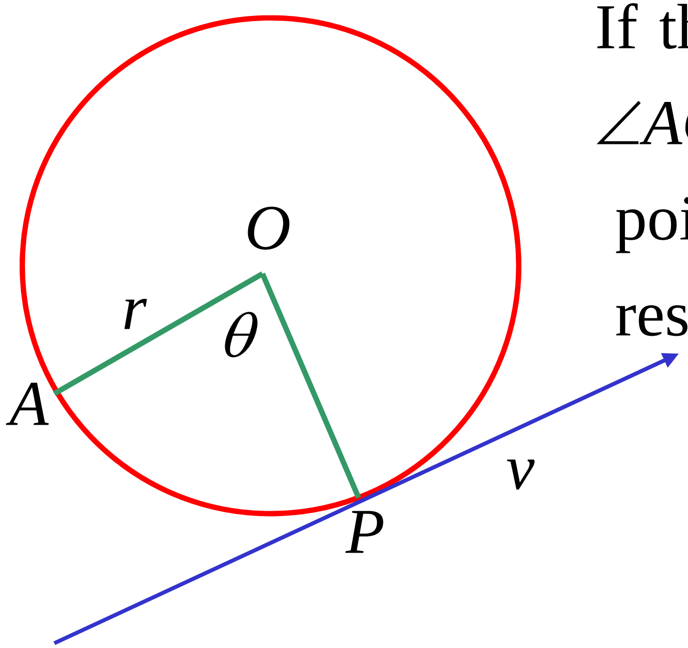
Circular Motion

Angular Velocity



Let O be the centre of a circle, radius r units.

If the point moves from A to P in time t, where $\angle AOP = \theta$, then the angular velocity, ω, of the point is defined as the rate of change of θ with respect to time.

[measured in radians/second]

$$\boxed{\begin{aligned}\omega &= \frac{d\theta}{dt}\\ &= \dot{\theta}\end{aligned}}$$

Linear Velocity (Tangential Velocity)

The linear velocity, v, of the point at every position on its path is tangential to the circle.

Let arc $AP = x$

$$x = r\theta$$

$$\frac{dx}{dt} = r\frac{d\theta}{dt}$$

$$= r\omega$$

$$\boxed{\begin{gathered} v = r\omega \\ OR \\ v = r\dot{\theta} \end{gathered}}$$

Period

$$\boxed{T = \frac{2\pi}{\omega} \qquad \text{(time taken for one revolution)}}$$

e.g. A satellite moves in a circular orbit of 20 rev/day

a) Describe ω in rad/s

$$\omega = 20 \times 2\pi \text{ rad/day}$$

$$= \frac{20 \times 2\pi}{24 \times 60 \times 60} \text{ rad/s}$$

$$= \frac{\pi}{2160} \text{ rad/s}$$

b) Find the satellite's tangential velocity, given that its radius is 9000km, in km/h

$$v = r\omega$$

$$= 9000 \times \frac{\pi}{2160} \text{ km/s}$$

$$= 9000 \times \frac{\pi}{2160} \times 60 \times 60 \text{km/h}$$

$$= 15000\pi \text{km/h}$$

***Patel* Exercise 9A; odd**