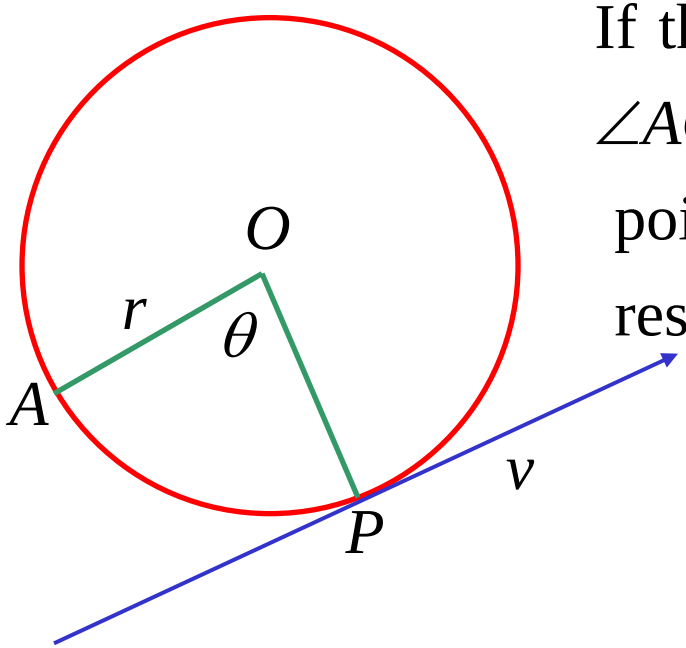
Circular Motion

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]

$$\omega = \frac{d\theta}{dt} = \dot{\theta}$$

Linear Velocity (Tangential Velocity)

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

Let arc $AP = x$

$$x = r\theta$$

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

$$= r\omega$$

$$v = r\omega$$

$$OR$$

$$v = r\dot{\theta}$$

Period

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

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

$$v = r\omega$$

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

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

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

Exercise 9A; odd