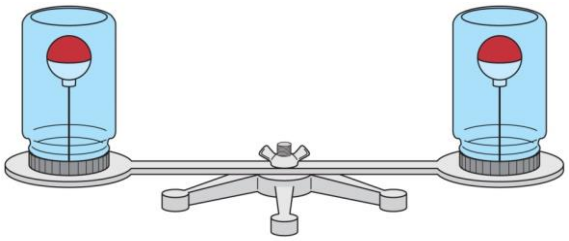
Physics **Circular & Rotational Motion** **Mr. McMullen**

Name_____ Date _____ Period _____

Circular & Rotational Motion – Problem Set 4

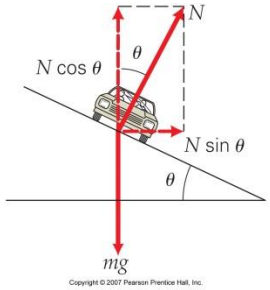
Answer the following questions a separate sheet of paper. Show all work and circle your answer.

1. The apparatus illustrated ► is used to demonstrate forces in a rotating system. The floats are in jars of water. When the arm is rotated, which way will the floats move? Does it make a difference which way the arm is rotated?



2. When rounding a curve in a fast-moving car, we experience a feeling of being thrown outward. It is sometimes said that this effect occurs because of an outward centrifugal (center-fleeing) force. However, in terms of Newton's laws, this pseudo, or false, force doesn't really exist. Analyze the situation in the figure to show that this is the case (that is, that the force does not exist). [*Hint*: Start with Newton's first law.]

3. Many racetracks have banked turns, which allow the cars to travel faster around the curves than if the curves were flat. Actually, cars could also make turns on these banked curves if there were no friction at all. Explain this statement using the free-body diagram shown ►.



4. An Indy car with a speed of $120\ \text{km/h}$ goes around a level, circular track with a radius of 1.00 km. What is the centripetal acceleration of the car?
5. A wheel of radius 1.5 m rotates at a uniform speed. If a point on the rim of the wheel has a centripetal acceleration of $1.2\ \text{m/s}^2$, what is the point's tangential speed?
6. A rotating cylinder about 16 km long and 7.0 km in diameter is designed to be used as a space colony. With what angular speed must it rotate so that the residents on it will experience the same acceleration due to gravity on Earth?
7. The Moon revolves around the Earth in 27.3 days in a nearly circular orbit with a radius of 3.8×10^5 km. Assuming that the Moon's orbital motion is a uniform circular motion, what is the Moon's acceleration as it "falls" toward the Earth?
8. Imagine that you swing about your head a ball attached to the end of a string. The ball moves at a constant speed in a horizontal circle. (a) Can the string be exactly horizontal? Why? (b) If the mass of the ball is 0.250 kg, the radius of the circle is 1.50 m, and it takes 1.20 s for the ball to make one revolution, what is the ball's tangential speed? (c) What centripetal force are you imparting to the ball via the string?
9. In problem #8, if you supplied a tension force of 12.5 N to the string, what angle would the string make relative to the horizontal?
10. A car with a constant speed of $83.0\ \text{km/h}$ enters a circular flat curve with a radius of curvature of 0.400 km. If the friction between the road and the car's tires can supply a centripetal acceleration of $1.25\ \text{m/s}^2$, does the car negotiate the curve safely? Justify your answer.

11. A student is to swing a bucket of water in a vertical circle without spilling any. (a) Explain how this task is possible. (b) If the distance from his shoulder to the center of mass of the bucket of water is 1.0 m, what is the minimum speed required to keep the water from coming out of the bucket at the top of the swing?