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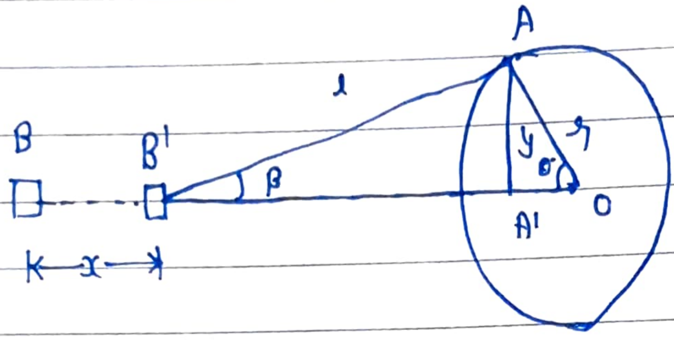
UNIT-1

Analytical method for finding out distance displacement



$\cos\theta = \frac{OA'}{r}$

$OA' = r\cos\theta$

$\cos\beta = \frac{A'B'}{l}$

$A'B' = l\cos\beta$

$$BB' = OB - OB'$$

$$x = (l + r) - (OA' + A'B')$$

$$x = (l + r) - (r\cos\theta + l\cos\beta)$$

$n = \frac{l}{r}$

$l = nr$

$$x = (nr + r) - (r\cos\theta + nr\cos\beta)$$

$$x = r\left[(n+1) - (\cos\theta + n\cos\beta)\right] \quad \text{—— (1)}$$

$$\cos\beta = \sqrt{1 - \sin^2\beta}$$

$$= \sqrt{1 - \frac{y^2}{l^2}}$$

$$\sin\theta = \frac{AA'}{OA}$$

$$\sin\theta = \frac{y}{r}$$

$$y = r\sin\theta$$

$$= \sqrt{1 - \frac{r^2\sin^2\theta}{l^2}}$$

$$\cos\beta = \sqrt{1 - \frac{\sin^2\theta}{n^2}}, \quad \cos\beta = \sqrt{\frac{n^2 - \sin^2\theta}{n^2}}$$

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in equation (1)

$$x = r\left[(n+1) - \left(\cos\theta + n\sqrt{\frac{n^2 - \sin^2\theta}{n^2}}\right)\right]$$

$$x = r\left[(n+1) - \left(\cos\theta + \frac{n}{n}\sqrt{n^2 - \sin^2\theta}\right)\right]$$

$$x = r\left[n+1 - \cos\theta - \sqrt{n^2 - \sin^2\theta}\right]$$

$$\boxed{x = r\left[(1-\cos\theta) + n - \sqrt{n^2 - \sin^2\theta}\right]}$$

If $\sin\theta$ is neglected ...

$$x = r\left[(1-\cos\theta) + \cancel{n} - \cancel{n}\right]$$

$$\boxed{x = r(1-\cos\theta)}$$

Velocity :→

$$v = \frac{dx}{dt}$$

$$v = \frac{dx}{d\theta} \cdot \frac{d\theta}{dt}$$

$$v = \frac{d}{d\theta}\, r\left(1-\cos\theta\right) + n - \sqrt{n^2 - \sin^2\theta}\Big)\ \frac{d\theta}{dt}$$

$$v = r\left[(0+\sin\theta) + 0 - \frac{d}{d\theta}(n^2 - \sin^2\theta)^{1/2}\right]\omega$$

$$V = r\left[\sin\theta - \frac{1}{2}(n^2-\sin^2\theta)^{-1/2}\cdot\frac{d}{d\theta}(-\sin^2\theta)\right]\omega$$

$$V = r\left[\sin\theta - \frac{1}{2}(n^2-\sin^2\theta)^{-1/2}\times(-2\sin\theta\cdot\cos\theta)\right]\omega$$

$$V = r\left[\sin\theta - \frac{1}{2}\frac{1}{\sqrt{n^2-\sin^2\theta}}\times(-\sin2\theta)\right]\omega$$

$$V = r\left[\sin\theta + \frac{\sin2\theta}{2\sqrt{n^2-\sin^2\theta}}\right]\omega$$

$\sin^2\theta$ = is neglect

$$\boxed{V = \omega r\left[\sin\theta + \frac{\sin2\theta}{2n}\right]}$$