

## AP Physics

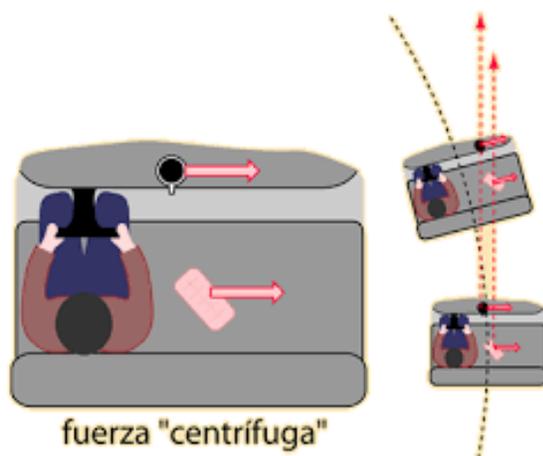
Instructor: Mr. Butler

Resource Doc

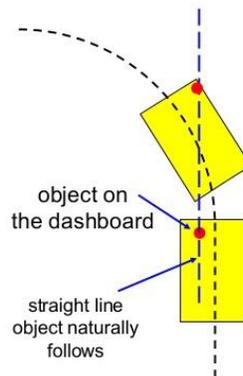
### Centrifugal Force

Centrifugal force is an apparent, fictitious or phantom force. It is not a real force because there is no real source producing it. Centrifugal force is a response to the effect of inertia in a rotating frame of reference. The feeling of being pulled or pushed outward requires that a force be invented to account for this feeling. But there is no real force acting in such cases. It is simply the effect of a body's inertia.

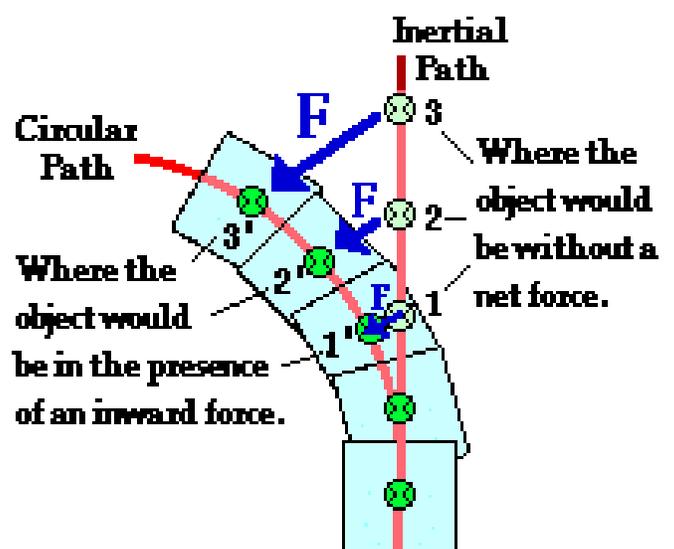
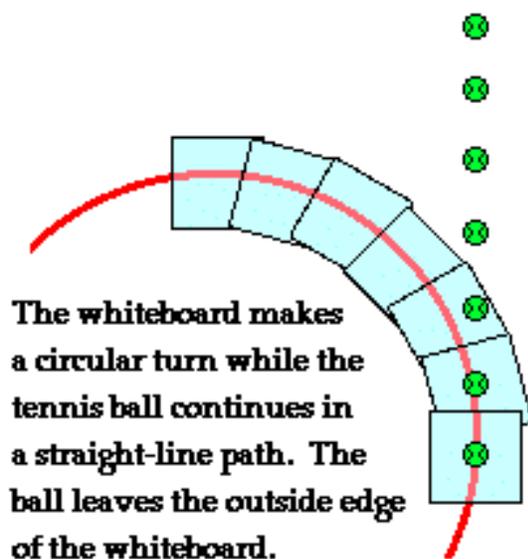
Example of a car going around a curve.



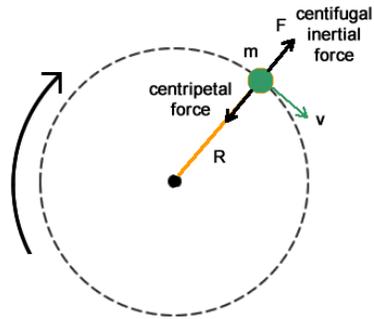
### What's this Centrifugal force ? ?



- The red object will make the turn only if there is enough friction on it
- otherwise it goes straight
- the apparent outward force is called the **centrifugal force**
- it is **NOT A REAL** force!
- an object will not move in a circle until something makes it!



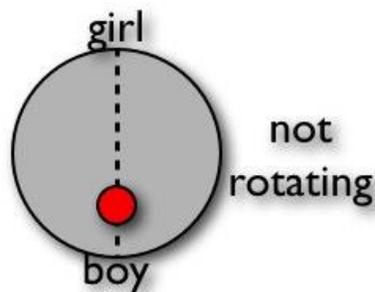
## Rotating Reference Frames



## Centrifugal Force

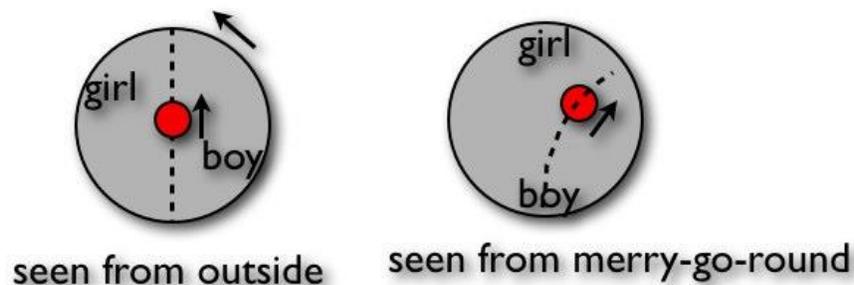
This term is much less common in introductory physics texts. It is not a real force. It does, however, have a useful role in some physics. Let me start with an example. Suppose a boy and girl are sitting on a stationary merry-go-round with a ball. The boy rolls the ball across to the girl on the other side.

Here is a diagram.



In this case, with the merry-go-round not rotating, the ball goes straight across to the girl. No problem. Now suppose the merry-go-round is spinning. If the boy tries to roll the ball straight across to the girl, the ball will indeed still go in a straight line **as seen by someone watching from above the merry-go-round who is stationary with the Earth. This reference frame is called the inertial frame.** The ball will not make it to the girl because she will rotate out of the way.

The boy and girl sitting on the spinning merry-go-round will see the ball not moving in a straight line in their reference frame of the merry-go-round. **Their frame is called the non-inertial frame because it is rotating and therefore accelerating.** Here are two diagrams that might help.



The problem is with the boy and the girl on the merry-go-round. They see the ball NOT going in a straight line. Since they understand force and motion, they are saying “hey – if it is not moving in a straight line, there must be a force on it”. They make a good point. However, they are not in an **inertial frame** of reference. Their frame is actually accelerating (because it is moving in a circle). In order for things to work out in a **non-inertial frame**, a force needs to be invented by them (a non-real or phantom force to account for what they perceive. This force is the **centrifugal force**.

The centrifugal force is the force (non-real force) that is needed to make things work as you would think in a reference frame that is accelerating. The best example is when you are in a car that is turning. If the car is turning left, it FEELS like there is a force pushing you to the right (in your frame of reference inside the car). This would correctly be called the centrifugal force. The only real problem is that if you call the centrifugal force a real (as in fundamental interaction) force.