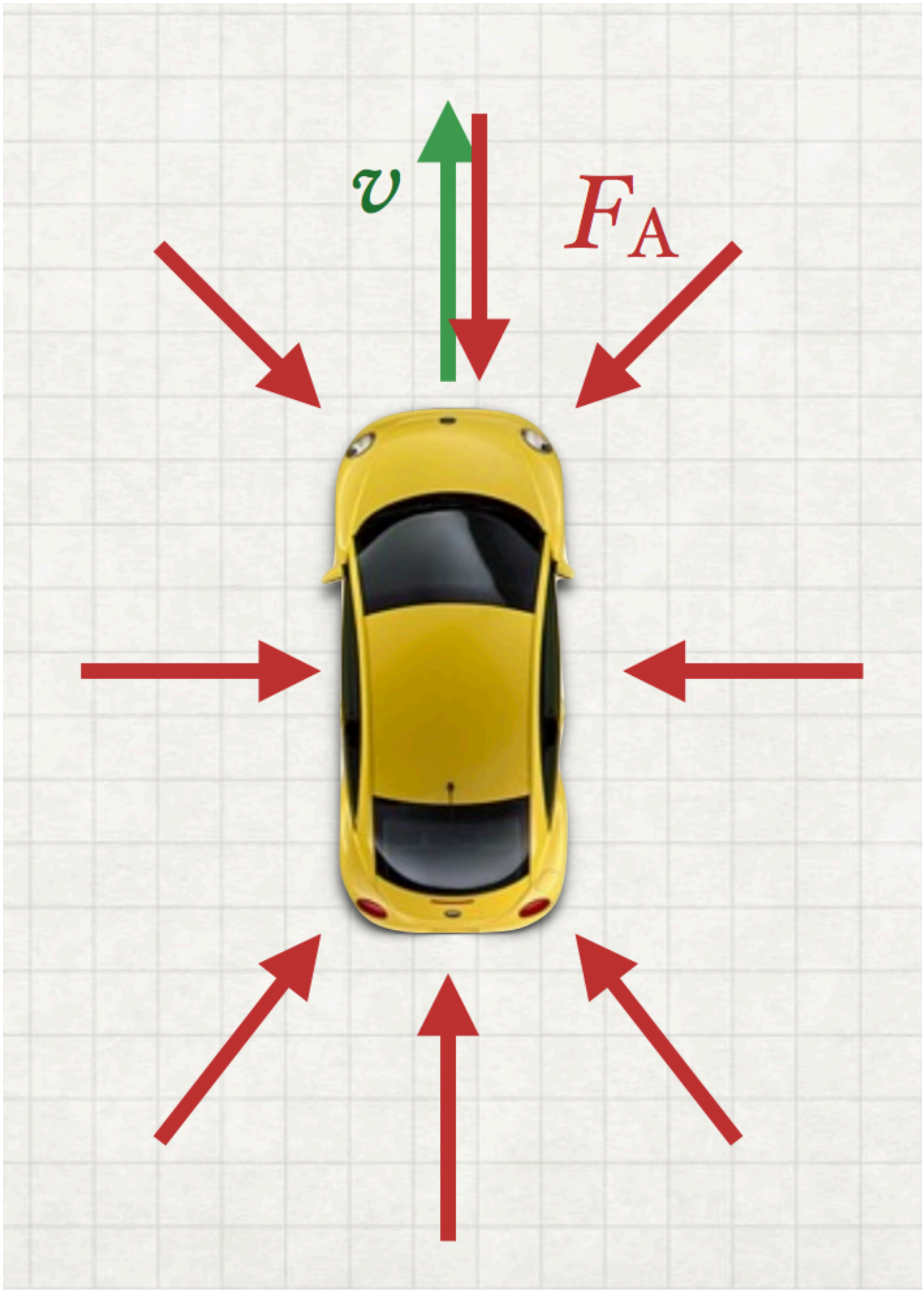
A cup is swung in a horizontal circle and released. Immediately after it is thrown, which path will the cup follow?

What path does the ball travel as the pitcher releases it?

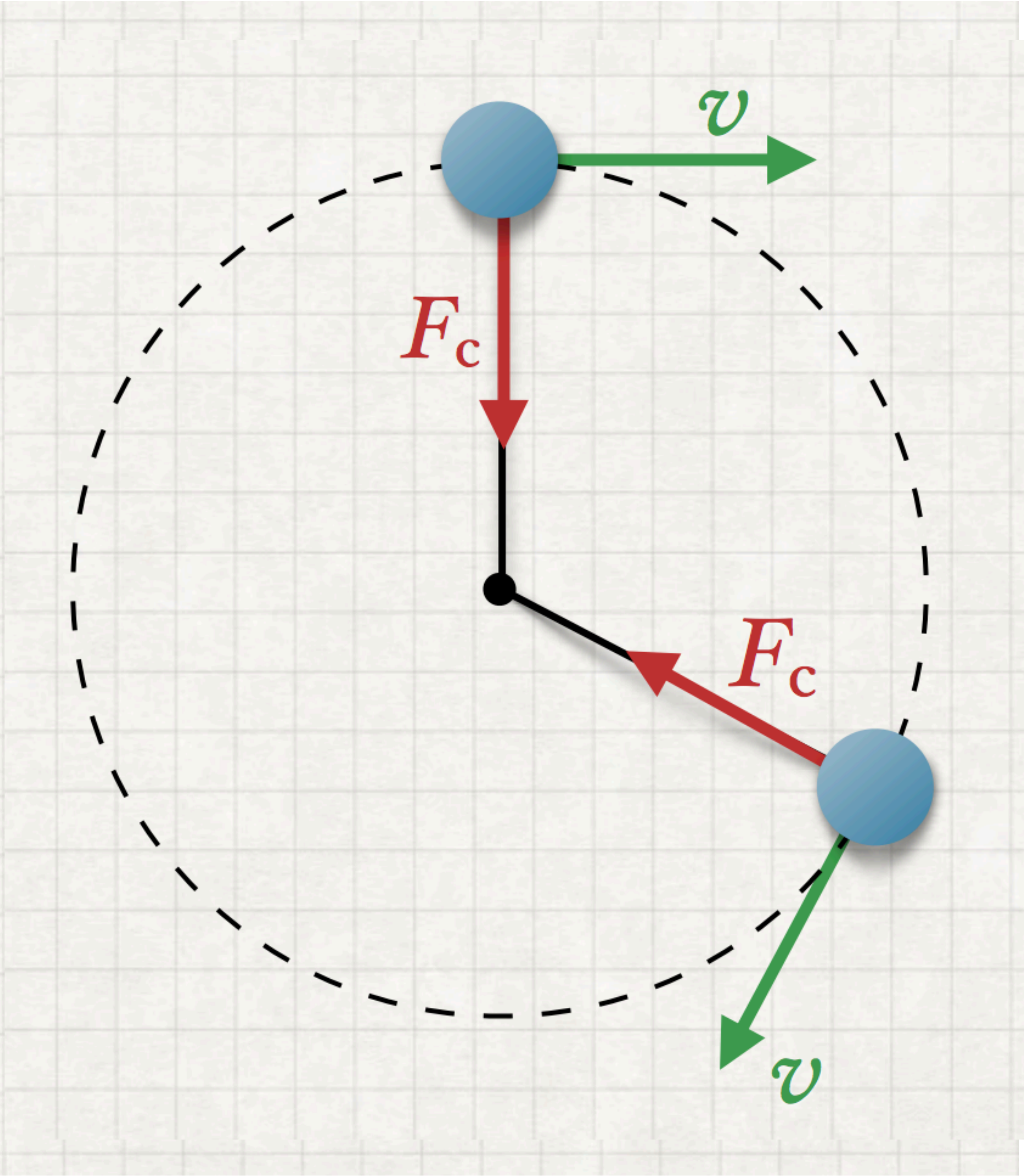
How do you make an object turn?

- So we need an unbalanced force. Where would be the most effective place to apply it?



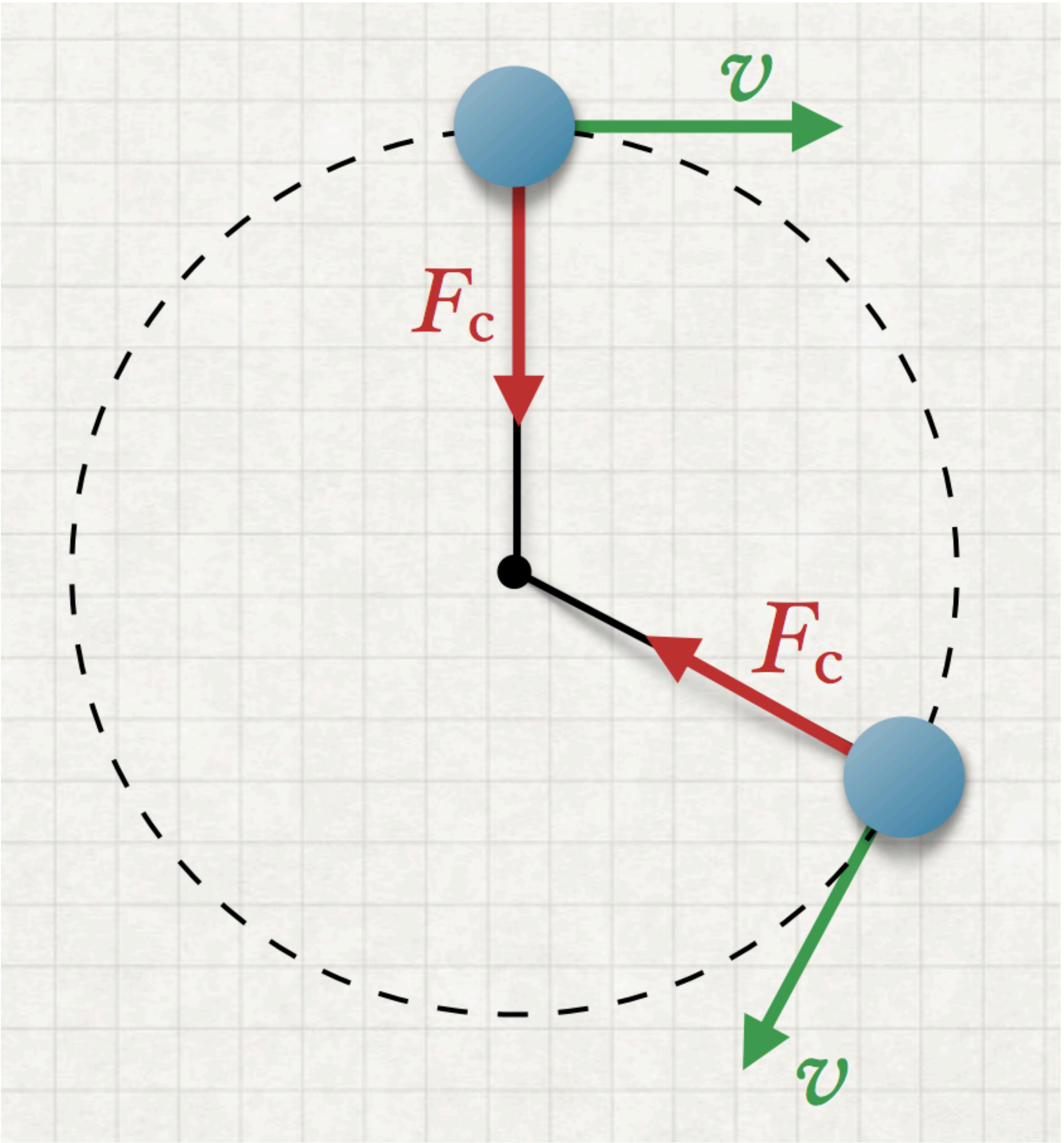
Which way should the force be applied to make the object move in a circle?

- Forces that point toward the center of rotation are called centripetal forces, meaning "center-seeking" forces
- Keep an object in rotation



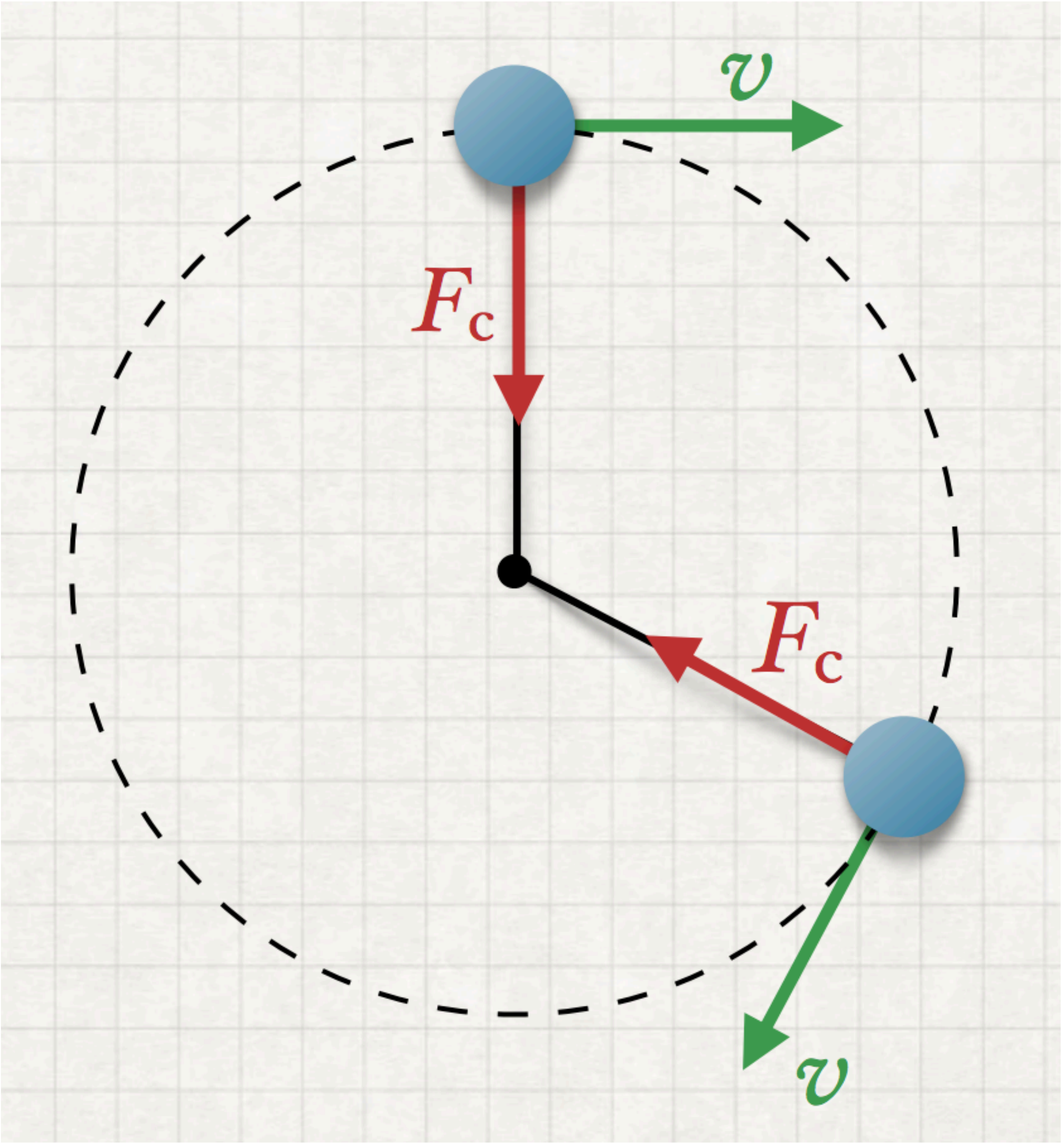
Centripetal forces aren't new forces, they're the same ones we've talked about before:

- Cup swung on a string- F_T
- Car making a turn- *f* (friction)
- Moon orbiting the Earth- F_G
- Rollercoaster car going around a loop- F_N



What's needed to determine the magnitude of the necessary centripetal force:

- Mass of object (*m*)
- How big is the circular path (*r*)
- How fast the object is moving around the circle (tangential velocity, *v*)

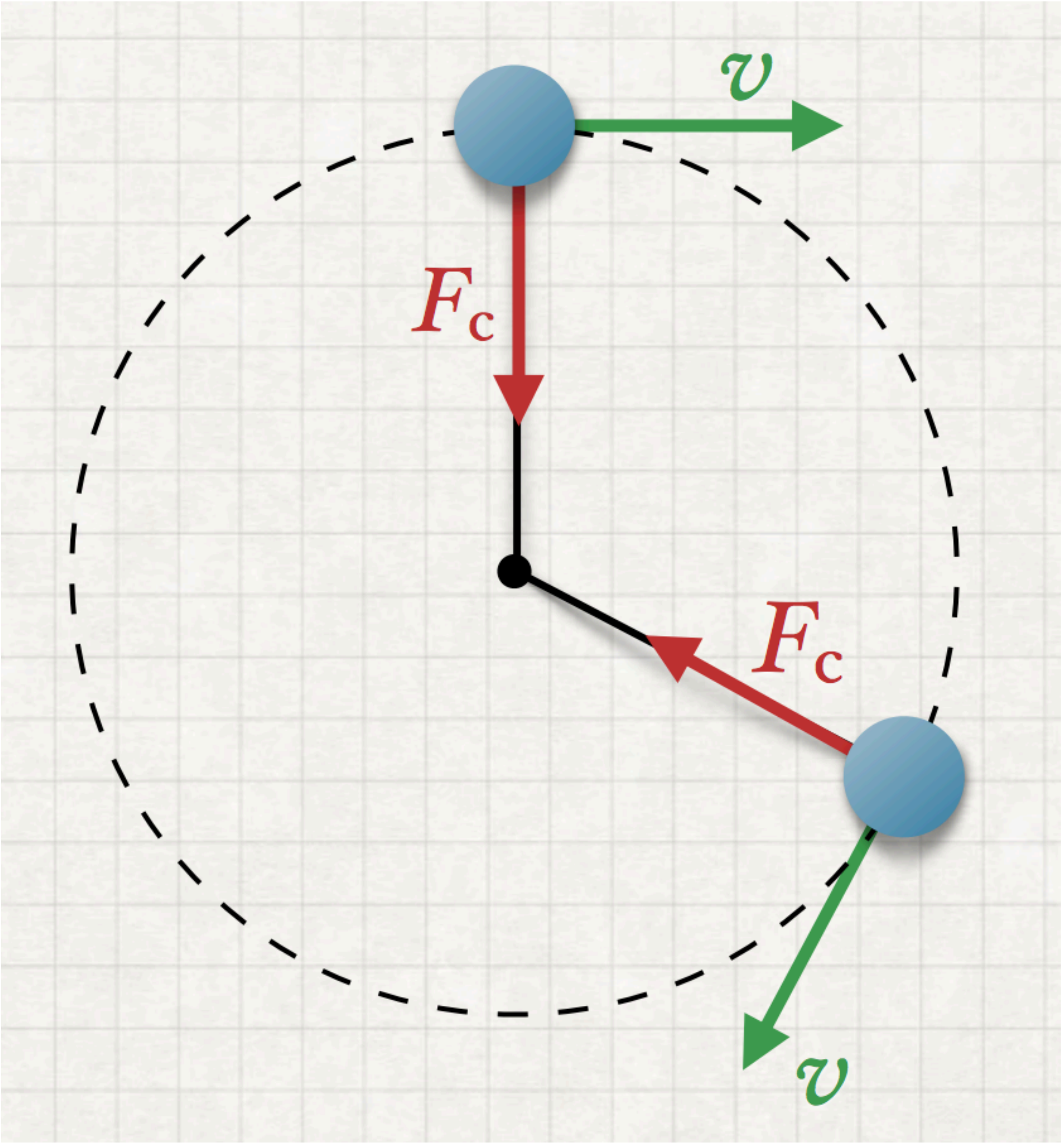


Centripetal Force

$$\Sigma F_c = ma_c$$

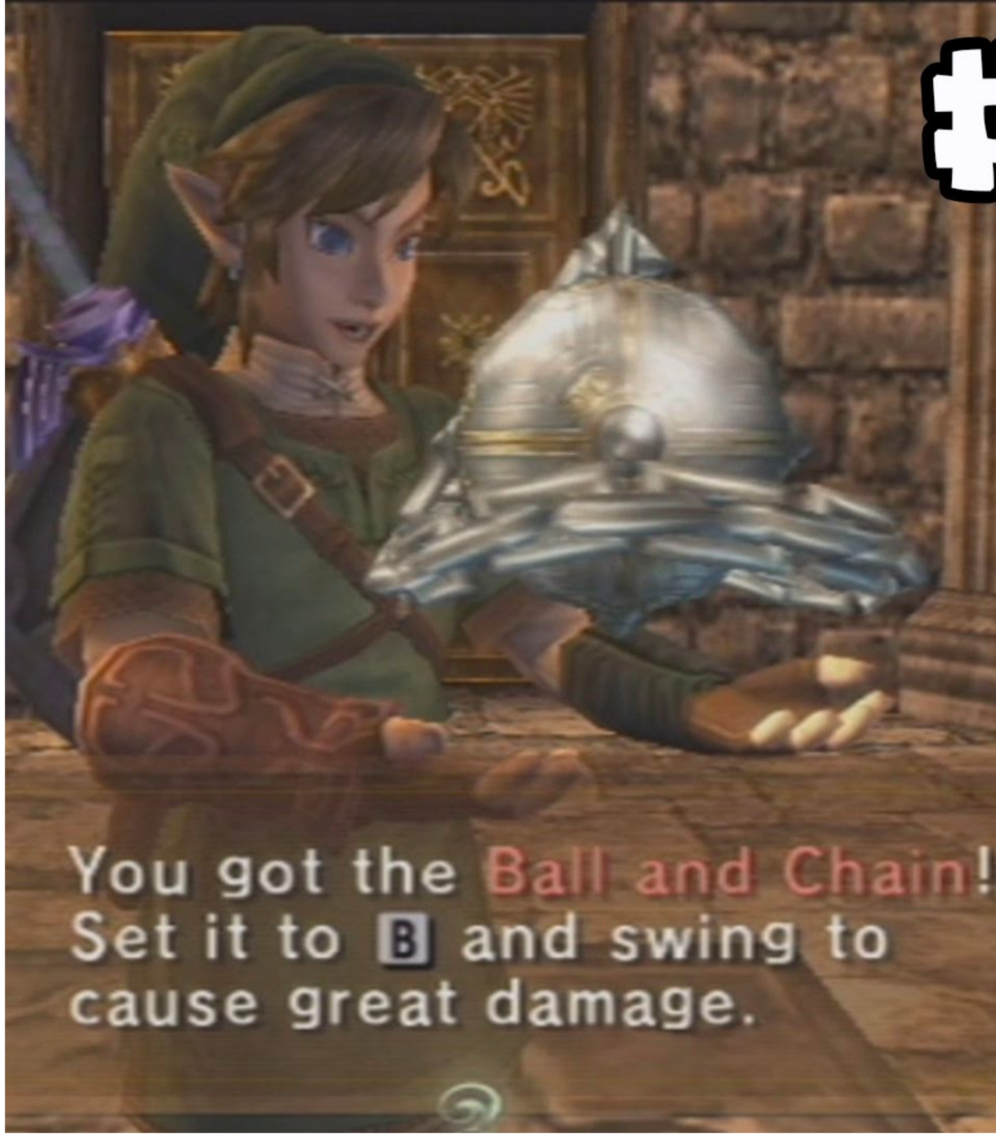
$$a_c = v_T^2/r$$

$$F_c = mv_T^2/r$$



You can swing the 18.0 kg ball from its 1.50 m long chain at 18.8 m/s. What is the force of tension in the chain?

4,240 N

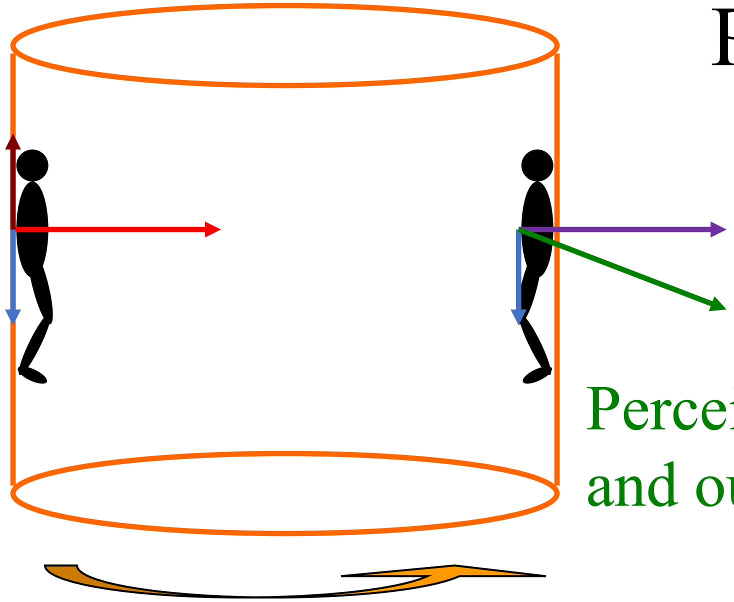


- You’re stuck in the middle passenger seat in a car, and the driver makes a quick left. What causes you to fall toward the person on your right?
- Your body *feels* like it’s being pushed to the right because your inertia resists changes to its motion
- This so-called “centrifugal” (“center-fleeing”) force is fictitious

Rotating drum ride: Real and Perceived forces

Real Forces:

Friction; up
Centripetal; inwards
Gravity (weight); down
<u>Actual net force</u>:
inward



Perceived Forces:

Centrifugal; outwards
Gravity (weight); down
Perceived weight; down and out

In *The Martian*, astronauts use a giant centrifuge to simulate gravity while in space (unfortunately, this isn't a reality just yet!)

If the centrifuge has a radius of 65 m, how fast should the outer edge be rotating to properly simulate gravity (a = 9.8 m/s^2)?

$$a_c = v_T^2/r$$

$$9.8\ m/s^2 = v^2/(65m)$$

$$v = \sqrt{9.8 * 65} = 25\ m/s$$