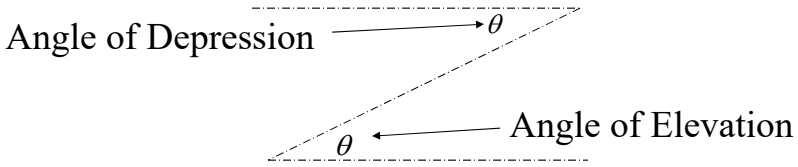
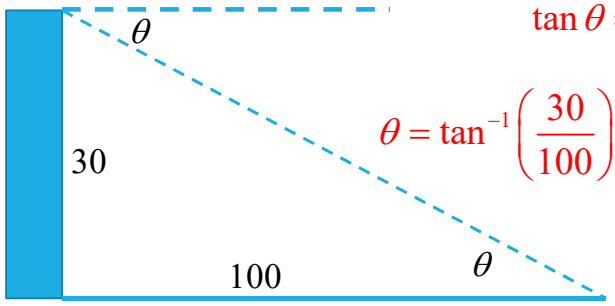
4-8: SOLVING PROBLEMS WITH TRIG

I. BASIC RIGHT TRIANGLE TRIG



II. Examples

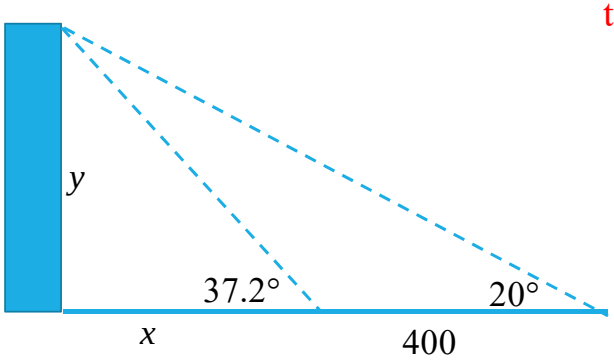
A.) For a laser light show at an amusement park, the laser beam directed from the top of a 30-ft. building is to reflect from an object that is 100 ft. away from a point directly below the location of the laser. What is the angle of depression from the laser to the reflecting object?



$$\tan\theta = \frac{30}{100}$$

$$\theta = \tan^{-1}\left(\frac{30}{100}\right) \approx 16.699°$$

B.) A surveyor observes that the top of a building makes an angle of 37.2° with the road. From another location 400 ft. away the angle of elevation is 20°. How far is the base of the building from the first observation point on the road?



$$\tan 37.2 = \frac{y}{x}$$

$$\tan 20 = \frac{y}{x+400}$$

$$\tan 37.2 = \frac{y}{x} \qquad \tan 20 = \frac{y}{x+400}$$

$$y = x \tan 37.2 \qquad y = (x+400)\tan 20$$

$$x \tan 37.2 = (x+400)\tan 20$$

$$x \tan 37.2 = x \tan 20 + 400 \tan 20$$

$$x \tan 37.2 - x \tan 20 = 400 \tan 20$$

$$x(\tan 37.2 - \tan 20) = 400 \tan 20$$

$$x = \frac{400 \tan 20}{\tan 37.2 - \tan 20} \approx 368.511'$$

II. SIMPLE HARMONIC MOTION

-A point moving on a number line is in simple harmonic motion if its directed distance d from the origin is given by

$$d = a \sin \omega t \text{ or } d = a \cos \omega t$$

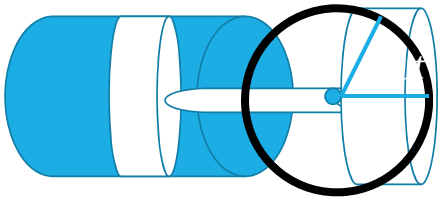
Where a and ω are real numbers and $\omega > 0$.

The motion has a frequency of $\frac{\omega}{2\pi}$, which is the number of oscillations per unit of time.

-A piston is an example of simple harmonic motion. A linkage converts the rotary motion of a motor to the back-and-forth motion of the piston.

(Fig. 4.94 on page 429 of your text.)

http://www.freestudy.co.uk/dynamics/velaccdiag.pdf



Ex. – In a certain mechanical linkage similar to the one in figure 4.94, a wheel with a 10 cm radius turns with an angular velocity of 6π radians per second.

A.) What is the frequency of the piston? $f = \frac{\omega}{2\pi} = \frac{6\pi}{2\pi} = 3$

B.) What is the distance the piston is from its starting point exactly 5.3 seconds after starting?

$$d(0) = 10\cos\left(6\pi(0)\right) = 10$$

$$d(5.3) = 10\cos(6\pi(5.3)) \approx 8.090$$

$$\text{distance from start} \approx 10 - 8.090 \approx 1.91 \text{ cm}$$

Ex.- A mass oscillating up and down on the end of a spring can be modeled as harmonic motion. If the weight is displaced a maximum of 8 cm, find the modeling equation if it takes 3 seconds to complete the cycle.

1.) Our choice of models sin or cos. Let's choose the one that starts at a maximum displacement.

2.) Find *a*. $a = 8$ $\qquad d = 8\cos\left(\frac{2\pi}{3}t\right)$

3.) Find ω. $\qquad 3 = \frac{2\pi}{\omega} \quad \therefore \quad \omega = \frac{2\pi}{3}$