Physics
Theory Part 25

Topics: Mechanics/ Electrostatics

Course: B.Sc/ Physics

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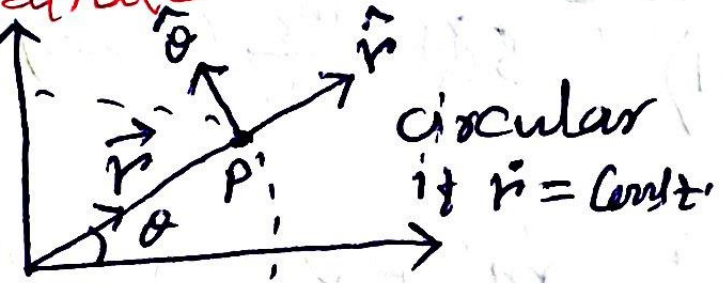
Ref. .....

Circular Motion in Polar Co-ordinate

Find components of v & a.

In Polar Co-ordinate



circular if $r = \text{Const}$

$$\vec{v} = \dot{\vec{r}} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta}$$

where $\vec{r} = r\hat{r}$

$$\vec{r} = x\hat{i} + y\hat{j}$$

$$= r(\cos\theta\,\hat{i} + \sin\theta\,\hat{j})$$

Given

$\dot{r} = 4$ m/s, $\dot{\theta} = 2$ rad/s

$r = 3$ m.

(a) Magnitud of velocity,

$$v = |\vec{v}| = \sqrt{\dot{r}^2 + r^2\dot{\theta}^2}$$

$$= \sqrt{4^2 + 3^2 \times 2^2} = \sqrt{52}$$

$$= \boxed{2\sqrt{13}\ \text{m/s}}$$

(b) Acceleration $\vec{\dot{v}} = (\ddot{r} - r\dot{\theta}^2)\hat{r} + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\hat{\theta}$ — ①

given $r = 3\,m = \text{Const}$ $\therefore \dot{r} = \ddot{r} = 0$

& $\dot{\theta} = \text{Const}$ $\therefore \ddot{\theta} = 0$

from eqn. $\vec{\dot{v}} = r\dot{\theta}^2\hat{r} + (0)\hat{\theta} = r\dot{\theta}^2\hat{r}$

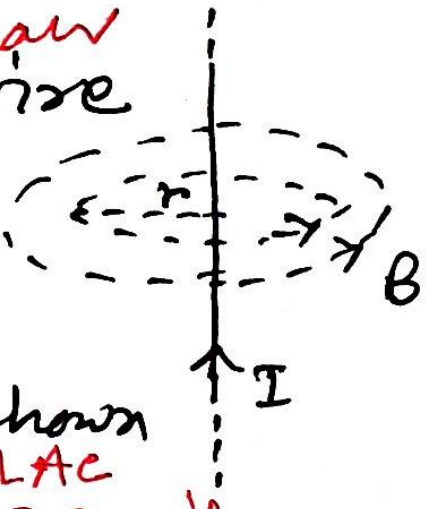
So there is no transverse component

Magnetic field of a current carrying wire by Biot-Savart Law

① Magnetic field Produced by current carrying wire

Biot-Savart law is used to determine magnetic field strength (B) with the current I.

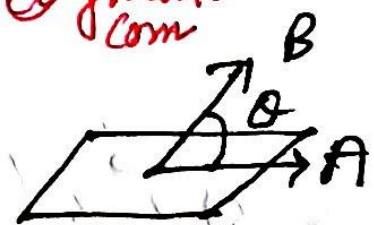
For an infinite straight current carrying wire as shown



is given by $$B = \frac{\mu_0 I}{2\pi r}$$

② Voltage (motional Emf by Faraday's Law)

$$\mathcal{E} = -\frac{d\Phi}{dt} = \frac{d}{dt}(BA\cos\theta) = \frac{d}{dt}(B \cdot A \cdot N\cos\theta)$$



A = Area

θ = Orientation

N = no. of coil.

If any of the quantities B, A, θ varies with time, then there will be an induced Emf(V).

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Thanksss