Learning Goal: I will be able to convert radians to degrees and vice versa. I will determine angular velocity using both degrees and radians.

Minds On: Terminology!

Action: Converting degrees to radians and back again...

Consolidation: Practice page - finish for homework

Minds On

What's a Radian?

To this point we have measured angles in degrees.

Sometimes in math and physics we need a way to represent angles as pure numbers, without units.

In these situations, we use **radians**.

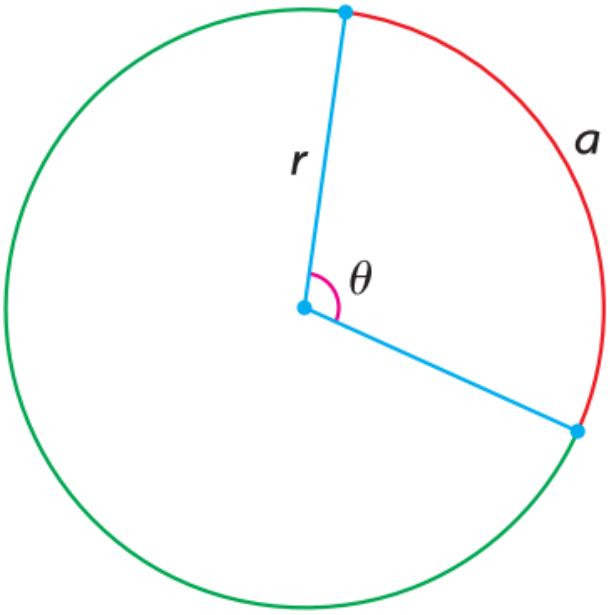
Minds On

What's a Radian?

When dealing in radians, the size of an angle is expressed in terms of the length of an arc, *a*, that subtends the angle θ, at the centre of a circle with radius *r*.

In this situation, *a* is proportional to *r* and to θ, where

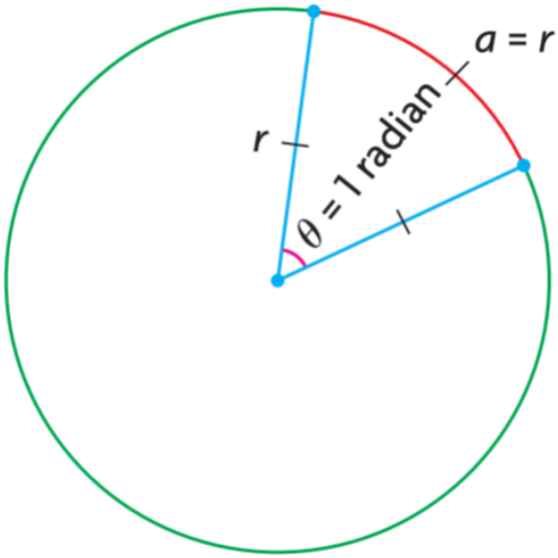
$$\theta = \frac{a}{r}$$



Action

How many degrees in 1 radian?

1 radian is defined as the angle subtended by an arc length, *a*, equal to the radius, *r*.

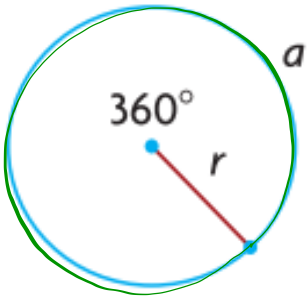


How many degrees are in 1 radian?

Action

How many degrees in 1 radian?

Let's start by considering the arc length created by an angle of 360°.



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

$\theta = 2\pi$

Remember that, in radians, $\theta = \frac{a}{r}$

$360° = 2\pi$ radians

$180° = \pi$ radians

$90° = \frac{\pi}{2}$ radians

$60° = \frac{\pi}{3}$ radians

$45° = \frac{\pi}{4}$ radians

$30° = \frac{\pi}{6}$ radians

If $360° = 2\pi$ radians...

how many degrees in 1 radian?

$$\frac{360°}{2\pi} = \frac{x}{1}$$

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

$$x \approx 57.3°$$

There is approximately $57.3°$ in 1 radian.

Action

Converting from Degrees to Radians

Convert 50° to radians

$\frac{180^\circ}{\pi} = \frac{50^\circ}{x}$

$x = \frac{50\pi}{180}$

$x = \frac{5\pi}{18}$

$50^\circ \longrightarrow \frac{50\pi}{180}$

Action

Converting from Degrees to Radians

To convert from degrees to radians,

multiply by $\frac{\pi}{180^\circ}$

Action

Converting from Degrees to Radians

Convert 30° to radians

$$30^\circ \times \frac{\pi}{180^\circ} = \frac{30\pi}{180}$$

$$= \frac{3\pi}{18} = \frac{1\pi}{6} = \frac{\pi}{6}$$

Action

Converting from Degrees to Radians

Convert 225° to radians

$$225^\circ \times \frac{\pi}{180^\circ} = \frac{225\pi}{180}$$

$$= \frac{45\pi}{36}$$

$$= \frac{5\pi}{4}$$

Action

Converting from Radians to Degrees

Convert 3π/2 radians to degrees

$\frac{3\pi}{2}$

If pi is 180 degrees, then we can just replace pi with 180.

$\pi = 180^\circ$

what is $\frac{\pi}{180^\circ}$? = 1

what is $\frac{180^\circ}{\pi}$ = 1

$= \frac{3 \times 180}{2} = 270^\circ$

OR

$\frac{3\pi}{2} \times \frac{180^\circ}{\pi} = 270^\circ$

Action

Converting from Radians to Degrees

To convert from radians to degrees,

multiply by $\frac{180^\circ}{\pi}$ **(or)** replace π with 180°

Action

Converting from Radians to Degrees

Convert 5π/6 radians to degrees

$$\frac{5\pi}{6} = \frac{5 \times 180^\circ}{6} = 150^\circ$$

OR

$$\frac{5\pi}{6} \times \frac{180}{\pi} = 150^\circ$$

Action

Converting from Radians to Degrees

Convert 1.75 radians to degrees

$$1.75 \times \frac{180^\circ}{\pi} \approx 100.3^\circ$$

Action

Angular Velocity

Angular, or rotational, velocity is the amount of rotation a spinning object undergoes per unit time.

For example: 3 rotations / min

100° / second

$\frac{\pi}{2}$ radians / hour

Action

Angular Velocity

The London Eye ferris wheel has a diameter of 135 m and completes one revolution every 30 minutes.

↳ $\times 60 = 1800$ s $\qquad$ 2π

Determine the angular velocity, ω, in radians per second.

$$\omega = \frac{2\pi}{1800\text{s}} = \frac{\pi}{900} \text{ radians/s}$$

Action

Angular Velocity

The London Eye ferris wheel has a diameter of 135 m and completes one revolution every 30 minutes.

How far has a rider travelled 10 minutes into the ride?

How many rotations in 10 minutes?

$$\frac{10 \text{ minutes}}{30 \text{ minutes/rotation}} = \frac{1}{3} \text{ rotation}$$

Distance in 1 rotation $= 2\pi r$ or πd

$\pi \times 135\text{m} \doteq 424.1\text{m}$

$\therefore$ distance travelled $= 424.1\text{m} \times \frac{1}{3}$

$\doteq 141.4\text{m}$

Consolidation

Working with Radians

A wheel is rotating at an angular velocity of 1.2π radians per second, while a point on the circumference of the wheel travels at 9.6π metres per second.

How many revolutions does the wheel make in 1 minute?

1.2π radians/s

radians per minute? $1.2\pi \times 60 = 72\pi$ rad/min

72π is how many rotations?

$$\frac{72\pi}{2\pi} = 36 \text{ rotations}$$

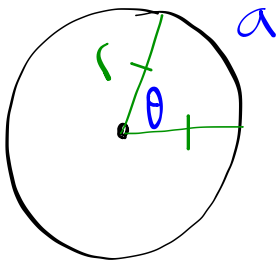
Consolidation

Working with Radians

A wheel is rotating at an angular velocity of 1.2π radians per second, while a point on the circumference of the wheel travels at 9.6π metres per second.

What is the radius of the wheel?

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



$1.2\pi = \frac{9.6\pi}{r}$

$r = \frac{9.6\pi}{1.2\pi}$

$r = 8 \text{ m}$

Pg. 320

1, 5 - 8, 11