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Circular Motion Evaluation

Name: _____ Date: __COVID-19 - 2020___

$\sum F = ma_c$ $a_c = \frac{v^2}{r} = 4\pi^2 r f^2 = \frac{4\pi^2 r}{T^2}$ $E_g = mgh$ $E_K = \frac{mv^2}{2}$ $F_s = k\Delta x$

* Show all of your work to get full marks.

Knowledge

1. [5 marks] Circle the correct answer; if it is false; correct it by changing a word or words.

T F The maximum tension in a rope with a mass rotating in the vertical occurs at the top of the rotation.

T F An object is rotating in a horizontal plane; the centripetal acceleration increases as the radius of rotation decreases.

T F Centripetal acceleration is always directed tangent to the circle.

T F If you are swinging an object in a horizontal plane and release it the object flies off at a tangent.

T F A roller coaster car at the top of a circular loop does not fall downward because the normal force is greater than the car's weight.

2. [1 mark] You swing a bucket of water attached to a string in a circle above your head. What keeps the water in the bucket?
   a) Friction b) Centripetal Force c) Gravity d) Inertia

3. [1 mark] As the moon orbits the Earth, what keeps the moon moving in a circular motion?
   a) Gravity b) Inertia c) Centripetal Force d) Friction

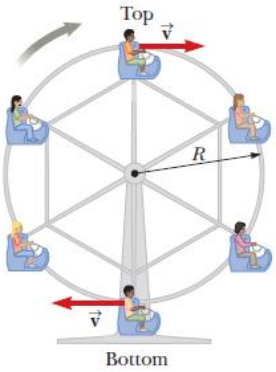
4. [1 mark] Where is the net force when a roller coaster is at the top of the loop?
   a) Towards the sky b) towards the right c) towards the left d) towards the ground

5. [1 mark] An object travels in a circular path of radius r at a constant speed v. What happens to the object's acceleration if the speed doubles and the radius stays unchanged?
6. It doubles b) it quadruples c) it cuts to a quarter d) stays unchanged

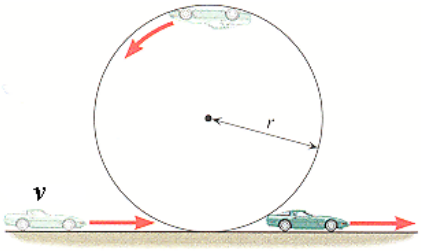
7. [1 mark] A boy stands on the edge of large rotating disc. Which of the following forces prevents him from sliding off the disc?
   a) Gravity b) Normal Force c) Friction d) ghosts

Application

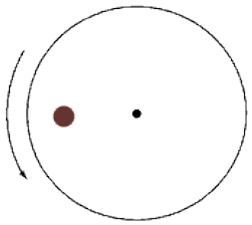
1. [10 marks] An ultra-highspeed Ferris wheel spins once every 20 s. The Ferris wheel is 80 m high. A passenger on the ride has a mass of 67kg. Calculate the apparent weight of the rider when at the top of the Ferris Wheel.



2. [10 marks] A hot Wheels car is on a track (frictionless) and is moving towards a loop with a diameter of 30cm. Calculate the speed it must enter the loop so that when it is at the top it has a normal force that is half its normal weight. [use energy conservation]

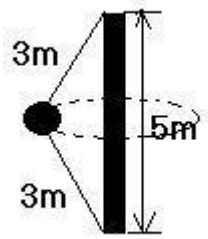


3. [10 marks] A coin placed 30 cm from the center of a rotating horizontal turntable slips when its speed is 50 cm/s. Calculate the coefficient of friction between the coin and the turntable.

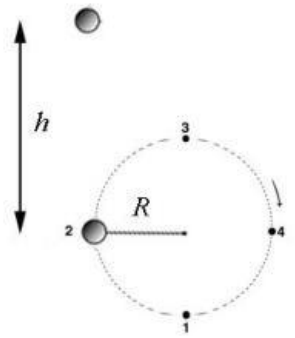


Thinking & Inquiry

4. [10 marks] A ball rotates in a horizontal circle at a constant speed of 10m/s as seen in the diagram to the right. Calculate the tensions in the upper and lower strings? The mass of the ball is 3kg. [Hint: break the tensions in the top rope and bottom rope into vertical and horizontal components]



5. [10 marks] A stone (or a ball in the demo), attached to a wheel and held in place by a string, is whirled in circular orbit of radius *R* in a vertical plane. Suppose the string is cut when the stone is at position 2 in the figure, and the stone then rises to a height h above the point at position. What was the frequency of rotation of the stone when the string was cut? Give your answer in terms of *R*, *h* and *g*.



6. [5 marks] A ball of mass 0.5kg attached to a spring (k=800 N/m) is rotating in a horizontal circle from a shaft that makes 5 revolutions every second. The equilibrium length of the spring is 5cm. Calculate the radius of rotation for the ball.