Gen Physics 12/10/11

Practice Exercises

WS 84 - 87

Exercise 1: Marianne puts her favorite Bon Jovi disc in her CD player. If it spins with a frequency of 1800 revolutions per minute, what is the period of spin of the compact disc?

$T = \frac{1}{f} = .034 s$

Answer: ____________________

Exercise 2: Hamlet, a hamster, runs on his exercise wheel, which turns around once every 0.5 s. What is the frequency of the wheel?

$f = \frac{1}{T} = 2 Hz$

Answer: ____________________

Exercise 3: A sock stuck to the inside of the clothes dryer spins around the drum once every 2.0 s at a distance of 0.50 m from the center of the drum. a) What is the sock's linear speed? b) If the drum were twice as wide but continued to turn with the same frequency, would the linear speed of a sock stuck to the inside be faster than, slower than, or the same speed as, your answer to part a?

$v = \frac{2\pi r}{T} = 1.6 m/s$ b.) faster (2x)

Answer: a. ____________________

Answer: b. ____________________

Exercise 4: What is the radius of an automobile tire that turns with a frequency of 11 Hz and has a linear speed of 20.0 m/s?

$t = 1/f = .091 s$

$r = \frac{vT}{2\pi} = .29 m$

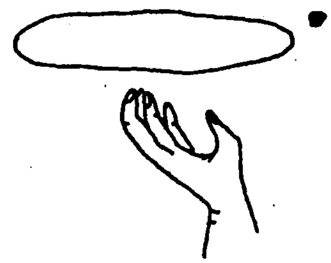
Answer: ____________________

$$\frac{60\text{ rev}}{1\text{ min}} = \frac{60\text{ rev}}{60\text{ s}} = \frac{1\text{ rev}}{1\text{ sec}} \qquad T = \frac{1\text{ s}}{1\text{ rev}}$$

Exercise 5: Luigi twirls a round piece of pizza dough overhead with a frequency of 60 revolutions per minute. a) Find the linear speed of a stray piece of pepperoni stuck on the dough 10 cm from the pizza's center. b) In what direction will the pepperoni move if it flies off while the pizza is spinning? Explain the reason for your answer.

$$v = \frac{2\pi r}{T} = .63\text{ m/s}$$

tangent



Answer: a. ____________________

Answer: b. ____________________

Exercise 6: The earth turns on its axis approximately once every 24 hours. The radius of the earth is 6.38×10^6 m. a) If some astronomical catastrophe suddenly brought the earth to a screeching halt (a physical impossibility as far as we know), with what speed would the earth's inhabitants who live at the equator go flying off the earth's surface? b) Because the earth is solid, it must turn with the same frequency everywhere on its surface. Compare your linear speed at the equator to your linear speed while standing near one of the poles.

$$v = \frac{2\pi r}{T} = 464\text{ m/s}$$

$>$ @ equator as $r >$

Answer: b. ____________________

Exercise 7: Jessica is riding on a merry–go–round on an outer horse that sits at a distance of 8.0 m from the center of the ride. Jessica's sister, Julie, is on an inner horse located 6.0 m from the ride's center. The merry–go–round turns around once every 40.0 s. a) Explain which girl is moving with the greater linear speed. ... of Julie and her horse?

$$v_{Je} = \frac{2\pi r}{T} = 1.3\text{ m/s} \qquad v_{Julie} = .94\text{ m/s}$$

$$a_c = \frac{v^2}{r} = .15\text{ m/s}^2$$

______ ______

$f = \frac{1}{T}$ $T = \frac{1}{f}$

Exercise 8: A cement mixer of radius 2.5 m turns with a frequency of 0.020 Hz. What is the centripetal acceleration of a small piece of dried cement stuck to the inside wall of the mixer?

$v = 2\pi r f$

$v = \frac{2\pi r}{T} = .314\ m/s$

$a_c = v^2/r = .039\ m/s^2$

Answer: ______________

Exercise 9: A popular trick of many physics teachers is to swing a pail of water around in a vertical circle fast enough so that the water doesn't spill out when the pail is upside down. If Mr. Hopkinson's arm is 0.60 m long, what is the minimum speed with which he can swing the pail so that the water doesn't spill out at the top of the path?

$v = \sqrt{a_c r} = \sqrt{(9.8\ m/s^2)(.26)} = 2.4\ m/s$

Answer: ______________

Exercise 10: To test their stamina, astronauts are subjected to many rigorous physical tests before they fly in space. One such test involves spinning the astronauts in a device called a *centrifuge* that subjects them to accelerations far greater than gravity. With what linear speed would an astronaut have to spin in order to experience an acceleration of 3 g's at a radius of 10.0 m? (1 g = 10.0 m/s²)

$v = \sqrt{a_c r} = 17.1\ m/s$

Answer: ______________

Exercise 11: At the Fermilab particle accelerator in Batavia, Illinois, protons are accelerated by electromagnets around a circular chamber of 1.00–km radius to speeds near the speed of light before colliding with a target to produce enormous amounts of energy. If a proton is traveling at 10% the speed of light, how much centripetal force is exerted by the electromagnets? (Hint: The speed of light is 3.00×10^8 m/s. $m_p = 1.67 \times 10^{-27}$ kg)

$$F_c = \frac{mv^2}{r} = \boxed{1.50 \times 10^{-15}\ N}$$

Answer: ______________________

Exercise 12: Roxanne is making a strawberry milkshake in her blender. A tiny, 0.0050–kg strawberry is rapidly spun around the inside of the container with a speed of 14.0 m/s, held by a centripetal force of 10.0 N. What is the radius of the blender at this location?

$$r = \frac{mv^2}{F_c} = \boxed{.098\ m}$$

Answer: ______________________

TORQUE

Vocabulary **Torque:** A measurement of the tendency of a force to produce a rotation about an axis.

torque = perpendicular force × lever arm or $\tau = F \times d$

The lever arm, d, is the distance from the pivot point, or fulcrum, to the point where the component of the force perpendicular to the lever arm is being exerted. The longer the lever arm, the larger the torque. This is why it is easier to loosen a tight screw with a long wrench than with your hand or a short pair of tweezers.

If a torque causes a counterclockwise rotation of an object around the fulcrum, it is positive. If the torque causes a clockwise rotation of an object around the

#	Name	Date	Period	Score /

General Physics Circular Motion & Rotation Small Group Review Sheet 11

1. Find the number of revolutions of a toy car wheel of diameter 0.25-m when the bike goes a distance of 3.0-m down the street.

2. A piece of string is used to swing a 0.25 kg toy plane in a horizontal circle. The string will break if its force of tension exceeds 50.0-N.

   a. If the plane is swung in a horizontal circle at the end of a 0.50 m cord, how fast can the ball move before the cord breaks?

   b. If the plane is to be swung with a speed of 15 m/s, what is the shortest length of cord that can be used?

3. Jet Li and Mike Tyson are having a fight at a construction site. They end up on opposite ends of ta 50.0 kg uniform steal beam hanging from a rope tied in the middle. Mike Tyson is 89.6 kg and 3.7 m from the fulcrum. Jet Li is 67.3 kg and crouches 4.2 m from the fulcrum. If neither of the men move from this position, determine the net torque on the beam.

4. Fill in the Chart.

Symbol	Name & Meaning	Equation(s)	Unit Name	Unit Symbol
θ	theta angular displacement	$\theta = s/r$	radian revolution	rad rev
ω				
α				
T				
r				
V_t				
τ				
L				
a_c				
F_c				
I				
f				

$L = I\omega$ $\quad f = \frac{1}{T}$ $\quad \tau = I\alpha$ $\quad \tau = r \times F$

$a_c = \frac{mv^2}{r}$ $\quad v = r\omega$ $\quad \omega = \frac{\Delta\theta}{\Delta t}$ $\quad F_c = \frac{mv^2}{r}$

$V_t = \frac{2\pi r}{T}$ $\quad \theta = \frac{s}{r}$ $\quad \alpha = \frac{\Delta\omega}{\Delta t}$