SPEED, TIMES AND DISTANCE

Concept of speed, time and distance is based on the formula

Speed × time=Distance

Speed(s):

The rate at which any moving body covers a particular distance is called is speed.

Speed= Distance/Time;

Time(t):

It is the time duration over which the movement has occurred. The unit used for measuring time is synchronous with denominator of the unit used for measuring speed. Thus, if the speed is measured in terms of km/h then time is measured in hours'

Time= Distace/Speed;

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Unit:

SI unit of speed is metre per second (mps). It is also measured in kilometres per hour (kmph) or miles per hour (mph).

Conversion of units:

- 1 hour=60 minutes=60×60 seconds
- 1km=1000 m
- 1km=0.625 mile
- 1 mile=1.60 km, i.e. 8km=5 miles
- 1 yard=3 feet
- 1 km/h=5/18m/sec,
- 1 m/sec= 18/5 km/h
- 1 miles/hr = 22/15ft/sec.
- Average speed= (Total distance)/(Total time)
- While travelling a certain distance d, if a man changes his speed in the ration m:n, then the ratio of time taken becomes n:m

- If a certain distance(d), say from A to B, is covered at 'a' km/hr and the same distance is covered again say from B to A in 'b' km/hr, then the average speed during the wholejouney is given by: Average speed= [2ab/(a+b)]km/h...(which is the harmonic means of a and b
- Also, if t1and t2is taken to travel from A to B and B to A respectively, the distance 'd' fromA to B
- d=(t1+ t2)[ab/(a+b)]
- d=(t1+ t2)[ab/(b-a)]
- d=(a-b) [t_(1t_2)/(t_2-t_1)]
- If a body travels a distance 'd' from A to B with speed 'a' in time t1 and travels back from B to A i.e., the same distance with m/nof the usual speed 'a' then the change in time taken to cover the same distance is given by:
- Change in time=[m/n-1]x t1; for n>m =[1-n/m]x t1; for m>n
- If first part of the distance is covered at the rate of v1 in time t1 and the second part of the distance is covered at the rate of v2 in time t2 then the average speed is [(v_(1t_1)+v_(2t_2))/(t_1+t_2)]

Relative speed:

- When two bodies are moving in same direction with speeds s1and s2respectively, their relative speed is the difference of their speeds. i.e. Relative Speed=s1-s2
- When two bodies are moving in opposite direction with speeds s1and s2 respectively, their relative speed is the sum of their speed. i.e. Relative Speed=s1+s2

Example 1:

The driver of a maruti car driving at the speed of 68 km/h locates a bus 40 metres ahead of him. After 10 seconds, the bus in 60 metres behind. Find the speed of the bus.

Solution:

Let speed of Bus=sb km/h

Now, in 10 sec, car covers the relative distance

=(60+40)m=100m

∴ Relative speed of car= 100/10 = 10 m/s

=10 x18/5= 36 km/h

∴68-sB=36

=>sB=32 km/h

Example 2:

If a person goes around an equilateral triange shaped field at speed of 10, 20 and 40 kmph on the first, second point, then find his average speed during the journey.

Solution:

Let the measure of each side of triangle is D km. The person travelled the distance from A to B with 10 kmph, B to C with 20 kmph and C to A with 40 kmph.

If TAB = Time taken by the person to travel from A to B,

TBC = Time taken by the person to travel from B to C and

TCA = Time taken by the person to travel from C to A.

Then total time = TAB + TBC + TCA

= D/10 + D/20 + D/40 = D((8+4+2)/80) = 7D/40

Total distance travelled = D + D + D = 3D

Hence, average speed =3D/(7D/40) = 120/7 = 171/7 kmph.

Example 3:

Two guns were fired from the same place at an interval of 15 min, but a person in a bus approaching the place hears the second report 14 min and 30sec after the first. Find the speed of the bus, supposing that sound travels 330 m per sec.

Solution:

Distance travelled by the bus in 14 min 30 sec could be travelled by sound in (15 min – 14 min 30 sec) = 30 sec./ Bus travels = 330 × 30 in 141/2 min./ Speed of the bus per hour = (330×30×2×60)/(29×1000) = (99×12)/29 = 1188/29 = 4028/29km/hr

Example 4:
A hare sees a dog 100m away from her and scuds off in the opposite direction at a speed of 12 km/h. A minute later the dog perceives her and gives chase at a speed of 16 km/h. How soon will the dog overtake the hare and at what distance from the spot where the hare took flight?

Solution:

Suppose the hare at H sees the dog at D.

D H K/ DH = 100m

Let k be the position of the hare where the dog sees her.

HK = the distance gone by the hare in 1 min = $(12\times1000)/60\times1$m = 200m

DK = 100+200 = 300m

The hare thus has a start of 300m.

Now the dog gains (16-12) or 4km/k.

The dog will gain 300m in $(60\times300)/(4\times1000)$ min or 41/2min. $= (12\times1000)/60\times 41/2 = 900$m

Distance of the place where the hare is caught from the spot H where the hare took flight = 200+900 = 1100m

If two persons(or vehicles or trains) start at the time in opposite directions from two points A and B, and after crossing each other they take x and y hours respectively to complete the journey, then

(Speed of first)/(Speed of second) = $\sqrt{(y/x)}$

Example 5:
A train starts from A to B and another from B to A at the same time. After crossing each other they complete their journey in 31/2 and 24/7 hours respectively. If the speed of the first is 60 km/h, then find the speed of the second train.

Solution:

(1st train^′ s speed)/(2nd train^′ s speed) = $\sqrt{(y/x)} = \sqrt{((2\ 4/7)/(3\ 1/2))} = \sqrt{(18/7\times2/7)} = 6/7$

60/(2nd train^’ s speed) = 6/7

2nd train’s speed = 70 km/h.

If new speed is a/b of usual speed, then Usual time = (Change in time)/((b/a-1))

Example 6:

A boy walking at 3/5 of his usual speed, reaches his school 14 min late. Find his usual time to reach the school.

Solution:

Usual time = $14/(5/3-1) = (14\times3)/2 = 21$ min

Example 7:

A train after travelling 50km, meets with an accident and then proceeds at 4/5 of its former rate and arrives at the terminal 45 minutes late. Had the accident happened 20'km further on, it would have arrived 12 minutes sooner. Find the speed of the train and the distance.

Solution:

Let A be the starting place. B the terminal, C and D the places where the accidents to be placed. A C D B

By travelling at 4/5 of its original rate the train would take 5/4 of its usual time, i.e., 1/4 of its original time more.

1/4 of the usual time taken to travel the distance CB = 45 min. ….(i)

and 1/4 of the usual time taken to travel the distance DB = (45-12) min …..(ii)

subtracting (ii) from (i),

1/4 of the usual time taken to travel the distance CD = 12 min.

By Usual time taken on travel 20km = 48 min

By Speed of the train per hour = 20/48×60 = or 25 km/h.

From (i), we have

Time taken to travel CB = 45×4 min = 3 hrs.

∴ The distance CB = 25 × 3 or 75 km

The distance CB = the distance (AC + CB) = 50 + 75 or 25 km.

A man covers a certain distance D. If he moves S1 speed faster, he would have taken t time less and if he moves S2 speed slower, he would have taken t time more. The original speed is given by 2×(S_1×S_2))/(S_2- S_1)

Example 8:

A man covers a certain distance on scooter. Had he moved 3 km/h faster, he would have taken 20 min less. If he had moved 2 km/h slower, he would have taken 20 min more. Find the original speed.

Solution:

Speed = (2×(3×2))/(3-2) = 12 km/hr.

If a person with two different speeds U & V cover the same distance, then required distance

$= (U\times V)/(U-V)\times$ Differnce between arrival time

Also, required distance = Total time taken $\times (U\times V)/(U+V)$

Example 9:

A boy walking at a speed of 10km/h reaches is school 12 min late. Next time at a speed of 15 km/h reaches his school 7 min late. Find the distance of his school from his house?

Solution:

Difference between the time = 12 – 7 = 5 min = 5/60 = 1/12hr

Required distance = $(15\times 10)/(15-10)\times 1/12 = 150/5\times 1/12 = 2.5$km

A man leaves a point A at t1 and reaches the point B at t2. Another man leaves the point B at t3 and reaches the point A at t4 then They will meet at $t_{(1+)}\ ((t_2-t_1)(t_4-t_1))/((t_2-t_1)+(t_4-t_3))$