LF LearnFrenzy

QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Boats and Streams

Formulas & Shortcut Tricks

Every important formula, shortcut and exam trick for Boats and Streams in one place – with solved examples, common mistakes and a one-page revision sheet.

WHAT'S INSIDE

1. Topic introduction
2. Important formulas
3. Shortcut tricks & smart techniques
4. Solved examples
5. Important exam tips
6. Quick revision sheet
7. A message from LearnFrenzy

USEFUL FOR

- Bank PO & Clerk (IBPS, SBI, RBI)
- SSC CGL / CHSL / MTS
- Railways (RRB NTPC, Group D)
- Campus placements (TCS, Infosys, Wipro, Accenture)
- UPSC CSAT & state PSC exams

Practise **Boats and Streams** free on LearnFrenzy – questions with instant explanations →

© 2026 LearnFrenzy · Free for personal study

1 Topic introduction

What it is, why it matters and how it is asked

A boat in a river moves at its own speed in still water (b) plus or minus the speed of the stream (s). Going with the current (downstream) the speeds add; going against it (upstream) they subtract. Every boat question is built from these two speeds: D = b + s and U = b − s.

From any two of b, s, D and U you can find the rest, and from times or distances you can find them all. Round trips, rafts drifting with the current, two boats meeting and crossing a river are all applications of the same pair of formulas.

Why it matters in exams

- Bank prelims and SSC papers ask 1–2 boat questions in most shifts.
- Placement tests like round-trip, time-ratio and “stream cancels out” questions.
- It sharpens relative-speed thinking used in trains and races.

Where it is used

- River transport and ferry timetables.
- Swimming, rowing and kayaking with a current.
- Aircraft with and against the wind – the same mathematics.

Common question patterns

Downstream / upstream
Speeds, times or distances with the current and against it.

Still water and stream
Find b and s from D and U.

Round trips
Total time or average speed for going and coming back.

Time ratio
Upstream takes k times as long as downstream.

Two equations
Two trips with different distances and the same total time.

Rafts and hats
Objects that float move at the stream’s speed.

Two boats
Meeting or chasing – the stream cancels out.

Crossing a river
Shortest time, drift and the straight-across path.

© 2026 LearnFrenzy · Free for personal study

2 Important formulas

Cards marked MOST USED are the ones to revise first

The two basic speeds

Downstream and upstream

MOST USED

$$\text{Downstream } D = b + s;\ \text{Upstream } U = b - s$$

The current helps on the way down and holds you back on the way up.

b – speed of the boat in still water **s** – speed of the stream

EXAMPLE b = 12 km/h, s = 3 km/h → D = **15 km/h**, U = 9 km/h.

Still water and stream from D and U

MOST USED

$$b = (D + U)/2;\ s = (D - U)/2$$

Half the sum and half the difference.

EXAMPLE D = 18 km/h, U = 10 km/h → b = **14 km/h**, s = 4 km/h.

Round trips

Total time for a round trip

$$T = d/(b + s) + d/(b - s)$$

The upstream half always takes longer.

EXAMPLE 24 km each way, b = 10, s = 2 → 24/12 + 24/8 = 2 + 3 = **5 h**.

Distance from the round-trip time

MOST USED

$$d = T \times (b^2 - s^2)/(2b)$$

Saves solving two fractions when the total time is known.

EXAMPLE T = 5 h, b = 10, s = 2 → d = 5 × 96/20 = **24 km**.

Average speed for a round trip

$$\text{Average} = (b + s)(b - s)/b = (b^2 - s^2)/b$$

It is the equal-distance average 2DU/(D + U).

EXAMPLE b = 10, s = 2 → 96/10 = **9.6 km/h**.

© 2026 LearnFrenzy · Free for personal study

Ratios and special cases

Time ratio

MOST USED

If going upstream takes k times as long as downstream: $b/s = (k + 1)/(k - 1)$

Same distance, so speeds are in the inverse ratio k : 1.

EXAMPLE Upstream takes twice as long → b : s = 3 : 1; if b = 9, s = **3 km/h**.

Rafts and floating objects

A raft (or a dropped hat) moves at the speed of the stream

It has no engine of its own.

EXAMPLE Stream 3 km/h → a raft drifts 18 km in **6 h**.

Two boats on the same river

MOST USED

Towards each other: closing speed = $b_1 + b_2$; chasing: $b_1 - b_2$ (the stream cancels)

The current pushes both boats equally, so it does not change the gap.

EXAMPLE Boats 30 km apart, 8 and 7 km/h in still water → meet after 30 ÷ 15 = **2 h**, whatever the current.

Crossing a river

Shortest time and drift

Head straight across: time = width/b; drift downstream = s × time

The current carries the boat sideways while it crosses.

EXAMPLE Width 400 m, b = 5 m/s, s = 3 m/s → 80 s, drift = 3 × 80 = **240 m**.

Reaching the point directly opposite

Aim upstream so that the across speed = $\sqrt{(b^2 - s^2)}$; time = width/$\sqrt{(b^2 - s^2)}$

Possible only when b > s.

EXAMPLE Same river → across speed $\sqrt{(25 - 9)}$ = 4 m/s → **100 s**.

© 2026 LearnFrenzy · Free for personal study

3 Shortcut tricks & smart techniques

Each trick says when to use it – that matters as much as the trick

Half-sum and half-difference

MOST USED

USE WHEN Downstream and upstream speeds (or both distances and times) are known.

1. Find D and U from distance ÷ time.
2. b = (D + U)/2 and s = (D – U)/2.

EXAMPLE 21 km down in 3 h (7 km/h), 15 km up in 5 h (3 km/h) → s = (7 – 3)/2 = **2 km/h**.

Time-ratio shortcut

MOST USED

USE WHEN "Rowing upstream takes k times as long as downstream."

1. b : s = (k + 1) : (k – 1).
2. Scale to the given b or s.

EXAMPLE Upstream takes 3 times as long and b = 12 → b : s = 4 : 2 → s = **6 km/h**.

Round-trip distance in one line

USE WHEN Total round-trip time is given; the one-way distance is asked.

1. $d = T(b^2 - s^2)/2b$.

EXAMPLE b = 8, s = 2, total 8 h → d = 8 × 60/16 = **30 km**.

The dropped-hat puzzle

USE WHEN Something falls into the river and the rower turns back later.

1. Relative to the water, the rower takes as long to return as he took to go away.
2. The hat drifts at the stream's speed for the whole time.

EXAMPLE Turns back after 15 min, catches the hat 1.5 km below the drop point → 1.5 km in 30 min → stream = **3 km/h**.

Ignore the stream for two boats

USE WHEN Two boats or swimmers on the same river meet or chase each other.

1. Use still-water speeds only: add for meeting, subtract for chasing.

EXAMPLE Boats 60 km apart at 14 and 16 km/h (still water) in a 4 km/h current → meet after **2 h**.

© 2026 LearnFrenzy · Free for personal study

4 Solved examples

The full method on the left, the exam shortcut on the right

1 DOWNSTREAM

A boat's speed in still water is 15 km/h and the stream flows at 3 km/h. How long does it take to go 54 km downstream?

STEP BY STEP

1. Downstream speed = 15 + 3 = 18 km/h.
2. Time = 54 ÷ 18 = 3 h.

SHORTCUT

54 ÷ (15 + 3) = 3.

Why it works: Downstream, the current adds to the boat's own speed.

Answer: 3 hours

2 STREAM SPEED

A man rows 21 km downstream in 3 hours and 15 km upstream in 5 hours. Find the speed of the stream.

STEP BY STEP

1. D = 21 ÷ 3 = 7 km/h; U = 15 ÷ 5 = 3 km/h.
2. s = (7 − 3) ÷ 2 = 2 km/h.

SHORTCUT

Half the difference of the two speeds.

Why it works: D and U differ by twice the stream speed.

Answer: 2 km/h

3 TIME RATIO

A boat takes three times as long to go upstream as to cover the same distance downstream. Its speed in still water is 12 km/h. What is the speed of the stream?

STEP BY STEP

1. U : D = 1 : 3 → (12 − s) : (12 + s) = 1 : 3.
2. 36 − 3s = 12 + s → s = 6.

SHORTCUT

b : s = (3 + 1) : (3 − 1) = 2 : 1 → s = 6.

Why it works: Speeds are in the inverse ratio of times for the same distance.

Answer: 6 km/h

4 ROUND TRIP TIME

A boat goes 24 km downstream and returns. Its speed in still water is 9 km/h and the stream's 3 km/h. How long does the round trip take?

STEP BY STEP

1. Down: 24 ÷ 12 = 2 h.
2. Up: 24 ÷ 6 = 4 h.
3. Total = 6 h.

SHORTCUT

24/12 + 24/6 = 6.

Why it works: The slower upstream leg takes twice as long here.

Answer: 6 hours

© 2026 LearnFrenzy · Free for personal study

5 ROUND TRIP DISTANCE

A man rows to a place and back in 8 hours. His speed in still water is 8 km/h and the stream flows at 2 km/h. How far is the place?

STEP BY STEP

1. $d/10 + d/6 = 8$.
2. $(3d + 5d)/30 = 8 \rightarrow d = 30$ km.

SHORTCUT

$T(b^2 - s^2)/2b = 8 \times 60 \div 16 = 30$.

Why it works: The formula combines both legs into one step.

Answer: 30 km

6 AVERAGE SPEED

A boat with still-water speed 10 km/h makes a round trip on a river flowing at 4 km/h. What is its average speed?

STEP BY STEP

1. $D = 14$, $U = 6$.
2. Average $= 2 \times 14 \times 6 \div 20 = 8.4$ km/h.

SHORTCUT

$(b^2 - s^2)/b = 84 \div 10 = 8.4$.

Why it works: Equal distances at two speeds give the harmonic-style average.

Answer: 8.4 km/h

7 TWO BOATS

Two boats start towards each other from points 60 km apart on a river flowing at 4 km/h. Their speeds in still water are 14 km/h and 16 km/h. When do they meet?

STEP BY STEP

1. One goes downstream at 18, the other upstream at 12.
2. Closing speed = 30 km/h.
3. Time = 2 h.

SHORTCUT

Stream cancels: $60 \div (14 + 16) = 2$.

Why it works: What the current gives one boat, it takes from the other.

Answer: 2 hours

8 TWO EQUATIONS

A boat goes 24 km downstream and 20 km upstream in 4.5 hours. It also goes 36 km downstream and 12 km upstream in 4.5 hours. What is its speed in still water?

STEP BY STEP

1. Let $x = 1/D$, $y = 1/U$: $24x + 20y = 4.5$ and $36x + 12y = 4.5$.
2. Solving: $x = 1/12$, $y = 1/8 \rightarrow D = 12$, $U = 8$.
3. $b = (12 + 8) \div 2 = 10$ km/h.

SHORTCUT

Test $D = 12$, $U = 8$: $2 + 2.5 = 4.5$ and $3 + 1.5 = 4.5$ ✓ $\rightarrow b = 10$.

Why it works: Using reciprocals of the speeds turns the times into linear equations.

Answer: 10 km/h

© 2026 LearnFrenzy · Free for personal study

9 DROPPED HAT

A man rowing upstream drops his hat. He notices after 15 minutes, turns back and catches the hat 1.5 km downstream of where it fell. What is the speed of the stream?

STEP BY STEP

1. Relative to the water he rows away 15 min and back 15 min.
2. The hat drifted for 30 minutes and covered 1.5 km.
3. Stream = 1.5 ÷ 0.5 = 3 km/h.

SHORTCUT

Drift distance ÷ (2 × time before turning) = 1.5 ÷ 0.5.

Why it works: In the water's frame the hat is still, so going and coming back take equal time.

Answer: 3 km/h

10 CROSSING A RIVER

A river is 300 m wide and flows at 4 m/s. A boat moves at 5 m/s in still water. How long does it take to reach the point exactly opposite?

STEP BY STEP

1. The boat must aim upstream so that the across speed = $\sqrt{(5^2 - 4^2)} = 3$ m/s.
2. Time = 300 ÷ 3 = 100 s.

SHORTCUT

width ÷ $\sqrt{(b^2 - s^2)}$ = 300 ÷ 3.

Why it works: Part of the boat's speed is used to cancel the current.

Answer: 100 seconds

11 SPEED DIFFERENCE

A boat's downstream speed is 20 km/h more than its upstream speed. It covers 48 km downstream in 2 hours. What is its speed in still water?

STEP BY STEP

1. D = 48 ÷ 2 = 24 km/h; D − U = 2s = 20 → s = 10.
2. U = 4 km/h → b = (24 + 4) ÷ 2 = 14 km/h.

SHORTCUT

b = D − s = 24 − 10 = 14.

Why it works: The gap between D and U is always twice the stream speed.

Answer: 14 km/h

© 2026 LearnFrenzy · Free for personal study

5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- Downstream / upstream times for given speeds.
- Still-water and stream speeds from two trips.
- Round-trip time, distance and average speed.
- Upstream takes k times as long as downstream.
- Two trips giving two equations.
- Rafts, floating objects and the dropped hat.
- Two boats meeting, and crossing a river.

Common mistakes to avoid

- Adding the stream speed for upstream travel.
- Averaging D and U to get the round-trip average speed.
- Swapping b and s in the half-sum / half-difference rule.
- Including the stream when two boats move on the same river.
- Trying to cross straight when the stream is faster than the boat.
- Mixing km/h and m/s in river-crossing questions.

Points to remember

- D = b + s, U = b − s.
- b = (D + U)/2, s = (D − U)/2.
- Round-trip average = $(b^2 - s^2)/b$.
- Upstream k times longer → b : s = (k + 1) : (k − 1).
- Rafts move at the stream speed; for two boats the stream cancels.

Speed and accuracy

- Find D and U first – everything follows.
- Use the round-trip distance formula instead of fractions.
- Test options in two-equation questions.
- Write b and s in a small table before solving.

Preparation strategy

- Master D, U, b and s conversions before the special cases.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Diagram-Based → Data Sufficiency.
- Aim for 40 seconds per boats question.
- Keep an error log of upstream/downstream sign mistakes.
- Read the Quick Revision Sheet (next page) the night before the exam.

© 2026 LearnFrenzy · Free for personal study

6 Quick revision sheet

Everything on one page for the night before the exam

Formulas

Downstream	$b + s$	Upstream	$b - s$
Still water b	$(D + U)/2$	Stream s	$(D - U)/2$
Round-trip time	$d/(b + s) + d/(b - s)$	Round-trip distance	$T(b^2 - s^2)/2b$
Round-trip average	$(b^2 - s^2)/b$	Upstream k× longer	$b : s = (k + 1) : (k - 1)$
Raft	speed = s	Two boats (meet)	$b_1 + b_2$
Two boats (chase)	$b_1 - b_2$	Shortest crossing	width/b
Drift	$s \times \text{width}/b$	Straight across	$\text{width}/\sqrt{(b^2 - s^2)}$

Shortcut tricks

- Half-sum, half-difference.
- D − U = 2s.
- Time ratio → b : s.
- Round trip in one formula.
- Hat: away time = back time.
- Two boats: ignore the stream.

Must-know numbers

Time ratio → b : s	k = 2 → 3 : 1 · k = 3 → 2 : 1 · k = 4 → 5 : 3 · k = 5 → 3 : 2
Speeds	1 m/s = 3.6 km/h · 5 m/s = 18 km/h · 10 m/s = 36 km/h

© 2026 LearnFrenzy · Free for personal study

7 A message from LearnFrenzy

For everyone preparing for placements, competitive and government exams

Keep going – you are closer than you think

Success in examinations is not just about how many hours you study. It is about how effectively you understand concepts, practise questions, and improve yourself every day.

Every formula you learn, every problem you solve, and every mistake you correct brings you one step closer to your goal.

Whether you are preparing for campus placements, competitive examinations, or government jobs, remember that consistency, confidence, and smart preparation make a real difference.

Don't just memorize formulas. Understand the concepts, practise smart techniques, and develop the confidence to solve problems independently.

Your hard work today can create the opportunities you dream of tomorrow.

— Team LearnFrenzy

Practise **Boats and Streams** free on LearnFrenzy – questions with instant explanations →

© 2026 LearnFrenzy · Free for personal study