Linear and Angular Velocity **Name:**_____

1. If an engine is making 1000 rpm, what is the angular velocity of the engine's crankshaft in radians per second?

$\theta = 1000 \text{ rev} \cdot \frac{2\pi \text{ rad}}{1 \text{ rev}} = 2000\pi \text{ rad}$ $AS = \frac{\theta}{t} = \frac{2000\pi}{1 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}} = 33\frac{1}{3}\pi \text{ rad/min} \approx \boxed{104.772 \text{ rad/min}}$

$r =$

$t = 1 \text{ min}$

2. A flywheel mounted on an engine crankshaft has a radius of 6 inches. If the engine is running at 2800 rpm, what is the linear velocity of a point on the outer edge of the flywheel in feet per second?

$LS = \frac{\theta r}{t}$

$\theta = 2800 \text{ rev} \cdot 2\pi = 5600\pi$

$r = r \text{ in}$

$t = 1 \text{ min}$

$= \frac{5600\pi \cdot 6 \text{ in}}{1 \text{ min}} \cdot \frac{1 \text{ min}}{60 \text{ sec}} \cdot \frac{1 \text{ ft}}{12 \text{ in}} = 146.608 \text{ ft/sec}$

3. A wheel has diameter 16 in. What is the linear velocity of a point on the edge of the wheel when it moves through an angle of 760 degrees in 1 second? Express your answer in inches per second.

$LS = \frac{\theta r}{t}$

$\theta = 760^\circ \cdot \frac{\pi}{180} = \frac{38\pi}{9}$

$r = 8 \text{ in}$

$t = 1 \text{ sec}$

$\frac{\frac{38\pi}{9} \cdot 8 \text{ in}}{1 \text{ sec}} \approx \boxed{106.116 \text{ in/sec}}$

4. A skater is skating around the edge of a circular pond at a distance of 6 meters from the center. Her linear velocity is 7.3 m/s. Determine her angular velocity in radians per second. How many times per minute does she go around the pond? RPM

$LS = \frac{\theta r}{t}$

7.3

$\theta =$

$r = 6 \text{ m}$

$t = 1 \text{ sec}$

$\frac{7.3 \text{ m}}{1 \text{ sec}} = \frac{\theta 6 \text{ m}}{1 \text{ sec}}$

$7.3 = \theta 6$

$\boxed{1.2167 \text{ radians}}$

$AS = \frac{\theta}{t}$ $\frac{1.2167 \text{ rad}}{1 \text{ sec}} \cdot \frac{60}{1 \text{ min}} \cdot \frac{1 \text{ rev}}{2\pi} = \boxed{11.618 \text{ rpm}}$

5. A tennis court roller is 28 in. in diameter. It makes 1.5 revolutions per second. Determine its angular velocity in radians per second. How fast is it moving across the courts?

$AS = \frac{\theta}{t}$

$\theta = 1.5 \text{ rev} \cdot 2\pi = 3\pi$

$r = 14 \text{ in}$

$t = 1 \text{ sec}$

$AS = \frac{3\pi}{1 \text{ sec}} = 3\pi \text{ rad/sec} \approx 9.425 \text{ rad/sec}$

$LS = \frac{3\pi \cdot 14 \text{ in}}{1 \text{ sec}} = 131.947 \text{ in/sec}$

6. A toy racing car is traveling around a circular track that is 3.2 m in diameter. Its linear velocity is 0.5 m/s. What is its angular velocity in degrees per minute? How many times per minute does it go around the track?

$LS = \frac{\theta}{t}$

$\theta =$

$r = 1.6 \text{ m}$

$t = 1 \text{ sec}$

$LS = .5 \text{ m}$

$\frac{.5}{1} = \frac{\theta \cdot 1.6 \text{ m}}{1}$

$.3125 \text{ radians}$

$AS = \frac{.3125 \text{ rad}}{1 \text{ sec}} \cdot \frac{60 \text{ sec}}{1 \text{ min}} = \boxed{18.75 \text{ rad/m}}$

$\frac{18.75 \text{ rad}}{1 \text{ min}} \cdot \frac{1 \text{ rev}}{2\pi \text{ rad}}$

$\boxed{2.985 \text{ rev/min}}$

7. A Ferris wheel 250 ft. in diameter makes on rotation every 45 seconds. Determine the linear velocity of a car on the rim of the wheel in feet per minute.

$\theta = 1 rev \cdot 2\pi = 2\pi$ $\quad LS = \frac{\theta r}{t}$

$r = 125 ft$

$t = 45 sec$

$LS = \frac{2\pi \cdot 125}{45 sec} \cdot \frac{60 sec}{1 min} = \boxed{1047.198 ft/min}$

8. A space telescope travels about the Earth in a circular orbit at a distance of 380 miles from the Earth's surface. It makes one orbit every 95 minutes. Find its linear velocity in miles per hour. (The radius of the Earth is approx. 3960 miles).

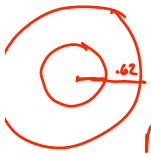
$\theta = 1 rev \cdot 2\pi$ $\quad LS = \frac{\theta r}{t} = \frac{2\pi \cdot 4340 m}{95 min} \cdot \frac{60 min}{1 H} =$

$r = 4340$

$t = 95 min$

$\boxed{17222.542 mph}$

9. A ship's radar rotating at 15 rpm shows a plane 29.74 miles away, directly east of the ship. On the next revolution of the radar, the plane is 29.12 miles away and still directly east of the ship. What is the plane's speed in mph?



$\theta = 15 rev$

$r_1 = 29.74 mile$

$r_2 = 29.12 miles$ > DISTANCE = .62

$t = 1 min$

$\frac{.62 m}{1 rev} \cdot \frac{15 rev}{1 min} \cdot \frac{60 m}{1 HR} = 558 mph$

this converts rev to minutes

10. A satellite placed in circular orbit over the equator in a west-east path and with a speed set to make one rotation in 24 hours is said to be synchronized with the earth. Such a satellite appears stationary to the observer below. Find the speed in miles per hour required to synchronous satellite 250 miles above the equator. Assume that the diameter of the earth at the equator is 7920 miles.

$\theta = 1 rev \cdot 2\pi$ $\quad LS = \frac{2\pi \cdot 4210 m}{24 H} = \boxed{1102.175 mph}$

$r = 4210$

$t = 24 H$

11. Approximate the linear speed of the earth in its orbit about the sun in miles per hour. Assume that the orbit of the earth about the sun is nearly a circle with a radius of 93000000 miles.

$1 rev = 1 YEAR$

$\theta = 1 rev \cdot 2\pi$ $\quad LS = \frac{2\pi \cdot 93000000}{365 D} \cdot \frac{1 DAY}{24 H} = \boxed{66705.09 MPH}$

$r = 93000000$

$t = 365 DAYS$

12. As Yoshio and Hiroko are skating, Yoshio spins his partner in a circle with a diameter of 1.8 meters and then releases her. If Hiroko is moving about the circle at the rate of one rotation every 3 seconds, what is her linear speed at the time she is released in meters per second.