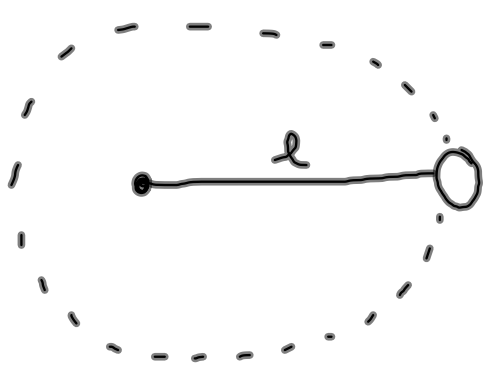
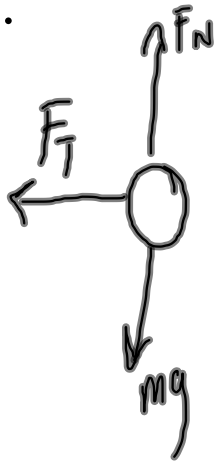
Applications of Circular Motion

* Mass attached to a string and moving in a horizontal circle.





l = length of string

F_T = Tension in string

$$F_T = \frac{mv^2}{R}$$

Ex1:

A 5kg ball is traveling 10 m/s on a string of length 8m. What is the tension in the string?

$$F_T = \frac{(5)(10)^2}{8} = \boxed{62.5\,N}$$

* What is the time of 1 revolution?

$$v = \frac{2\pi R}{T}$$

$$10 = \frac{2\pi(8)}{T}$$

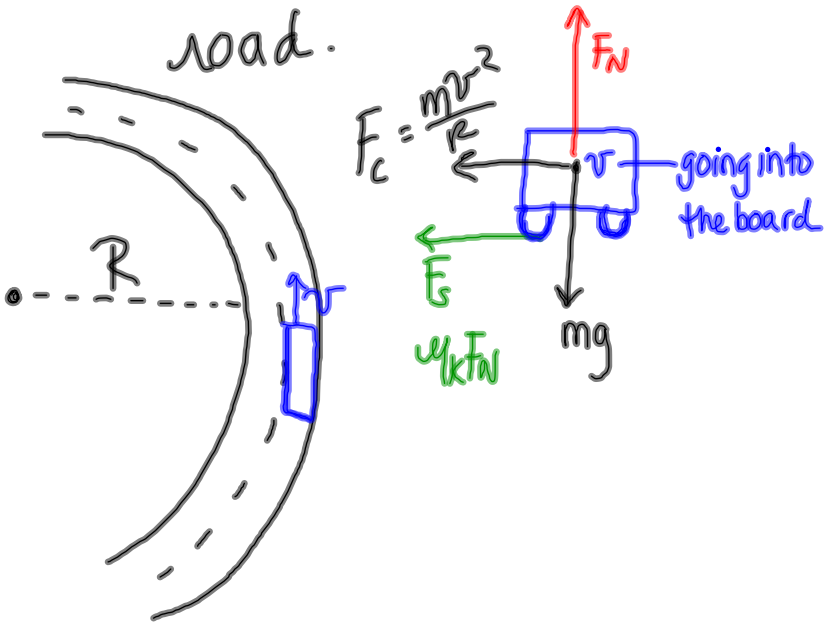
$$\boxed{T = 5\,s}$$

Ex 2:

What happens to tension if v is doubled and everything else is constant?

T quadruples (x4 greater)

* Car making a turn on a horizontal road.



$$F_N = mg$$

$$\mu_s F_N = \frac{mv^2}{R}$$

$$\mu_s mg = \frac{mv^2}{R}$$

$$\mu_s g = \frac{v^2}{R}$$

$$v^2 = \mu_s g R$$

* $$\boxed{v_{max} = \sqrt{\mu_s g R}}$$

Ex3:

A 1500kg vehicle is turning on a horizontal road of radius 50m. The $\mu_s = 0.9$.

Find the maximum with which the car can safely make the turn.

1000m = 1km

1.6093km = 1mi

$$\frac{21\text{m}}{1\text{s}} \times \frac{1\text{km}}{1000\text{m}} \times \frac{1\text{mi}}{1.6093\text{km}} \times \frac{60\text{s}}{1\text{min}} \times \frac{60\text{min}}{1\text{hr}}$$

47mi/hr

* icy condition → $\mu_s = 0.1$

$7\frac{\text{m}}{\text{s}}$ → 15.7 mi/hr

Ex4:

A vehicle is traveling 30 m/s in a circle of radius 100 m. The coefficient of static friction is 0.9. Can the vehicle make this turn safely?

NO! 29.7 m/s < 30 m/s