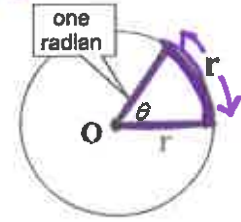


# 8.1 – Understanding Angles

Date: May 9

## Definitions:

- **Radian:** The measure of the central angle of a circle subtended by an arc that is the same length as the radius of the circle.
- **Radians:**  $360^\circ$  equals  $2\pi$  radians.



Angles can be measured in units of degrees or radians.

For one rotation around a circle, we pass through  $360^\circ$  degrees or  $2\pi$  radians.

Radians relate the angle measure to pi ( $\pi$ ), which allows us to represent the measure of a circle using fractions rather than approximate decimals.

$$360^\circ = 2\pi \text{ radians} \approx 6.28 \text{ radians}$$

exact ↑
↑ approximate

**Example:** Calculate the number of degrees in one radian.

$$2\pi \text{ radians} = 360^\circ$$

$$\frac{\pi \text{ radians}}{\pi} = \frac{180^\circ}{\pi}$$

$1 \text{ radian} \approx 57.3^\circ$   
(about  $60^\circ$ )

$$1 \text{ radian} \approx 57.2957...^\circ$$

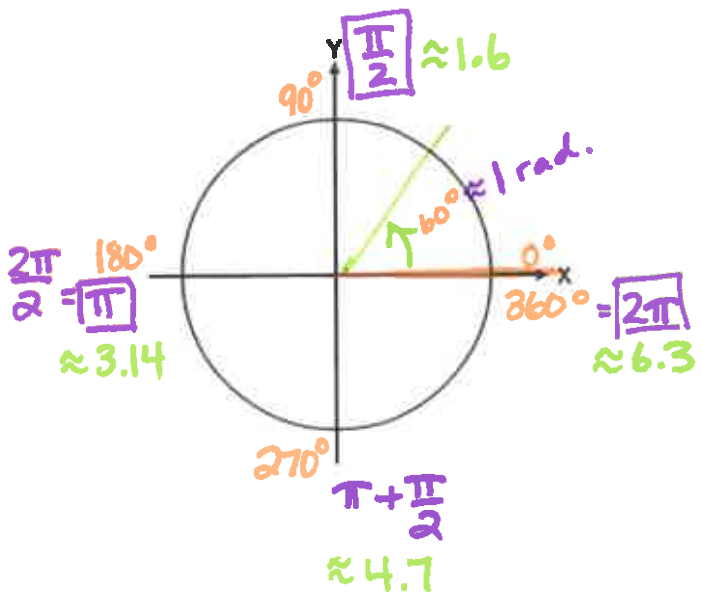
**Example:** Estimate the value of each angle in radian measure.

a.  $90^\circ = \frac{\pi}{2}$   
 $\approx \frac{3.14}{2} \approx 1.6$

b.  $135^\circ = 90^\circ + 45^\circ$   
 $= \frac{\pi}{2} + \frac{\pi}{4}$   
 $\approx 1.6 + 0.8 \approx 2.4$

c.  $240^\circ = 180^\circ + 60^\circ$   
 $= \pi + 1$   
 $\approx 3.14 + 1 \approx 4.1$

d.  $450^\circ = 360^\circ + 90^\circ$   
 $= 2\pi + \frac{\pi}{2}$   
 $= 6.3 + 1.6$   
 $\approx 7.9$



\* to change between Radians and Degrees on calculator → **MODE**

A note on angle measures! When there is no unit provided after an angle measure, or the unit is 'rad', the answer is in radians. So:

$40 \text{ rad} \left. \begin{array}{l} \text{angle} \\ \text{in radians} \end{array} \right\} \cos(40) \neq \cos(40^\circ)$   
 $40 \left. \begin{array}{l} \text{angle} \\ \text{in degrees} \end{array} \right\} \cos(40^\circ)$   
 radians →  $-0.6669$       degrees →  $0.7660$   
 $-0.6669 \neq 0.7660$

**Example:** Determine which angle is larger.

a.  $4\pi$  or  $12$

$4\pi$  or  $4(3)$   
 $\pi > 3$   
 $4\pi > 4(3)$   
 $4\pi > 12$

b.  $700^\circ$  or  $\frac{13\pi}{2}$

$6\frac{1}{2} \cdot \pi$   
 more than 2 full circles  
 $(2 \cdot 2\pi = 4\pi)$   
 $700^\circ$  less than 2 full circles

$700^\circ < \frac{13\pi}{2}$

c.  $28.26$  or  $9\pi$

$\frac{28.26}{3.14}$  or  $\frac{9\pi}{\pi}$   
 $9$  or  $9$   
 $28.26 \approx 9\pi$