

Trains, Boats & Streams

Trains Formulae:

- i) If a train of length l -metres moving with a speed of S -mps passes a pole or tower or tree in t - seconds,

$$\text{then } t = \frac{l}{S} \Rightarrow l = S \times t$$

- ii) If a train of length of l - meters moving with a speed of " S " - mps passes a bridge or platform or tunnel of length p - metres in t - seconds, then

$$t = \left(\frac{l+p}{S} \right) \Rightarrow (l+p) = S \times t$$

- iii) If a train of length l -meters moving with a speed of S -mps crosses a man moving with a speed of S_M - mps, then the time taken by the train is given by

$$t = \frac{l}{(S \pm S_M)}$$

Use (+) sign if the train and the man move in opposite direction and (-) sign if the man and the train move in the same direction.

- iv) Two trains of lengths l_1 and l_2 moving with respective speeds of S_1 and S_2 cross each other in a time t , then.

$$t = \frac{l_1 + l_2}{(S_1 \pm S_2)}$$

Use (+) sign if the two trains move in opposite direction and (-) sign if the two trains move in the same direction.

Boats & Streams Theory:

The speed at which the boat moves in still water is called the speed of the boat in still water (x). If there is movement for water then it is called a stream. The rate at which water flows is called rate of stream or rate of flow (y).

If the boat moves against a stream then the boat will be moving towards the upstream and rate at which it is moving then, is called upstream (U) = $x - y$

If the boat moves with the stream then the boat will be moving towards the downstream

and the rate at which it is moving then, is called downstream (D) = $x + y$

$$\therefore D + U = (x + y) + (x - y) = 2x$$

$$\therefore x = \frac{1}{2} (D + U)$$

$$D - U = (x + y) - (x - y) = 2y$$

$$\Rightarrow y = \frac{1}{2} (D - U)$$

Some Formulae:

v) If a boat travels a distance k km and returns in a time of t hours then $k = \frac{t(x^2 - y^2)}{2x}$

vi) If the boat travels a certain distance and returns back then the average speed for the whole journey is

$$S_A = \frac{(x^2 - y^2)}{xy}$$

vii) If the time taken by a boat to travel a certain distance upstream is k -times the time taken by the boat to travel the same distance downstream then

$$\frac{x}{y} = \frac{k + 1}{k - 1}$$

PROBLEMS

1. A train crosses a pole in 17 seconds. If the length of the train is 425 metres, what will be the speed of the train in kmph?

- 1) 90 2) 93 3) 83 4) 87 5) 80

Ans: 1

$$l = 425 \text{ m, } t = 17 \text{ sec, } S = ?$$

$$\text{When a train crosses a pole, then } S = \frac{l}{t} = \frac{425}{17} = 25 \text{ mps}$$

$$\therefore S = 25 = 90 \text{ kmph}$$

2. A train 800 metre long is running at the speed of 78 kmph. If it crosses a tunnel in 1 minute, then the length of the tunnel (in metres) is?

- 1) 77200 2) 500 3) 1300 4) 13 5) None of these

Ans: 2

$$l = 800 \text{ m,}$$

$$S = 78 \times \frac{5}{18} = \frac{65}{3} \text{ mps}$$

$$t = 1 \text{ min} = 60 \text{ sec}, \quad P = ?$$

When a train crosses a tunnel

$$\text{then } t = \frac{l + P}{S}$$

$$\Rightarrow P = S \times t - l = \frac{65}{3} \times 60 - 800$$

$$= 1300 - 800 = 500 \text{ m}$$

3. If the speed of the train be 80 kmph and it takes 6 seconds to pass a platform. Next it takes 5 seconds to pass a cyclist walking at the rate of 12 kmph in the same direction. What is the length of the platform?

- 1) 38.56 metres 2) 35.56 metres 3) 48.56 metres
4) 45.56 metres 5) None of these

Ans: 5

Cyclist:

$$t = 5 \text{ sec}, \quad S_R = 80 - 12 \text{ kmph}$$

$$= 68 \times \frac{5}{18} = \frac{340}{18} \text{ mps}, \quad l = ?$$

$$t = \frac{l}{S_R} \Rightarrow l - t \times S_R = 5 \times \frac{340}{18} = \frac{1700}{18} \text{ m}$$

Platform

$$t = 6, \quad S = 80 \times \frac{5}{18} = \frac{200}{9} \quad l + P = ?$$

$$\therefore l + P = \frac{200}{9} \times 6 = \frac{400}{3}$$

$$P = \frac{400}{3} - \frac{1700}{18} = \frac{700}{18} = 38.89$$

4. A man crosses a stationary train-A of 720 metres in 8 minutes. A woman crosses another stationary train-B in 2 minutes and 30 seconds. If the respective ratio between the speed of the man and that of the woman is 15:16, what is the length of train-B?

- 1) 260 metres 2) 360 metres 3) 340 metres
4) Cannot be determined 5) None of these

Ans: 5

l_1 and l_2 be the lengths of Train-A and Train-B and S_M and S_W be the speeds of man and woman respectively.

Man

$$l_1 = 720, t_1 = 8 \text{ min} = 480 \text{ sec},$$

$$S_M = \frac{l_1}{t_1} = \frac{720}{480} = \frac{3}{2} = 1.5 \text{ mps}$$

Woman

$$S_W = \frac{1.5}{15} \times 16 = 1.6 \quad (\because S_M : S_W = 15 : 16)$$

$$l_2 = ?, t_2 = 2 \text{ min } 30 \text{ sec} = 150 \text{ sec} \quad l_2 = S_W \times t_2 = 1.6 \times 150 = 240 \text{ m}$$

5. Train-A crossed a stationary train in 39 seconds. It also crossed a man standing on a platform in 19 seconds. The length of the train-A is 456 metres. What is the length of the stationary train?

- 1) 460 metres 2) 480 metres 3) 490 metres
4) Cannot be determined 5) None of these

Ans: 2

l_1, l_2 and be the length of Train-A and the stationary train and S_1 be the speed of Train-A.

$$\frac{l_1}{S_1} = 19; \quad \frac{l_1 + l_2}{S_1} = 39$$

$$\Rightarrow \frac{19}{39} = \frac{\left(\frac{l_1}{S_1}\right)}{\left(\frac{l_1 + l_2}{S_1}\right)} = \frac{l_1}{l_1 + l_2}$$

$$19l_1 + 19l_2 = 39l_1$$

$$19l_2 = 20l_1$$

$$\text{But } l_1 = 456,$$

$$\therefore l_2 = \frac{20 \times 456}{19} = 20 \times 24 = 480 \text{ m}$$

6. Two trains, 80 metres and 120 metres long, are running at the speed of 25 kmph and 35 kmph respectively in the same direction on parallel tracks. How many seconds will they take to pass each other?

- 1) 48 2) 64 3) 70 4) 72 5) None of these

Ans: 4

$$l_1 = 80, l_2 = 120, S_1 = 25, S_2 = 35$$

∴ Trains are moving on the same direction $t =$

$$\frac{l_1 + l_2}{S_2 - S_1} = \frac{(80 + 120) \times 18}{(35 - 25) \times 5} = \frac{200 \times 18}{50}$$

$$= 72$$

7. A man rows a boat 18 kilometres in 4 hours downstream and returns upstream in 12 hours. The speed of the stream (in km per hour) is?

- 1) 1 2) 1.5 3) 2 4) 1.75 5) None of these

Ans: 2

$$\text{Downstream Speed (D)} = \frac{18}{4} = 4.5$$

$$\text{Upstream speed (U)} = \frac{18}{12} = 1.5, y = ?$$

$$\text{Speed of stream (y)} = \frac{1}{2}(D - U) = \frac{1}{2}(4.5 - 1.5) = 1.5$$

8. A man can row 30 km downstream and return in a total of 8 hours. If the speed of the boat in still water is four times the speed of the current, then the speed of the current is?

- 1) 1 km/hour 2) 2 km/hour 3) 4 km/hour 4) 3 km/hour 5) None of these

Ans: 2

Refer to formula (v) $k = 30, t = 8, x = 4y$ $30 =$

$$\frac{8(x^2 - y^2)}{2x} = \frac{8(16y^2 - y^2)}{8y} = \frac{8 \times 15y^2}{8y} = 15y \quad \Rightarrow y = 2$$

9. A boat takes 8 hours for travelling downstream from A to B and coming back to A upstream. If the velocity of the stream is 3 kmph and the speed of the boat in still water is 8 kmph, what is the distance between A and B?

- 1) 55 km 2) 150 km 3) 48 km 4) 95 km 5) None of these

Ans: 5

$$x = 8, \quad y = 3,$$

$$D = x + y = 8 + 3 = 11,$$

$$U = x - y = 8 - 3 = 5$$

Let the distance between A and B be 'k', then

$$\frac{k}{11} + \frac{k}{5} = 8$$

$$\frac{5k + 11k}{55} = 8$$

$$16k = 8 \times 55$$

$$k = 27.5 \text{ km}$$

10. A man swims downstream a distance of 15 km in 1 hour. If the speed of the current is 5 kmph, the time taken by the man to swim the same distance upstream is?

1) 1 hour 30 minutes

2) 45 minutes

3) 2 hours 30 minutes

4) 3 hours

5) None of these

Ans: 4

$$D = \frac{15}{1} = 15, \quad y = 5$$

$$\therefore x = D - y = 15 - 5 = 10$$

$$U = x - y = 10 - 5 = 5$$

$$\therefore t_{\text{up}} = \frac{15}{5} = 3 \text{ hours}$$

11. The current of a stream runs at the rate of 4 km an hour. A boat goes 6 km and comes back to the starting point in 2 hours. The speed of the boat in still water is?

1) 6 kmph

2) 8 kmph

3) 7.5 kmph

4) 6.8 kmph

5) None of these

Ans: 2

$$y = 4, \quad k = 6, \quad t = 2 \quad 6 = \frac{2(x^2 - 4^2)}{2x}$$

$$x^2 - 6x - 16 = 0$$

$$(x - 8)(x + 2) = 0$$

$$\therefore x = 8$$

12. The rate at which a river flows is one-third the speed of a boat in still water. If that boat travels down the river for 2 hours and then back up river for 2 hours, it will be 16 km short of its starting point. The speed (kmph) of the boat in still water is?

1) 4 kmph

2) 6 kmph

3) 8 kmph

4) 12 kmph

5) None of these

Ans: 4

$$\text{Let the speed of boat in still water be } 3k, \text{ then river flows at } \frac{1}{3}(3k) = k$$

$$\therefore \text{Downstream speed (D)} = 3k + k = 4k$$

$$\text{Upstream speed (U)} = 3k - k = 2k$$

$$\text{Given that } 2 \times 4k - 2 \times 2k = 16 \quad \Rightarrow k = 4$$

$$\text{Speed of boat in still water} = 3(4) = 12 \text{ kmph}$$



Time & Distance, Trains, Boats & Streams Tricks and Formulas

Get unlimited access to the best preparation resource for UGC : Get **detailed illustrated notes covering entire syllabus**: point-by-point for high retention.

Time & Distance

Suppose a man covers a distance at 'x' kmph and an equal distance at 'y' kmph, and then average speed during his whole journey is $\left[\frac{2xy}{x + y} \right]$ kmph

Trains

- Lengths of trains are 'x' km and 'y' km, moving at 'u' kmph and 'v' kmph (where, $u > v$) in the same direction, then the time taken by the over-taker train to cross the slower train is $\left[\frac{(x + y)}{(u - v)} \right]$ hrs
- Time taken to cross each other is $\left[\frac{(x + y)}{(u + v)} \right]$ hrs
- If two trains start 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.
- $x \text{ kmph} = (x \times 5/18) \text{ m/sec.}$
- $y \text{ metres/sec} = (y \times 18/5) \text{ km/hr.}$

Boats & Streams

- If the speed of a boat in still water is $u \text{ km/hr}$ and the speed of the stream is $v \text{ km/hr}$, then:
Speed downstream = $(u + v) \text{ km/hr.}$. and Speed upstream = $(u - v) \text{ km/hr.}$
- If the speed downstream is $a \text{ km/hr}$ and the speed upstream is $b \text{ km/hr}$, then: Speed in still water = $\frac{1}{2}(a + b) \text{ km/hr}$. and Rate of stream = $\frac{1}{2}(a - b) \text{ km/hr.}$

Developed by: **Mindsprite Solutions**

Trains

Trains are special case in the concept of speed, time and distance. The basic relation is same as,

Speed \times time = distance.

These points need to be kept in mind while solving a train related questions.

1. When a train is crossing a moving object, the speed has to be taken as relative speed of the train with respect to the object.

2. The distance to be covered while crossing an object whenever a train crosses an object will be equal to

Length of train + Length of the object

3. Time taken by the train to cross a pole, man etc. by a train,
=

Length of train Speed of train

Example:

A train crosses a pole in 8 seconds. If the length of the train is 200 meters, find the speed of train.

Solution:

Time taken to cross the pole =

Length of train Speed of train.

Speed of train =

Length of train Time taken to cross the pole

Speed of train =

2008

= 25 m/s.

=

25 \times 185

= 90 km/h.

1. Time taken to cross another train or bridge or platform etc. by a train is given by,
=

Length of (train+platform etc.) Speed of the train

Example:

A 150 m long train passes another train 100 m long traveling in opposite direction. If the speeds of the trains are 39 km/h and 21 km/h respectively, how long will it take to cross each other?

Solution:

Total distance = length of 1st train + length of 2nd train
 = 150 + 100 = 250 m.

Since, trains are moving in opposite directions, their relative speed = 39 + 21 = 60 km/h.

$$= 60 \times \frac{5}{18} = 16.67 \text{ m/sec.}$$

Hence, time taken to cross =

$$\frac{250}{16.67}$$

=

$$15 \text{ seconds.}$$

= 15 seconds.

Key Facts:

1) If two persons start at the same time from two different positions towards each other and they complete their journey in 'a' and 'b' hours respectively after meeting each other then-

$$\frac{\text{Speed of A}}{\text{Speed of B}} = \sqrt{\frac{b}{a}}$$

Example:

Two trains are approaching each other from two different points at the same time. They complete their journey in

$$3 \text{ hours}$$

and

$$4 \text{ hours}$$

hours after they met each other. Speed of A is 8 km/h. what is that of speed of B.

Solution:

$$\frac{\text{Speed of A}}{\text{Speed of B}} = \sqrt{\frac{4}{3}} \quad \text{Speed of B} = \frac{8}{\sqrt{\frac{4}{3}}} = 8 \times \frac{\sqrt{3}}{2} = 4\sqrt{3} \text{ km/h}$$

1. A monkey or man tries to climb a pole 'x' m high. In 't' time he climbs 'y' m but slips down 'z' m. How much time will be required by him to reach the top?

$$[\text{ht. of pole} - \text{slipped dist. climbed dist.} - \text{slipped dist.}] \times t = [x - zy - z] \times t$$

Example:

A monkey tries to climb a pole 12 m high. In each minute he climbs 2 m but slips down 1 m. how much time will be required by him to reach the top?

Solution:

$$[ht.ofpole-slippeddist.climbeddist.-slippeddist.]\times t = [x-zy-z]\times t = [12-12-1]\times 1 = 11 \text{ minute}$$

Boat and Stream

The problem of boats and streams are also based on formula,

Speed × time = distance

Some points need to be kept in mind while solving problem related with Boat and stream.

1. Speed of boat moving downstream or in direction of flow of stream = speed of boat in still water + speed of stream.
2. Speed of boat moving upstream or in opposite direction of the flow of stream = Speed of boat in still water - speed of stream.
3. Speed of boat in still water = speed of boat

1. A boat can travel with a speed of 13 km/hr in still water. If the speed of the stream is 4 km/hr, find the time taken by the boat to go 68 km downstream.

- [A.](#) 2 hours
- [B.](#) 3 hours
- [C.](#) 4 hours
- [D.](#) 5 hours

Answer: Option C

Explanation:

Speed downstream = (13 + 4) km/hr = 17 km/hr.

Time taken to travel 68 km downstream = $\left(\frac{68}{17}\right)_{\text{hrs}} = 4 \text{ hrs.}$

[Home](#) » [Aptitude](#) » [Boats and Streams](#) » General Questions

Exercise :: Boats and Streams - General Questions

- [Boats and Streams - Important Formulas](#)
- [Boats and Streams - General Questions](#)
- [Boats and Streams - Data Sufficiency 1](#)
- [Boats and Streams - Data Sufficiency 2](#)

1. A boat can travel with a speed of 13 km/hr in still water. If the speed of the stream is 4 km/hr, find the time taken by the boat to go 68 km downstream.

- [A.](#) 2 hours
- [B.](#) 3 hours
- [C.](#) 4 hours
- [D.](#) 5 hours

Answer: Option C

Explanation:

Speed downstream = $(13 + 4)$ km/hr = 17 km/hr.

Time taken to travel 68 km downstream = $\left(\frac{68}{17}\right)$ hrs = 4 hrs.

[View Answer](#) [Discuss in Forum](#) [Workspace](#) [Report](#)

2. A man's speed with the current is 15 km/hr and the speed of the current is 2.5 km/hr. The man's speed against the current is:

[A.](#) 8.5 km/hr

[B.](#) 9 km/hr

[C.](#) 10 km/hr

[D.](#) 12.5 km/hr

Answer: Option C

Explanation:

Man's rate in still water = $(15 - 2.5)$ km/hr = 12.5 km/hr.

Man's rate against the current = $(12.5 - 2.5)$ km/hr = 10 km/hr.

A boat running upstream takes 8 hours 48 minutes to cover a certain distance, while it takes 4 hours to cover the same distance running downstream. What is the ratio between the speed of the boat and speed of the water current respectively?

[A.](#) 2 : 1

[B.](#) 3 : 2

[C.](#) 8 : 3

[D.](#) Cannot be determined

[E.](#) None of these

Answer: Option C

Explanation:

Let the man's rate upstream be x kmph and that downstream be y kmph.

Then, distance covered upstream in 8 hrs 48 min = Distance covered downstream in 4 hrs.

$$\Rightarrow \left(x \times 8\frac{4}{5}\right) = (y \times 4)$$

$$\Rightarrow \frac{44}{5}x = 4y$$

$$\Rightarrow y = \frac{11}{5}x.$$

$$\therefore \text{Required ratio} = \left(\frac{y+x}{2}\right) : \left(\frac{y-x}{2}\right)$$

$$= \left(\frac{16x+11x}{5 \times 2}\right) : \left(\frac{6x+11x}{5 \times 2}\right)$$

$$= 8:3$$

$$\frac{5}{8} = \frac{5}{3}$$

A motorboat, whose speed in 15 km/hr in still water goes 30 km downstream and comes back in a total of 4 hours 30 minutes. The speed of the stream (in km/hr) is:

- [A.4](#)
- [B.5](#)
- [C.6](#)
- [D.10](#)

Answer: Option B

Explanation:

Let the speed of the stream be x km/hr. Then,

Speed downstream = (15 + x) km/hr,

Speed upstream = (15 - x) km/hr.

$$\therefore \frac{30}{(15+x)} + \frac{30}{(15-x)} = 4\frac{1}{2}$$

$$\Rightarrow \frac{900}{225 - x^2} = \frac{9}{2}$$

$$\Rightarrow 9x^2 = 225$$

$$\Rightarrow x^2 = 25$$

$$\Rightarrow x = 5 \text{ km/hr.}$$

In one hour, a boat goes 11 km/hr along the stream and 5 km/hr against the stream. The speed of the boat in still water (in km/hr) is:

- [A.3 km/hr](#)
- [B.5 km/hr](#)
- [C.8 km/hr](#)
- [D.9 km/hr](#)

Answer: Option C

Explanation:

Speed in still water = $\frac{1}{2}(11 + 5)$ kmph = 8 kmph.