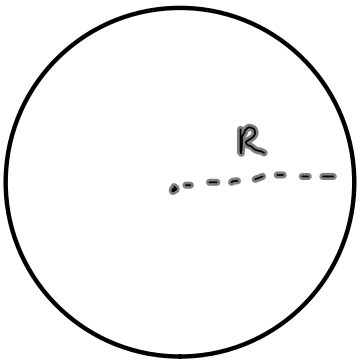
Circular Motion

- Properties of a Circle



$C = 2\pi R$

Circular Motion is the motion of an object around a circle.

Uniform circular motion: motion around a circle w/ constant speed.

Time period: time for one revolution (T)

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

Ex 1

The radius of the Earth is 6.38×10^6 m.

Find the speed of a point on the Equator of the Earth.

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

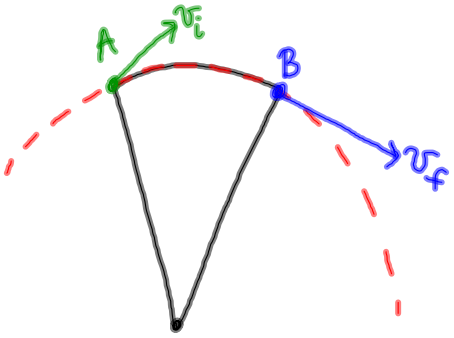
$$v = \frac{2\pi(6.38E6)}{86400}$$

$$\boxed{v = 464 \text{ m/s}}$$

$R = 6.38 \times 10^6$ m

$$T = 1 \text{ day} \times \frac{24 \text{ hrs}}{1 \text{ day}} \times \frac{60 \text{ min}}{1 \text{ hr}} \times \frac{60 \text{ s}}{1 \text{ min}}$$

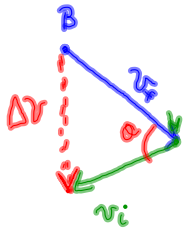
$T = 86{,}400$ s

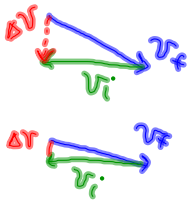


* since a particle traveling around a circle is always changing direction, there is an accel.

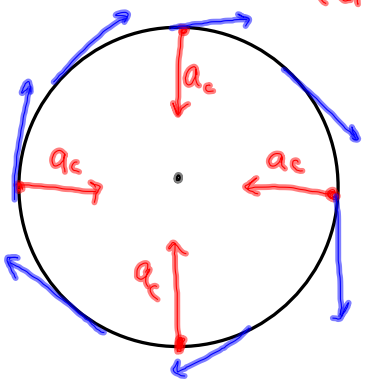
* assume that v_i and v_f are same magnitude but they differ in direction.

* The change in v ($\Delta v = v_f - v_i$) can be determined by:





The more parallel v_f and v_i become, Δv forms a 90° angle and will point towards the center of the circle.



a_c = centripetal acceleration

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

Centripetal Force: $F_c = ma_c$

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

Ex2

An object of mass 5 kg is moving in a circle of radius 10 m at 20 m/s.

a) Find a_c

b) Find F_c

c) Find the time period

$$a_c = \frac{v^2}{R} = \frac{20^2}{10} = 40 m/s$$

$$F_c = m a_c = 5(40) = 200N$$

$$v = \frac{2\pi R}{T} \rightarrow 20 = \frac{2\pi 10}{T}$$

$$T = \pi = 3.14s$$

A 15 kg block is moving in a circle of radius 25 m. It completed 25 revolutions in 1 minute.

a) Find the time period

$$T = \frac{60s}{25\,rev.} = \boxed{2.4s}$$

b) Find a_c

c) Find F_c

$$v = \frac{2\pi R}{T} = \frac{2\pi(25)}{2.4} = 65.4\,m/s$$

$$a_c = \frac{v^2}{R} = \frac{65.4^2}{25} = 171.35\,m/s^2$$

$$F = ma_c = 15(171.35) = 2570N$$