Date: _____ Name: _____

PRACTICE Radian Problems

1. If the radius of the circle is 4.5 m, determine the measure of the angle if the arc length is 8π m.

2. Determine the arc length, if the radius of the circle is 21 cm and the angle is 0.75π.

3. Determine the angular velocity in radians/second of a spot on the blade of a windmill if the windmill makes 70 revolutions in 1 minute.

4. Determine the velocity in cm/s of a point on the circumference of a wheel with a radius of 33 cm if the wheel makes 66 revolutions in 1 minute.

5. Determine the number of revolutions that a car makes around a circular track in an hour if the angular velocity of the car is 11 radians/second.

6. Suppose a 10-inch diameter wheel is rotating at 25 rotations per minute along a road. At what rate is the wheel moving along the road? (in mph units)

$$\frac{12 \text{ inches}}{1 \text{ foot}}, \frac{5280 \text{ feet}}{1 \text{ mile}}, \frac{2\pi \text{ radians}}{1 \text{ rev}}, \frac{1 \text{ minute}}{60 \text{ sec}}, \frac{1000 \text{ meters}}{1 \text{ km}}$$

Date: _____ Name: _____

7. The rim of a bicycle has a diameter of 26 inches. How many pedals (rotations) per second does the cyclist have to achieve to push the bicycle along a flat surface at 16 miles/hour?

8. A bicycle's wheel has a 30 inch diameter. If the wheel makes 1.5 revolutions per second, find the speed of the bike in mph.

9. A flight simulator has pilots traveling in a circular path very quickly in order to experience g-forces. If the pilots are traveling at 400 mph and the circular room has a radius of 25 feet, find the number of rotations that simulator makes per second.

10. A large clock has its seconds hand traveling at 2.5 inches per second. Find the length of the second hand.

11. Two gears are connected by a belt. The large gear has a radius of 6 inches while the small gear has a radius of 3 inches. If a point on the small gear travels at 16 rpm, find the angular velocity of the large gear.

12. A clock has a second hand of length 8 inches. How far **in inches** does the tip travel from when it is on the 12 to when it is on the 4.

Date: _____ Name: ANSWERS

PRACTICE Radian Problems

1. If the radius of the circle is 4.5 m, determine the measure of the angle if the arc length is 8π m.

given: $r = 4.5\text{m}$, $a = 8\pi\text{ m}$

find: $\theta = ?$ not told what units, do all!

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

$\theta = \frac{8\pi\ \text{m}}{4.5\ \text{m}} \doteq 5.585\ (\text{radians})$ → not really a unit!

or $\theta = \frac{8\pi}{4.5} \times \frac{360^\circ}{2\pi} = 320^\circ$

or $\theta = \frac{8\pi}{45} \times \frac{1\text{ rev}}{2\pi} \doteq \frac{8}{9}\text{ rev}$

2. Determine the arc length, if the radius of the circle is 21 cm and the angle is 0.75π.

given: $r = 21\text{ cm}$ $\theta = 0.75\pi$ (radians)

find: $a = ?$ cm ← same unit as radius if not specified.

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

$\therefore a = \theta r$

$= (0.75\pi)(21\text{ cm}) \doteq 49.5\text{ cm}$

3. Determine the angular velocity in radians/second of a spot on the blade of a windmill if the windmill makes 70 revolutions in 1 minute.

given: $\omega = \frac{70\text{ rev}}{\text{min}}$

find: $\omega = ?\ \frac{\text{radians}}{\text{sec}}$

$\frac{70\text{ rev}}{\text{min}} \times \frac{2\pi}{1\text{ rev}} \times \frac{1\text{ min}}{60\text{ sec}}$

$\doteq 7.33\ \text{rad/sec}$

4. Determine the velocity in cm/s of a point on the circumference of a wheel with a radius of 33 cm if the wheel makes 66 revolutions in 1 minute.

given: $r = 33\text{cm}$, $\omega = 66\frac{\text{rev}}{\text{min}}$

find: $v = ?\ \text{cm/sec}$

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

$\therefore v = \omega r$

$= \left(66\frac{\text{rev}}{\text{min}}\right)(33\text{ cm}) \times \frac{1\text{ min}}{60\text{ sec}} \times \frac{2\pi}{1\text{ rev}}$

$\doteq 228\ \text{cm/sec}$

5. Determine the number of revolutions that a car makes around a circular track in an hour if the angular velocity of the car is 11 radians/second.

given: $\omega = 11\frac{\text{rad}}{\text{sec}}$

find: $\omega = ?\ \frac{\text{rev}}{\text{hr}}$

$11\frac{\text{rad}}{\text{sec}} \times \frac{1\text{ rev}}{2\pi\text{ rad}} \times \frac{3600\text{ sec}}{1\text{ hr}}$

$\doteq 6302.5\ \text{rev/hr}$

6. Suppose a 10-inch diameter wheel is rotating at 25 rotations per minute along a road. At what rate is the wheel moving along the road? (mph)

$\frac{12\text{ inches}}{1\text{ foot}}, \frac{5280\text{ feet}}{1\text{ mile}}, \frac{2\pi\text{ radians}}{1\text{ rev}}, \frac{1\text{ minute}}{60\text{ sec}}, \frac{1000\text{ meters}}{1\text{ km}}$

given: $r = 5\text{ inches}$, $\omega = 25\frac{\text{rev}}{\text{min}}$

find: $v = ?\ \frac{\text{miles}}{\text{hr}}$

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

$\therefore v = \omega r$

$= 25\frac{\text{rev}}{\text{min}}\left(5\text{ inches}\right) \times \frac{2\pi}{1\text{ rev}} \times \frac{60\text{ min}}{\text{hr}} \times \frac{1\text{ ft}}{12\text{ inches}} \times \frac{1\text{ mile}}{5280\text{ ft}}$

$\doteq 0.74\ \text{mph}$

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7. The rim of a bicycle has a diameter of 26 inches. How many pedals (rotations) per second does the cyclist have to achieve to push the bicycle along a flat surface at 16 miles/hour?

$r = 13$ inches $\quad v = 16 \frac{\text{miles}}{\text{hr}}$

find: $\omega = ? \frac{\text{rev}}{\text{sec}}$

$$\omega = \frac{v}{r} = \frac{16 \text{ miles}}{\text{hr}} \times \frac{1}{13 \text{ inches}} \times \frac{1 \text{ rev}}{2\pi} \times \frac{12 \text{ inch}}{1 \text{ ft}} \times \frac{5280 \text{ ft}}{1 \text{ mile}} \times \frac{1 \text{ hr}}{3600 \text{ sec}}$$

$$\approx 3.4 \text{ rev/sec}$$

8. A bicycle's wheel has a 30 inch diameter. If the wheel makes 1.5 revolutions per second, find the speed of the bike in mph.

given: $r = 15$ inches, $\omega = 1.5 \frac{\text{rev}}{\text{sec}}$

find: $v = ? \frac{\text{mile}}{\text{hr}}$

$\omega = \frac{v}{r} \quad \therefore v = \omega r$

$$v = 1.5 \frac{\text{rev}}{\text{sec}} \left(15 \text{ inches}\right) \times \frac{2\pi}{1 \text{ rev}} \times \frac{3600 \text{ sec}}{1 \text{ hr}} \times \frac{1 \text{ ft}}{12 \text{ in}} \times \frac{1 \text{ mile}}{5280 \text{ ft}}$$

$$\approx 8.03 \text{ mph}$$

9. A flight simulator has pilots traveling in a circular path very quickly in order to experience g-forces. If the pilots are traveling at 400 mph and the circular room has a radius of 25 feet, find the number of rotations that simulator makes per second.

given: $v = 400 \frac{\text{mile}}{\text{hr}} \quad r = 25$ feet

find: $\omega = ? \frac{\text{rev}}{\text{sec}}$

$$\omega = \frac{v}{r} = \frac{400 \text{ mile}}{\text{hr}} \times \frac{1}{25 \text{ ft}} \times \frac{1 \text{ rev}}{2\pi} \times \frac{1 \text{ hr}}{3600 \text{ sec}} \times \frac{5280 \text{ ft}}{1 \text{ mile}}$$

$$\approx 3.73 \frac{\text{rev}}{\text{sec}}$$

10. A large clock has a seconds hand traveling at 2.5 inches per second. Find the length of the second hand.

given: $v = 2.5 \frac{\text{in}}{\text{sec}} \quad$ know: $\omega = \frac{1 \text{ rev}}{60 \text{ sec}}$

find: $r = ?$ inches

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

$$\therefore r = \frac{v}{\omega} = \frac{2.5 \text{ in}}{\text{sec}} \times \frac{60 \text{ sec}}{1 \text{ rev}} \times \frac{1 \text{ rev}}{2\pi}$$

$$\approx 23.9 \text{ inches}$$

11. Two gears are connected by a belt. The large gear has a radius of 6 inches while the small gear has a radius of 3 inches. If a point on the small gear travels at 16 rpm, find the angular velocity of the large gear.

rotations per min

Both gears have same v

small	large
$r = 3$ in	$r = 6$ in
$\omega = 16 \frac{\text{rev}}{\text{min}}$	$\omega = ?$

$v = \omega r$

$$= \frac{16 \text{ rev}}{\text{min}} \times 3 \text{ inch} \times \frac{2\pi}{1 \text{ rev}}$$

$$= 96\pi \frac{\text{inch}}{\text{min}}$$

use this for large too

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

$$= \frac{96\pi \text{ inch}}{\text{min}} \times \frac{1}{6 \text{ inch}} \times \frac{1 \text{ rev}}{2\pi}$$

$$= 8 \frac{\text{rev}}{\text{min}}$$

12. A clock has a second hand of length 8 inches. How far **in inches** does the tip travel from when it is on the 12 to when it is on the 4.

given: $r = 8$ in $\quad \theta = \frac{4}{12}$ of $360^\circ = 120^\circ$

find: $a = ?$

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

$$a = 120^\circ \left(8 \text{ in}\right) \times \frac{2\pi}{360^\circ}$$

$$\approx 16.8 \text{ inches}$$