

Review

Evaluate the trigonometric expression:

$$\sin(-120^\circ) = -\frac{\sqrt{3}}{2}$$



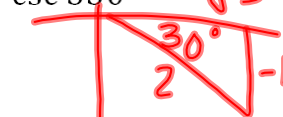
$$\sec 180^\circ = -1$$



$$\cos 225^\circ = -\frac{1}{\sqrt{2}}$$



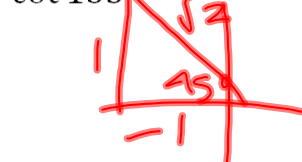
$$\csc 330^\circ = -2$$



$$\tan(-270^\circ) = \text{undef.}$$



$$\cot 135^\circ = -1$$



Convert to degrees:

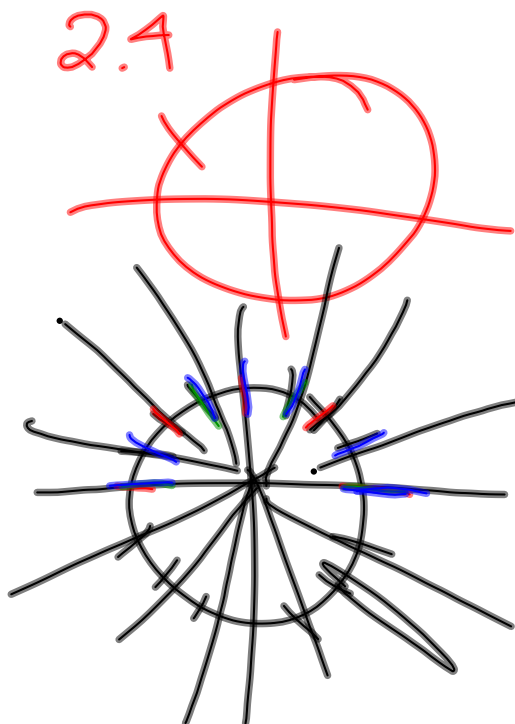
$$\frac{3\pi}{4} \cdot \frac{180^\circ}{\pi} = 135^\circ$$

$$\frac{4\pi}{3} = 240^\circ$$

$$\frac{11\pi}{6} = 330^\circ$$

$$-\frac{5\pi}{2} = -450^\circ$$

Homework questions?



$$\frac{\pi}{2} \approx 1.5$$

$$\pi \approx 3.14$$

$$2\pi \approx 6.28$$

$$4\pi \approx 12.56$$

Evaluate the trigonometric function of an angle given in radians

$\cos \frac{11\pi}{6} = \frac{\sqrt{3}}{2}$

$\sin 329\pi = 0$

$\tan \frac{7\pi}{2} = \text{Undefined}$

$\sec \frac{5\pi}{6} = -\frac{2}{\sqrt{3}}$

$\cot \frac{3\pi}{4} = -1$

$\sec \frac{7\pi}{4} = \sqrt{2}$

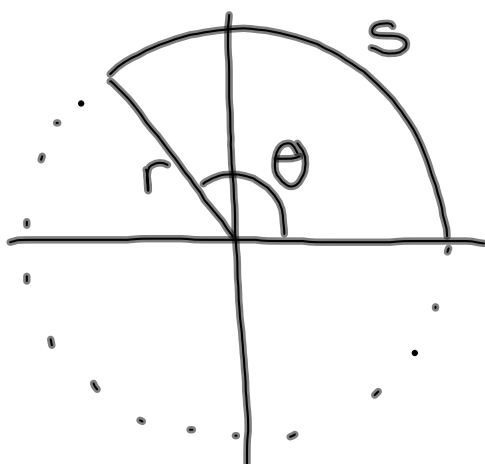
$\csc \left(-\frac{2\pi}{3}\right) = -\frac{2}{\sqrt{3}}$

$\csc \frac{3\pi}{2} = -1$

$\sin \frac{4\pi}{3} = -\frac{\sqrt{3}}{2}$

$\tan \frac{7\pi}{6} = \frac{1}{\sqrt{3}}$

## 5.4 Arc Length & Angular Speed



### Arc Length

$r$  = radius or distance from the center of rotation  
(in, cm, km, etc.)

$s$  = arc length or distance traveled along the circumference of a circle  
(in, cm, km, etc.)

$\theta$  = angle or amount of rotation  
(deg, rad, revolutions, etc.)

$$s = r\theta$$

1.  $r = 5 \text{ in}$  ;  $\theta = 45^\circ$  ;  $s = ? \text{ in}$

$$s = r\theta = 5 \text{ in} \cdot \cancel{45^\circ} \cdot \frac{\pi}{\cancel{180^\circ} \cdot 4} = \frac{5\pi}{4} \text{ in}$$

2.  $s = 16 \text{ yards}$  ;  $\theta = 5$  ;  $r = ? \text{ yards}$

$$\frac{s}{\theta} = \frac{r\theta}{\theta}$$

$$r = \frac{s}{\theta} = \frac{16 \text{ yd}}{5}$$

3. Find the measure of a rotation in radians when a point 2 meters from the center of rotation travels 4 meters.

$$\theta = ? \text{ rad} ; r = 2\text{m} ; s = 4\text{m}$$

$$\frac{s}{r} = \frac{\theta}{1}$$

$$\theta = \frac{s}{r} = \frac{4\text{m}}{2\text{m}} = \boxed{2}$$

### Linear Speed

$$v = \frac{s}{t}$$

### Angular Speed

$$\omega = \frac{\theta}{t}$$

$\omega$  "omega"

### Arc Length

$$s = r\theta$$

### Relating Linear & Angular Speed

$$v = \frac{s}{t} = \frac{r\theta}{t} = r \cdot \frac{\theta}{t} = r\omega$$

$$v = r\omega$$

$r$  = radius or distance from the center of rotation  
(in, cm, km, etc.)

$s$  = arc length or linear distance along the circumference of a circle  
(in, cm, km, etc.)

$\theta$  = angle or amount of rotation  
(deg, rad, revolutions, etc.)

$t$  = time  
(sec, min, hours, years, etc.)

$v = \frac{\text{linear distance}}{\text{time}} = \text{linear speed}$   
( $\frac{\text{km}}{\text{s}}, \frac{\text{mi}}{\text{h}}, \text{etc.}$ )

$\omega = \frac{\text{amount of rotation}}{\text{time}} = \text{angular speed}$   
( $\frac{\text{rev}}{\text{min}}, \frac{\text{deg}}{\text{s}}, \text{etc.}$ )

Handout Problems:

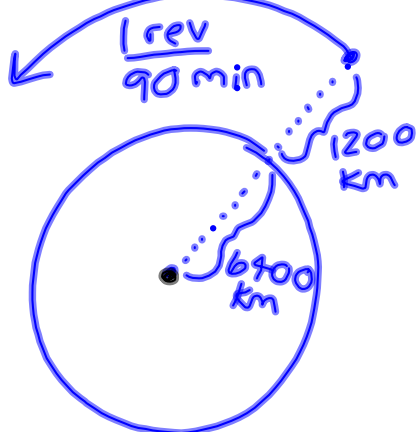
1. A wheel with a 15 inch diameter rotates at a rate of 6 radians per second. What is the linear speed of a point on its rim in feet per minute?

$$r = \frac{15 \text{ in}}{2} ; \omega = \frac{6 \text{ rad}}{\text{s}} ; v = ? \text{ ft/min}$$

$$v = r\omega = \frac{15 \cancel{\text{ in}}}{2} \cdot \frac{6 \cancel{\text{ rad}}}{\cancel{\text{s}}} \cdot \frac{1 \text{ ft}}{12 \cancel{\text{ in}}} \cdot \frac{60 \cancel{\text{ s}}}{1 \text{ min}}$$

$$= \boxed{225 \text{ ft/min}}$$

2. An earth satellite in circular orbit 1200 km high makes one complete revolution every 90 minutes. What is its linear speed in km/min, given that the earth's radius is 6400 km?



$$\omega = \frac{1 \text{ rev}}{90 \text{ min}} ; r = 7600 \text{ km}$$

$$v = ? \text{ km/min}$$

$$v = r\omega = 7600 \cancel{\text{ km}} \cdot \frac{1 \cancel{\text{ rev}}}{90 \cancel{\text{ min}}} \cdot \frac{2\pi}{1 \cancel{\text{ rev}}} = \boxed{\frac{1520\pi}{9} \text{ km/min}}$$

3. Through how many radians does the minute hand of a clock rotate from 12:45pm to 1:25pm?

$$\theta = ? \text{ rad} ; t = 40 \text{ min} ; \omega = \frac{1 \text{ rot}}{60 \text{ min}}$$

$$t \cdot \omega = \frac{\theta}{\cancel{t}} \cdot \cancel{t}$$

$$\theta = \omega \cdot t = \frac{1 \cancel{\text{rot}}}{\cancel{60 \text{ min}}_3} \cdot \frac{40 \cancel{\text{min}}}{1} \cdot \frac{2\pi}{\cancel{1 \text{ rot}}}$$

$$= \frac{4\pi}{3}$$

4. A car travels at 60 miles per hour. Its wheels have a 24 inch diameter. What is the angular speed of a point on the rim of a wheel in revolutions per minute?

$$v = \frac{60 \text{ mi}}{\text{h}} ; r = 12 \text{ in} ; \omega = ? \text{ rev/min}$$

$$\frac{v}{r} = \frac{K\omega}{K}$$

$$\omega = \frac{v}{r} \cdot \frac{1}{r}$$

$$\omega = \frac{60 \cancel{\text{mi}}}{\cancel{\text{h}}} \cdot \frac{1}{\cancel{12 \text{ in}}} \cdot \frac{1 \cancel{\text{h}}}{60 \cancel{\text{min}}} \cdot \frac{12 \cancel{\text{in}}}{1 \cancel{\text{ft}}} \cdot \frac{5280 \cancel{\text{ft}}}{1 \cancel{\text{mi}}} \cdot \frac{1 \text{ rev}}{2\pi}$$

$$= \frac{2640}{\pi} \text{ rev/min}$$

Homework:

Evaluating trig functions of angles in radians:

**5.5 #7-24 all** (\*\*super mega-important hw section!)

HW to be checked on Friday: sections 5.3-5.5

Quiz Friday on trig functions of any angle in degrees (like 5.3#39-58)

In class on Friday/homework to have completed by Monday after the break (go ahead and start working on it now if you don't want too much hw over the break!): **Five problems on handout and 5.4#61-79odd**