SPEED, TIME & DISTANCE (TRAINS, BOAT & STREAM)

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= $\frac{Distance}{Time}$;

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= $\frac{Distace}{Speed}$;

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:

(i) 1 hour=60 minutes=60x60 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=$\frac{5}{18}$m/sec,

1 m/sec= $\frac{18}{5}$ km/h

1 miles/hr = $\frac{22}{15}$ft/sec.

❖ Average speed= $\frac{Total\ distance}{Total\ time}$

❖ 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 whole jouney is given by:

Average speed= $\frac{2ab}{a+b}$ km/h

…(which is the harmonic means of a and b

Also, if $t_1$and $t_2$is taken to travel from A to B and B to A respectively, the distance 'd' from A to B is given by:

d=$(t_1+t_2)\left[\frac{ab}{a+b}\right.$

d=$(t_1+t_2)\left[\frac{ab}{b-a}\right.$

d=(a-b) $\frac{t_1t_2}{t_2-t_1}$

❖ If a body travels a distance 'd' from A to B with speed 'a' in time t_1 and travels back from B to A i.e., the same distance with $\frac{m}{n}$of the usual speed 'a' then the change in time taken to cover the same distance is given by:

Change in time= $\left.\frac{m}{n}-1\right]$x t_1; for n>m

=$\left[1-\frac{n}{m}\right]$x t_1; for m>n

❖ If first part of the distance is covered at the rate of v_1 in time t_1 and the second part of the distance is covered at the rate of v_2 in time t_2 then the average speed is $\frac{v_1t_1+v_2t_2}{t_1+t_2}$

Relative speed: When two bodies are moving in same direction with speeds $s_1$and $s_2$respectively, their relative speed is the difference of their speeds.

i.e. Relative Speed=s_1-s_2

When two bodies are moving in opposite direction with speeds $s_1$and s_2 respectively, their relative speed is the sum of their speed.

i.e. Relative Speed=s_1+s_2

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=s_b km/h

Now, in 10 sec, car covers the relative distance

=(60+40)m=100m

∴ Relative speed of car= $\frac{100}{10} = 10$ m/s

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

∴$68 - s_B = 36$

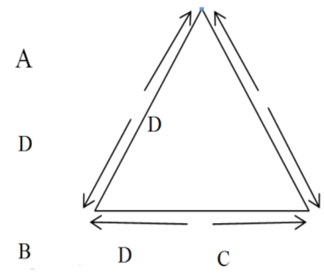
=>s_B=32 km/h

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 T_{AB} = Time taken by the person to travel from A to B,

T_{BC} = Time taken by the person to travel from B to C and

T_{CA} = Time taken by the person to travel from C to A.

Then total time = $T_{AB} + T_{BC} + T_{CA}$

$= \frac{D}{10} + \frac{D}{20} + \frac{D}{40} = D\left(\frac{8+4+2}{80}\right. = \frac{7D}{40}$

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

Hence, average speed

$= \frac{\frac{3D}{\frac{7D}{40}}}{} = \frac{120}{7} = 17\frac{1}{7}$ 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 $14\frac{1}{2}$ min.

/ Speed of the bus per hour

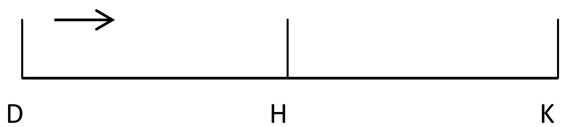
$= \frac{330 \times 30 \times 2 \times 60}{29 \times 1000} = \frac{99 \times 12}{29} = \frac{1188}{29} = 40\frac{28}{29}$km/hr

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.



/ 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

$$= \frac{12\times1000}{60} \times 1\text{m} = 200\text{m}$$

/ 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 $\frac{60\times300}{4\times1000}$ min or $4\frac{1}{2}$min.

$= \frac{12\times1000}{60} \times 4\frac{1}{2} = 900\text{m}$

/ 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

$$\frac{\text{Speed of first}}{\text{Speed of second}} = \frac{\sqrt{y}}{\sqrt{x}}$$

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 $3\frac{1}{2}$ and $2\frac{4}{7}$ hours respectively. If the speed of the first is 60 km/h, then find the speed of the second train.

Solution:

$$\frac{\text{1st train's speed}}{\text{2nd train's speed}} = \frac{\sqrt{y}}{\sqrt{x}} = \sqrt{\frac{2\frac{4}{7}}{3\frac{1}{2}}}$$

$$= \sqrt{\frac{18}{7} \times \frac{2}{7}} = \frac{6}{7}$$

$$/ \frac{60}{\text{2nd train's speed}} = \frac{6}{7}$$

$\Rightarrow$ 2nd train's speed = 70 km/h.

❖ If new speed is $\frac{a}{b}$ of usual speed, then

$$\text{Usual time} = \frac{\text{Change in time}}{\frac{b}{a}-1}$$

Example 6:

A boy walking at $\frac{3}{5}$ of his usual speed, reaches his school 14 min late. Find his usual time to reach the school.

Solution:

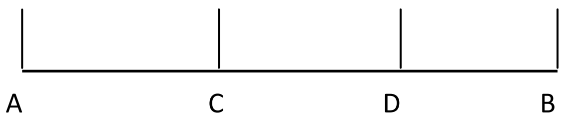
$$\text{Usual time} = \frac{14}{\frac{5}{3}-1} = \frac{14\times3}{2} = 21 \text{ min}$$

Example 7:

` A train after travelling 50km, meets with an accident and then proceeds at $\frac{4}{5}$ 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.



By travelling at $\frac{4}{5}$ of its original rate the train would take $\frac{5}{4}$ of its usual time, i.e., $\frac{1}{4}$ of its original time more.

/$\frac{1}{4}$ of the usual time taken to travel the distance

CB = 45 min. ….(i)

and $\frac{1}{4}$ of the usual time taken to travel the distance

DB = (45-12) min …..(ii)

Subtracting (ii) from (i),

$\frac{1}{4}$ of the usual time taken to travel the distance CD = 12 min.

/ Usual time taken on travel 20km = 48 min

/ Speed of the train per hour = $\frac{20}{48} \times 60$

= 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 S_1 speed faster, he would have taken t time less and if he moves S_2 speed slower, he would have taken t time more. The original speed is given by

$$\frac{2 \times (S_1 \times S_2)}{S_2 - S_1}$$

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 = $\frac{2\times(3\times2)}{3-2}$ = 12 km/hr.

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

$= \frac{U\times V}{U-V} \times$Differnce between arrival time

Also, required distance = Total time taken$\times \frac{U\times V}{U+V}$

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

$= \frac{5}{60} = \frac{1}{12}$hr

Required distance = $\frac{15\times10}{15-10} \times \frac{1}{12}$ = $\frac{150}{5} \times \frac{1}{12}$ = 2.5km

❖ A man leaves a point A at t_1 and reaches the point B at t_2. Another man leaves the point B at t_3 and reaches the point A at t_4 then They will meet at

$$t_{1+}\frac{(t_2-t_1)(t_4-t_1)}{(t_2-t_1)+(t_4-t_3)}$$

Example 10:

A bus leaves Ludhiana at 5 am and reaches Delhi at 12 noon. Another bus leaves Delhi at 8 am and reaches Ludhiana at 3 pm. At what time do the buses meet?

Solution:

Converting all the times into 24 hour clock time. We get 5 am = 500, 12 noon = 1200, 8 am = 800 and 3 pm = 1500

Required time = $500+\frac{(1200-500)(1500-500)}{(1200-500)+(1500-800)}$

$= 500+\frac{700\times1000}{700+700} = 1000 = 10$ am.

❖ Relation between time taken with two different modes of transport: $t_{2x} + t_{2y} = 2(t_x + t_y)$

Where,

t_x = time when mode of transport x is used single way.

t_y = time when mode of transport y is used single way.

t_{2x} = time when mode of transport x is used both ways.

t_{2y} = time when mode of transport y is used both ways.

Example 11:

A man takes 6 hours 30 min. In going by a cycle and coming back by scooter. He would have lost 2 hours 10 min by going on cycle both ways. How long would it take him to go by scooter both ways?

Solution:

Clearly, time taken by him to go by scooter both ways

= 6h.30m-2h.10m = 4h.20m = $4\frac{1}{3}$h

Example 12:

A man travels 120 km by ship, 450 km by rail and 60 m by horse taking altogether 13 hrs 30 min. The speed of the train is 3 times that of the horse and $1^1/_2$times that of the ship. Find he speed of the train.

Solution:

If the speed of the horse is x km/hr; that of the train is 3x and that of the ship is $\frac{3x}{1^1/_2}$ = 2x km/hr

$/\frac{120}{2x}+\frac{450}{3x}+\frac{60}{x}=\frac{27}{2}$

$/\frac{60}{x}+\frac{150}{x}+\frac{60}{x}=\frac{27}{2}$

$/\frac{270}{x}=\frac{27}{2}$

/ x = 20 / Speed of the train = 60 km/hr.

Example 13:

Rajesh travelled from the city A to city B covering as much distance in the second part as he did in the first part of his journey. His speed during the second part was twice his speed during the first part of the journey. What is his average speed of journey during the entire travel?

(1) His average speed is the harmonic mean of the individual speed for the two parts.

(2) His average speed is the arithmetic mean of the individual speed for the two parts.

(3) His average speed is the geometric mean of the individual speeds for the two parts.

(4) Cannot be determined.

Solution:

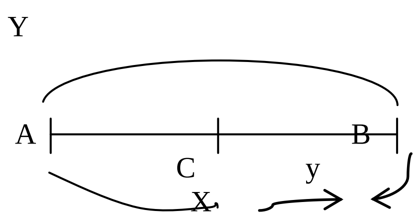
The first part is ½ of the total distance & the second part is ½ of the total distance. Suppose, he travels at a km/hr speed during the first half & b km/hr speed during the second half. When distance travelled is the same in both parts of the journey, the average speed is given by the formula $\frac{2ab}{a+b}$ i.e. the harmonic mean of the two speeds.

Example 14:

Two friends X and Y walk from A to B at a distance of 39 km, at 3 km an hour and $3\frac{1}{2}$ km an hour respectively. Y reaches B, returns immediately and meet x at C. Find the distance from A to C.

Solution:

When Y meets X at C, Y has walked the distance AB+BC and X has walked the distance AC.



So, both X and Y have walked together a distance

$= 2 \times AB = 2 \times 39 =$ 78 km.

The ratio of the speeds of X and Y is 3: $3\frac{1}{2}$ i.e.,$\frac{6}{7}$

Hence, the distance travelled by X = AC = $\frac{6}{6+7} \times 78 = 36$ km

Example 15:

A man rides one-third of the distance from A and B at the rate of 'a' kmph and the remainder at the rate of '2b' kmph. If he had travelled at the uniform rate of 3c kmph, he could have rode from A to B and back again in the same time. Find a relationship between a, b and c.

Solution:

Let the distance between A and B is X km and T_1 and T_2 be the time taken, then

$T_1 = \frac{X}{3a}$, $T_2 = \frac{2X}{6b} = \frac{X}{3b}$, $T_1+T_2 = \frac{X}{3}\frac{a+b}{ab}$

Let T_3 be the time taken in third case, then $T_3 = \frac{2X}{3c}$

$\Rightarrow \frac{2X}{3c} = \frac{X}{3ab}(a+b) \Rightarrow \frac{2}{c} = \frac{a+b}{ab}$

$\Rightarrow C = \frac{2ab}{a+b}$

Example 16:

Two cyclists start from the same place to ride in the same direction. A starts at noon at 8 kmph and B at 1.30 pm at 10 kmph. How far will A have ridden before he is overtaken by B? Find also at what times A and B will be 5 km apart.

Solution:

If A rides for X hours before he is overtaken, then B rides for (X-15)hrs.

$\Rightarrow$ 8X = 10(X-1.5)

$\Rightarrow$ X = 7.5

$\Rightarrow$ A will have ridden 8×7.5 km or 60km.

For the second part, if Y = the required number of hours after noon, then

8X = 10(X-1.5)$\pm$5

$\Rightarrow$ X=10 or 5 according as B is ahead or behind A.

$\Rightarrow$ The required times are 5 p.m. and 10 p.m.

Example 17:

Two men A and B start from a place P walking at 3 kmph and $3^1/_2$ kmph respectively. How many km apart will they be at the end of $2^1/_2$ hours?

(i) If they walk in opposite directions?

(ii) If they walk in the same direction?

(iii) What time will they take to be 16 km apart if.

(a) They walk in opposite direction?

(b) In the same direction?

Solution:

(i) When they walk in opposite directions, they will be

$3+3\frac{1}{2} = 6\frac{1}{2}$km apart in 1 hour.

/ In $2\frac{1}{2}$ hours they will be $6\frac{1}{2}\times\frac{5}{2}$ $=16\frac{1}{4}$km apart

(ii) If they walk in the same direction, they will be

$3\frac{1}{2}-3=\frac{1}{2}$km apart in 1 hour.

$\Rightarrow$ In $2\frac{1}{2}$ hours they will be $\frac{1}{2}\times\frac{5}{2}=1\frac{1}{4}$km apart.

(iii) Time to be 16 km apart while walking in opposite directions

$=\frac{16}{3+3\frac{1}{2}}=2\frac{6}{13}$ hours.

But if they walk in the same direction,

Time $=\frac{16}{3\frac{1}{3}-3}$= 32 hours

TRAINS

A train is said to have crossed an object (stationary or moving) only when the last coach of the train crosses the said object completely. It implies that the total length of the train has crossed the total length of the object.

❖ Time taken by a train to cross a pole/ a standing man

$=\frac{\text{Length of train}}{\text{speed of train}}.$

❖ Time taken by a train to cross platform/bridge etc. (i.e. a stationary object with some length)

$=\frac{\text{length of train}+\text{length of } \frac{\text{platform}}{\text{bridge}} \text{ etc.}}{\text{speed of train}}$

❖ When two trains with lengths L_1 and L_2 and with speeds S_1 and S_2 respectively, then

(a) When they are moving in the same direction, time taken by the faster train to cross the slower train

$=\frac{L_1+L_2}{\text{difference of their speeds}}.$

(b) When they are moving in the opposite direction, time taken by the trains to cross each other

$=\frac{L_1+L_2}{\text{sum of their speeds}}.$

❖ Suppose two trains or two bodies are moving in the same direction at u km/hr respectively such that u>v, then

then

their relative speed = (u-v) km/hr.

If their lengths be x km and v km respectively, then time taken by the faster train to cross the slower train (moving in the same direction) = $\left.\frac{x+y}{u-v}\right)$ hrs.

❖ Suppose two trains or two bodies are moving in moving in opposite directions at u km/hr and v km/hr, then their relative speed = (u-v)km/hr.

If their lengths be x km & y km, then:

time taken to cross each other = $\frac{x+y}{u+v}$)hrs.

❖ If a man is running at a speed of u m/sec in the same direction in which a train of length L meters is running with a speed v m/sec, then (v-u) m/sec is called the speed of the train relative to cross the man. Then the time taken by the train to cross the man $= \frac{1}{v-u}$ seconds.

❖ If a man is running at a speed of u m/sec in a direction opposite to that in which a train of length L meters is running with a sped v m/sec, then (u+v)
is called the speed of the train relative to man.
Then the time taken by the train to cross the man
$=\frac{1}{u+v}$ seconds.

❖ If two trains at the same time from two points A and B towards each other and after crossing, they take a and b hours in reaching B and A respectively. then,
A's speed : B's speed = $(\sqrt{b} + \sqrt{a})$.

Example 18:

How long does a train 90 m long running at the rate of 54 km/h take to cross –

(a) a Mahatma Gandhi's statue?
(b) a platform 120 m long?
(c) another train 150 m long, standing on another parallel track?
(d) another train 160 m long running at 36 km/h in same direction?
(e) another train 160 m long running at 36 km/h in opposite direction?
(f) a man running at 6 km/h in same direction?
(g) a man running at 6 km/h in opposite direction?

Solution:

(a) The statue is a stationary object, so time taken by train is same as time taken by train to cover a distance equal to its own length,
Now, 54 km/h = $54\times\frac{5}{18}$ = 15m/s
/ Required time = $\frac{90}{15}$ = 6 sec.

(b) The platform is stationary of length = 120 m.
Length to be covered
=Length of the train + Length of the other train
=90+120 = 210 m
/ Required time = $\frac{210}{15}$ = 14 sec.

(c) Length to be covered
=Length of the train + Length of the other train
= 90+150 = 240 m.
/ Required time = $\frac{240}{15}$ = 16 sec.

(d) Another train is moving in same direction.
Length to be covered
=Length of the train + length of the other train
= 90+160 = 250 m
Relative speed = 54 – 36 = 18 kmph.
/ Required time = $\frac{250}{18\times\frac{5}{18}}$ = 50 sec.

(e) Another train is moving in opposite direction.
Length to be covered
=Length of the train + length of the other train
= 90+160 = 250 m
Relative speed = 54 + 36 = 90 kmph
/ Required time $=\frac{250}{\frac{5}{18}\times 90}$ 10 sec.

(f) The man is moving in same direction,

so Length to be covered = Length of the train,
and relative speed=speed of train-speed of man

/ Required time = $\frac{90}{(54-6)\times\frac{5}{18}}$

$= \frac{90}{40} \times 3 = \frac{27}{4} = 6\frac{3}{4}$sec.

(g) The man is moving in opposite direction, so Length to be covered = length of the train, and relative speed = speed of train + speed of man

/ Required time = $\frac{90}{(54+6)\times\frac{5}{18}} = \frac{27}{5} = 5\frac{2}{5}$sec.

Example 19:

Two trains of equal lengths running on parallel tracks in same direction at 46 km/h and 36 km/h, respectively. The later train passes the slower train in 36 sec. Find the length of each train is?

Solution;

Let the length of each train be x metres.

then, the total distance covered = (x + x)=2xm

Relative speed = (46-36) = 10 km/h = $\frac{10\times5}{18}$ m/s

Now, 36 = $\frac{2x\times18}{50}$ or x = 50 m

Example 20:

A train 110 m in length travels at 60 km/h. How much time does the train take in passing a man walking at 6 km/h against the train?

Solution:

Relative speeds of the train and the man

= (60+6) = 66 km/h = $\frac{66\times5}{18}$ m/s

Distance = 110 m

Therefore, time taken in passing the men

$= \frac{110\times10}{66\times\times5} = 6$s

Example 21:

Two trains 137 metres and 163 metres in length are running towards each other on parallel lines, one at the rate 42 kmph and another at 48 kmph. In what time will they be clear of each other from the moment they meet?

Solution:

Relative speed of the trains

= (42+48)kmph = 90 kmph

$=\left(90 \times \frac{5}{18}\right)$m/sec = 25 m/sec.

Time taken by the train to pass each other

= Time taken to cover (137+163) m at 25 m/sec

$= \left(\frac{300}{25}\right)$sec = 12 seconds.

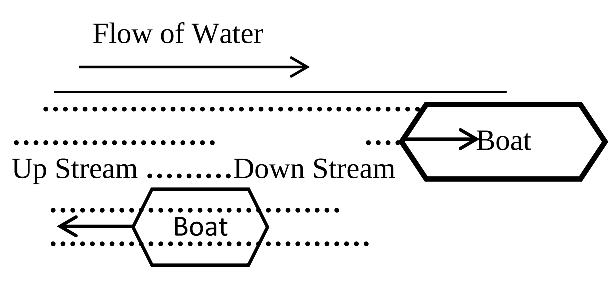
BOAT & STREAM

Stream: It implies that the water in the river is moving or flowing.

Upstream: Going against the flow of the river.

Downstream: Going with the flow of the river.

Still water: It implies that the speed of water is zero (generally, in a lake).



Let the speed of a boat (or man) in still water be X m/sec and the speed of the stream (or current) be Y m/sec. Then,

- ❖ Speed of boat with the stream (or downstream or D/S)
  =(X+Y) m/sec.
- ❖ Speed of boat against the stream (or upstream or U/S)
  =(X - Y) m/sec.
- ❖ Speed of boat in still water is
  $X = \frac{(X+Y)+(X-Y)}{2} = \frac{\text{Downstream} + \text{Upstream}}{2}$
- ❖ Speed of the stream or current is $Y = \frac{X+Y)+(X-Y)}{2}$
  $= \frac{\text{Downstream} + \text{Upstream}}{2}$

Example 22:

A boat is rowed down a river 28 km in 4 hours and up a river 12 km in 6 hours. Find the speed of the boat and the river.

Solution:

Downstream speed is $\frac{28}{4}$ = 7 kmph

Upstream speed is $\frac{12}{6}$ = 2 kmph

Speed of Boat = $\frac{1}{2}$(Downstream + Upstream speed)

$= \frac{1}{2}[7+2] = 4.5$ kmph

Speed of current= $\frac{1}{2}$(Downstream– Upstream speed)

$= \frac{1}{2}[7-2] = 2.5$ kmph

Example 23:

P, Q, and R are the three towns on a river which flows uniformly. Q is equidistant from P and R. 1 row from P to Q and back in 10 hours and 1 can row from P to R in 4 hours. Compare the speed of my boat in still water with that of the river.

Solution:

Let the speed of the boat be v_1 and the speed of the current be v_2 and d be the distance between the cities.

Now, $\frac{d}{v_1+v_2} = 4$ and $\frac{d}{v_1-v_2} = 6$

$\Rightarrow \frac{v_1+v_2}{v_1-v_2} = \frac{6}{4}$

or $\frac{2v_1}{2v_2} = \frac{10}{2}$ or $\frac{v_1}{v_2} = 5:1$

Required ratio = (5+1) : 5 = 6:5

- ❖ A man can row X km/h in still water. If in a stream which is flowing of Y km/h, it takes him Z hours to row to a place and back, the distance between the two places is $\frac{Z(X^2-X^2)}{2X}$

Example 24:

A man can row 6 km/h in still water. When the river is running at 1.2 km/h, it takes him 1 hour to row to a place and back. How far is the place?

Solution:

Man's rate downstream = (6+1.2) = 7.2 km/h.

Man's rate upstream = (6-1.2) km/h = 4.8 km/h.

Let the required distance be x km.

Then $\frac{x}{7.2} + \frac{x}{4.8} = 1$ or $4.8x + 7.2x = 7.2 \times 4.8$

$\Rightarrow x = \frac{7.2 \times 4.8}{12} = 2.88$km

By direct formula:

Required distance = $\frac{1 \times (6^2-(1.2)^2)}{2 \times 6}$

$= \frac{36-1.44}{12} = \frac{34.56}{12} =$ 2.88km

- ❖ A man rows a certain distance downstream in X hours and returns the same distance in Y hours. If the stream flows at the rate of Z km/h, then the speed of the man in still water is given by

$\frac{Z(X+Y)}{Y-X}$ km/h

❖ And if speed of man in still water is Z km/h then the speed of stream is given by

$\frac{Z(Y+X}{X+Y}$ km/h

Example 25:

Vikas can row a certain distance downstream in 6 hours and return the same distance in 9 hours. If the stream flows at the rate of 3 km/h, find the speed of vikas in still water.

Solution:

By the formula,

Vikas's speed in still water = $\frac{3(9+6)}{9-6}$ = 15 km/h

❖ If a man capable of rowing at the speed u of m/sec in still water, rows the same distance up and down a stream flowing at a rate of v m/sec, then his average speed through the journey is

$=\frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}} = \frac{(u-v)(u+v)}{u}$

Example 26:

Two ferries start at the same time from opposite sides of a river, travelling across the water on routes at right angles to the shores. Each boat travels at a constant speed though their speeds are different. They pass each other at a point 720m from the nearer shore. Both boats remain at their sides for 10 minutes before starting back. on the return trip they meet at 400m from the other shore. Find the width of the river.

Solution:

Let the width of the river be x.

let a, b be the speeds of the ferries.

$\frac{720}{a} = \frac{(x-720)}{b}$ ……(i)

$\frac{(x-720)}{a} + 10 + \frac{400}{a} = \frac{720}{b} + 10 + \frac{(x-400)}{b}$ …..(ii)

(Time for ferry 1 to reach other shore + 10 minute wait + time to cover 400m) =Time for freely 2 to cove 720m to other shore + 10 minute wait + Time to cover (x-400m))

Using (i), we get $\frac{a}{b} = \frac{720}{(x-720)}$

Using (ii), $\frac{(x-320)}{a} = \frac{(x+320)}{a}$

$\Rightarrow \frac{a}{b} = \frac{(x-320)}{(x+320)}$

on solving we get, x = 1760m

Example 27:

A man rows 27 km with the stream and 15 km against the stream taking 4 hours each time. Find this rate per hour in still water and the rate at which the stream flows.

Solution:

Speed with the stream = $\frac{27}{4} = 6\frac{3}{4}$ kmph

/ Speed against the stream = $\frac{15}{4} = 3\frac{3}{4}$ kmph.

/ Speed of the man in still water = $\frac{1}{2}\left(6\frac{3}{4} - 3\frac{3}{4}\right) = 5\frac{1}{4}$ kmph.

/ Speed of the stream = $\frac{1}{2}\left(6\frac{3}{4} - 3\frac{3}{4}\right)$= 1.5 kmph

Example 28:

On a river, B is between A and C is also equidistant from A and C. A boat goes from A to B and back in 5 hours 15 minutes and from A to C in 7 hours. How long will it take to go from C to A if the river flows from A to C?

Solution:

If the speed in still water is x kmph and speed of the river is y kmph, speed down the river = x + y and speed up the river = x – y.

$/ \frac{d}{x+y} + \frac{d}{x-y} = 5\frac{1}{4}$ ……(i)

$\frac{2d}{x+y} = 7$ …….(ii)

Multiplying (1) by 2, we get $\frac{2d}{x+y} + \frac{2d}{x-y} = 10\frac{1}{2}$

$\Rightarrow \quad 7 + \frac{2d}{x-y} = \frac{21}{2} \quad [/ \frac{2d}{x+y} = 7].$

$\Rightarrow \quad \frac{2d}{x-y} = 3\frac{1}{2}$ hours = Time taken to travel from C to A.