Chapter#2

KINEMATICS

Q:1 In a park, children are enjoying a ride on Ferris wheel as shown. What kind of motion the big wheel has and what kind of motion the riders have?

The motion of Ferris wheel is **rotatory motion** because it is moving around fixed axis which passes through itself while riders are in **circular motion** (translatory motion) as they are moving about axis which does not passes through their bodies.

Q:2 A boy moves for some time, give two situations in which his displacement is zero but the covered distance is not zero?

Two situations where displacement is zero but distance is not:

1. A boy starts walking from point A, moves around a circular track and returns to point A.

If circumference of circle is 10m.Then distance & displacement be

Distance = Circumference of the circle (10 m)

Displacement = 10m-10m = 0 m (initial and final positions are the same)

2. A boy starts moving from point "A" & moves 50 m forward to point "B" and then returns to point "A".

Distance = 100 m (50 m forward + 50 m backward)

Displacement = 50m-50m= 0 m (initial and final positions are the same)

Q:3 A stone tied to string is whirling in a circle, what is the direction of its velocity at any instant?

The direction of velocity of stone at any instant is tangential to the circle. At all points the velocity of stone is away from its circular path and is tangent to the circle.

Q:4 Is it possible to accelerate an object without speeding it up or slowing it down?

Yes, it is possible to accelerate an object without speeding it up or slowing it down. As acceleration is defined as changed in velocity, where velocity is vector quantity and is speed of object in specific direction. So if there is either change in speed or direction we can accelerate an object. And in our situation we can accelerate an object by changing direction, (for example Circular motion or random motion).

Q:5 Can a car moving towards right have direction of acceleration towards left?

Yes, it is possible for a car moving to the right to have acceleration towards the left. If the car is slowing down while moving to the right. In this scenario, its acceleration is towards the left, opposite to its direction of motion.

Q:6 With the help of daily life examples, describe the situations in which:

a. Acceleration is in the direction of motion.

1. Speeding up of car on highway while speeding up the acceleration is in the direction of motion
2. Free falling objects have acceleration in direction of motion like a ball is falling from high tower.

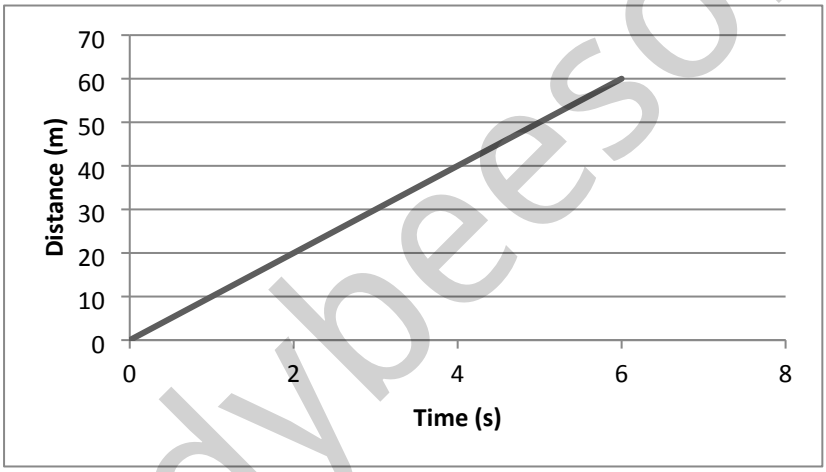
b. Acceleration is against the direction of motion.

1. Slowing down car (applying brakes gradually) produces acceleration against the direction of motion.
2. Throwing objects upward have acceleration against the direction of motion.

c. Acceleration is zero and body is in motion.

1. An object moving with uniform speed in fixed direction has zero acceleration like a car is moving on straight road with uniform speed.
2. Satellites orbiting earth have zero acceleration and are in motion.

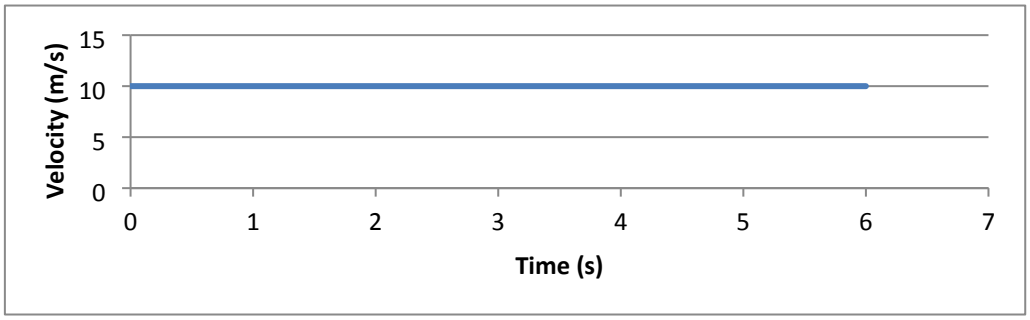
Q: 7. Examine distance-time graph of a motorcyclist (as shown), what does this graph tell us about the speed of motorcyclist? Also plot its velocity-time graph.



Distance-Time Graph

The above distance-time graph shows that motorcyclist is moving with constant/uniform speed it means he covers equal distance in equal interval of time.

The velocity-time graph for above distance-time graph is as below that has parallel line to time axis.



Q:8 Which controls in the car can produce acceleration or deceleration in it?

The Accelerator of the car: It produces acceleration in car while pressing it.

Brakes of car: It produces deceleration in car while pressing it.

Q:9 If two stones of 10 kg and 1 kg are dropped from a 1 km high tower. Which will hit the ground with greater velocity? Which will hit the ground first? (Neglect the air resistance).

Both stone have same initial conditions (height & acceleration), in reality, air resistance would slow down the smaller stone, making it hit the ground later than the larger stone but on neglecting air resistance, both stones fall together with same velocity, because its velocity and time taken by object falling from certain distance under gravity is independent of its mass.

$$h = v_i t + \frac{1}{2} g t^2$$

When $v_i = 0$ $\quad h = \frac{1}{2} g t^2$

So $\quad t = \sqrt{\frac{2h}{g}}$

And $v_f^2 - v_i^2 = 2gh$

When $v_i = 0$ $\quad v_f = \sqrt{2gh}$

Q: 10. A 100 g ball is just released (from rest) and another is thrown downward with velocity of 10 m/s, which will have greater acceleration? (Neglect the air resistance)

Both balls will have same acceleration as initial velocity does not affect the acceleration as both objects are moving under gravity neglecting air resistance having same gravitational acceleration (g=9.8 m/s^2).

$$h = v_i t + \frac{1}{2} g t^2$$

When $v_i = 0$ $\quad h = \frac{1}{2} g t^2$

So $\quad g = \frac{2h}{t^2}$

Extra Questions

Q: What are freely falling bodies? What is gravitational acceleration? Write down sign conventions for gravitational acceleration? Write three equations of motion of a freely falling body?

Free Falling Bodies:

The bodies that are falling under the influence of gravity only are called free falling bodies.

Gravitational Acceleration:

The acceleration produce in free falling bodies due to gravity is known as gravitational acceleration and denoted as **"g"** whose value is 9.8 m/s^2 and is always remain same for objects of different masses on earth.

Sign Convention:

Gravitational acceleration is positive when object is moving towards center of gravity (falling downward) i.e g = 9.8 m/s^2.

It is negative when object is moving away from center of gravity (thrown upward)

i.e g = -9.8 m/s^2.

General equations of motion

i. $v_f = v_i + at$

ii. $S = v_i t + \frac{1}{2} a t^2$

iii. $2aS = {v_f}^2 - {v_i}^2$

Equations of motion for freely falling bodies (a = g, S = h)

i. $v_f = v_i + gt$

ii. $h = v_i t + \frac{1}{2} g t^2$

iii. $2gh = {v_f}^2 - {v_i}^2$