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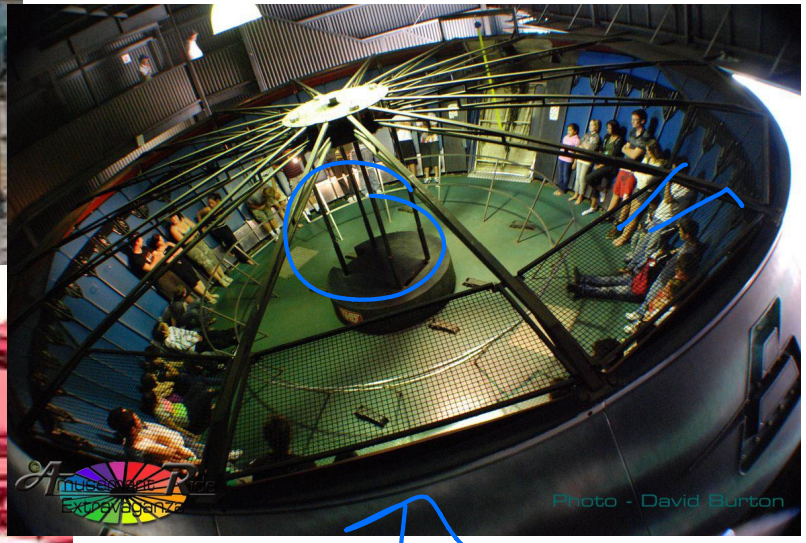
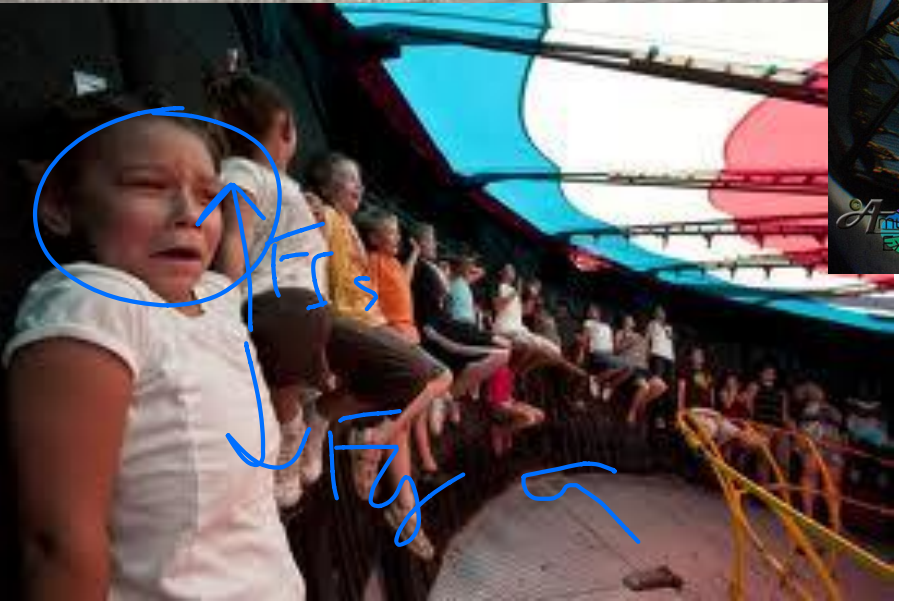


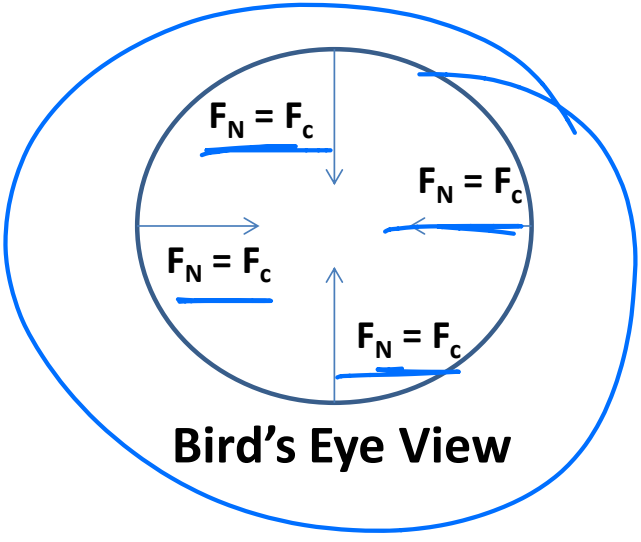


$F_{fs} = F_N \mu_s$

Normal Force as Centripetal Force

- Example Situations:
  - Roller coasters
  - Centrifuges
  - Skate ramps

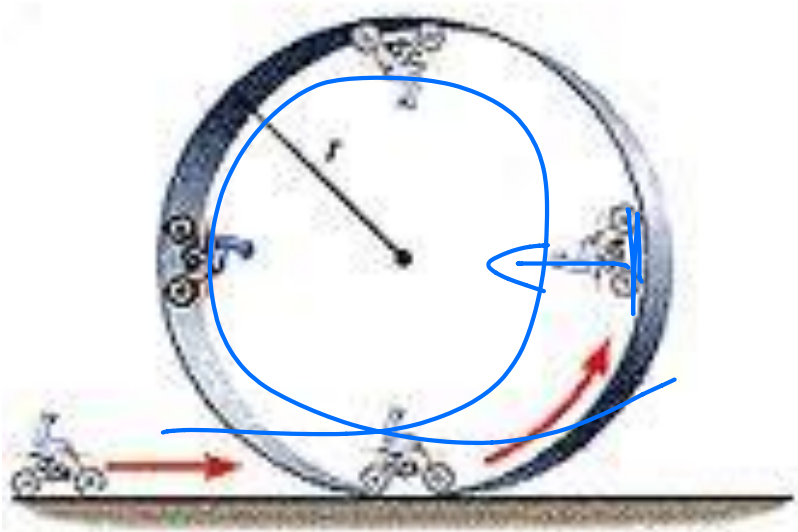
  In a horizontal rotational frame, the centripetal force is just equal to the normal force exerted inwardly on the object.

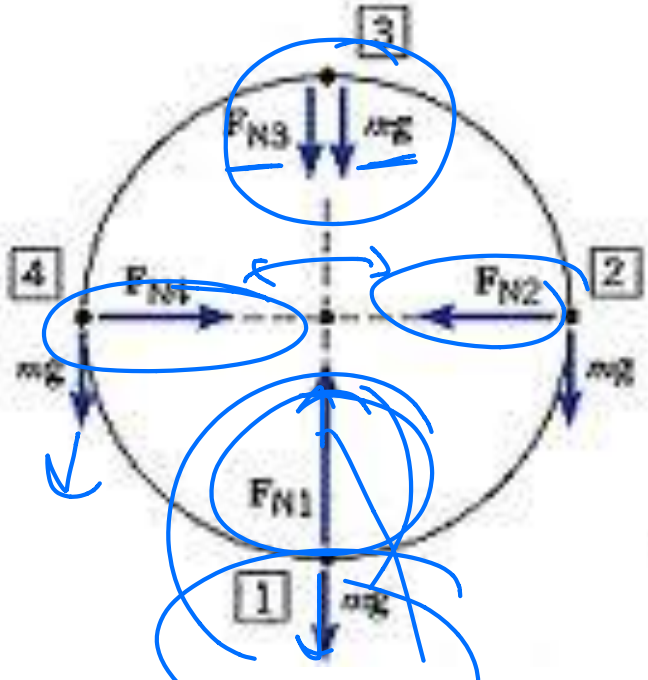


$F_c = mv^2/r$

Normal Force as Centripetal Force

- For vertical circles, the problems get a little bit more difficult, because gravity comes into play.
- The equation for F_c is dependent on where in the loop the object is.





2 & 4: $F_C = F_N$

$$\frac{mv^2}{r} = F_N$$

3: $F_C = F_N + F_g$

$$\frac{mv^2}{r} = F_N + mg$$

1: $F_C = F_N - F_g$

$$\frac{mv^2}{r} = F_N - mg$$

Example

$F_c = F_g - F_N$

- A roller coaster, loaded with passengers, has a mass of 3000 kg and loop with a radius 20 m. At the bottom loop, the coaster travels at 30 m/s. What force is exerted on the car by the track?

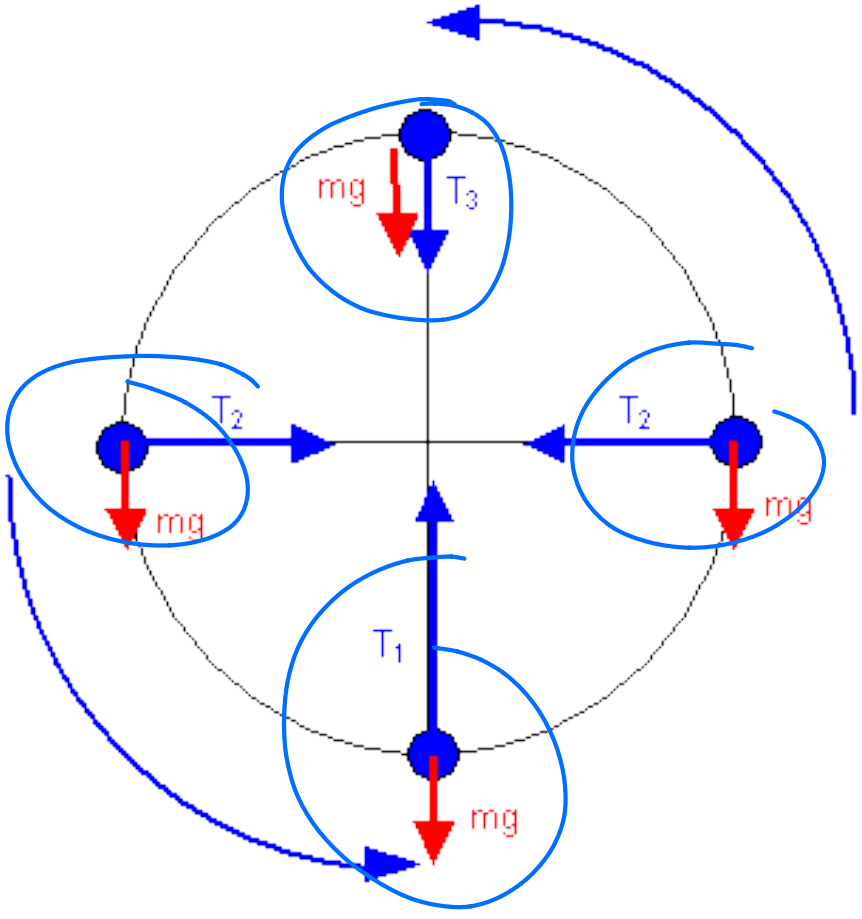
F_N

$F_c = F_N - F_g$

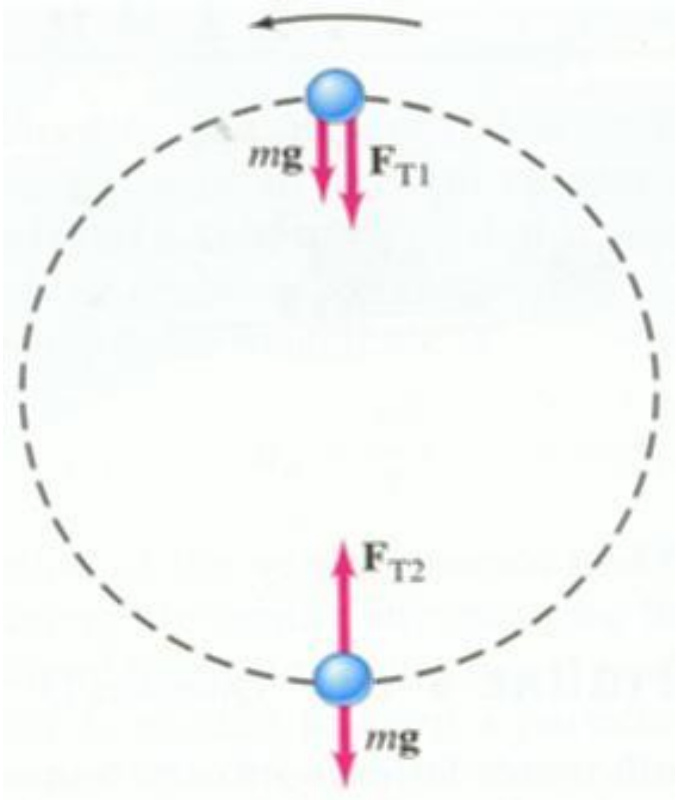
$\frac{(3000)(30)^2}{20} = F_N - (3000)(10)$

Tension as a Centripetal Force

- Tension equations will be done in the same way as the normal force:



Example



- A ball tied to a string is spun around vertically in a circle. The ball has a mass of 0.5 kg and a velocity of 4 m/s, the string has a length of 1.5 m.
- What is the tension in the string at the top and bottom of the circle?