AILET

Maths: Time, Speed and Distance

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Time, Speed and Distance

Speed is a basic concept of motion that tells about how fast and slow an object is moving. **Speed is defined as the distance travelled per unit time**. Usually, we denote speed by **s or v, the distance by d and time by t**.

The unit of speed is meters per second **(*m/s*)** but many times in exam we deal with questions in kilometre per hour **(*km/hr*)**. In such cases, we use a very basic unit conversion method as described below.

Unit Conversion:

- To convert speed given in m/s into speed km/s, multiply it with 18/5
- To convert speed given in km/s into speed m/s, multiply it with 5/18

Now let's see how we get to above conversions:

1 km= 1000 m while 1 hr=60 min=60*60 sec = 3600 sec

Therefore, 1 km/hr =1000/3600 m/s = 5/18 m/s

Similarly, 1m/s = 18/5 km/hr

Even if the distance is given in km with time in seconds, then using the above conversions we can convert time in hr or distance in m as per asked in the question.

Illustration 1: A boy taking 5 hrs to cover a distance of 20 km on foot. At what speed is the boy travelling? Also, what would be the distance covered by the boy is he continues to travels at the same speed for 7 hrs?

Sol: Speed = D/T = 20/ 5 =4 km/hr

As the boy took 5 hrs to cover a distance of 20 km, we can that the speed at which he travels is 4 km/hr i.e **he travels 4 km every hour**.

Nor he the boy travels for 7 more hrs the distance would be

d = s*t

d = 4*7 =28 km

Concept of average speed:

Average speed is that speed with which if an object had travelled a certain distance, the body would have taken the same time as it takes with the different speeds in travelling the same distance.

The average speed is calculated by **dividing the total distance travelled by the object by the total time taken to travel the distance**.

Average Speed = Total Distance travelled/ Total Time taken

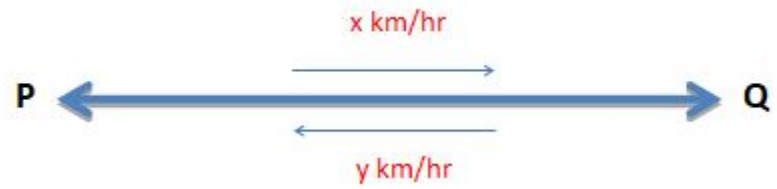
Illustration 2: A car moves from A to B travelling 50 km in 2 hr, then from B to C travelling 70 km in 4 hr. Find the average speed of the car is travelling from A to C via B.

Sol: Average Speed = Total D/ Total T = 50+70/ 2+4 = 120/6= 20 km/hr

Thus, if the car had moved at a constant speed of 20 km/hr, it would have taken the same time of 6 hrs to cover the distance of 120 km.

Now there are two types of questions of average speed :

TYPE 1: When the distance travelled is constant



Suppose a Car travels from P to Q with the speed of x km/hr and comes back to P from Q at the speed of y km/hr and you have to find the average speed of that car when distance between P and Q is D.

Here the total distance that the car travelled is 2D (from P to Q then from Q to P). Time taken to travel from P to Q would be distance upon speed i.e., D/x and similarly, time taken from Q to P

would be D/y. Thus Total time becomes D/x +D/y = D (1/x + 1/y)

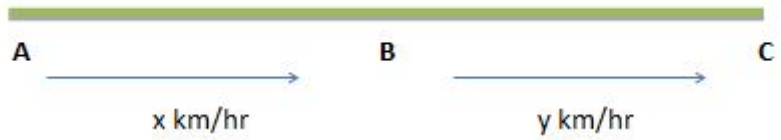
$$Average\ Speed = \frac{2D}{D(\frac{1}{x}+\frac{1}{y})}$$

$$Average\ Speed = \frac{2xy}{x+y}$$

TYPE 2: When the Time taken is constant

Suppose A car travelled from point A to point B at a speed of x km/hr in t hrs and then from point B to point C at the speed of y km/hr at the same time i.e., t hr.

Here distance of A to B would become x*t and distance from B to C would be y *t, therefore total distance would become xt + yt. The total time would be 2t as it took t hr from A to B and t hr from B to C.



Thus the formula for average speed would be

Illustration 3: Ankit goes to office at a speed of 6 km/hr and comes back home at a speed of 4 km/hr. If it took him 10 hrs in all to complete the journey then what is the distance from his office to home?

Sol: As the question states that Ankit travelled from home to office then back to home the distance would be constant, thus formula for average speed would be **2xy/(x+y)**.

Average speed = 2 * 6 * 4 /6+4 =48/10= 4.8 km/hr

Total distance traveled = 4.8 * 10 = 48 km

Distance from office to home would be half the total distance i.e., **48/2=24 km**

Concept of Relative Speed

Relative speed is calculated when we need **the speed of one object with respect to another**.

Suppose A started driving from P to Q at a speed of 40 km/hr while B started driving from Q at the speed of 60 km /hr. The distance between P and Q is 100 km.

In this case, as A and B are travelling in the opposite direction the speed of A relative to B would be the *sum of the speed of A and B***,** i.e, 40+50= 100 km/hr.

If both A and B in the same condition started from Point P then relative speed would have been the *difference of speeds of A and B,* i.e, 60-40=20 km/hr

NOTE:

Speed of two bodies is u and v

- If objects are moving in the opposite direction then the relative speed of distance is the sum of their speed, i.e. u + v
- If objects are moving in the same direction then the relative speed of distance is the difference of their speed, i.e. u – v if u >v and v – u if v>u

By

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