TIME SPEED AND DISTANCE

RELATIONSHIP BETWEEN TIME, SPEED AND DISTANCE

As we know, Distance = Speed × Time

It means that if a person is running at a speed of 20 km/h and he runs for 2 h, he will be covering a total distance of 40 km.

Distance = 20 × 2 = 40 km

Distance

When an object is moving with a certain speed in a particular time, the displacement made by an object is called the distance.

Unit of Distance Kilometre (km) and metre (m) is usually taken as the unit of distance. Sometimes, mile or feet, etc., can be found as the unit.

Time

Time is defined as a quantity, which governs the order or sequence of an occurrence. In the absence of time, the actual sequence of any occurrence or incident would be lost. If we did not have the concept of time, we would not be able know in what period or in what order something took place.

So, time could be seen as a big building with a number of floors where all the floors are designated according to the occurrence of incidents/events on the respective floors. In our case time shall be seen as the duration of happening of any event.

Unit of Time Hour and second are mostly taken as the unit of time. However, day or minute are also taken as units.

Speed

Speed is defined as the distance covered per unit time. In other words, it is the rate at which the distance is covered.

Unit of Speed Though we commonly take km/hour and metre/sec as the units of speed. Yet, any unit of distance upon any unit of time can be taken as the unit of speed. For example, mile/h, feet/s, mile/s, feet/h, etc.

Conversion from m/s to km/h and vice versa

If speed is given in m/s and it is required to convert it into km/h, then we multiply it by $\frac{18}{5}$ and when speed is given in km/h and we have to convert it into m/s, we multiply it by $\frac{5}{18}$.

$36 \text{ km/h} = 36 \times \frac{5}{18} = 10 \text{ m/s}$

$20 \text{ m/s} = 20 \times \frac{18}{5} = 72 \text{ km/h}$

MOTION IN A STRAIGHT LINE

This is one of the primary areas of application of time, speed and distance. By using the basic relationship between time, speed and distance the following three different cases are possible:

Case 1 When S (Distance) is constant

$V \propto \frac{1}{T}$

So, $V_1/V_2 = T_2/T_1$

It is read as V is inversely proportional to T.

It can be understood in terms of the reciprocal-ratio-multiplication relationship between V and T.

Suppose distance = 1000 km and Speed = 100 km/h

Speed = 100 km/h	Time = 10 h
Speed = 100 × 2	Time = ½ × 10
Speed = 100 × 3	Time = 1/3 × 10
Speed = 100 × ½	Time = 2 × 10

To simplify it, the product stability ratio can be further used. So, the more the speed, the lesser is the time taken and the lesser the speed, more will be the time taken.

Example 1 A man cycles with a speed of 10 km/h and reaches his office at 1 p.m. However, when he cycles with a speed of 15 km/h, he reaches his office at 11 a.m. At what speed should he cycle so that he reaches his office at 12 noon? **(CAT 2004)**

Solution Using the product stability ratio,

The speed is being increased by 50%, so the time taken will reduce by 33.33%.

So, 33.33 % of Time = 2 h

Hence, total time = 6 h

So, distance = 10 × 6 = 60 km

This distance is to be covered in 5 h.

So, speed = 60/5 = 12 km/h

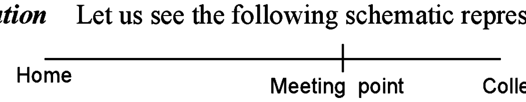
Alternatively, it can be seen that time taken in three (Given) situations are in AP. Hence speeds will be in HP.

Required Speed = Harmonic Mean of two speeds.

So, Required Speed = $\frac{2 \times 15 \times 10}{15 + 10}$ = 12 km/h

Example 2 Siddharth goes by a bike to pick up his girlfriend everyday from college and then drops her at her house. College timings are till 5 p.m. daily, but today the college at 4 p.m. His girlfriend, not finding Siddharth at the college gate, starts walking towards her house. Siddharth, unaware of this fact, leaves his house as usual meets his girlfriend on way, picks her up and drops her at her house. At night, Siddharth realizes that he had saved 40 min that day. What is the ratio of the speed of Siddharth to that of his girlfriend? (Both of them live in the same building).

Solution Let us see the following schematic representation:



The usual route of Siddharth is home-college-home

His route today is – home – meeting point – home.

And, in this way, 40 min are saved. So, he takes 20 min to cover the distance between the meeting point and the college. It can be further concluded that he usually reaches college at

5 P.M., but today he reached at 4:40 (20 min. are saved) and his girlfriend took 40 min. (she starts at 4 P.M.) to cover the distance between her college to the meeting point.

The ratio of time of Siddharth and his girlfriend = 20:40 = 1:2

The ratio of the speed of Siddharth and his girlfriend = 2:1.

Case 2 When T (Time) is constant

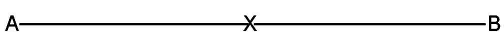
$S \alpha V$

So, $S_1/S_2 = V_1/V_2$

The higher is the speed, the more will be the distance covered and the lower the speed, the lesser will be the distance covered.

We'll see that T constant is a situation specific to meeting point cases.

Example 3 Distance between two points AB = 110 km. Manoj starts running from A at a speed of 60 km/h and Ravi starts running from B at a speed of 40 km/h at the same time. They meet at a point X, somewhere on the line AB. What is ratio of A*X* to B*X*?



Solution Since both Manoj and Ravi are running for the same time, T is constant. Hence, the ratio of the distance covered by them will be the same as the ratio of their speed.

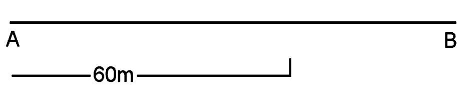
So, AX/BX = Speed of Manoj/Speed of Ravi = 60/40 = 3:2

Some typical meeting point cases

When two persons are running between the ends of a linear track for infinite time:

Example 4 Two robots Mango and Bango start from the opposite ends A and B of a linear track respectively and keep running between the ends for infinite time. They meet for the first time at a point 60 m from A. If AB = 100 m, which point is their point of 4th meeting?

Solution 1st meeting point



The ratio of the speed of Mango and Bango is 60:40 = 3:2. Now Mango is moving towards B and Bango is moving towards A.

For the 2nd meeting, Bango reaches A after covering 60 m, Mango must have covered 90 m in the same time. So, he is at the mid-point of A and B. Now, the distance between Mango and Bango is 50 m. They will cover this distance of 50 m in the ratio of 3:2.

So, the point of their 2nd meeting is

It can be seen here that the sum of the distance covered by both Mango and Bango from the starting till now is 300 m, and the difference between the distance covered between the 1st meeting and the 2nd meeting is 200 m.

So, again they will meet for the 3rd time when they have covered a total distance of 200 m together. Mango and Bango will cover this distance of 200 m in the ratio of 3:2.

Distance covered by Mango = 120 m and distance covered by Bango = 80 m.

So, the 3rd meeting point is point B.

To have a 4th meeting, they will again have to cover a total distance of 200 m. So, the point of their 4th meeting is 20 m from A.

So, we can now generalize the above situation as:

Distance covered by both of them for the 1st meeting = 100 m

Distance covered by both of them for the 2nd meeting = 100 m + 200 m = 300 m

Distance covered by both of them for the 3rd meeting = 300 m + 200 m = 500 m

Distance covered by both of them for the 4th meeting = 500 m + 200 m = 700 m

The ratio of the speed of Mango and Bango is 3:2, so the distance covered by Mango = 420 m

Hence they will meet at 20 m from A.

Example 5 Two persons, Ram and Mohan, start from the same end A of a linear track AB and keep running to and fro for infinite time. They meet for the first time at a point 20 m from B. If AB = 100 m, which point is their point of 4th meeting?

Solution Using the above generalization, distance covered by both of them for the 1st meeting = 200 m

Distance covered by both of them for the 2nd meeting = 200 m + 200 m = 400 m

Distance covered by both of them for the 3rd meeting = 400 m + 200 m = 600 m

Distance covered by both of them for the 4th meeting = 600 m + 200 m = 800 m

The ratio of the speed of Ram and Mohan is 3:2, so the distance covered by Ram = 480 m

Hence they will meet at 80 m from A.

Limitation of above generalization For the meeting to occur after every 200 m, the ratio of the speed of the two runners should be less than 2. If it is more than or equal to 2, then the problems can only be evaluated on the basis of actual calculation.

Case 3 When V (Speed) is constant

$S \alpha T$

So, $S_1/S_2 = T_1/T_2$

In layman terms, if a person is running with a speed of 20 km/h, then the ratio of the distance covered in one hour to the distance covered in two hours will be 1:2.

BOATS AND STREAMS/ESCALATOR

Boats and streams should be ideally seen as just a logical extension of the motion in a straight Line, with distance being constant.

As we know, if the distance is constant then $V \alpha 1/T$.

Basic Terminology

Downstream movement When the direction of the movement of a river and a boat is the same, their collective movement is known as the downstream movement. And the distance covered by boat is known as downstream distance.

If the speed of the River = R and the speed of the boat = B, then Downstream Speed = B + R

Upstream movement When the direction of the movement of the river and a boat is opposite, they are said to be in upstream movement. The distance covered in this case is known as upstream distance.

If the speed of the river = R and the speed of the boat = B, then upstream speed = B – R (Conventionally the speed of one boat is taken more the than speed of the river otherwise the boat would not be able to go back.)

Now, speed of boat = ½ (downstream speed + upstream speed) = ½ (B + R + B – R) = B

And speed of river = ½ (downstream speed – upstream speed) = ½ (B + R – B + R) = R

Hence, if downstream speed and upstream speed are given as 20 km/h and 10 km/h respestively, then the speed of the boat = 15 km/h and speed of the river = 5 km/h.

In most of the cases of boats and streams, the distances covered downstream and upstream are the same. In those cases, the ratio of the time taken becomes inverse of the ratio of the speeds.

Time taken downstream: Time taken upstream = upstream speed: downstream speed

Example 6 The speed of the boat in still water is 6 km/h and the speed of the river is 1.2 km/h. Boat takes a total of 10 h to go to a place and come back. What is the total distance covered in the whole process?

Solution Let us assume D is the distance.

Upstream Speed = 4.8 km/h

Downstream speed = 7.2 km/h

According to the question, D/4.8 + D/7.2 = 10

So, D = 28.8 km and hence the total distance = 57.6 km

Alternatively, the ratio of downstream speed: upstream speed = 3:2

Ratio of the downstream time: upstream time = 2:3

The time taken in the downstream movement = 4 h and the time taken in the upstream movement = 6 h

So, the distance covered = $4 \times 7.2 = 6 \times 4.8 = 28.8$ km

Hence the total distance = 57.6 km

In the case of escalators, moving staircase works like an external agent as the river works for boats and streams. The speed of an escalator and the person will be added when the staircase is going up and the person walking up with it have the same direction of the movement.

Now if the direction of the movement of an escalator and the person are opposite, then the resultant speed (or, the relative speed) will be equal to the speed of the person – to the speed of an escalator.

Example 7 A man can walk up in a moving escalator (upwards) in 30 s. The same man can walk down this moving 'up' escalator in 90 s. Assume that this walking speed is the same both upwards and downwards. How much time will he take to walk up the escalator when it is not moving?

Solution Let us assume that the speed of the man = m steps/s and the speed of the escalator = e steps/s

Distance covered while going up = 30 m + 30 e

Distance covered while going down = 90 m – 90 e

Now, these two are equal.

So, 30 m + 30 e = 90 m – 90 e

Or, 60 m = 120 e, Hence, 1 m = 2 e

So, the total length of escalator = 45 m

So, the time taken by the man to cover the whole escalator = Distance/Speed = 45m/m = 45 s

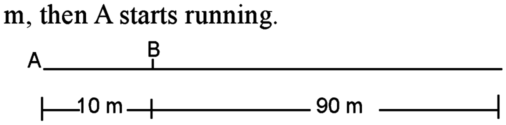
Alternatively, Answer would be Harmonic Mean of the given time = $\frac{2 \times 30 \times 90}{30 + 90} = 45$ secs.

[See the solution of Example 1 on last page].

RACES

Basic Statements

1. A gives a start of 10 m to B → When B has already run 10 m, then A starts running.

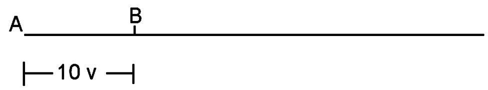


Example 8 In a race of 100 m, A gives a start of 10 m to B. Despite this, A wins the race by 20 m. What is the ratio of the speed of A and B?

Solution Time taken by A to cover 70 m = Time taken by B to cover 100 m

Since the distance is constant, the ratio of speed of A and B = 10:7

2. A gives a start of 10 secs to B → B has already run for 10 secs, now A starts running.



Where v m/s is the speed of B.

Example 9 In a 100 m race, Tom runs at a speed of 1.66 m/s. If Tom gives a start of 4 m to Jerry and still beats him by 12 s, what is the speed of Jerry?

Solution Time taken by Tom to cover 100 m = 60 s

Now, since Tom beats Jerry by 12 s, time taken by Jerry = 72 s

And the distance covered by Jerry = 96 m

So, speed = 96/72 = 1.33 m/s

Example 10 Karan and Arjun run a 100-m race where Karan beats Arjun by 10 m. To do a favour to Arjun, Karan starts 10 m behind the starting line in a second 100 m race. They both run at their earlier speeds. Which of the following is true in connection with the second race?

1. Karan and Arjun reach the finishing line simultaneously.
2. Arjun beats Karan by 1 m.
3. Arjun beats Karan by 11 m.
4. Karan beats Arjun by 1 m.

Solution Situation (I)

In whatever time Karan covers a distance of 100 m, Arjun covers 90 m in the same time.

Situation (II)

Karan is 10 m behind the starting point. Once again to cover 100 m from this new point Karan will take the same time as before. In the same time Arjun will cover only 90 m. This means that both of them now will be at the same point, which is 10 m away from the finish point. Since both of them are required to cover the same distance of 10 m and Karan has a higher speed, he will beat Arjun. There is no need for calculations as option (4) is the only such option.

CIRCULAR MOTION

In the case of races and motions in straight line, we have observed that if the two bodies or persons are moving with different speeds in a straight line in one direction, then they will never meet. This is due to the fact that with the passage of time, the distance between them is increasing constantly.

Circular motion should be seen as a logical extension of Races where runners are running on a circular track. Since it an enclosed track (by virtue of it being circular), runners are bound to meet at some point or the other.

Case 1 When two or more than two persons are running around a circular track in the same direction.

Example 11 When will they meet for the first time anywhere on the track?

Solution To understand the situation completely, let us assume that there are two persons A and B. Speed of A = 20 m/s, speed of B = 10 m/s, length of the track is 1000 m and they are running in the same direction. It can be seen in figure 1 that initially both of them are at the same point i.e., the starting point.

They will be meeting for the first time only if the faster runner A has taken one more round of the track than the slower runner B. This can be interpreted as—A will have to cover 1000 m more than B.

It is understood with the figures given above that the distance will keep on increasing between them with the passage of time. And the moment distance between them becomes equal to 1000 m, they will be at the same point.

So, the time taken = distance/relative speed = $\frac{1000}{10}$ = 100 s

Or, this can be done by using unitary method also:

Distance of 10 m is created in 1 s

So, the distance of 1000 m will be created in 100 s

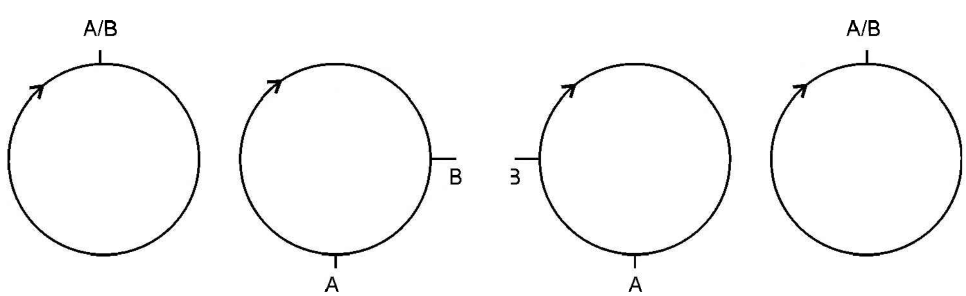
Now, let us assume that there are three persons A, B and C running with following speeds in the same direction:

Speed of A = 30 m/s

Speed of B = 20 m/s

Speed of C = 10 m/s

To calculate when will they meet for the first time, we are required to find the time taken by the fastest runner to take one round over the other runners.



Starting After 25 s After 75 s After 100 s

Time taken by A to take one round over B = t_{A-B} = 1000/10 = 100 s

Time taken by A to take one round over C = t_{A-c} =1000/20 = 50 s

Now, the LCM of these two values t_{A-B} and t_{A-c} will give us the time after which all of them will be meeting at the same place.

LCM = (100, 50) = 100 s

It can also be seen that they will be meeting after every 100 s.

Example 12 When will they meet for the first time at the starting point?

To calculate this, we will use the concept of LCM (Usage of LCM and HCF, chapter 2, case 2)

Find the time taken by each individual to take one round and then calculate LCM of these values.

Assume there are three persons A, B and C with a respective speed of 30 m/s, 20 m/s and 10 m/s running in the same direction. Length of the circular track is 1000 m.

Time taken by A to take one round = t_1 = 1000/30 = 33.33 s

Solution Time taken by B to take one round = t_2 = 1000/20 = 50 s

Time taken by C to take one round = t_3 =1000/10 = 100 s

LCM of t_1, t_2, t_3 = 100 sec.

Example 13 At how many different points of the track will they be meeting?

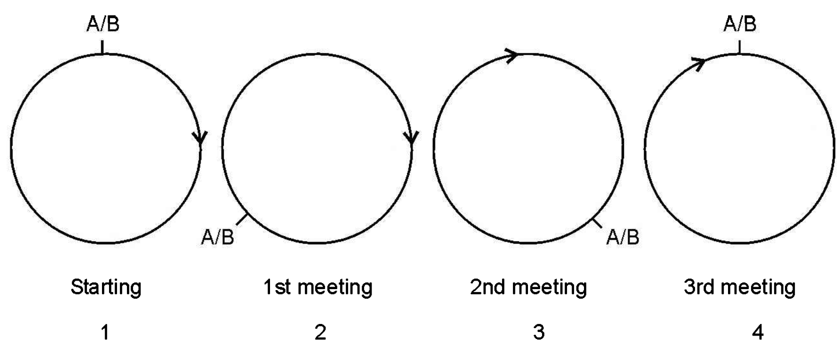
Solution Let us assume that the speed of A = 25 m/s and the speed of B = 10 m/s and the length of the track =1000 m

They will be meeting for the first time after a time-gap of 1000/15 = 66.66 s

Till this time, A has covered 1666.66 m and B has covered 666.66 m. This point is 666.66 m from the starting point. Now, this point can be assumed to be the starting point.

So, they will meet at a distance of 666.66 m from here. This is the second meeting point, at a distance of 333.33 m from the starting point. Next meeting point will be 666.66 m from here. This point will be nothing but the starting point again (Fig.1 and Fig.4 are same).

This can be seen through the figures given below:



So, there are a total of 3 distinct meeting points on the track.

In general, number of meeting points = difference of ratio of the speed the of A and B in its simplest form.

Ratio of speed of A and B = 5 : 2

So, the number of different meeting points = 5 – 2 = 3 points

Case 2 When two or more than two persons are running around a circular track in the opposite direction.

Here again there are two persons A and B with a speed of 20 m/s and 10 m/s respectively, and length of track is 1000 m.

Example 14 When will they meet for the first time anywhere on the track?

Solution Since they are running in the opposite direction, relative speed =10 + 20 = 30 m/s

So, time taken = distance/relative speed = 1000/30 = 33.33 s

Example 15 When will they meet for the first time at the starting point?

First, we will calculate the time taken by each individual to take one round and then calculate the LCM of those values.

Time taken by A to take one round = t_1 = 1000/20 = 50 s

Time taken by B to take one round = t_2 = 1000/10 = 100 s

LCM of (t_1, t_2) = 100 s

Example 16 At how many different points of the track will they be meeting?

Solution They are meeting after 33.33 s for the first time. Till this time, A has covered 666.66 m and B has covered 333.33 m. So, obviously they are meeting at a distance of 666.66 m from starting point in the direction of A. Next point will be again 666.66 m ahead of this point. And, the next point will be another 666.66 m ahead of this point, which will be the starting point.

So, a total of 3 points will be there.

In general, number of distinct meeting points = addition of the ratio of the speed of A and B in its simplest form.

The ratio of speed of A and B = 2 : 1

So, the number of different meeting points = 2 + 1 = 3 points

Example 17 Anup and Shishir start running from the same point of a circular track at the same time. After how much time will Anup and Shishir, who are running with a speed of 35 m/s and 40 m/s, respectively, meet at diametrically opposite point?

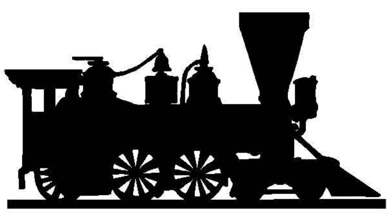
Solution The simplest ratio of speed of Anup and Shishir = 7:8

So, if they are running in the same direction, they will meet at 1 point and if they are running in the opposite direction, they will meet at 15 different points.

Now, for them to meet at a diametrically opposite point, there should be atleast two meeting points or the number of meeting points should be a multiple of 2.

Since, they would meet either at 1 point or at 15 different points, depending on the direction of their movement, they will, therefore, not meet at a diametrically opposite point.

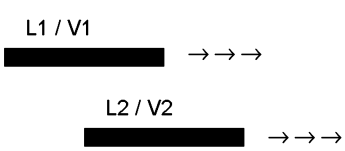
TRAINS



We know that when the direction of the movement of a boat and a river is the same, the relative speed is obtained by adding the speeds of both, the boat and the river. But if two trains are moving in the same direction, then what is the relative speed?

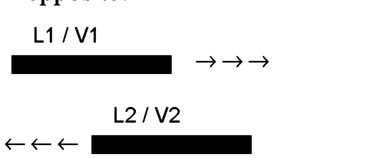
Let us see some cases:

1. When two trains of length L_1 and L_2 and speed V_1 m/s and V_2 m/s respectively are crossing each other:
   i. The direction of the movement of both the trains are the same:



Relative speed = $| V_1 - V_2 |$
Total distance covered = $L_1 + L_2$

ii. The direction of the movement of both the trains are opposite:



Relative speed = $| V_1 + V_2 |$
Total distance covered = $L_1 + L_2$

2. When a train is crossing a stationary object:
   i. When the train is crossing a pole or a stationary human being:

(Fig. 1)

(Fig. 2)

Let us assume that A is a pole. In figure 1, the front of the train is about to cross the pole and in figure 2, the tail of the train has just crossed the pole. It is understood here that the train has crossed its whole length with respect to the pole. So, when the train is crossing any stationary object of negligible width, total distance covered is its own length.

Relative speed = $V_1 + V_2$, since $V_2 = 0$, then, the relative speed = V_2

Total distance covered = $L_1 + L_2$, since L_2 (width of the pole) is negligible with respect to L_2 (Length of the train), so we do not consider it while calculating the quantities. Thus, distance = L_1

However, it should be remembered that this is mathematically not correct and all the solutions are on the assumption that the width of the pole is zero, which is obviously not true.

ii. When the train is crossing a platform or a standing train:

Relative speed = $V_1 + V_2$,

Where V_1 is the speed of the moving train and V_2 is the speed of the standing train or the platform.

Since $V_2 = 0$, so the relative speed = V_1

Total distance covered = $L_1 + L_2$

Where L_1 is the length of the moving train and L_2 is the length of the standing train or the platform.

Example 18 A train takes 10 s to cross a pole and 20 s to cross a platform of length 200 m. What is the length of train?

Solution The train takes 10 s to cross its own length and 20 s to cross its own length and length of the platform. So, it is infered that the train takes 10 s to cross the platform and 10 s to cross its own length.

Since the time taken to cross the platform = time taken to cross its own length

So, length of the platform=length of the train=200 m

Example 19 Speed of a train is 36 km/h. It takes 25 s to cross a pole. What is the length of this train?

Solution Speed of train = 10 m/s (36 × 5/18)

Distance covered = 10 × 25 = 250 m

So, length of train = 250 m

Some Special Cases

Case 1 Two trains are moving in an opposite direction with a speed of V_1 and V_2. Their lengths are L_1 and L_2. Now, see the whole situation from the point of view of a person sitting on the window seat of the 1st train.

Relative speed = $V_1 + V_2$ (This person can be assumed to be running with a speed of V_2.)

Relative distance = L_2

Case 2 A train is running with a speed V_1 and a person X is running inside the train with a speed of V_2 in the direction of the movement of train. Now if a person Y is watching this from the outside of the train, then the relative speed of Y with respect to X = $V_1 + V_2$.

Speed of person X with respect of another person Z who is sitting in the train = V_2

There is also a person P who is outside the train and is moving with a speed of V_3 in the opposite direction of train.

Relative speed of P with respect to person

X = $V_1 + V_2 + V_3$

Had this person P been running in the same direction as that of the train, then the relative speed of P with respect to person X = $|V_1 + V_2 - V_3|$

CLOCKS

A clock is a typical example of a circular motion where length of the track is equal to 60 km (Assume 1 min = 1 km). Now on this track, two runners i.e., hour hand and minute hand are running with a speed of 5 km/h and 60 km/h respectively. Since the direction of their movement is the same, so the relative speed = 55 km/h.

Example 20 When will the hour hand and the minute hand of a clock be together between 1 and 2?

Solution Hands have to be together in between 1 o'clock to 2 o'clock.

At 1 o'clock, the distance between hour and minute = 5 km

And the relative speed = 55 km/h

Time = 5/55 h = 1/11 h = 60/11 min = 5 5/11 min. = 5300/11 s = 5:27.27s

So, the hour hand and the minute hands will be together at 1:05:27.27 s

Students can learn this value 5 min 27.27 s as a standard result.

So, both the hands will meet at

1:05:27.27 – Between 1 o'clock and 2 o'clock
2:10:54.54 – Between 2 o'clock and 3 o'clock
3:16:21.81 – Between 3 o'clock and 4 o'clock
and so on.

Example 21 How many times in a day will the hands of a clock be together?

Solution Using the data from the above question, hands of a clock meet at a regular interval of 5 min 27.27 s. So, the number of times they will the meet = $\frac{60}{5:27.27}$ = 11.3 times.

So, the hands will meet for a total of 11 times.

However, it can also be observed that the hands of a clock meet once every hour except in between 11–1. They meet just once in between 11–1. So, they are meeting for 11 times.

Degree Concept of Clocks

Total angle subtended at the centre of a clock = 360°.

Angle made by an hour hand at the centre per hour = 30° per hour, or, 0.5° per min

Angle made by the minute hand at the centre per hour = 360° per hour, or, 6° per min

Example 21 solving 20 by this method,

Angle between an hour hand and the minute hand at 1 o'clock = 30°

Relative speed (in terms of angle) = 5.5°/h

So, time taken = 30°/5.5° = 60/11 min

Example 22 Mr Binod Kumar Roy goes to a market between 4 P.M. and 5 P.M. When he comes back, he finds that the h hand and the min hand have interchanged their positions. For how much time was he out of his house?

Solution Since hands are interchanging their position, minute hand is taking the place of an hour hand and an hour hand is taking the place of min hand. So sum of the angles formed by h hand and min hand = 360°

Let us assume that he was out of house for 't' min.

So, the angle formed by min hand = $6 \times t$ and by hour hand = $0.5 \times t$

So, $0.5 \times t + 6 \times t = 360$

Or, $6.5 \times t = 360$

So, $t = 55.38$ min

Important Derivations

→The number of times hands of a clock are in a straight line (either at 0° or at 180°) in 24 h = 44

→The number of times hands of a clock are at a right angle (at 90°) in 24 h = 44

→Both the hands of clock are together after every $65\frac{5}{11}$ min

(So if both the hands of the clock are meeting after every 65 min or anything less than $65\frac{5}{11}$ mins, then the clock is running fast and if both the hands of the clock are meeting after every 66 min or anything more than $65\frac{5}{11}$ min, then clock is running slow.)