

Circular Rotation: Radians and Arc Lengths
Class Practice

1. Convert 65° to radians

$$\frac{65^\circ}{360^\circ} \cdot 2\pi = 1.13 \text{ radians}$$

2. Convert 1.75 radians to degrees

$$\frac{1.75 \text{ rad}}{2\pi \text{ rad}} \cdot 360^\circ = 100^\circ$$

3. A motor in your car is rotating at 3000 rpms.

a. What does RPM stand for? Revolution per minute

b. How many degrees per minute?

$$\frac{3000 \text{ rev}}{1 \text{ min}} \cdot \frac{360^\circ}{1 \text{ rev}} = 1,080,000^\circ/\text{min}$$

c. How many radians per minute?

$$\frac{3000 \text{ rev}}{1 \text{ min}} \cdot \frac{2\pi \text{ rad}}{1 \text{ rev}} = 18840 \text{ rad/min}$$

4. A 1.5M tire rotates 3 full rotations forward. How far did it move?

$d = \theta r$
 $r = .75 \text{ m}$

\downarrow
 $2\pi \cdot 3 = 6\pi$

$6\pi \cdot .75 = 14 \text{ m}$

5. A baseball pitcher throws a ball from just behind his head releasing just in front of his face a total of 60° . If his arm is 90cm long how far did the ball travel along the arc?



$d = \theta r$

$\frac{60^\circ}{360^\circ} \cdot 2\pi \text{ rad} = 1.04 \text{ rad}$

$d = 1.04 \text{ rad} \cdot .9 \text{ m} = .94 \text{ m}$

6. The International space station (ISS) rotates around the Earth 15.5 times per day and the Moon rotates 1 time in 28 days.

a. What is the angular displacement per day of the ISS?

b. What is the angular displacement of the moon per day?

$$\frac{2\pi}{28 \text{ day}} = 0.22 \frac{\text{rad}}{\text{day}}$$

$$\theta = \omega t + \frac{1}{2} \alpha t^2$$

$$\frac{15.5 \text{ rev}}{\text{day}} \cdot \frac{2\pi}{1 \text{ rev}} = 97.3 \text{ rad/day}$$

7. The international space station rotates at a distance of $6.79 \text{ E}6 \text{ m}$ from the center of Earth and the Moon is $3.84 \text{ E}8 \text{ m}$ from Earth. The space station is in what is call a Low Earth Orbit (LEO) but the Moon is far enough away to fit 30 Earth sized planets between us.

a. How far does the space station actually travel in 1 day?

b. How far does the Moon travel in 1 day?

$$V_t = \omega \cdot r$$

$$0.22 \cdot 3.84 \text{ E}8 = 8.36 \text{ E}7 \text{ m}$$

$$97.3 \cdot 6.79 \text{ E}6 = 6.6 \text{ E}8 \text{ m}$$

Circular Rotation: Radians and Arc Lengths
Student Practice

1. Convert 180° to radians

$$\frac{180^\circ}{360^\circ} \times 2\pi \text{ rad} = \pi$$

2. Convert 1 revolution to radians.

$$\hookrightarrow 360^\circ$$

3. A merry-go-round travels at 5 rmps.
 a. How many radians did ride travel in a minute?
 b. How many degrees did the ride travel in a minute?

$$\frac{5 \text{ rev}}{1 \text{ rev}} \times 2\pi \text{ rad} = 10\pi$$

$$b) \frac{5 \text{ rev} \times 360^\circ}{1 \text{ rev}} = 1800^\circ$$

4. A circular saw travels at 4800 rpms with a radius of 8cm.
 a. How many radians will a tooth on the saw travel in 1 minute?
 b. How far will the tooth travel in 1 minute? (cm)

$$\frac{4800 \text{ rev}}{1 \text{ min}} \times \frac{2\pi \text{ rad}}{1 \text{ rev}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 502 \frac{\text{rad}}{\text{sec}}$$

5. A wheel rotates 3 times. What is its angular displacement?

$$3 \cdot 2\pi = 6\pi$$

6. A tracker has large wheels on the back and small wheels on the front. As it moves through the field,
 a. The angular displacement of the small wheel is (equal/larger/smaller)?
 b. The arc length of the small wheel is (equal/larger/smaller)?

7. A drum (50cm radius) is rotating moving paper in a factory. 200m of paper (lengthwise) is required or an order.

- a. What angular displacement is required for the order?
 b. How many revolutions?

$$d = \theta r$$

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

$$\frac{200}{.5 \text{ m}} = 400 \text{ rad}$$

$$\frac{400 \text{ rad}}{2\pi \text{ rad}} = 63.6 \text{ rev}$$