# 4.1: Radian Measure

Determining the meaning of a radian measure: GSP Demo

- Follow the invesgaon on page 203 - 204

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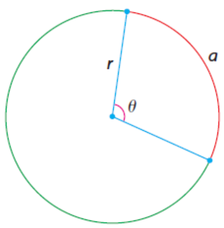
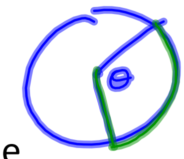
*Definion of a Radian*

$C = 2\pi r.$

- The radian measure of an angle $\theta$ is defined as the length, *a*, of the arc that subtends the angle divided by the radius, *r*, of the circle.

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




- For one complete revoluon, the length of the arc equals the circumference of the circle, $2\pi r$

$$\theta = \frac{2\pi r}{r}$$
$$= 2\pi$$

$\theta = \frac{a}{r} = \frac{2\pi \cancel{r}}{\cancel{r}}$

$\theta = 2\pi$

- One complete revoluon measures $2\pi$ radians.

$\pi = 180°$

$\frac{360°}{2} = \frac{2\pi}{2}$

$180° = \pi$

## Converng Between Radians and Degrees

1 rad = ?

**Converng Radians to Degrees**

$$2\pi rad = 360°$$

$$1rad = \left(\frac{360}{2\pi}\right)^{\circ}$$

$$1rad = \left(\frac{180}{\pi}\right)^{\circ}$$

1° = rad ?

**Converng Degrees to Radians**

$$360° = 2\pi rad$$

$$1° = \frac{2\pi}{360} rad$$

2π = 360

$$1° = \frac{\pi}{180} rad$$

One radian is $\left(\frac{180}{\pi}\right)^{\circ}$, or approximately $57.3°$. One degree is $\frac{\pi}{180}$ rad, or approximately 0.0175

*Example 1: Convert $30°$ to radians*

$30° \rightarrow$ rad

$=(30°)\left(\frac{\pi}{180}\right)$

$=\frac{3\cancel{0}\pi}{18\cancel{0}}$

$=\pi/6$ rad or

$\pi/6 \rightarrow 0.52$ rad

*Example 2: Converng Radian Measure to Degree Measure*

Determine the degree measure, to the nearest tenth, for each radian measure.

(a) $\frac{\pi}{4}$

(b) 5.86

(a) $\frac{\cancel{\pi}}{4} \times \frac{180}{\cancel{\pi}}$

$=\frac{180}{4}$

$=45°$

(b) $5.86 \times \frac{180}{\pi}$

$= 5.86 \times 57.29577951$

$= 335.8°$

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$45°$ to radians

$= 45° \times \frac{\pi}{180}$

$= \frac{45\pi}{180}$

$= \frac{\pi}{4}$ rad.

$\frac{45\pi}{180}$

$\frac{45 \div 45}{180 \div 45} = \frac{1\pi}{4}$

$15°$ to radians:

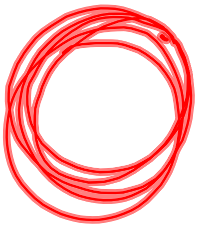
$15° \times \frac{\pi}{180}$

$= \frac{15\pi}{180}$

$= \frac{\pi}{12}$ rad

*Example 3: Arc Length for a Given Angle*

Bruce Wayne chooses a horse to ride on a carousel. The horse is located 9 m from the centre of the carousel. If this carousel turns through an angle of $15\pi$, determine the length of the arc travelled by the horse, to the nearest tenth of a metre.



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

$$15\pi = \frac{a}{9}$$

$$(15\pi)9 = a$$

$$135\pi = a$$

$$\underline{424.1\text{m} \doteq a}$$

*Example 4: Angular Velocity of a Rotang Object*

The angular velocity of a rotang object is the rate at which the central angle changes with respect to me.

The London Eye Ferris wheel has a diameter of 135 m and completes one revoluon in 30 min.

(a) Determine the **angular velocity, v,** in radians per second.

30min = 1800 seconds. $2\pi$

$V = \frac{1 \text{ revolution}}{1800 \text{ seconds}}$

$= \frac{2\pi}{1800}$ $V = \frac{\pi}{900}$

(b) How far has a rider travelled at 10 min into the ride?

10min = 600 seonds.

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$\theta = (600 \text{ seconds})\left(\frac{\pi}{900}\right)$

$= \frac{600\pi}{900}$

$\theta = 2\pi/3$. $\theta = \frac{a}{r}$

distance travelled: $a = \theta r$

$= \frac{2\pi}{3}(67.5)$

$\doteq 141.4\text{m}$.

*Example 5: Angular Velocity of a Rotang Object*

The hard disk in a personal computer rotates at 7200 rpm (revoluons per minute). Determine its angular velocity, in:

(a) Degrees per second

(b) Radians per Second.