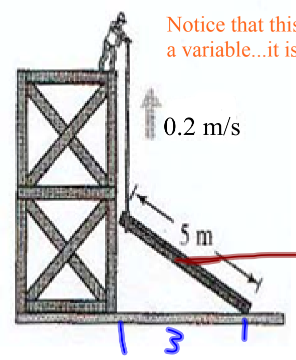
Example 2:

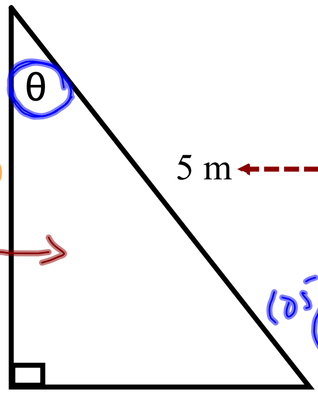
A construction worker pulls a 5 m plank up the side of a building under construction by means of a rope tied to one end of the plank (see diagram). Assume the opposite end of the plank follows a path perpendicular to the wall of the building and that the worker is able to pull the rope at a rate of 0.2 m/s. What is the rate of change of the angle between the plank and the building when it is 3 m from the base of the building ?

decreasing at 3.82°/sec

Let t represent the time elapsed after plank is started to be pulled up the side of the building



Notice that this side requires a variable...it is changing!!



Length of this ladder will never change...measurements that do not change will be placed on the diagram

$$\cos^{-1}(\cos\theta) = \cos^{-1}\left(\frac{0.2t}{5}\right)$$

$$\theta = \cos^{-1}\left(\frac{0.2t}{5}\right)$$

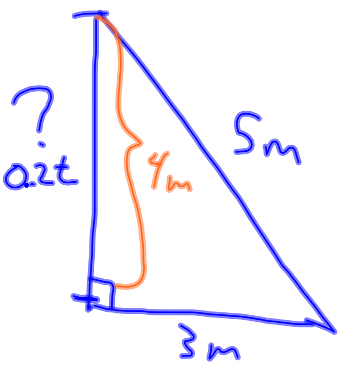
What rate of change are we given?

How does this relate to this diagram?

What rate of change are we trying to determine?

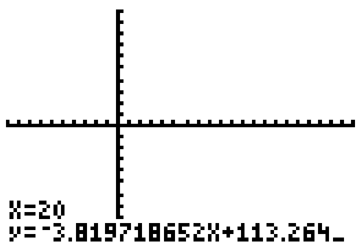
Determine a function that will relate the changing quantities.

Determine the exact "TIME" when we would like this instantaneous rate of change



$$\frac{4}{0.2} = \frac{0.2t}{0.2}$$

t = 20 seconds



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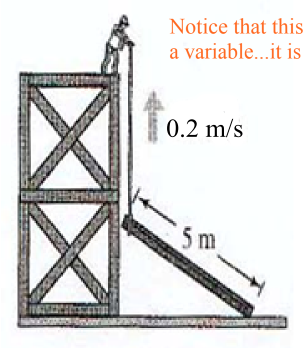

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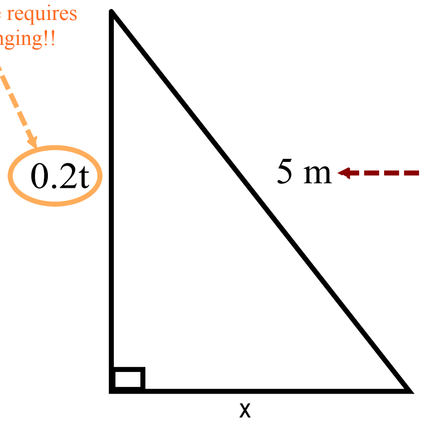

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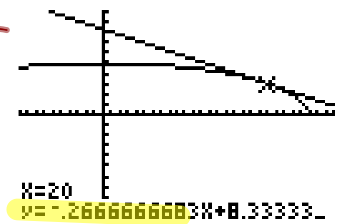
(b) determine the rate at which the plank is moving toward the platform at this same instant.

$$(0.2t)^2 + x^2 = 5^2$$

$$x = \sqrt{25-(0.2t)^2}$$



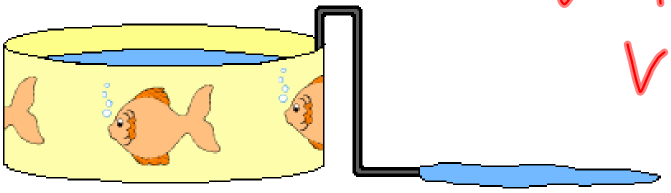
IRC @ 20 sec = $^{-}0.267$ m/s

Example 3

Water is being pumped from a full cylindrical shaped pool having a radius of 2 m and a depth of 80 cm at the rate of 1 m^3/min. Determine the rate at which the depth of the water is falling 1 minute and 12 seconds after the pump is started.

7.95 cm/minute

Cylinder: $V = \pi r^2 h$



$V = \pi(2)^2 h$

$V = 4\pi h$

$h = \dfrac{V}{4\pi}$

Volume of water at any time "t" minutes after the pump is started

Starting Volume: → Volume at any time

$V = \pi r^2 h$

$V = \pi(2)^2(0.8)$

$V = 3.2\pi\ m^3$

$V = (3.2\pi - 1t)\ m^3$

Sub. into formula

$h = \dfrac{V}{4\pi}$

$h = \dfrac{3.2\pi - t}{4\pi}$

$y = mx + b$

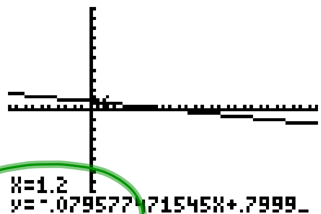
$h = \dfrac{3.2\pi}{4\pi} - \dfrac{1}{4\pi}t$

1 min & 12 sec

$= 1.2$ minutes

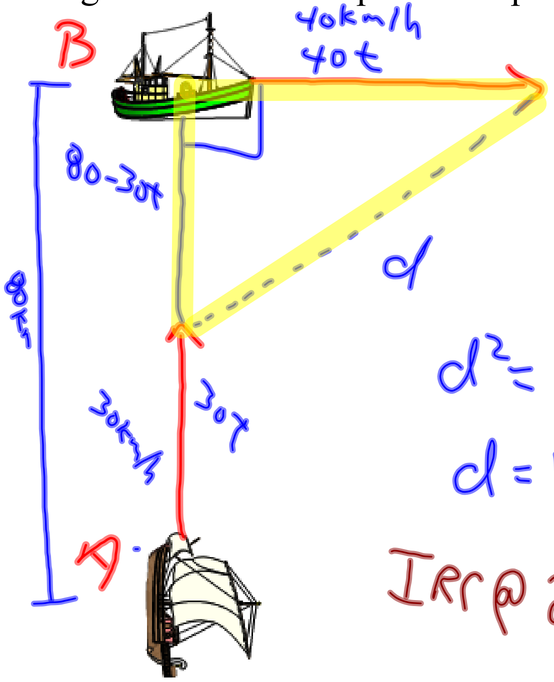
$\frac{12}{60} = \frac{1}{5} = 0.2$

IRC $= -0.0796$ m/min.

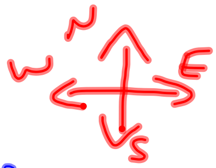


Example 4

At 1:00 pm ship A was 80 km due south of ship B. Ship A is travelling north at 30 km/h and ship B is travelling east at 40 km/h. What is the instantaneous rate of change between the ships at 3:00 pm?



Let t Rep. time in hours since 1:00PM



$$d^2 = (40t)^2 + (80-30t)^2$$

$$d = \sqrt{(40t)^2 + (80-30t)^2}$$

IRC @ 2hours: