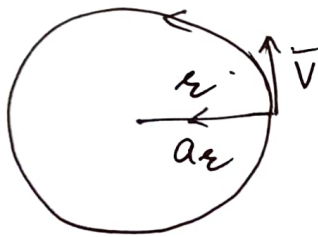


Circular motion.

Velocity is a vector quantity. Its magnitude is called speed & ~~then~~ ^{also} it has a direction. If a body ^{of mass m} is moving in circular path, ~~its with a~~ ^{at a} constant speed of radius r . There are two possibilities.

I. If the speed is constant, the motion is called uniform circular motion.

Speed is constant but the direction is changing continuously, so the motion is accelerated. And the acceleration is along the radius towards the centre. This acceleration is called centripetal



acceleration or even radial acceleration & is given by the relation -

$$a_c \quad a_r = \frac{v^2}{r}$$

where v is the speed.

The direction of velocity is along the tangent to the circular path. Thus it changes as the body is at different positions at different times.

~~If mass~~ Centripetal force = Mass $\times$ centripetal acceleration.

$$F_c = \frac{mv^2}{r}$$

The relation between linear velocity v & angular velocity ω is $v = \omega r$ where $\omega = 2\pi f$.

f is the frequency of revolution (units rev/s).

ω has the units rad/s.

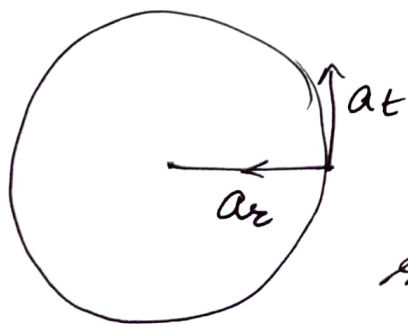
Since centripetal force is always perpendicular to the velocity, it can not change the magnitude of velocity (speed) or it can not change its speed. It can only change its direction, thus making it move in circular path with constant speed.

Other relations for F_c :

Ex Since $v = \omega r$ $F = \frac{mv^2}{r} = \frac{m(\omega r)^2}{r}$
 $= m\omega^2 r$

Also $r = \frac{v}{\omega} \Rightarrow F = \frac{mv^2}{r} = \frac{mv^2}{v/\omega} = mv\omega$

II. To change the speed of the body in circular motion, a tangential force has to be applied. If it acts along the direction of velocity, it will increase its speed. On the other hand if it acts opposite to the direction of velocity it will slow it down. Now the motion is called non-uniform circular motion.



Net acceleration = a

$$= \sqrt{a_r^2 + a_t^2}$$

In non-uniform circular motion, speed as well as direction changes continuously.



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