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Aptitude Made Simple

Boats and Streams

Various competitive examinations ask questions regularly based on Boats and Streams.

Many students face challenges in understanding and solving Boats and Stream problems.

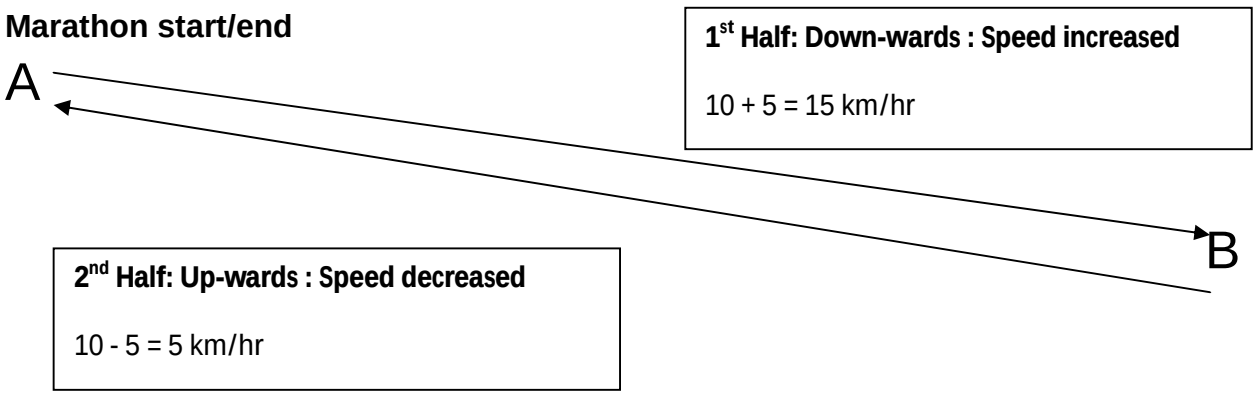
Mainly we face challenge to solve Boats and Stream problems, as we never experienced much in boat travelling or rowing with/against flow of water etc. Therefore we get confused when we see terms like downstream, upstream, Speed of stream/current, still water etc.

Let us take real life example and will try to understand Boats and stream. Once you understand concept clearly you need not to take much effort to remember formula and even if you forget it during exam, with help of known concept you can generate formula as and when required.

Real life example to understand concept of Boats and Streams:.

Consider you have enrolled for 1 of the marathon for 1st time. Marathon means you need to complete **42km running**. As you are participating for 1st time in marathon, you started doing practice in one of playground nearby your home.
Playground is completely plain surface with-out any upward or downward slope in it.
After practicing for couple of month you achieved speed of running on this **plain play-ground as 10 km/hr.**

On Marathon day, you saw the Marathon track:
1st half : Start from Point A and reach to Point B [21 Km slope **downwards**]
2nd Half: Same route return from point B to Point A. [21 km slope **upwards**]



As you see in image, 1st half there is complete slope downwards. So obviously you get some boost for your speed and let us assume that boost is 5km/hr.
While returning whatever extra boost you got in 1st half is reduced as you were coming upwards of slope and naturally your speed would reduce by 5 km/hr.

Let us summarize in terms of Boats and Stream

Real life example	Term	Speed (km/hr)
Speed on playground	Speed in still water	10
Boost you got during slope	Speed of **stream / Current**	5
Speed Downwards slope(A to B)	Speed at **Downstream / with stream**	10 + 5 = 15
Speed Upwards slope(B to A)	Speed at **Upstream/against stream**	10 – 5 = 5

So Downstream speed will always greater than Upstream speed.

Let us practice of calculating Upstream, Downstream speed and then will look at formulae and different types of problem.

Sr. No	Speed in still water(km/hr)	Speed of Stream/ Current(km/hr)	Speed at Downstream / with direction of stream(km/hr)	Speed at Upstream/against direction of stream(km/hr)
1	10	3	10 + 3 = 13	10 - 3 = 7
2	14	4	14 + 4 = 18	14 – 4 = 10
3	18	5	18 + 5 = 23	18 -5 = 13
4	16	2	16 + 2 = 18	16 – 2 = 14
5	21	6	21 + 6 = 27	21 – 6 = 15
6	15	5	15 + 5 = 20	15 – 5 = 10

Observe this table and respective values carefully and we can get below formulae:

1) Speed at Downstream = Speed in Still water + Speed of Stream
2) Speed at Upstream = Speed in Still water – Speed of Stream
3) Speed in Still water = $\frac{\text{Downstream speed+ Upstream speed}}{2}$
4) Speed of stream = $\frac{\text{Downstream speed} - \text{Upstream speed}}{2}$
5) Speed = $\frac{\text{Distance}}{Time}$ and Time = $\frac{\text{Distance}}{Speed}$

Types of Problems:

Type	Given	To Find
Type 1	Speed in still water Speed of Stream/Current	Speed at Upstream and Downstream
Type 2	Speed at Upstream and downstream	Speed in still water or speed of current
Type 3	Upstream, Downstream distances and time required	Speed in still water or speed of current
Type 4	Miscellaneous	

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Type1:

Problem 1:

Speed of boat in still water is 20 km/hr and rate of stream is 4 km/hr. What is speed of boat during downstream and upstream?

Solution :

Speed in still water = 20 km/hr

Speed of stream = 4 km/hr

Downstream speed = ?

Upstream speed = ?

Formula:

Speed at Downstream = Speed in Still water + Speed of Stream
= 20 + 4
= **24 km/hr**

Speed at Upstream = Speed in Still water – Speed of Stream
= 20 – 4
= **16 km/hr**

Answer is Speed at Downstream is 24 km/hr and speed at upstream is 16 km/hr

Problem 2:

Speed of boat in still water is 15 km/hr and speed of stream is 1.5 km/hr. What is speed of boat during downstream and upstream?

Solution :

Speed in still water = 15 km/hr

Speed of stream = 1.5 km/hr

Downstream speed = ?

Upstream speed = ?

Formula:

Speed at Downstream = Speed in Still water + Speed of Stream
= 15 + 1.5
= **16.5 km/hr**

Speed at Upstream = Speed in Still water – Speed of Stream
= 15 – 1.5
= **13.5 km/hr**

Answer is Speed at Downstream is 16.5 km/hr and speed at upstream is 13.5 km/hr

Type2:

Problem 1:

Speed of boat at Upstream is 7 km/hr and speed of boat at downstream is 10 km/hr. Find speed of boat in still water and rate of stream

Solution :

Speed at Upstream = 7 km/hr

Speed at Downstream = 10 km/hr

Speed in still water = ?

Speed of stream = ?

Formula:

$$\text{Speed in Still water} = \frac{\text{Downstream speed} + \text{Upstream speed}}{2}$$

$$= \frac{10+7}{2} = \frac{17}{2}$$

= **8.5 km/hr**

$$\text{Speed of stream} = \frac{\text{Downstream speed} - \text{Upstream speed}}{2}$$

$$= \frac{10-7}{2} = \frac{3}{2}$$

= **1.5 km/hr**

Answer is Speed in still water is 8.5 km/hr and Speed of stream is 1.5 km/hr

Problem 2:

In one hour, a boat goes 11 km along the stream and 5 km against the stream.Find speed of boat in still water and rate of stream

Solution :

Speed at Upstream [against stream] = 5 km/hr

Speed at Downstream [along stream] = 11 km/hr

Speed in still water = ?

Speed of stream= ?

Formula:

Speed in Still water = $\frac{\text{Downstream speed} + \text{Upstream speed}}{2}$

$= \frac{11+5}{2} = \frac{16}{2}$

= **8 km/hr**

Speed of stream = $\frac{11-5}{2}$

$= \frac{6}{2}$

= **3 km/hr**

Answer is Speed in still water is 8 km/hr and Speed of stream is 3 km/hr

Problem 3:

A man can row upstream at 8 km/hr and downstream at 13km/hr. Find speed of boat in still water and rate of stream

Solution :

Speed at Upstream = 8 km/hr

Speed at Downstream = 13 km/hr

Speed in still water = ?

Speed of stream= ?

Formula:

Speed in Still water = $\frac{\text{Downstream speed} + \text{Upstream speed}}{2}$

$= \frac{13+8}{2} = \frac{21}{2}$

= **10.5 km/hr**

Speed of stream = $\frac{13-8}{2}$

$= \frac{5}{2}$

= **2.5 km/hr**

Answer is Speed in still water is 10.5 km/hr and Speed of stream is 2.5 km/hr

Type 3:

Problem 1:

A man takes 3 hours 45 minutes to row a boat 15 km downstream of river and 2 hours and 30 minutes to cover 5 km upstream. Find speed of the river current in km/hr.

Solution :

1 hour is 60 minutes so divide by 60 whenever time is given in minutes

Time taken to go 15 km downstream = 3 hours 45 minutes = $3\frac{45}{60} = 3\frac{3}{4}$

$$= \frac{15}{4} \text{ hours}$$

Time taken to go 5 km Upstream = 2 hours 30 minutes = $2\frac{30}{60} = 2\frac{1}{2}$

$$= \frac{5}{2} \text{ hours}$$

Speed of river current = ?

We need to find downstream and upstream speed first to identify speed of river current.

Formula:

Speed $= \frac{\text{Distance}}{Time}$

For Downstream speed = $\frac{15}{(\frac{15}{4})} =$ **4 km/hr**

For Upstream speed = $\frac{5}{(\frac{5}{2})} =$ **2 km/hr**

Now we have Upstream and downstream speed both available so we can easily find out speed of current

Speed of stream = $\frac{\text{Downstream speed} - \text{Upstream speed}}{2}$

Speed of stream = $\frac{4-2}{2} = \frac{2}{2}$ = **1 km/hr**

Answer is speed of river Current is 1 km/hr

Problem 2:

A man rows downstream 32 km and 14 km upstream. If he takes 6 hours to cover each distance, velocity (speed) of current is?

Solution:

Time taken to go 32 km downstream = 6 hours

Time taken to go 14 km Upstream = 6 hours

Speed of river current = ?

We need to find downstream and upstream speed first to identify speed of river current.

Formula:

Speed = $\frac{\text{Distance}}{Time}$

For Downstream speed = $\frac{32}{6} = \frac{16}{3}$ **km/hr**

For Upstream speed = $\frac{14}{6} = \frac{7}{3}$ **km/hr**

Now we have Upstream and downstream speed both available so we can easily find out speed of current

Speed of stream = $\frac{\text{Downstream speed} - \text{Upstream speed}}{2}$

Speed of stream = $\frac{\frac{16}{3}-\frac{7}{3}}{2} = \frac{\frac{9}{3}}{2} = \frac{3}{2}$ = **1.5 km/hr**

Answer is Speed of Stream is 1.5 km/hr

Problem 3:

A motorboat covers certain distance downstream in 1 hour, while it comes back in $1\frac{1}{2}$ hours. If speed of stream is 3 km/hr, what is speed of boat in still water?

Solution :

Let us assume speed in still water x km/hr.

Downstream speed = Speed in still water + speed of current = (x + 3) km/hr

Upstream speed = Speed in still water - speed of current = (x -3) km/hr

Distance is constant during upstream and downstream.

Downstream 1 hr distance = Upstream 1.5 hr distance

Distance = Speed * time

During downstream distance: (x + 3) * 1 = x + 3

During upstream distance = (x – 3) * $\frac{3}{2}$

We need to solve below to get answer

x + 3 = (x – 3) * $\frac{3}{2}$

x + 3 = $\frac{3x-9}{2}$

2x + 6 = 3x – 9

X = 6 +9 =15

Answer is speed in still water is 15 km/hr

Type 4:

Problem 1:

A motorboat whose speed is 15 km/hr in still water goes 30 km downstream and comes back in total 4 hours 30 minutes. The speed of stream in km/hr is?

Solution :

Speed in still water = 15 km/hr

Downstream 30 km + Upstream 30 km Time = 4 hours 30 minutes = $4\frac{30}{60} = 4\frac{1}{2}$

$= \frac{9}{2}$ hours

Speed of stream = ?

Let us assume speed of stream x

Downstream speed = Speed in still water + Speed of current = (15 + x) km/hr

Upstream speed = Speed in still water - Speed of current = (15 - x) km/hr

Formula:

Time $= \frac{\text{Distance}}{Speed}$

Downstream Time = $\frac{30}{15+x}$

Upstream Time = $\frac{30}{15-x}$

$$\frac{30}{15+x} + \frac{30}{15-x} = \frac{9}{2}$$

$$\frac{450 - 30x + 450 + 30x}{225 - x^2} = \frac{9}{2}$$

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

$1800 = 2025 - 9x^2$

$9x^2 = 2025 - 1800 = 225$

$x^2 = \frac{225}{9} = 25$

Square of 5 is 25

So x = 5

Answer is speed of stream is 5 km/hr

Problem 2:

A man can row 5 km/hr in still water. If the velocity of current is 1 km/hr and it takes him 1 hour to row a place and come back, how far is the place?

Solution :

Speed in still water = 5 km/hr

Speed of current = 1 km/hr

Man rows to some place and returns back in 1 hour.

First we calculate speed of Downstream and upstream:

Downstream speed = Speed in still water + speed of current

= 5 + 1 = 6 km/hr

Upstream speed = Speed in still water + speed of current

= 5 - 1 = 4 km/hr

Let us assume total distance is 2x means x distance downstream and x distance back.

Time $= \frac{\text{Distance}}{Speed}$

Downstream Time = $\frac{x}{6}$

Upstream Time = $\frac{x}{4}$

$\frac{x}{6} + \frac{x}{4} = 1$

$\frac{4x+6x}{24} = 1$

10x = 24

x = 2.4 km

Answer is place is 2.4 km far

Problem 3:

A man can row $7\frac{1}{2}$ km/hr in still water. If river running at 1.5 km/hr, it takes him 50 minutes to row to a place and back, how far off is the place?

Solution :

Speed in still water = $7\frac{1}{2}$ km/hr or 7.5 km/hr

Speed of current = 1.5 km/hr

As person going and coming back in 50 minutes:

Downstream + Upstream time = 50 minutes = $\frac{50}{60} = \frac{5}{6}$ hours

Downstream speed = speed in still water + Speed of current

= 7.5 + 1.5

= 9 km/hr

Upstream speed = speed in still water - Speed of current

= 7.5 - 1.5

= 6 km/hr

Let us assume total distance is 2x means x distance downstream and x distance back.

Time $= \frac{\text{Distance}}{Speed}$

Downstream Time = $\frac{x}{9}$

Upstream Time = $\frac{x}{6}$

$\frac{x}{9} + \frac{x}{6} = \frac{5}{6}$

$\frac{6x+9x}{54} = \frac{5}{6}$

$\frac{15x}{54} = \frac{5}{6}$

Cross multiply:

90x = 54* 5

90x = 270

x = 3

Answer is distance is at 3 km far

Problem 4:

In stream running at 2 km/hr, motorboat goes 6 km upstream and back again to starting point 33 minutes. Find the speed of motorboat in still water.

Solution:

Speed of stream = 2 km/hr

Upstream + Downstream time = 33 minutes = $\frac{33}{60} = \frac{11}{20}$

1 side distance is 6 km.

Let us assume speed in still water x km/hr

Downstream speed = speed in still water + Speed of current

= x + 2

Upstream speed = speed in still water - Speed of current

= x -2

Time = $\frac{\text{Distance}}{Speed}$

Upstream Time = $\frac{6}{x-2}$

Downstream Time = $\frac{6}{x+2}$

$\frac{6}{x-2} + \frac{6}{x+2} = \frac{11}{20}$

$\frac{6x+12+6x-12}{x^2-4} = \frac{11}{20}$

$\frac{12x}{x^2-4} = \frac{11}{20}$

240x = 11x^2 – 44

11x^2 - 240x – 44 = 0

(44 * 11 = 484 242 and 2 are factors)

11x^2 – 242x + 2x – 44 = 0

(x-22)(11x +2) = 0

x = 22

Answer is Speed of boat is 22 km/hr