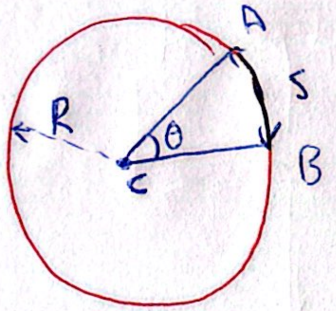
chapter 3 : Motion in a circle

→ Describing circular motion itself is not of great importance to the Biological sinces
However it's imoporant to delolping an understanding of oscillatory systems and waves.

* Angular Displacement and Radians



$S = \theta r$

θ: in radians (the angular displacment)

→ if aparticle complete awole circle

$\therefore \theta = \frac{S}{r} = \frac{2\pi r}{r} = 2\pi$

$1\text{ rad} = \frac{360}{2\pi} = 57.3°$

* Angular Velocity

→ If it takes time t to move adistance S raud the circle, this distance subtends an angle. θ

$$\omega = \frac{\theta}{t} = \frac{S}{rt}$$

→ then The angular velocity:

$\omega = \frac{\theta}{t}$: the rate at which the angular displacement changes

→ where

$v = \frac{S}{t}$ is the speed

* frequency:

~~number of rotation per second~~

If an object rotates around a circle at f cycles (complete rotations) per second

$\omega = 2\pi f$

angular velocity in radian

freq in Hertz

$\therefore f = \frac{1}{\text{Second}}$ unit

$1 \text{ Hz} = 6.28 \text{ rad} \cdot s^{-1}$

* Circular acceleration and velocity:

Period: the time needed to travel around a circle once $\underline{T}$

→ don't change
→ scaler

$V = \frac{2\pi r}{T}$ ← one circle
← period

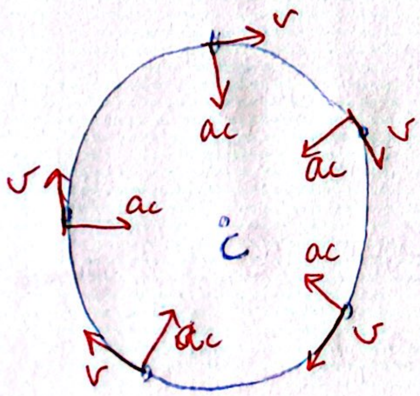
In circular motion :-

the velocity changes continuously since the direction in which the object is moving is changing continuously.

→ the vector of the velocity will always be tangential to the circle.

→ Since the velocity changes, the acceleration will keep changing

→ the instantaneous acceleration is always pointed exactly toward the center of the circle.



centripetal acceleration

$$a_c = \frac{v^2}{r}$$

The relation between Translational and angular motion:

	Translational	angular
Displacement	$S = r\theta$	$\theta = \frac{S}{r}$
Velocity	$v = r\omega$	$\omega = \frac{v}{r}$
acceleration	$a = r\alpha$	$\alpha = \frac{a}{r}$
time	t	t

$$\omega_f^2 = \omega_i^2 + 2\alpha\theta$$

$$V_f^2 = V_i^2 + 2ad$$

$$\theta = \omega_i \Delta t + \frac{1}{2}\alpha \Delta t^2$$

$$d = V_i \cdot \Delta t + \frac{1}{2} a \Delta t^2$$

* Centripetal force

→ Since there is centripetal acceleration associated with circular motion of an object, there must be F_c to produce that acceleration.

→ This force must be directed toward the centre of the circular path of the object

$$F = m a_c$$

$$\boxed{F_c = m \frac{v^2}{r}}$$

* Sources of the centripetal force:

1. friction between the rubber tyres and the road surface.

2. If the road angled, this allows the Normal reaction component contribute to the F_c

3. if an object is swung in a circle from a string, the tension in string provides the F_c needed.

4. a satellite in a circular orbit about the Earth is maintained in this circular path by the Earth's gravitational attraction i.e, gravity provides the F_c

→ Example 3.2