Circular Motion

8.01

W04D1

Next Reading Assignment: W04D2

Young and Freedman: 3.4; 5.4-5.5

Experiment 2: Circular Motion

Concept Question: Coastal Highway

A sports car drives along the coastal highway at a constant speed. The acceleration of the car is

1. zero

2. sometimes zero

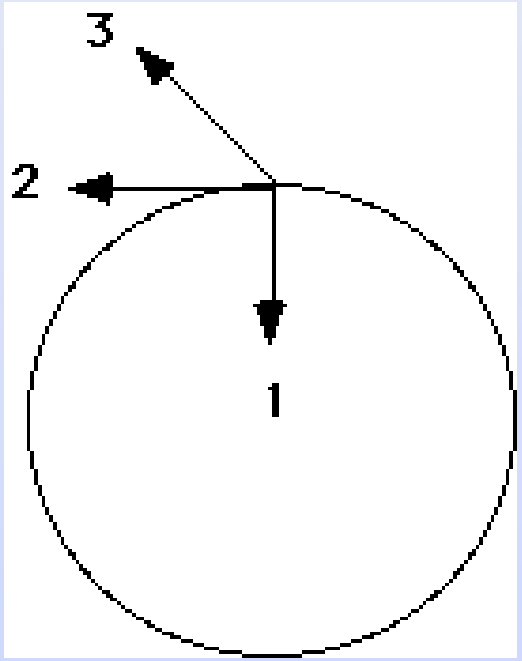
3. never zero

4. constant



Concept Question: Circular Motion

As the object speeds up along the circular path in a counterclockwise direction shown below, its acceleration points:

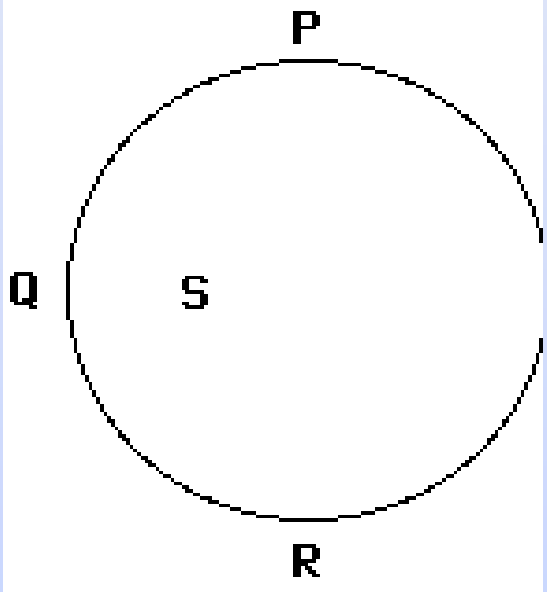


1. toward the center of the circular path.
2. in a direction tangential to the circular path.
3. outward.
4. none of the above.

Concept Question: Circular Motion

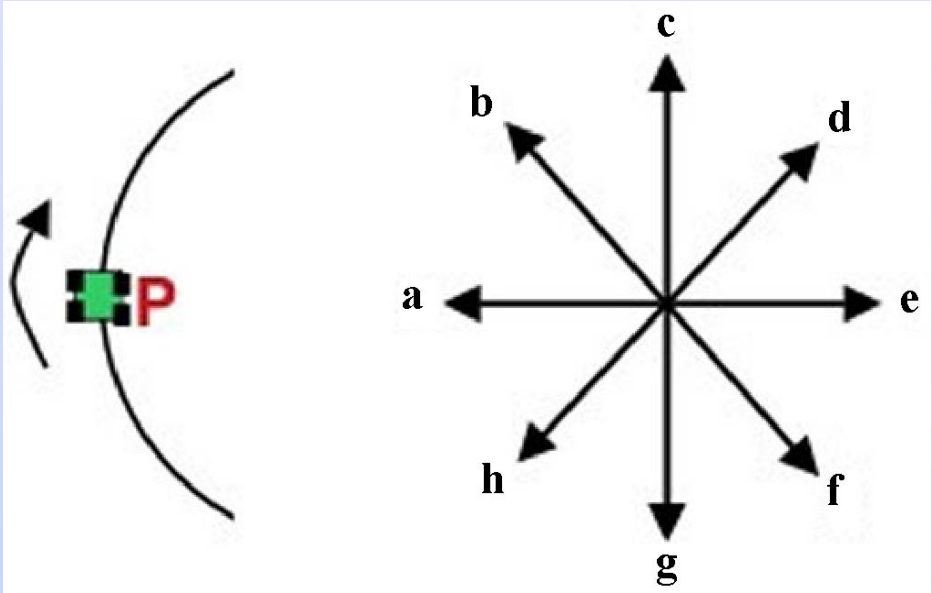
An object moves counter-clockwise along the circular path shown below. As it moves along the path its acceleration vector continuously points toward point *S*. The object

1. speeds up at *P*, *Q*, and *R*.
2. slows down at *P*, *Q*, and *R*.
3. speeds up at *P* and slows down at *R*.
4. slows down at *P* and speeds up at *R*.
5. speeds up at *Q*.
6. slows down at *Q*.
7. No object can execute such a motion.



Concept Question: Cart in a Turn

A golf cart moves around a circular path on a level surface with decreasing speed. Which arrow is closest to the direction of the car's acceleration while passing the point P?



Strategy: Circular Orbits

i) Understand geometry

ii) From geometry determine acceleration

iii) Find combination of forces that give acceleration

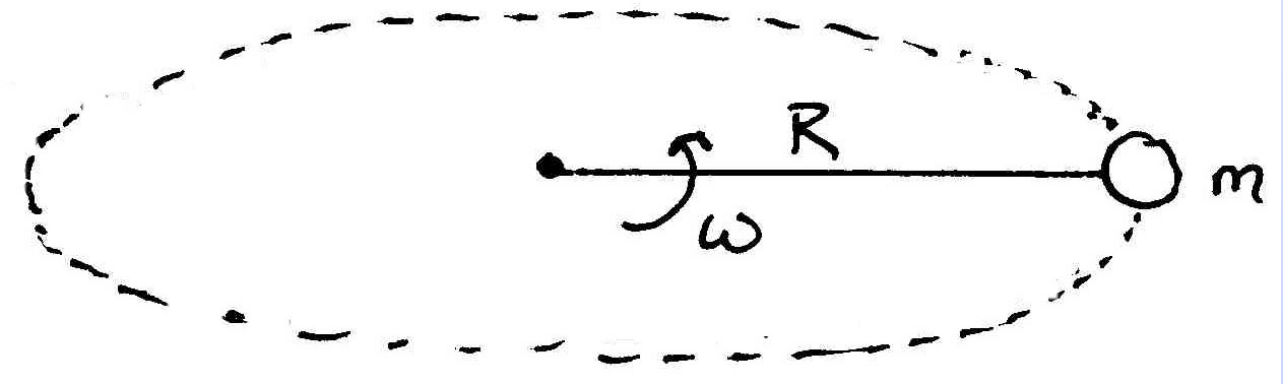
Concept Question: Car in a Turn

You are a passenger in a racecar approaching a turn after a straight-away. As the car turns left on the circular arc at constant speed, you are pressed against the car door. Which of the following is true during the turn (assume the car doesn't slip on the roadway)?

1. A force pushes you away from the door.
2. A force pushes you against the door.
3. There is no force that pushes you against the door.
4. The frictional force between you and the seat pushes you against the door.
5. There is no force acting on you.
6. You cannot analyze this situation in terms of the forces on you since you are accelerating.
7. Two of the above.
8. None of the above.

Table Problem: Horizontal Circular Motion no Gravity

A point-like object of mass m is attached to the end of a string and rotated in a circle of radius R in a horizontal plane with angular speed ω. Assume that the string is massless and you may ignore the effect of gravitation. What is the tension in the string?



Worked Example: Vertical Circular Motion

A point-like object of mass m is attached to the end of a string of length R and rotated in a vertical plane. How fast must the object move at the top of its orbit in order not to depart from a circular trajectory? For faster speeds, what is the tension in the string when the object is at the top and bottom of its trajectory? Assume that the string is massless and that gravity is acting on the object with constant g.

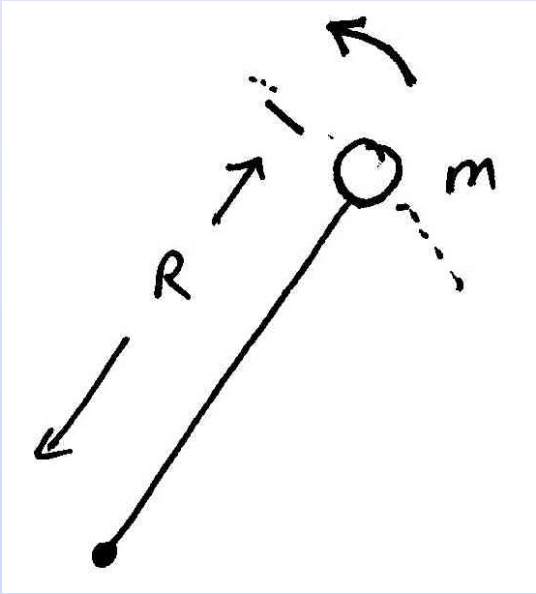
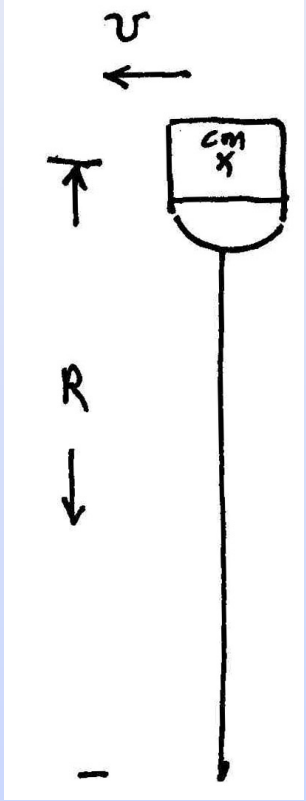


Table Problem: Rotating Bucket

A pail of mass m_p is full of water (mass m_w). A string is attached to the handle of the pail which is then whirled around a vertical circle at constant speed v. You may assume that the center of mass of the bucket and the water undergoes circular motion with radius R. What is the minimum speed that the pail must have at the top of its circular motion if the water is not to spill out of the upside-down pail? For faster speeds, find the tension in the string and the magnitude of the contact force between the water and the bucket.



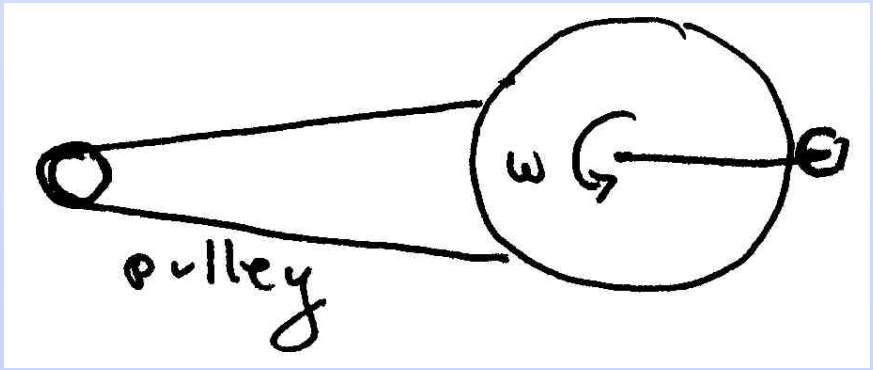
Demo: Rotating Bucket B104

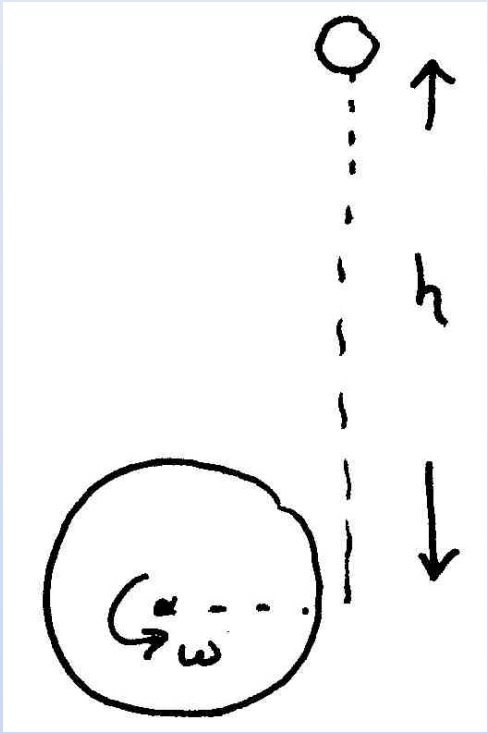
http://tsgphysics.mit.edu/front/index.php?page=demo.php?letnum=B%20104&show=0

A bucket of balls is spun in a circle. No ball spills out.

Table Problem: Demo Centripetal Force

A wheel is connected via a pulley to a motor. A thread is knotted and placed through a hole in a ping pong ball of mass *m*. A wing nut secures the thread holding the ball a distance *R* from the center of the wheel. The wheel is set in motion. When a satisfactory angular speed ω is reached, the string is cut and the ball comes off at a tangent to the spinning wheel, traveling vertically upward a distance h. Find the frequency of the motor as a function of the height that the ball rises.





Demo: Centripetal vs. Centripetal B102

1. http://tsgphysics.mit.edu/front/index.php?page=demo.php?letnum=B%20102&show=0

   A wooden ball is attached to the rim of a spinning wheel. The ball is held in place by a string. When the string is cut, the ball flies in a straight tangent to the wheel.

Concept Question: Circular Motion and Force

A pendulum bob swings down and is moving fast at the lowest point in its swing. *T* is the tension in the string, *W* is the gravitational force exerted on the pendulum bob. Which free-body diagram below best represents the forces exerted on the pendulum bob at the lowest point? The lengths of the arrows represent the relative magnitude of the forces.

