TOPIC 6 · REVIEW

6-1 Circular Motion

- any object moving on a circular path has (centripetal) acceleration
- the net force is called the centripetal force

centripetal → "centre seeking"

- the direction of both the accelation and the net force is to the centre of the circular path.

Angular displacement (θ)
Angular velocity (ω)

$$\omega = \frac{2\pi}{T} \begin{matrix} \leftarrow \Delta\theta \\ \leftarrow \Delta t \end{matrix}$$

or $\omega = 2\pi f$

Speed (v) $v = \omega r = \frac{2\pi r}{T} \begin{matrix} \leftarrow \Delta d \\ \leftarrow \Delta t \end{matrix}$

acceleration (a) $a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = 4\pi^2 r f^2$

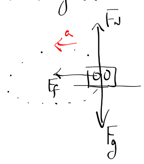
centripetal force (F) $F = ma$

$F_{net} \rightarrow F = \frac{mv^2}{r} = m\omega^2 r$

FBDs are KEY in setting up your expression for the net force.

Here a few examples:

Travelling in a horizontal circle in your car:

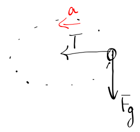


* inertia makes you feel as though you are being pushed to the outside

$\vec{F}_{net} = m\vec{a}$

$F_f = \frac{mv^2}{r}$ recall: $F_f = \mu F_N$

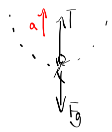
Twirling ball in a horizontal circle:



$\vec{F}_{net} = m\vec{a}$

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

Spiderman at the bottom of his swing:

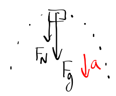


$\vec{F}_{net} = m\vec{a}$

$T - F_g = \frac{mv^2}{r}$

$T = F_g + \frac{mv^2}{r}$

Roller coaster at top of loop-de-loop



$\vec{F}_{net} = m\vec{a}$

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

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

* $F_N = 0$ at the minimum speed.

§6-2 Newton's Law of Gravitation

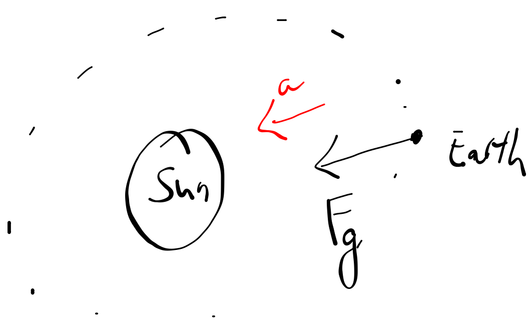
$$F = \frac{GMm}{r^2}$$ ← the force of gravity between any 2 objects. Always attractive.

$$g = \frac{F}{m}$$ ← gravitational field strength.

the mass that experiences the field of another mass (M)

$$g = \frac{GM}{r^2}$$

Consider the Earth orbiting the Sun:



$$\vec{F}_{net} = m\vec{a}$$

orbiting mass

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

acceleration

$$\frac{GM\cancel{m}}{r^2} = \frac{\cancel{m}v^2}{r}$$

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