Concepts

1) There is a relationship between speed, distance and time:

Speed = Distance / Time OR

Distance = Speed* Time

2) Average Speed = 2xy / x+y

where x km/hr is a speed for certain distance and y km/hr is a speed at for same distance covered.

**** Remember that average speed is not just an average of two speeds i.e. x+y/2. It is equal to 2xy / x+y

3) Always remember that during solving questions units must be same. Units can be km/hr, m/sec etc.

**** Conversion of km/ hr to m/ sec and m/ sec to km/ hr

x km/ hr = (x* 5/18) m/sec i.e. u just need to multiply 5/18

Similarly, x m/sec = (x*18/5) km/sec

4) As we know, Speed = Distance/ Time. Now, if in questions Distance is constant then speed will be inversely proportional to time i.e. if speed increases ,time taken will decrease and vice versa.

Time and Distance Problems

Problem 1: A man covers a distance of 600m in 2min 30sec. What will be the speed in km/hr?

Solution: Speed =Distance / Time
=> Distance covered = 600m, Time taken = 2min 30sec = 150sec
Therefore, Speed= 600 / 150 = 4 m/sec

=> 4m/sec = (4*18/5) km/hr = 14.4 km/ hr.

Problem 2: A boy travelling from his home to school at 25 km/hr and came back at 4 km/hr. If whole journey took 5 hours 48 min. Find the distance of home and school.

Solution: In this question, distance for both speed is constant.
=> Average speed = (2xy/ x+y) km/hr, where x and y are speeds
=> Average speed = (2*25*4)/ 25+4 =200/29 km/hr
Time = 5hours 48min= 29/5 hours
Now, Distance travelled = Average speed * Time
=> Distance Travelled = (200/29)*(29/5) = 40 km
Therefore distance of school from home = 40/2 = 20km.

Problem 3: Two men start from opposite ends A and B of a linear track respectively and meet at point 60m from A. If AB= 100m. What will be the ratio of speed of both men?

Solution: According to this question, time is constant. Therefore, speed is directly proportional to distance.
Speed∝ Distance
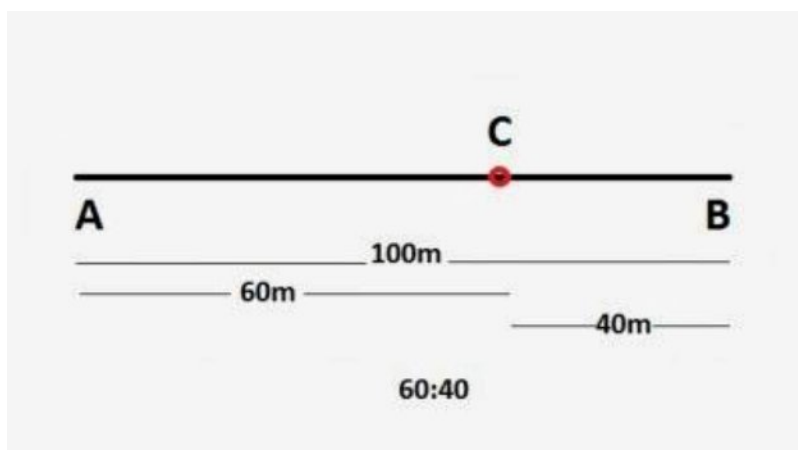
=> Ratio of distance covered by both men = 60:40 = 3:2
=> Therefore, Ratio of speeds of both men = 3:2

Problem 4: A car travels along four sides of a square at speeds of 200, 400, 600 and 800 km/hr. Find average speed.

Solution: Let x km be the side of square and y km/hr be average speed
Using basic formula, Time = Total Distance / Average Speed

x/200 + x/400 + x/600 + x/800 = 4x/y => 25x/ 2400 = 4x/ y=> y= 384
=> Average speed = 384 km/hr

Formulae

Speed = Distance/Time

Time = Distance/Speed

Distance = Speed × Time

If the speed of a body is changed in the ratio a : b, then the ratio of the time taken changes in the ratio b : a.

m km/hr = [m × 5/18] m/sec.

m metres/sec = [m × 18/5] km/hr.

I recommend you to watch the following concept video before solving the questions.

Q.1. Express 18km/hr in meters per second.

Solution: 18 km/hr = [18 × 5/18] m/sec. = 5 metres/sec.

Q. 2. Express 10 m/s in km/hr.

Solution: 10 metres/sec = [10 × 18/5] km/hr. = 36 km/hr.

Theorem

If a certain distance is covered at m km/hrand the same distance is covered at n km/hr, then the average speed during the entire journey is 2mn/ (m+n) km/hr.

Let the distance be A km.

Time taken to travel the distance at a speed of m km/hr = A/m hr.

Time taken to travel the distance at a speed of n km/hr = A/n hr.

we see that the total distance of 2A km is travelled in (A)/m+A/n hr.

$$\therefore \quad \text{Average speed} = \frac{2A}{\frac{A}{m}+\frac{A}{n}} = \frac{2Amn}{A(m+n)} = \frac{2mn}{m+n} \text{ hrs.}$$

Q. 3. Amar covers a certain distance by car driving at 70 km/hr and he returns to the initial point on a scooter by 55 km/hr. Find his average speed for the entire journey.

Solution: Average speed $= \frac{2 \times 70 \times 55}{70+55}$ km/hr $= 61.6$ km/hr.

Q. 4. Rohan covers distance between his house and office on scooter. Going with an average speed of 30 km/hr he reaches his office 10 minutes late. However, going with an average speed of 40 km/hr, he reaches his office 5 minutes earlier. Find thedistance between his office and his house.

Solution: Let the distance be x km.

Time taken to cover x km at 30 km/hr = $\frac{m}{30}$ hrs.

Time taken to cover x km at 40 km/hr = $\frac{m}{40}$ hrs.

Difference between the time taken = 15 min = $\frac{1}{4}$ hr.

∴ $\frac{m}{30} - \frac{m}{40} = \frac{1}{4}$ Or,   4m − 3m = 30   or,   m = 30

Hence, the required distance is 30 km.

DIRECT FORMULA

REQUIRED DISTANCE =
$$\frac{product\ of\ two\ speeds}{difference\ of\ two\ speeds} \times difference\ between\ arrival\ times.$$

Thus, in this case, the required distance

$\frac{30 \times 40}{40-30} \times \frac{10+5}{60}$ = 30 km.

Q. 5. A woman walking with a speed of 5km/hr reaches her office 5 minutes late.If she walks at a speed of 6 km/hr, she reaches on time.Find the distance of her office from her house.

Solution: Here the difference in time is 5 minutes only.

Thus, required distance = $\frac{5 \times 6}{6-5} \times \frac{5}{60} = \frac{5}{2}$ km = 2.5km.

Q. 6. A boy goes to school at a speed of 3 km/hr and returns to the village at a speed of 2 km/hr. If he takes 5 hours in total, what is the distance between the village and the school?

Solution: Let the required distance be x km.

Then time taken during the first journey = $\frac{x}{3}$ hr.

And time taken during the second journey = $\frac{x}{2}$ hr.

$$\therefore \frac{x}{3} + \frac{x}{2} = 5 \quad \text{or,} \quad \frac{2x+3x}{6} = 5 \quad \text{or,} \quad 5x = 30.$$

$$\therefore X = 6 \quad \therefore \text{ the required distance = 6 km.}$$

DIRECT FORMULA:

Required distance =

total time taken $\times \dfrac{Product\ of\ the\ two\ speeds}{Addition\ of\ the\ two\ speeds}$

$$= 5 \times \frac{3 \times 2}{3+2} = 6 \text{ km.}$$