

Inertia and Circular Motion

Lesson Notes

Learning Outcomes

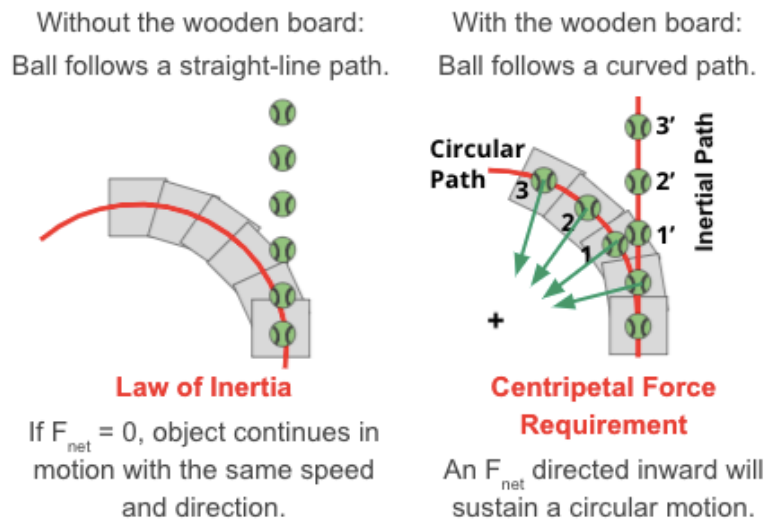
- How can you explain the sensation of there being an outward force when you move along a curved path in a car or an amusement park ride?

The Common Misconception

- A commonly held belief by beginning Physics students is that objects moving in circles experience a centrifugal (outward) force.
- The belief is supported in part by experience; there is a sensation of being pulled outwards away from the circle's center when on a turn.

Whiteboard Demonstration and Analysis

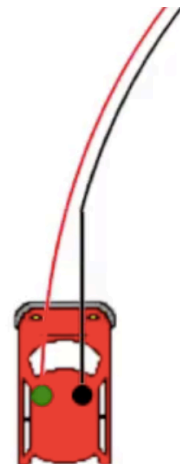
- A whiteboard, a tennis ball, and a block of wood can be used to simulate the experience of a passenger in a car on a left-hand turn.
- An inward force is required for an object to make a circular turn; without such a force, the object moves straight ahead and away from the circle's center.



The Right Hand Turn

A car passenger on a right hand turn feels pushed to the outside of the car. But is s/he? Is there an outward force pushing the passenger away from the circle's center?

The passenger is actually moving forward in a straight line as the car is veering away from its straight line path and along a curved path.



Upside Down Buckets Don't Spill

- The water doesn't spill out of upside-down bucket when it is at the top of the circle. Why not?
- The water (and the bucket) is moving upward along the circular arc. It's tendency is to continue moving upward. So why would one expect it to fall down?
- A reasonable expectation would be that the water to follow a parabolic trajectory.
- But the bucket walls and bottom push inward on the water to sustain the circular motion.

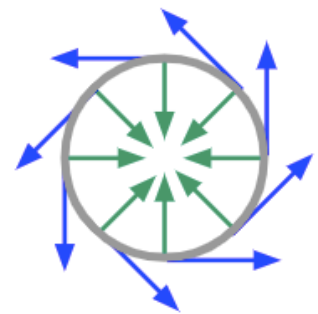


Newton's Third Law

“For every action, there is an equal and opposite reaction.”

Riders of a rotor ride or barrel ride feel pressed against the wall of the barrel.

The riders push outward upon the wall. The wall pushes inward upon the riders. The inward force on the riders is what keeps them moving in a circle.



Will the Real Centrifugal Force Please Stand Up?

There are two types of people who use the phrase “centrifugal”:

1. Those who don't know what they're talking about (and shouldn't be talking about it).
2. Those who know what they're talking about and should be careful about the messages they might be conveying to first-time physics students.

In more advanced studies of Physics, it becomes useful to analyze a motion from the reference frame of a rotating object. In such instances, the conception of an outward force becomes a useful part of the analysis. But those who do know what they're talking about will identify the centrifugal force as a fictitious force ... not a real force.