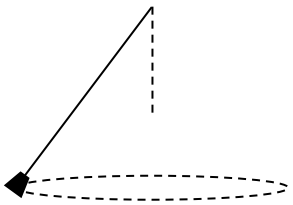
Circular Motion Homework

Name: _____

Hour: _____ Date: _____

1. A rubber stopper on a string is spun horizontal circle with a constant speed so that the string makes some angle with the vertical.



In the space below, draw a top view **motion map** for one revolution of the stopper (velocity and acceleration arrows).

In the space below, draw a side view **force diagram** for the stopper at the point shown above.

   a. Is the velocity constant? How do you know?

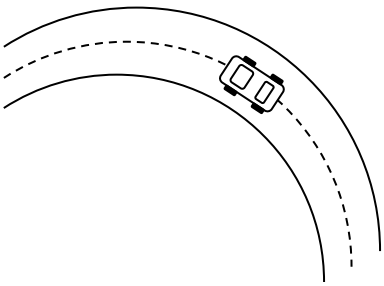
   b. In what direction is the acceleration?

   c. In what direction is the net (unbalanced) force?

   d. What provides this net (unbalanced) force?

   e. What is the name we give to the net (unbalanced) force and acceleration?

2. A car moves with a constant speed around a circular as shown at the right.



   On the drawing at the right, draw a top view **motion map** for the car – use 5 dots.

   In the space at the right, draw a *front view* **force diagram** for the car at any point.

   a. Is the velocity constant? How do you know?

   b. In what direction is the acceleration?

   c. In what direction is the net (unbalanced) force?

   d. What provides this net (unbalanced) force?

   e. What is the name we give to the net (unbalanced) force and acceleration?

3. A 1650 kg Subaru Outback takes a turn of radius 30 m on a flat road at 9 m/s (20 mph).
   a. Find the centripetal force on the Outback.

   b. Find the centripetal acceleration of the Outback.

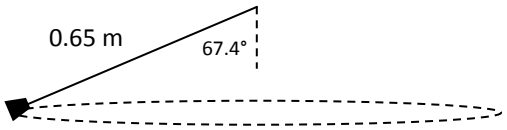
   c. Find the coefficient of friction necessary to make this turn.

4. The coefficient of friction between a rubber tire and a wet concrete road is 0.3.
   a. What is the maximum speed a Pontiac GTO of mass 1693 kg can take a turn of radius 12 m?

   b. Convert that speed to mph by multiplying by 2.25 mph/m/s.

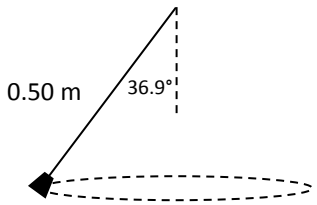
Solve the following:

5. A stopper with mass 0.05 kg spins around in a horizontal circle with a radius of 0.60 m at a constant speed of 3.8 m/s. Using the diagram at the right:
   a. Find the centripetal force on the stopper.



   b. Find the tension in the string.

6. A stopper with mass 0.16 kg spins around in a horizontal circle with a constant speed and the force applied by the string is 2.0 N. Using the diagram at the right:
   a. Find the speed of the stopper.



   b. Find the time for the stopper to complete 1 complete circle.

7. An elementary physics student (mass 30 kg) finds herself 1.5 m from the center of a merry-go-round that is spinning around once every 4 seconds.
   a. What is his period of rotation?

   b. What is her speed at this distance?

   c. What is her centripetal acceleration?

   d. Draw a force diagram for the student.
   e. What is the amount of force she needs to apply to keep herself on the merry-go-round? Multiply by 0.22 to find the force in pounds. In what direction does she pull?

   f. She inches herself outward so that she is 3 m from the center. What is the new force she needs to apply (both speed and radius change)?

   g. Where on the ride is the force she needs to apply zero? Why?

8. A coin of mass 0.005 kg (5 gram) sits 0.10 m (10 cm) from the center of a record player that is rotating at 45 rpm (revolutions per minute).
   a. Find the period of rotation (remember the units are seconds per revolution).

   b. Find the speed of the coin.

   c. Draw a force diagram for the coin.
   d. Find the centripetal force on the coin. What provides this force?

   e. Find the coefficient of friction is necessary to keep the coin on the record.

9. The giant swings at Cedar Point are by far the best ride in the park! When going their fastest the swings complete one rotation every 8 seconds. An average rider has a mass of about 60 kg and spins at a radius of about 6 meters.
   a. How fast is the rider moving?

   b. What is the centripetal force on the rider?

   c. What is the centripetal acceleration rider?

   d. To what angle (measured with the vertical) does the rider swing out?

   e. How would this angle change if the rider were only 30 kg?

10. The 3rd turn at the Talladega speedway has a radius of 254 meters and is banked at an angle of 33° with the horizontal.
   a. Draw a force diagram for a 60 kg driver on the turn.

   b. At what speed could a driver take the turn without steering?

   c. What is the value of the force of the seat on the driver?

   d. How would he feel?