

Circular Motion and Acceleration

There is more to this topic than is noted below but the explanation here is essential to help understand circular motion.

An object moving in a circle at a constant speed is accelerating. How? Well to explain this we need to look at the difference between velocity and speed.

Speed is how fast an object is moving. Velocity is how fast an object is moving *in a particular direction*, i.e. direction is important in velocity but not with speed.

Why did scientists come up with the concept of velocity? Well speed is what people need in everyday life to say how quickly something is travelling. In the case of scientists and engineers who need to find out what exactly is happening to an object whenever there is a change in its movement they had to come up with velocity. If you were to throw an object in outer space the speed and direction it's travelling in at the moment it leaves your hand is the speed and direction it will travel in until the end of time (i.e. objects when moving always want to travel in a straight line) unless a force acts on it. When a force interacts with an object it will do at least one of two things to it:

- change it's speed (ie acceleration or deceleration)
- change it's direction

Therefore the direction in which an object moves is important since if it changes direction a force was applied and this is what physics is about – understanding the impact of forces on objects so we can apply them in the real world. It should be noted that even if an object changes direction but its speed remains constant then we still say that its velocity has changed. (Remember to have constant velocity both its speed and direction must remain the same. If either change then its velocity has changed).

Now in the case of circular motion if an object is to move in a circle it means it's not going in a straight line ie it's changing direction. Therefore it must be experiencing a force which pulls it all the time from heading off in a straight line (it pulls it a little in the direction of the centre of the circle all the time). If its direction is changing all the time then its velocity is changing all the time. *This means it is accelerating* even though it is probably going at the same speed. This is called **centripetal acceleration**.

Think of it this way; imagine a stone tied to a string and spinning it around your head; at the instant the string breaks what direction does it move off in?

- a straight line (it may then follow a curve as the force of gravity takes effect and causes it to fall but at the instant the string breaks it leaves in a straight line)

In other words when the force that's keeping it in a circle is released the object goes in a straight line. The force that's needed to keep something moving in a circle is called **centripetal force**. In the case of the string and stone the force that's keeping it in a circle comes from the string and your hand pulling the stone inwards. In the case of satellites moving around Earth the centripetal force is gravity which stops them flying off into space)