9.Time, Speed & Distance

9.1 Basics of Time, Speed & Distance

The most important relationship between these three quantities, and possibly the only one which needs to be known is,

Distance = Speed $\times$ Time
Speed = Distance traveled/Time
Time = Distance traveled/Speed

- Average speed, if equal distances are covered at a km/hr and b km/hr is 2ab/a+b

- If two bodies are moving in the same direction at a speed of a and b respectively, then their relative speed is the difference of the two speeds.
- If two bodies are moving in the opposite directions at a speed of a and b respectively, then their relative speed is a + b.
- Two objects A and B moving along a circular path in the same direction, having started simultaneously and from the same point traveling at speeds of a and b, will meet again when the faster object has gained one full circle over the slower object, i.e. when the relative speed |a-b| completes one full round. The two objects will

again meet at the starting point at a time, which is the LCM of the time taken for each of the objects individually to complete one round.

- If the length of a train is L meters and the speed of the train is S m/s, then the time taken by the train to pass a stationary man/pole is L/S sec.
- If the length of the train is L_1 and its speed is S m/s and the length of a platform (stationary object of comparable length) is L_2, then the time taken by the train to cross the platform is $(L_1 + L_2)/S$ sec.
- If the lengths of two trains are L_1 (faster) and L_2 (slower) m, and their speeds are S_1 and S_2 m/s resp., then

the time taken by the faster train to overtake the slower train is L_1+L_2/S_1+S_2 sec, and the time taken for the trains to cross each other is L_1+L_2/S_1+S_2 sec.

- If the average speed of a train, without stoppages, is S_1 km/hr and the speed with stoppages is S_2, then Stoppage time (in min/hr) = $S_1-S_2/S_1 \times 60$.

9.2 Boats & Streams:

If the speed of the boat in still water is say B kmph and if the speed at which the stream is flowing is W kmph,

(i) When the boat is traveling with the stream the speed of the boat = (B + W) kmph

(ii) When the boat is traveling against the stream the speed of the boat = (B – W) kmph.

(iii) If the upstream is denoted as U and downstream is denoted as D then

(iv) B = (D+U) / 2, W= (D – U) / 2

Important Distance & Time Conversions:

1 km = 1000 meter

1meter = 100 cm

1 hour = 60 min

1 min = 60 sec

1 hour = 3600 sec

1 km/hr= (1×1000) / (1×3600)=5/18 m/sec.

9.3 Races

If A beats B by x meters or s seconds, then the speed of B is x/s meters/sec.

If the length of a circular track is L m, and if A and B take x and y sec. respectively, to complete one round, then both of them will meet at the starting point after LCM (x, y) sec.

If the length of a circular track is L m, and if the speeds of A and B are x m/sec. and y m/sec respectively, then the time after which both of them will meet at a point other than the starting point is L/x-y sec, if they are running in the same direction and L/x+y, if running in the opposite direction.