Uniform Circular Motion

Motion that occurs when an object is moving in a circle with constant speed and a constant radius.

The speed of the object remains constant, as does the radius, but the *velocity vector changes direction*. The velocity vector is always tangent to the circle.

IMPORTANT – even though the speed is constant the velocity vector is changing direction and thus **acceleration is occurring**!!

Direction of *Centripetal Acceleration*

Centripetal acceleration is toward the centre of the circle!

(Centripetal acceleration and the instantaneous velocity are perpendicular to each other.)

Origin of Centripetal:

In Latin

centrum – “centre”

petere – “to seek”

Thus, Newton coined the term Centripetal – “centre-seeking.”

Misconceptions: Centripetal vs. Centrifugal

In Latin

Fugal - “ to flee”

Thus, centrifugal forces are “centre-fleeing” forces, and are in reality non-existent, but can be a useful tool in calculations.

Magnitude of *Centripetal Acceleration*

From the derivation, it is thus concluded that,

$$a_C = \frac{v^2}{r}$$

Often the speed of an object is not known, but the radius and period are known. Since the speed is constant and equals the circumference of the circle ($2\pi r$) divided by the period of revolution, *T*.

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

It is easily shown that, $a_C = \frac{4\pi^2 r}{T^2}$

And since, $f = \frac{1}{T}$, we can finally conclude that:

$$a_C = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2} = 4\pi^2 r f^2$$

(Check the units to be sure they are correct and remember that the centripetal acceleration is always toward the centre of the circle!)