A level Physics

~~Circular Measure~~

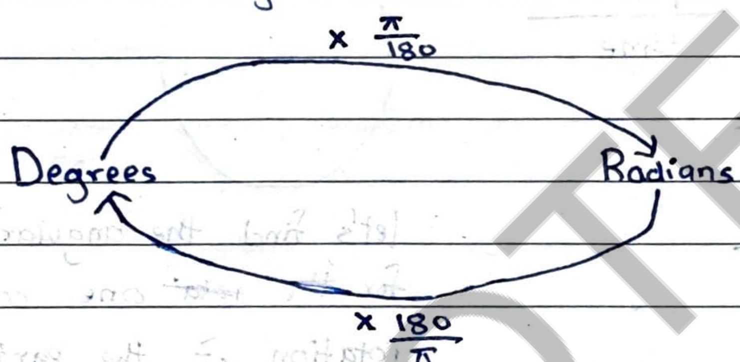
Circular Motion

→ Radians is S.I unit for size of angles.

→ $360° = 2\pi$ radians

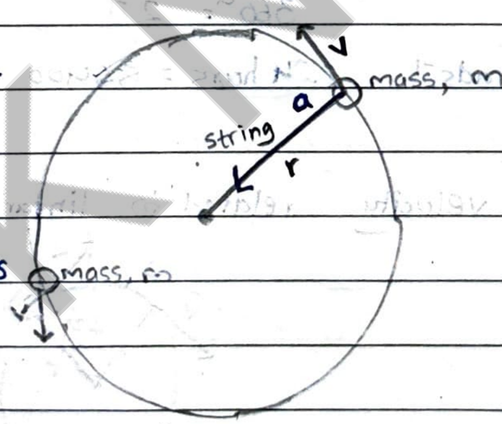
→ $180° = \pi$ radians

→ Conversion from degrees to radians.



⇒ Centripital acceleration and force.

→ acceleration of the mass will always be pointing towards the center.



→ Mass is moving at constant speed.

→ Velocity will be changing.

→ Now as the velocity changes there will be acceleration even when it is at a constant speed.

Centripital acceleration $= \frac{v^2}{r}$

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

Centripital force $= ma = m \times \frac{v^2}{r}$

The net force is perpendicular to the direction of motion → the velocity

hence there is no work done. $W = F \times d \cos\theta$ $\quad \cos 90 = 0$

centripital force in terms of angular velocity (ω)

$F_c = mr\omega^2$

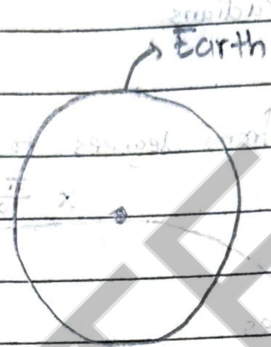
$a_c = r\omega^2$

⇒ Angular Velocity (ω)

velocity = $\frac{\text{displacement}}{\text{time}}$

$V = \frac{\Delta S}{\Delta t}$

$\omega = \frac{\Delta \theta}{\Delta t}$



let's find the angular velocity for ~~the~~ ~~tota~~ one complete rotation of the earth.

Which means 360° in 24 hours

converting them to SI units

360° = 2π

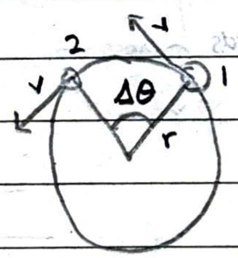
24 hours = 86400 seconds

Plug in the values

$\omega = \frac{2\pi}{86400}$

$= 7.3 \times 10^{-5}$ rads^{-1}

→ How is angular velocity related to linear velocity.



$V = \frac{\Delta S}{\Delta t}$

here ΔS = arc length

$= r\Delta\theta$

∴ $V = \frac{r\Delta\theta}{\Delta t}$

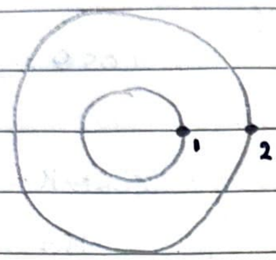
$V = r \times \frac{\Delta\theta}{\Delta t}$

$\boxed{V = r\omega}$

∴ linear velocity = radius × angular velocity

PAGE NO.:
DATE: / /

Questions

1. 

A CD has a diameter of 120 mm and it rotates at 500 RPM.
Find the angular and linear velocities at points 1 and 2.

at point 1

$\omega = \frac{\Delta\theta}{\Delta t} = \frac{1000\pi}{60}$

$= 52$[illegible] rads^{-1}

$v = r\omega$

$= 0.015 \times 52.4$

$= 0.78 \text{ ms}^{-1}$

at point 2

$\omega = \frac{\Delta\theta}{\Delta t}$

$= \frac{1000\pi}{60} = 52$[illegible] rads^{-1}

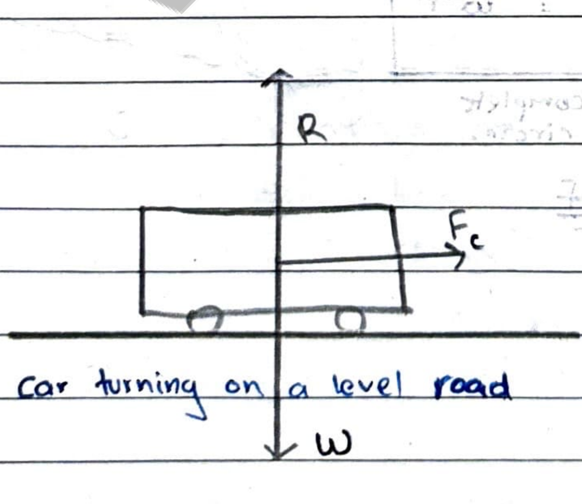
$v = r\omega$

$v = 0.06 \times 52.4$

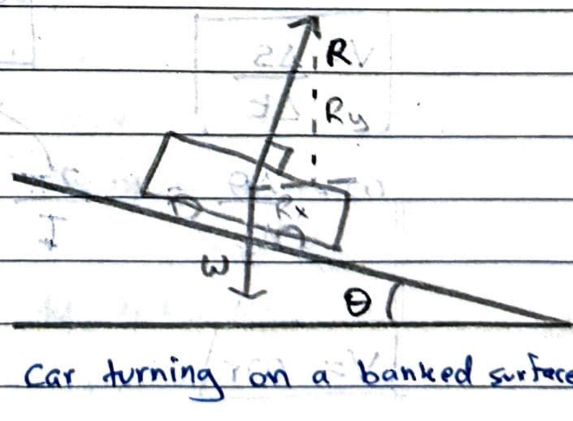
$v = \pi$

$v = 3.14 \text{ ms}^{-1}$

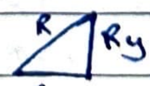
⇒ Circular motion at an angle.



Car turning on a level road



Car turning on a banked surface

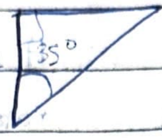


$R_y = mg = R\cos\theta$

$R_x = \frac{mv^2}{r} = R\sin\theta$

Questions

1. $F_c = \frac{mv^2}{r}$

60822 

$\cos\theta = \frac{A}{H}$

$F_c = \frac{6200 \times 86^2}{r}$

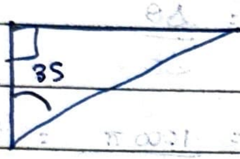
$\cos\theta H = A$

$H = \frac{60822}{\cos(35)}$

$F_c = \frac{45855200}{r}$

$H = 74249$ N

$L = 74$ kN

6082 

TOH: $\tan(35) = \frac{r}{60822}$

42588

$r = \frac{45855200}{42588}$

$r = 1076.7$ m

$= 1077$

$= 1100$ m

★ IMP ★

How is speed constant but velocity isn't
→ velocity is a vector quantity
→ ∴ magnitude remains same (ie speed)
→ and direction is changing
→ The centripetal acceleration changes the direction.

⟹ Formulas

$T = 1/f$
$f = 1/T$

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

$a = \frac{v^2}{r} = \omega^2 r$

$V = \frac{\Delta S}{\Delta t}$

for one complete circle.

$\omega = \frac{\Delta\theta}{\Delta t} = \frac{2\pi}{T} = 2\pi f$

$V = \omega r$