Time & Distance

The ratio between distance (D) travelled by an object and the time (t) taken by that to travel the distance is called the speed (S) of the object.

$S = \frac{D}{t} \Rightarrow D = S \times t \Rightarrow t = \frac{D}{S}$

Generally if the distance (D) is measured in kilometers (KM), the time (t) will be measured in hours (h) or if the distance (D) is measured in meters (m), then the time (t) will be measured in seconds (s).

$\therefore$ Speed $(S) = \frac{D}{t}$

$= \frac{KM}{H}$ = KMPH (OR) $\frac{m}{s}$ = mps i.e. the speed will be measured in KMPH or mps.

$1 \text{ KMPH} = \frac{1KM}{1H} = \frac{1000m}{3600Secs} = \frac{5}{8}$ mps $\Rightarrow 1$mps $= \frac{18}{5}$ KMPH

If an object travels the same distance (D) with two different speeds S_1 and S_2 taking different times t_1 and t_2 then

$S_1 : S_2 = \frac{1}{t_1} : \frac{1}{t_2} = t_2 : t_1 \Rightarrow t_1 : t_2 = S_2 : S_1$

FORMULAE

i) Two objects travel the same distance (D) with different spee ds of S_1 and S_2. If the difference between the journey times is t then

$D = \frac{(S_1 \times S_2)}{|S_1 - S_2|} \times t$

ii) If an object travels a distance of D with a speed of S_1 and returns with a speed of S_2 taking a total time of 't', then

$D = \left(\frac{S_1 S_2}{S_1 + S_2} \right) \times t$

iii) If two objects travel the same distance with speeds of S_1 and S_2 taking the journey times of t_1 and t_2 respectively, then

$S_1 : S_2 = t_2 : t_1$ OR $t_1 : t_2 = S_2 : S_1$

iv) Walking at p/qth of usual speed a man reaches his destination t-hours late (or early) then usual time to reach the office is given

by $\frac{p \times t}{|p-q|}$

v) If a person walks a distance D with a speed of S_1 kmph then he will be late (early) by $t_1$hours. If he walks at S_2 kmph he will be late (early) by t_2 hours. Then the distance travelled by the person

is $D = \frac{S_1 \times S_2}{|S_1 - S_2|} \times |t_1 \pm t_2|$

Note: Use (+) sign if the person is late in one case and early in the other case. Use (-) sign if he is late in both the cases or early in both the cases.

vi) If an object travels different distances with different speeds during a journey then the entire journey can be represented by a single equivalent speed called Average Speed (S_A)

Average Speed (S_A) $= \frac{\text{Total Distance (T.D)}}{\text{Total Time (T.t)}}$

vii) If an object travels a distance of D_1–km with S_1–kmph another D_2–km with a speed of S_2-kmph and D_3-km with a speed of S_3-kmph, then the average speed of the journey is

$$S_A = \frac{(D_1 + D_2 + D_3)}{\left(\frac{D_1}{S_1} + \frac{D_2}{S_2} + \frac{D_3}{S_3}\right)}$$

viii) If an object travels with a speed of S_1-kmph for t_1-hours, next wi-th a speed of S_2 kmph for t_2 -hours and with a speed of S_3-kmph for t_3–hours, then the average speed (S_A) for the whole journey is

$$S_A = \frac{(S_1t_1 + S_2t_2 + S_3t_3)}{(t_1 + t_2 + t_3)}$$

PROBLEMS

1. A bus covers a distance of 624 km in 780 minutes. What is the average speed of the bus in kmph?

1) 44 2) 48 3) 52 4) Cannot be determined 5) None of these

Ans: 2

Solution: D = 624 km t = 780 min = 13 h $S = \frac{D}{t} = \frac{624}{13} = 48$ kmph

2. The average speed of a bus is 55 kmph. How much distance will a car cover in eight hours if the average speed of the car is 26 percent more than the average speed of the bus?

1) 568.4 km 2) 563.6 km 3) 548.6 km 4) 554.4 km 5) None of these

Ans: 4

Solution: S_b = 55 kmph, $S_c = 55\times \frac{126}{100} = 69.3$, t = 8 h

D =S× t = 69.3 × 8 = 554.4 km

3. One third of a certain journey is covered at the rate of 25km/hour, one-fourth at the rate of 30 km/ hour and the rest of 50 km/hour. The average speed for the whole journey is?

1) 35 km/hour 2) $33\ ^1/_3$ km/hour 3) 30 km/hour

4) $37\ ^1/_{12}$ km/hour 5) None of these

Ans: 2

Solution: Let the total distance covered = 600 km

Distance covered with the speed of 25 km/hr = 200 km

Distance covered with the speed of 30 km/hr = 150 km

Distance covered with the speed of 50 km/hr = 250 km

Total time taken to cover the distance

$$=\frac{200}{25}+\frac{150}{30}+\frac{250}{50} = 8+5+5=18 \text{ h}$$

Average speed $=\frac{600}{18}=33\frac{1}{3}$ km/hr

4. A car covers a distance from to-wn A to town B at the speed of 58 kmph and covers the distance fr-om town B to town A at the speed of 52 kmph. What is the appro-ximate average speed of the car?

1) 55 kmph 2) 52 kmph 3) 48 kmph 4) 50 kmph 5) 60 kmph

Ans: 1

Solution: Distance between AB be 58×52

∴Total distance covered = 2× 58 × 52

Time taken by car to travel from

A to B $=\frac{58\times52}{58}=52$

Time taken by car to travel from

B to A $\frac{58\times52}{52}=58$

Total time = 52 + 58 = 110

Average speed

$=\frac{2\times58\times52}{110}\cong55\text{kmph}$

5. The average speed of a train is $1\ ^3/_7$ times the average speed of a car. The car covers a distance of 588 km in 6 hours. How much distance will the train cover in 13 hours?

1) 1750 km 2) 1760 km 3) 1720 km 4) 1850 km 5) None of these

Ans: 5

Solution: Speed of car $=\frac{588}{6}=98$

Speed of train $=\frac{10}{7}\times98=140$ kmph

Distance covered by the train = 140×13 = 1820 km

6. A person leaves a place A to pla-ce B at 6 a.m. and reaches place B at 10 a.m. Another person leaves B at 7:30 a.m. and reaches A at 11 a.m. They will meet each other at?

1) 7:40 a.m. 2) 8:20 a.m. 3) 8:40 a.m. 4) 9:20 a.m. 5) None of these

Ans: 3

Solution: Let distance be 28 km

Speed of the first person $=\frac{28}{4}=7$

Speed of the second person

$=\frac{28}{3.5}=8$

Distance covered by the first person upto 7:30 a.m. = 7 × 1.5 = 10.5

Remaining distance = 28–10.5 = 17.5 km

Time taken by both the persons to

travel 17.5 km $=\frac{17.5}{15}$

= 1 hr 10 min

Time they met = 7:30 + 1 hr 10 min = 8:40 a.m.

7. If a man decides to travel 80 km in 8 hours, partly by foot and partly on, a bicycle, his speed on foot being 8km/hr and that on bicycle being 16 km/hr, what distance would he travel on foot?

1) 20 km 2) 48 km 3) 36 km 4) 40 km 5) None of these

Ans: 2

Solution: Let the time taken to travel a part of distance by foot = x

$\therefore$ Time taken to travel by bicycle = 8–x

$8 \times x + 16 (8 - x) = 80$

$8x + 128 - 16x = 80$

$8x = 48 \; x = \frac{48}{8} = 6$

Distance travelled by foot = $8 \times 6 = 48$ km

8. A car covers the first 39 km of its journey in 45 minutes and the remaining 25 km in 35 minutes. What is the average speed of the car?

1) 46 km/hr 2) 40 km/hr 3) 48 km/hr 4) 42 km/hr 5) None of these

Ans: 3

Solution: Total distance = 39 + 25 = 64 km

Total time = 45 + 35 = 80 min = 4/3 hr

Average speed = $\frac{64}{\frac{4}{3}} = \frac{64 \times 3}{4} = 16 \times 3 = 48$ km/hr

9. A man walks a certain distance and rides back taking a total time of 37 minutes. He could walk both ways in 55 minutes. How long would he take to ride both ways ?

1) 19 minutes 2) 20 minutes 3) 9.5 minutes 4) 18 minutes 5) None of these

Ans: 1

Solution: Walk + ride = 37 min $2 \times$ Walk = 55 $\Rightarrow$ W = 27.5

Ride = 37 - 27.5 = 9.5 Ride both ways = $2 \times 9.5 = 19$ min

10. Walking 6/7 th of his usual speed, a man is 12 minutes too late. The usual time taken by him to cover that distance is?

1) 1 hour 2) 1 hour 12 minutes 3) 1 hour 15 minutes

4) 1 hour 20 minutes 5) None of these

Ans: 2

Solution: Refer to formula (iv) $\frac{p}{q}=\frac{6}{7}$, t = 12

Usual time $=\frac{6\times12}{|6-7|}$ = 72 = 1 hr 12 min

11. If I walk at 5 km/hour, I miss a train by 7 minutes. If, however, I walk at 6 km/hour, I reach the station 5 minutes before the departure of the train. The distance (in km) between my house and the station is?

1) 6 km 2) 5 km 3) 4 km 4) 3 km 5) None of these

Ans: 1

Solution: Refer to formula (v) $S_1 = 5$, $S_2 = 6$, $t_1 = 7$ min, $t_2 = 5$ min

Distance between my house and Station

$=\frac{5\times6}{|5-6|}\times\frac{(7+5)}{60}=\frac{30\times12}{60}=6$km

12. A walks at a uniform rate of 4 km an hour and 4 hours after his start, B bicycles after him at the uniform rate of 10 km an hour. How far from the starting point will B catch A?

1) 16.7 km 2) 18.6 km 3) 21.5 km 4) 26.7 km 5) None of these

Ans: 4

Solution: Distance covered by A in 4 hours = 16 km

For every hour B covers 6 km more than A.

So he covers 16 km in $\frac{16}{6}=\frac{8}{3}$ hours

Distance covered by B in hours is $10\times\frac{8}{3}=\frac{80}{3}$ = 26.7 km

13. If a man walks 20 km at 5 km/hr, he will be late by 40 minutes. If he walks at 8km per hr, how ear-ly from the fixed time will he re-ach?

1) 15 minutes 2) 25 minutes 3) 50 minutes 4) 1½ minutes 5) None of these

Ans: 3

Solution: Refer to formula (v) D = 20 km, $S_1 = 5$, $S_2 = 8$, $t_1 = 40$ min, $t_2 = ?$

$20 = \frac{5\times8}{|5-8|}\times\frac{(40+t_2)}{60}=\frac{2(40+t_2)}{9}$ $\Rightarrow 40 + t_2 = 90$ $\therefore t_2 = 50$ minutes

$\therefore$ The man reaches 50 minutes early from the fixed time.