Name: _____

Class: _____

Due Date: _____

Physics Topic 14B – Applying Newton's Second Law of Motion to Circular Motion

Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. C: Define *centripetal.*

2. C: Define *centrifugal.*

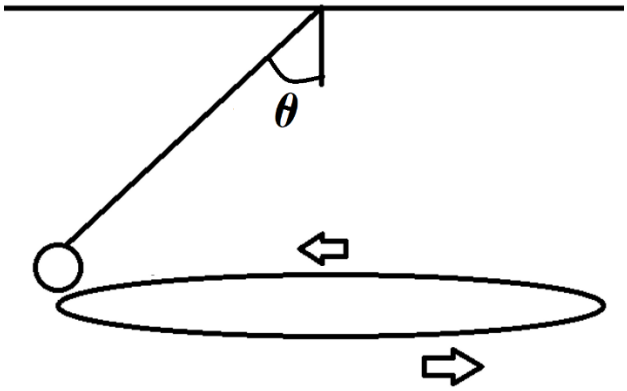
3. C: Are there *centripetal forces*?

4. C: Are there *centrifugal forces*?

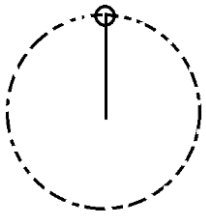
5. C: Imagine driving in a straight line with a constant speed of 60 km/h. You then quickly make a right turn. Do you feel a force? In which direction? Is it a centripetal force or a centrifugal force? Is it a real force? Why?

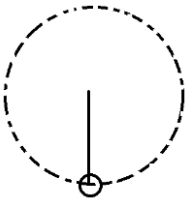
6. C: In circular motion how much work does the centripetal force do? Use the equation $W = \vec{F}\vec{d}\cos\theta$.

7. E: Draw a free body diagram and use Newton's second law of motion to obtain an equation for the <u>force of tension</u> and then the <u>speed</u> of a mass on a string in horizontal circular motion which makes an angle θ from the vertical. Your answer should be in terms of the mass of the object m, the length of the string l, the angle from the vertical θ, and the acceleration from gravity g.

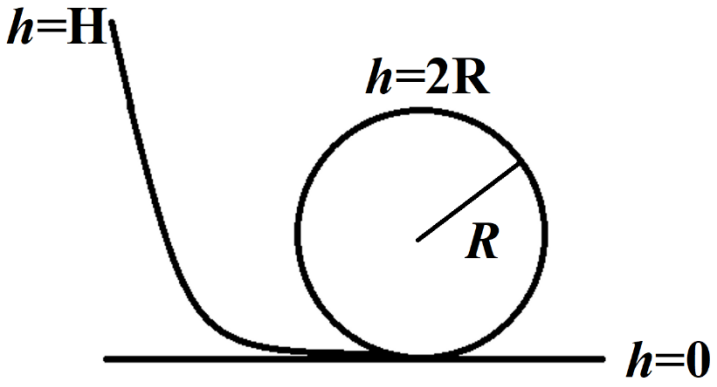


8. E: A point mass is attached to a massless string with length r. The mass and string are moving in vertical circular motion with a constant speed v. Draw free body diagrams and use Newton's second law of motion to obtain equations of the force of tension at the top and bottom of the string. Where is the force of tension greater? Your answers should be in terms of the mass of the object m, the radius of the string r, the speed of the point mass v, and the acceleration from gravity g.



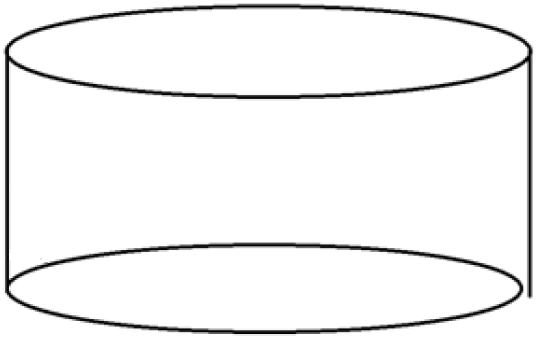


9. E: An object is released from rest from a height H. First use the law of conservation of energy to obtain an equation for the speed of the object when it has reached the top of the loop of the roller coaster. Second use Newton's second law of motion to obtain an equation for the normal force on the object when it has reached the top of the loop of the roller coaster. Your answer for the normal force should be in terms of the mass of the object m, the initial height of the object H, the radius of the loop r, and the acceleration from gravity g.

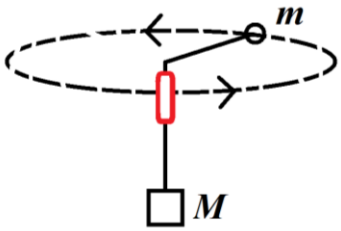


10.E: Draw a free body diagram and use Newton's second law of motion to obtain an equation for the speed of an object in the amusement park ride "The Well of Death." Your answer should be in terms of the radius of the cylinder/well R, the coefficient of friction μ, and the acceleration from gravity g.

"Mauth Ka Kua" (The Well Of Death): Basic physics at its best!
Swastik Ghosh
https://www.youtube.com/watch?v=cFLNknvi7QE



11. You are holding a red hollow cylinder and spinning a rubber stopper over your head. The rubber stopper has a mass of 18.5 g and is moving in a circle which has a radius of 110 cm. You measure that the rubber stopper moves 10 times around your head every 9.00 s.



a. What is the distance once around this circular path?

b. What is the distance ten times around this circular path?

c. What is the average speed of this rubber stopper as it circles above your head?

d. What is the direction of the centripetal acceleration of the stopper as it circles above your head?

e. What is the magnitude of the centripetal acceleration of the stopper as it circles over your head?

f. What is the direction of the velocity of this stopper when in the position shown in the diagram?

g. How much force would be required to keep this stopper moving in the given circular path?

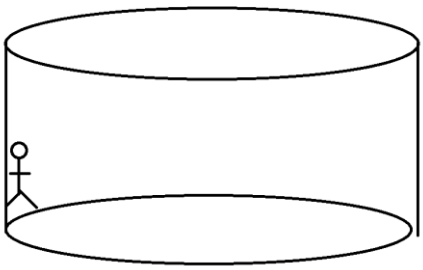
h. How much mass *M* must be hung on the lower end of the string to keep the stopper moving in the given circular path?

12. There is an amusement ride called the "ROTOR" where you enter a cylindrical room. The room begins to spin very fast until at some point the floor beneath you "falls out." Suppose that this room has a radius of 4.20 m and that the room rotates such that you make one complete revolution in 3.65 s.

    a. What will be your linear speed as the room spins at this speed?

    b. What is the magnitude of your centripetal acceleration? How many "*g*'s" is this?

    c. Label all of the forces acting on the rider.



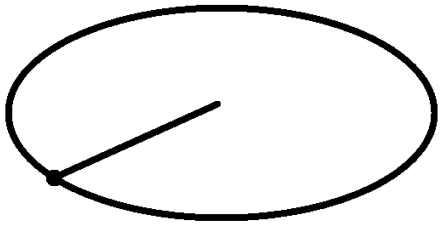
    d. What will be the magnitude of the centripetal force acting on a 50.0 kg person on this ride?

e. What will be the magnitude of the normal force acting on this person?

f. What will be the minimum frictional force acting on this person?

g. What is the minimum coefficient of friction between the rider and the wall?

13.E: A mass at the end of a string, with a radius R_1, is undergoing circular motion on a frictionless horizontal surface. The mass undergoes an angular displacement of θ in a time *t*. If the force of tension in the string is held constant but the angular displacement of the mass increases to 3θ in the same time *t* then determine R_2.



14. Write down the common terms and equations for circular motion.