Rotational Speed Problems Name Sudbury Key Block____ Date____

Objects that rotate have velocity. Velocity is still a ratio of how far they travel divided by the time it took them to travel. Since the objects are moving on a curved or circular path, the formula to solve for their tangential (or rotational) velocity must have pi (π) in it. To solve for the velocity of an object on a circular path, we must also know the period of the object. The period is the time it takes for the circular-path traveling object to make one complete rotation or revolution around its axis. If you do not know the period, you can use the frequency to find the period; the frequency is how many complete rotations or revolutions the object makes in a specific unit of time.

Formulas:

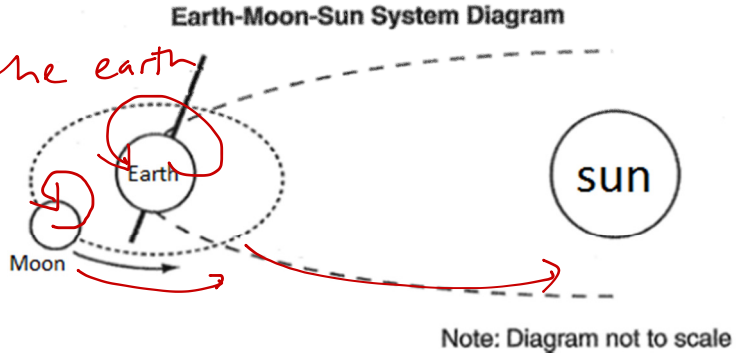
Period	Frequency	(Tangential) Velocity	Period	Radius
$T = \frac{1}{f}$	$f = \frac{1}{T}$	$V = \frac{2\pi r}{T}$	$T = \frac{2\pi r}{V}$	$r = \frac{VT}{2\pi}$

Rotation vs. Revolution

1. Below is a diagram of the sun, earth, and moon. Describe all aspects of the motion of the earth and moon relative to the sun (assume the sun is stationary). Make sure to use rotation and revolution correctly when describing their earth and moon's motion.

Moon rotates on axis & revolves around the earth

Earth rotates on axis & revolves around sun



2. What is the period of the earth's rotation?

Once ever 1 day or 24 hours

3. What does the earth's rotation cause?

day & night

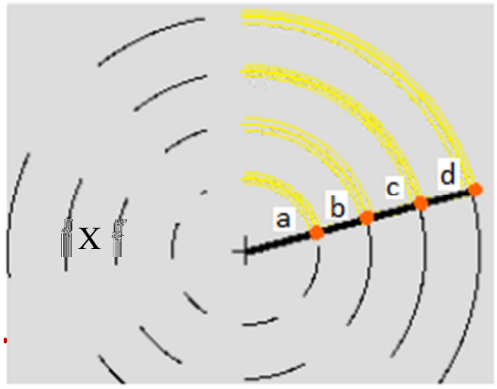
4. What is the period of the earth's revolution?

Once every year or 365 days

5. What does the earth's revolution cause?

Seasons

Four ladybugs are standing on a spinning record player and you observe from above (See picture below). The record is spinning at a rate of 45 RPM (rotations per minute) or 1.33 seconds per rotation.



6. The record player has only been spinning for a fraction of a second. Which ladybug has traveled the furthest in this time?

ladybug D

7. In 1 minute, which ladybug rotates around the axis the most times?

all rotate an equal amount.

8. Which lady bug travels the least distance?

ladybug A

9. If ladybug B is 0.25 m away from the center of the record, what is her tangential velocity?

$$V = \frac{2\pi r}{T} = \frac{2\pi(0.25\text{ m})}{1.33\text{ sec}} = 1.18\text{ m/s}$$

10. If ladybug D is 0.5 m away from the center of the record, what is her tangential velocity?

$$V = \frac{2\pi r}{T} = \frac{2\pi(0.5\text{ m})}{1.33} = 2.36\text{ m/s}$$

11. What is the period of revolution for ladybug B if the tangential velocity speeds up to 3.5 m/s?

$$T = \frac{2\pi r}{V} = \frac{2\pi(.25\text{ m})}{3.5\text{ m/s}} = 0.45\text{ sec.}$$

12. What is the frequency of ladybug B's revolution if her period was the answer to # 11?

$$f = \frac{1}{T} = \frac{1}{0.45\text{ sec}} = 2.2\text{ Hz}$$

13. Back at the original speed of 45 RPM, a new ladybug lands on the spinning record a point "X". The new ladybug is moving faster than ladybug A and B, but slower than ladybugs C and D. If the ladybug is moving with a tangential velocity of 2.25 m/s, what is the distance from the center of the record (AKA radius of her circular path)?

$$r = \frac{VT}{2\pi} = \frac{2.25\text{ m/s} \cdot 1.33\text{ sec}}{2\pi} = 0.476\text{ m}$$

14. A merry-go-round is spinning around at a high rate of speed. It spins completely around 30 times in a minute. How far away from the center are you if you have a tangential velocity of 5.5 m/s?

1 spin every 2 sec

$T = 2\text{ sec}$ $\quad r = \frac{VT}{2\pi} = \frac{5.5\text{ m/s} \cdot 2\text{ sec}}{2\pi} =$ 1.8 m