \qquad a = \sqrt{1250}$$

$$\frac{da}{dt} = +1 \qquad \left.\frac{dh}{dt}\right|_{h=50}$$

$$2(\sqrt{1250})(+1) = 50\left(\frac{dh}{dt}\right) \rightarrow \frac{dh}{dt} = \frac{+2\sqrt{1250}}{50} \approx 1.4$$

A box-shaped ice cube is melting such that each of its length, width and height decrease at the same rate of 0.5 cm/sec. Furthermore, the cube's width and height are always equal. Find the rate of the change of the ice cube's surface area at the moment when its length is 8 cm and its surface area is 210 cm².



$$A = 4WL + 2W^2$$

$$\frac{dA}{dt} = 4\left(\frac{dw}{dt}\right)L + 4w\left(\frac{dL}{dt}\right) + 4w\frac{dw}{dt}$$

$$210 = 4w(8) + 2(w)^2$$
$$210 = 32w + 2w^2$$
$$2w^2 - 32w - 210 = 0$$
$$w \neq -21, \quad w = +5$$

$$\frac{dA}{dt} = 4(-.5)(8) + 4(5)(-0.5) + 4(5)(-0.5)$$

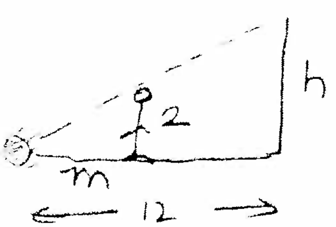
$$\frac{dL}{dt} = \frac{dw}{dt} = -0.5$$

$$\frac{dA}{dt} = -16 - 10 - 10$$

$$\left.\frac{dA}{dt}\right|_{\substack{L=8\\A=210}}$$

$$\frac{dA}{dt} = -36\text{ cm}^2/\text{sec.}$$

A spotlight on the ground shines on a wall 12 metres away. If a man 2 metres tall walks from the spotlight toward the building at a speed of 1.6 metres/sec, how fast is the height of his shadow on the building shrinking when he is 4 metres from the building?



$$\frac{2}{h} = \frac{m}{12}$$

$$h(8) = 24 \qquad h = 3$$

* use $m = 8$
That's how far he has walked from light.

$$(h)(m) = 24$$

$$\frac{dh}{dt}(m) + \frac{dm}{dt}(h) = 0$$

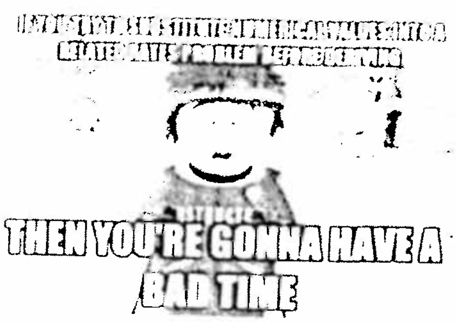
$$\frac{dm}{dt} = 1.6$$

$$\frac{dh}{dt}(8) + 1.6(3) = 0$$

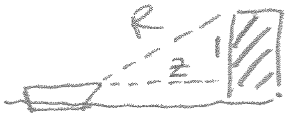
$$\frac{dh}{dt} = \frac{-4.8}{8}$$

$$\left.\frac{dh}{dt}\right|_{m=8}$$

$$\approx -0.6$$



A boat is pulled into a dock by a rope attached to the bow of the boat. The rope passes through a pulley on the dock that is 1 metre higher than the bow of the boat. If the rope is pulled in at a rate of 1 metre per second, how fast is the boat approaching the dock when it is 8 metres from the dock? Approximate your answer to two decimal places.



$$R^2 = z^2 + 1^2$$

$$\cancel{2}R\frac{dR}{dt} = \cancel{2}z\frac{dz}{dt} + 0$$

Find R

$R^2 = (8)^2 + (1)^2$

$R^2 = 65$

$R = \sqrt{65}$

$\frac{dr}{dt} = -1 \text{ m/s}$

$$(\sqrt{65})(-1) = 8\left(\frac{dz}{dt}\right)$$

$\left.\frac{dz}{dt}\right|_{z=8}$

$$\frac{-\sqrt{65}}{8} = \frac{dz}{dt}$$

≈ -1.01 m/s

Doctor Who runs out of a building in pursuit of a Dalek. He is travelling south and running at 10 ft/sec. Two minutes later, his friend Clara leaves the same building to chase a second Dalek. She heads east and moves at 6 ft/sec. To one decimal place, how fast are the Doctor and Clara separating five minutes after the Doctor left the building?

5 MIN = 300 sec

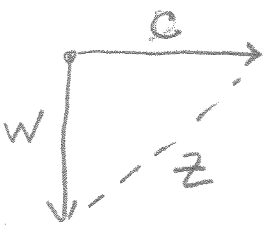
* convert to seconds

$W = 10 \times 300 = 3000$

$C = 6 \times 180 = 1080$

$3000^2 + 1080^2 = z^2$

$3188.5 \approx z$



$$w^2 + c^2 = z^2$$

$$\cancel{2}w\frac{dw}{dt} + \cancel{2}c\frac{dc}{dt} = \cancel{2}z\frac{dz}{dt}$$

$$3000(10) + (1080)(6) = 9548.1\frac{dz}{dt}$$

$\frac{dw}{dt} = 10$ ft/sec

$\frac{dc}{dt} = 6$ ft/sec

$\left.\frac{dz}{dt}\right|_{w=}$

$$\frac{36480}{3188.5} = \frac{dz}{dt}$$

≈ 11.4 ft/sec

A spherical soap bubble is absorbing 10 cm^3 of air every second. How quickly is the radius of the bubble increasing at the moment when it measures 1 cm?

$\frac{dv}{dt} = 1 \text{ cm}^3/\text{sec}$

$\left.\frac{dr}{dt}\right|_{r=1}$

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

$$\frac{dv}{dt} = 3\left(\frac{4}{3}\pi r^2\right)\frac{dr}{dt}$$

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

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

$$\frac{dr}{dt} = \frac{1}{4\pi}$$