## Centripetal Force

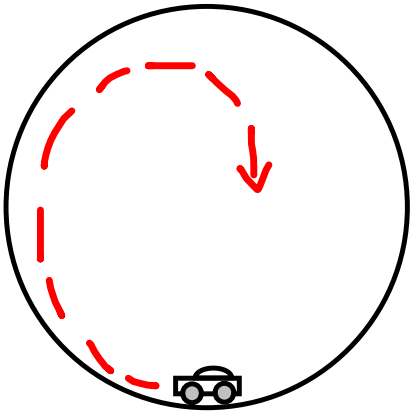
The net Force toward the center required for the centripetal acceleration.

$$F_c = \frac{mV_T^2}{r}$$

It's the NET FORCE: whatever forces are acting would have to add or subtract to make it happen

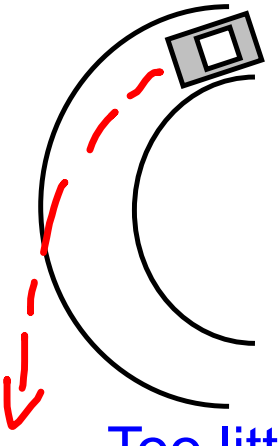
It's the NET FORCE: whatever forces are acting have to add or subtract to make it happen.

**What if they don't?**



Too much?

(Move toward center.)



Too little?

(Leave the circle.)

Condition for circular motion:

$$F_c = \text{Forces toward the center} - \text{Forces away from the center}$$

Some forces can adjust themselves to make circular motion happen:

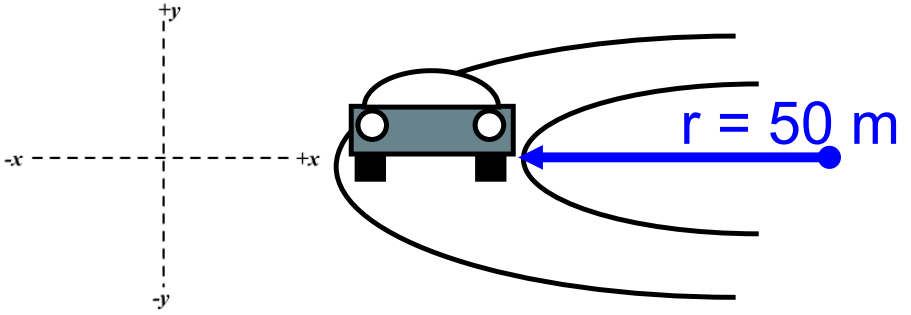
- **Friction**
- **Tension**
- **Normal**
- **Applied Forces**

Some forces just are what they are:

- **Gravity/weight**

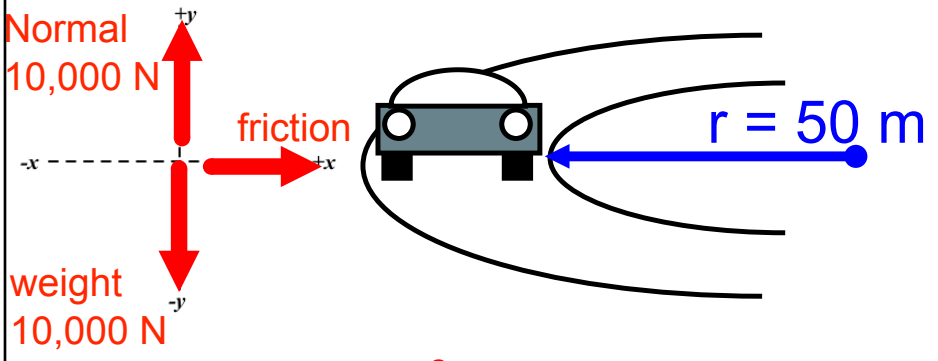
## horizontal circle

The 1,000 kg car rounds the corner at 20 m/s. How much friction is required?



# horizontal circle

The 1,000 kg car rounds the corner at 20 m/s. How much friction is required?

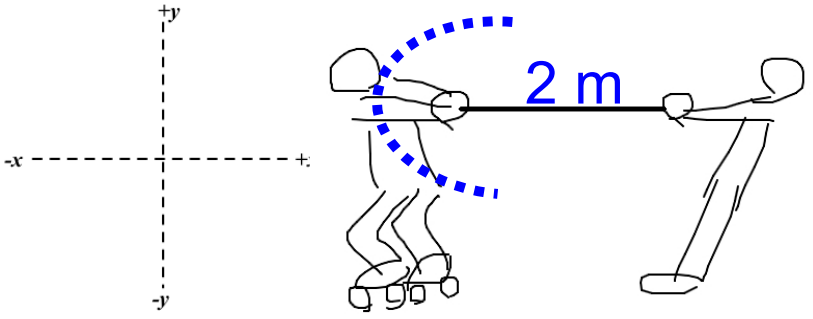



$$F_c = \frac{mV_T^2}{r} = \frac{(1{,}000)(20^2)}{(50)} = 8{,}000 \text{ N}$$

Since friction acts toward the center and no forces act away from the center, friction must be 8,000 N.

# horizontal circle

The 50 kg person gets pulled around the circle at 10 m/s. How much tension is required?

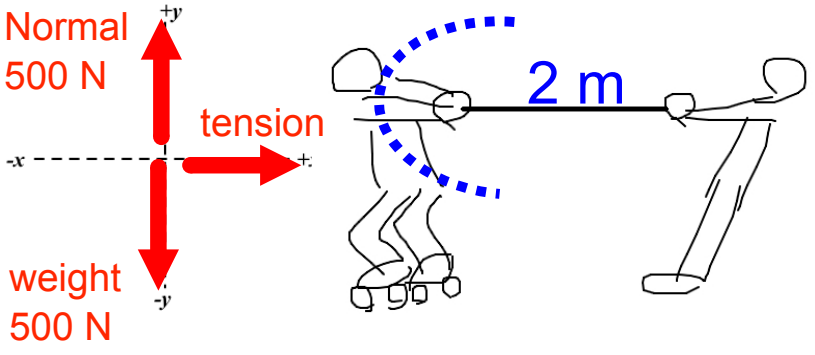


# horizontal circle

The 50 kg person gets pulled around the circle at 3 m/s. How much tension is required?

$$F_c = \frac{mV_T^2}{r} = \frac{(50)(3^2)}{(2)}$$

$$= 225 \text{ N}$$




Since tension acts toward the center and no forces act away from the center, tension must be 225 N.

Condition for circular motion:

$$F_c = \text{Forces toward the center} - \text{Forces away from the center}$$

Some forces can adjust themselves to make circular motion happen:

**Friction**

**Tension**

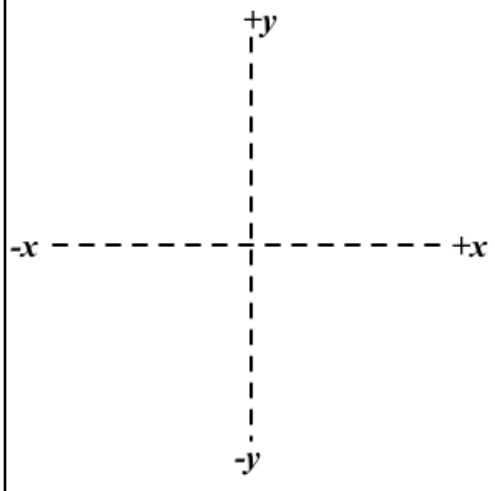
**Normal**

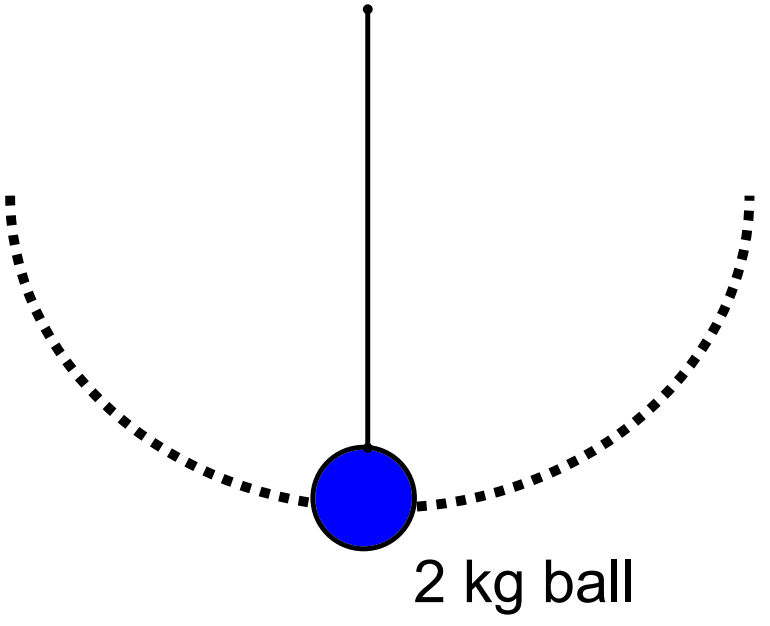
**Applied Forces**

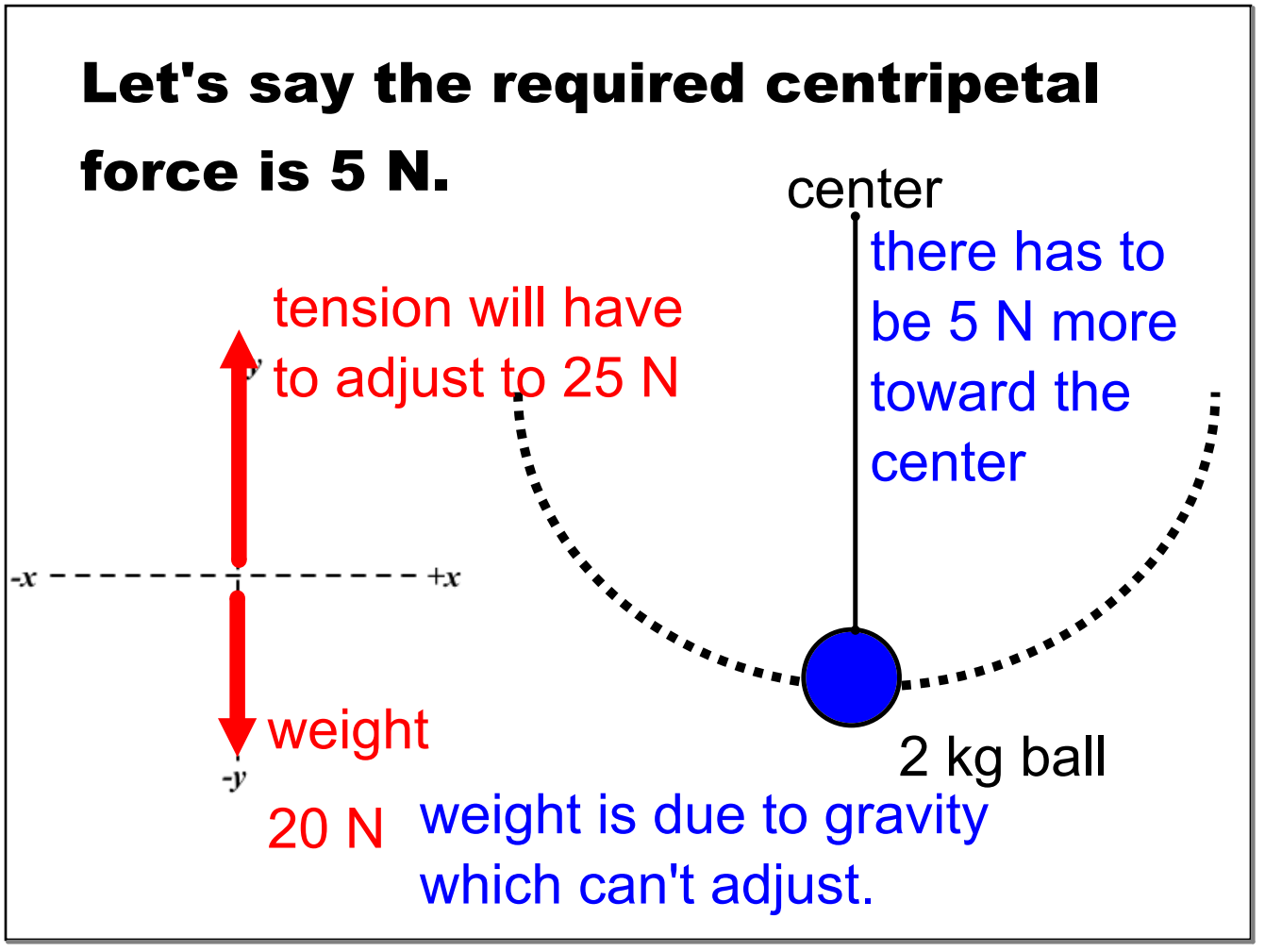
Some forces don't adjust:

**Gravity/weight**

**Let's say the required centripetal force is 5 N.**




Let's say the required centripetal force is 5 N.
center
there has to be 5 N more toward the center
tension will have to adjust to 25 N
-x
+x
weight
-y
20 N
weight is due to gravity which can't adjust.
2 kg ball

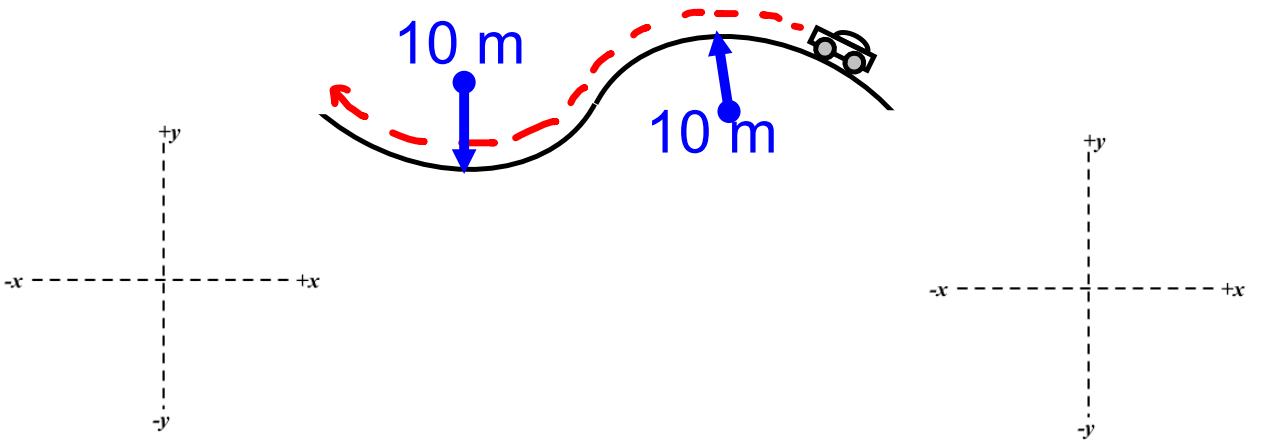
# vertical circle

The 1,000 kg car moves at a constant at 5 m/s.

a) What is the required centripetal force for the car?

b) What is the Normal Force at the top of the hill?

c) What is the Normal Force at the bottom?



# vertical circle

The 1,000 kg car moves at a constant at 5 m/s.

a) What is the required centripetal force for the car?

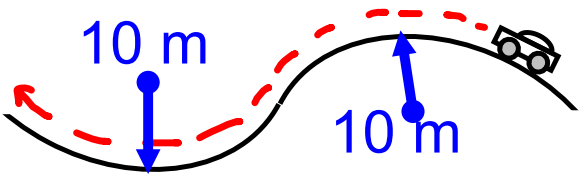
b) What is the Normal Force at the top of the hill?

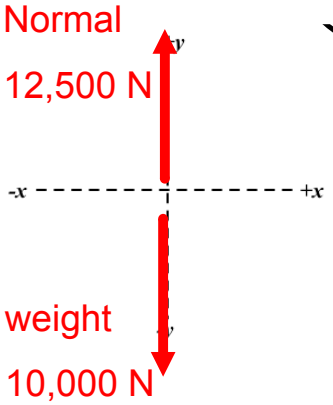
c) What is the Normal Force at the bottom?

$$F_c = \frac{mV_T^2}{r}$$

$$= \frac{(1{,}000)(5^2)}{(10)}$$

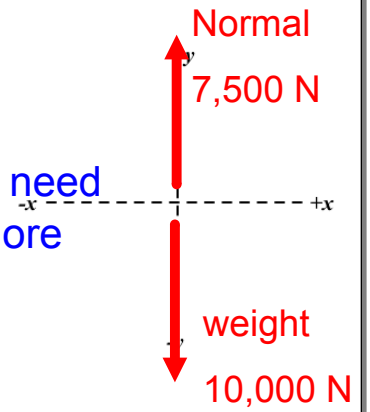
$$= 2{,}500 \text{ N}$$



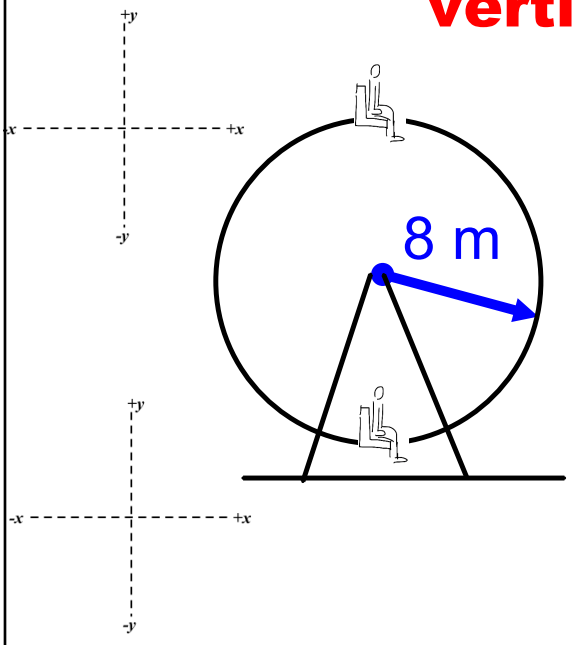




Bottom of hill: need 2,500 N more upward

Top of hill: need 2,500 N more downward



# vertical circle



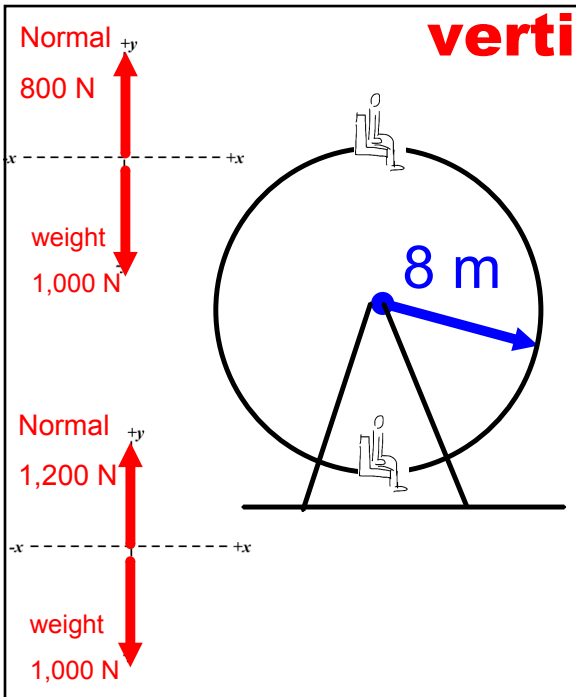

The 100 kg person moves at a constant at 4 m/s.

a) What is the required centripetal force for the person?

b) What is the Normal Force at the bottom of the ride?

c) What is the Normal Force at the top of the ride?

# vertical circle




The 100 kg person moves at a constant at 4 m/s.

a) What is the required centripetal force for the person?

b) What is the Normal Force at the bottom of the ride?

c) What is the Normal Force at the top of the ride?

$$F_c = \frac{mV_I^2}{r}$$

$$= \frac{(100)(4^2)}{(8)}$$

$$= 200 \text{ N}$$