17 Motion in a Circle

17.1 Uniform Circular Motion

An object rotating at a steady rate is said to be in **uniform circular motion**.

$$v = \frac{2\pi r}{T}$$

- **Angular displacement** θ of the object in time t is

$$\theta = 2\pi f t$$

- **Angular speed** is defined as the angular displacement per second.

$$\omega = \frac{2\pi}{T} = 2\pi f$$

The unit of ω is $\mathrm{rad\,s^{-1}}$.

17.2 Centripetal Acceleration

The velocity of an object moving in a circle at constant speed is **constantly changing direction**, therefore the object is **accelerating**.

The direction of the **centripetal acceleration** is always towards the centre of the circle.

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

where $\omega = \dfrac{v}{r}$

The **resultant force** on an object moving around a circle at constant speed is called the **centripetal acceleration**, which acts towards the centre of the circle.

The centripetal force on an object is the **resultant force** on it.

$$\text{Centripetal force } F = \frac{mv^2}{r} = m\omega^2 r$$