Boats and Streams

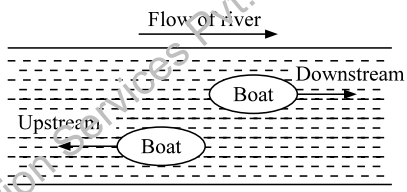
13

Some Important Terms

1. **Still Water:** If the speed of the water in a river is zero, it is called, 'still water'.
2. **Stream:** If the water of a river is moving, it is called, a *stream*'.
3. **Upstream:** If a boat (or a swimmer) moves against a stream, i.e., in the direction is opposite to that of the stream, it is called, '*upstream*'.
4. **Downstream:** If a boat (or a swimmer) moves with a stream, i.e., along the direction of a stream, it is called, '*downstream*'.

Note:

When the speed of a boat or a swimmer is given, it usually means speed in the still water.



SOME BASIC FORMULAE

1. If the speed of a boat (or a swimmer) be x Km/h and the speed of a stream or the current be y Km/h, then:
   (a) the speed of the boat (or swimmer) downstream $= (x + y)$ Km/h.
   (b) the speed of the boat (or swimmer) upstream $= (x - y)$ Km/h.

Illustration 1: The speed of a boat in still water is 20 Km/h. If the speed of the stream be 4 Km/h, find out its downstream and upstream speeds.

Solution: Speed of the boat (x) = 20 Km/h

Speed of the stream (y) = 4 Km/h

$\therefore$ Downstream speed = $x + y$ = (20 + 4) = 24 Km/h

Upstream speed = $x - y$ = (20 − 4) = 16 Km/h.

2. (a) Speed of the boat (or swimmer) in still water

$$= \frac{1}{2}(\text{Downstream Speed} + \text{Upstream Speed})$$

(b) Speed of the stream

$$= \frac{1}{2}(\text{Downstream Speed} - \text{Upstream Speed})$$

Illustration 2: A boat is rowed down a river 40 Km in 5 h and up a river 21 Km in 7 h. Find the speed of the boat and the river.

Solution: Speed of the boat downstream $= \frac{40}{5} = 8$ Km/h.

Speed of the boat upstream $= \frac{21}{7} = 3$ Km/h.

$\therefore$ Speed of the boat

$$= \frac{1}{2}(\text{Downstream Speed} + \text{Upstream Speed})$$

$$= \frac{1}{2}(8 + 3)$$

$$= \frac{11}{2} \quad \text{or, } 5{\cdot}5 \text{ Km/h.}$$

and, speed of the river

$$= \frac{1}{2}(\text{Downstream Speed} - \text{Upstream Speed})$$

$$= \frac{1}{2}(8 - 3) = \frac{5}{2}$$

or, 2·5 Km/h.

SOME USEFUL SHORTCUT METHODS

1. If a man capable of rowing at the speed of x Km/h in still water, rows the same distance up and down a stream which flows at a rate of y Km/h, then his average speed throughout the journey is

$$= \frac{\text{Uptream} \times \text{Downstream}}{\text{Man's rate in still water}}$$

$$= \frac{(x-y)(x+y)}{x} \text{ Km/h.}$$

Illustration 3: A man rows at a speed of 8 Km/h in still water to a certain distance upstream and back to the starting point in a river which flows at 4 Km/h. Find his average speed for total journey.

Solution: Average Speed

$$= \frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}}$$

$$= \frac{(8-4)(8+4)}{8} = 6 \text{ Km/h.}$$

2. A man can row a boat in still water at x Km/h. In a stream flowing at y Km/h, if it takes t hours more in upstream than to go downstream for the same distance, then the distance is given by

$$\frac{(x^2-y^2)t}{2y} \text{ Km.}$$

Illustration 4: A man can row 7 Km/h in still water. If the river is running at 3 Km/h, it takes 6 hours more in upstream than to go downstream for the same distance. How far is the place?

Solution: The required distance

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

$$= \frac{(49-9)6}{2\times 3} = 40 \text{ Km.}$$

3. A man rows a certain distance downstream in t_1 hours and returns the same distance upstream in t_2 hours. If the speed of the stream be y Km/h, then the speed of the man in still water is given by

$$y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h.}$$

Explanation:

Let, the speed of the man in still water be x Km/h.

Then, downstream speed = $(x + y)$ Km/h

and upstream speed = $(x - y)$ Km/h.

Since the distance covered downstream and upstream are equal, we have

$$(x + y)t_1 = (x - y)t_2$$

or, $$xt_1 + yt_1 = xt_2 - yt_2$$

or, $$x(t_2 - t_1) = y(t_2 + t_1)$$

$$\therefore \quad x = y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h.}$$

Illustration 5: A motorboat covers a certain distance downstream in 6 hours, but takes 8 hours, to return upstream to the starting point. If the speed of the stream be 6 Km/h, find out the speed of the motor boat in still water.

Solution: Speed of the motorboat in still water

$$= y\left(\frac{t_2+t_1}{t_2-t_1}\right) \text{ Km/h}$$

$$= 6\left(\frac{8+6}{8-6}\right) = 42 \text{ Km/h.}$$

4. A man can row a boat in still water at x Km/h. In a stream flowing at y Km/h if it takes him t hours to row to a place and come back, then the distance between the two places is

$$\frac{t(x^2-y^2)}{2x} \text{ Km.}$$

Explanation:

Downstream speed = $(x + y)$ Km/h

Upstream speed = $(x - y)$ Km/h.

Let, the distance between the two places be d Km. We have,

Total time = Sum of time taken downstream and upstream

$$\Rightarrow \quad t = \frac{d}{x+y} + \frac{d}{x-y}$$

$$= d\left[\frac{(x-y)+(x+y)}{(x-y)(x+y)}\right]$$

$$= d\left[\frac{2x}{x^2-y^2}\right]$$

$$\therefore \quad d = \frac{t(x^2-y^2)}{2x} \text{ Km.}$$

Illustration 6: A man can row 6 Km/h in the still water. If the river is running at 2 Km/h, it takes him 3 hours to row to a place and back. How far is the place?
Solution: The required distance

$$= \frac{t(x^2 - y^2)}{2x} \text{ Km} = \frac{3(36-4)}{2\times 6} = 8 \text{ Km.}$$

5. A boat (or a swimmer) takes n times as long to row upstream as to row downstream the river. If the speed of boat (or swimmer) be x Km/h and the speed of stream be y Km/h, then

$$x = y\left(\frac{n+1}{n-1}\right).$$

Illustration 7: A man can row at the rate of 4 Km/h in still water. If the time taken to row a certain distance upstream is 3 times as much as to row the same distance downstream, find the speed of the current.
Solution: We have

Speed of the man $= \left(\frac{n+1}{n-1}\right)$ speed of the current

$\Rightarrow \quad 4 = \left(\frac{3+1}{3-1}\right)$ speed of the current.

$\therefore$ Speed of the current = 2 Km/h.

EXERCISE-I

1. A boat goes 13 Km upstream in 39 minutes. The speed of stream is 3 Km/h. The speed of boat in still water is:
(a) 23 Km/h (b) 27 Km/h
(c) 25 Km/h (d) None of these

2. The speed of a boat in still water is 8 Km/h. If its speed downstream be 15 Km/h, then speed of the stream is:
(a) 7.5 Km/h (b) 7 Km/h
(c) 9 Km/h (d) None of these

3. Speed of a man is 10 Km/h in still water. If the rate of current is 3 Km/h, then the effective speed of the man upstream is:
(a) 7 Km/h (b) 8.5 Km/h
(c) 9 Km/h (d) None of these

4. A man can row with the stream at 7 Km/h and against the stream at 3 Km/h. His speed in still water is:
(a) 6.5 Km/h (b) 7 Km/h
(c) 5 Km/h (d) None of these

5. A swimmer covers a distance of 28 Km against the current and 40 Km in the direction of the current. If in each case he takes 4 hours, then the speed of the current is:
(a) 3.5 Km/h (b) 1.5 Km/h
(c) 2.5 Km/h (d) None of these

6. A boat moves downstream at the rate of one Km in 10 minutes and upstream at the rate of 4 Km an hour. What is the velocity of the current:
(a) 5 Km/h (b) 3 Km/h
(c) 1 Km/h (d) None of these

7. If a man's rate with the current is 12 Km/h and the rate of the current is $1\frac{1}{2}$ Km/h, then his rate against the current is:
(a) 13 Km/h (b) 7 Km/h
(c) 9 Km/h (d) None of these

8. A boatman can row 2 Km against the stream in 20 minutes and return in 18 minutes. Find the rate of current.
(a) $\frac{1}{3}$ Km/h (b) $\frac{2}{3}$ Km/h
(c) $\frac{1}{3}$ Km/h (d) None of these

9. A boatman can row 48 Km downstream in 4 hours. If the speed of the current is 5 Km/h, then find in what time will he be able to cover 8 Km upstream?
(a) 6 hours (b) 4 hours
(c) 8 hours (d) None of these

10. A man can row at a speed of 10 Km/h in still water to a certain upstream point and back to the starting point in a river which flows at 4 Km/h. Find his average speed for total journey.
(a) $9\frac{2}{5}$ Km/h (b) $8\frac{2}{5}$ Km/h
(c) $11\frac{2}{5}$ Km/h (d) None of these

11. A man can row 6 Km/h in still water. If the river is running at 2 Km/h, it takes 3 hours more in upstream than to go downstream for the same distance. How far is the place?

(a) 24 Km (b) 28 Km
(c) 36 Km (d) None of these

12. A boat covers a certain distance downstream in 2 hours, but takes 4 hours to return upstream to the starting point. If the speed of the stream be 3 Km/h, find the speed of the boat in still water.

(a) 11 Km/h (b) 13 Km/h
(c) 9 Km/h (d) None of these

13. In a river flowing at 2 Km/h, a boat travels 32 Km upstream and, then returns downstream to the starting point. If its speed in still water be 6 Km/h, find out the journey time.

(a) 16 hours (b) 12 hours
(c) 12 hours (d) None of these

14. A boat travels upstream from B to A and downstream from A to B in 3 hrs. If the speed of the boat in still water is 9 Km/h and the speed of the current is 3 Km/h, the distance between A and B is:

(a) 8 Km (b) 16 Km
(c) 12 Km (d) None of these

15. A boat travels 2 Km upstream in a stream flowing at 3 Km/h and, then returns downstream to the starting point in 30 minutes. The speed of the boat in still water is:

(a) 17 Km/h (b) 9 Km/h
(c) 13 Km/h (d) None of these

16. A man swimming in a stream which flows $1\frac{1}{2}$ Km/h finds that in a given time he can swim twice as far with the stream as he can against it. At what rate does he swim?

(a) $4\frac{1}{2}$ Km/h (b) $5\frac{1}{2}$ Km/h
(c) $7\frac{1}{2}$ Km/h (d) None of these

17. A boat travels upstream from B to A and downstream from A to B in 3 hours. If the speed of the boat in still water is 9 Km/h and the speed of the current is 3 Km/h, the distance between A and B is:

(a) 4 Km (b) 6 Km
(c) 8 Km (d) 12 Km

18. A man rows upstream 12 Km and downstream 28 Km taking 5 hours each time. The velocity of water current is:

(a) $2\frac{1}{5}$ Km/h (b) $2\frac{1}{2}$ Km/h
(c) 3 Km/h (d) $1\frac{3}{5}$ Km/h

19. Twice the speed downstream is equal to the thrice the speed upstream, the ratio of speed in still water to the speed of the current is:

(a) 1:5 (b) 5:1
(c) 1:3 (d) 2:3

20. A man can swim 3 Km/h in still water. If the velocity of the stream be 2 Km/h, the time taken by him to swim to a place 10 Km upstream and back, is:

(a) $8\frac{1}{3}$ hours (b) $9\frac{1}{5}$ hours
(c) 10 hours (d) 12 hours

21. A boat covers 24 Km upstream and 36 Km downstream in 6 hours, while it covers 36 Km upstream and 24 Km downstream in $6\frac{1}{2}$ hours. The velocity of the current is:

(a) 1.5 Km/h (b) 1 Km/h
(c) 2 Km/h (d) 2.5 Km/h

22. A boatman goes 2 Km against the current of the stream in 1 h and goes 1 Km along the current in 10 min. How long will he take to go 5 Km in stationary water?

(a) 1 hour (b) 1 hour 15 minutes
(c) $1\frac{1}{2}$ hours (d) 40 minutes

23. P, Q, R are three towns on a river which flows uniformly. Q is equidistant from P and R. A man rows from P to Q and returns in 10 h. He can row from P to R in 4 h. The ratio of speed of the man in still water to the speed of the current is:

(a) 5:3 (b) 3:5
(c) 2:5 (d) 1:2

24. In a stream running at 2 Km/h, a motor boat goes 10 Km upstream and returns to the starting point in 55 min. Find out the speed of the motorboat in still water.

(a) 20 Km/h (b) 21 Km/h
(c) 22 Km/h (d) 24 Km/h

25. A man can row 30 Km upstream and 44 Km downstream in 10 hours. Also, he can row 40 Km upstream and 55 Km downstream in 13 hours. Find the rate of the current and the speed of the man in still water.

(a) 3 Km/h, 8 Km/h
(b) 3·5 Km/h, 7·5 Km/h
(c) 4 Km/h, 7 Km/h
(d) 4·5 Km/h, 6·5 Km/h

EXERCISE-2
(BASED ON MEMORY)

1. The speed of a motor-boat is to that of the current of water as 36:5. The boat goes along with the current in 5 hours 10 minutes. It will come back in:

(a) 5 hours 50 minutes
(b) 6 hours
(c) 6 hours 50 minutes
(d) 12 hours 10 minutes

[SSC (GL) Prel. Examination, 2007]

2. A boat goes 8 Km in 1 h along the stream and 2 Km in 1 h against the stream. The speed of the stream (in Km/h) is:

(a) 2 (b) 3
(c) 4 (d) 5

[SSC (GL) Prel. Examination, 2000]

3. A man rows a boat 18 Km in 4 h downstream and returns upstream in 12 h. The speed of the stream (in Km/h):

(a) 1 (b) 1.5
(c) 2 (d) 1.75

[SSC (GL) Prel. Examination, 2003]

4. A boat takes 6 hours to travel from place M to N downstream and back from N to M upstream. If the speed of the boat in still water is 4 Km/h, what is the distance between the two places?

(a) 8 Km (b) 12 Km
(c) 6 Km (d) Data inadequate
(e) None of these

[SSC (GL) Prel. Examination, 2000]

5. A person can swim at $7\frac{1}{2}$ Km/h in stagnant water. In a river with 1·5 Km/h current, the person swims to a certain distance and comes back within 50 min. What is the distance between the two points?

(a) 3 Km (b) 4 Km
(c) 1 Km (d) 2 Km

[RRB Mahendraghat Patna Goods Guard Examination, 2002]

6. A boat takes 9 h to travel a distance upstream and 3 h to travel the same distance downstream. If its speed in still water is 4 Km/h, what is the velocity of the stream?

(a) 4 Km/h (b) 3 Km/h
(c) 6 Km/h (d) None of these

[DMRC Examination, 2002]

7. A boat goes 20 Km downstream in 1 h and the same distance upstream in 2 h. The speed of the boat in still water is:

(a) 15 Km/h (b) 10 Km/h
(c) 5 Km/h (d) 7.5 Km/h

[SSC CPO (SI) Prel. Examination, 2003]

8. A boat takes 4 hours for travelling downstream from point A to point B and coming back to point A upstream. If the velocity of the stream is 2 Km/h and the speed of the boat in still water is 4 Km/h, then what is the distance between A and B?

(a) 8 Km (b) 9 Km
(c) 4 Km (d) 6 Km

[RRB Allahabad ASM Examination, 2002]

9. A boat takes 9 hours to travel a distance upstream and takes 3 hours to travel the same distance downstream. If the speed of the boat in still water is 4 Km/h, then what is the velocity of the stream?

(a) 4 Km/h (b) 3 Km/h
(c) 6 Km/h (d) 2 Km/h
(e) None of these

[RRB Bhubaneshwar ASM Examination, 2002]

10. A boat running downstream covers a distance of 16 Km in 2 hours while for covering the same distance upstream it takes 4 hours. What is the speed of the boat in still water?

(a) 4 Km/h (b) 6 Km/h
(c) 8 Km/h (d) Data inadequate
(e) None of these

[SBI Associates Bank PO, 2002]

11. A boat has to travel upstream 20 Km distance from point X of a river to point Y. The total time taken by boat in travelling from point X to Y and Y to X is 41 minutes 40 second. What is the speed of the boat?

(a) 66 Km/h (b) 72 Km/h
(c) 48 Km/h (d) Data inadequate
(e) None of these

[BSRB Hyderabad PO, 1999]

12. A boat takes 2 h to travel from point A to B in still water. To find out its speed upstream, which of the following information is/are required?

A. Distance between point A and B.
B. Time taken to travel downstream from B to A.
C. Speed of the stream of water.

D. Effective speed of boat while travelling downstream from B to A.

(a) All are required
(b) Even with all these, the answer cannot be determined
(c) Only A, C and either B or D
(d) Only A, C and D
(e) None of these

[BSRB Bhopal Bank PO, 2000]

13. A man can row 6 Km/h in still water. If the speed of the current is 2 Km/h, it takes 3 hrs more in upstream than in the downstream for the same distance. The distance is:

(a) 30 Km (b) 24 Km
(c) 20 Km (d) 32 Km

[SSC (GL), 2011]

14. A boat covers 12 Km upstream and 18 Km downstream in 3 hours, while it covers 36 Km upstream and 24 Km downstream in $6\frac{1}{2}$ hours. What is the speed of the current?

(a) 1.5 Km/h (b) 1 Km/h
(c) 2 Km/h (d) 2.5 Km/h

[SSC, 2012]

15. A motor-boat can travel at 10 Km/h in still water. It travelled 91 Km downstream in a river and then returned to the same place, taking altogether 20 hours. Find the rate of flow of river.

(a) 3 Km/h (b) 4 Km/h
(c) 2 Km/h (d) 5 Km/h

[SSC, 2011]

16. A motor-boat, travelling at the same speed, can cover 25 Km upstream and 39 Km downstream in 8 hours. At the same speed, it can travel 35 Km upstream and 52 Km downstream in 11 hours. The speed of the stream is:

(a) 2 Km/h (b) 3 Km/h
(c) 4 Km/h (d) 5 Km/h

[SSC, 2011]

17. A man can row against the current $\frac{3}{4}$ of a kilometre in 15 minutes and returns the same distance in 10 minutes. The ratio of his speed to that of the current is:

(a) 3:5 (b) 5:3
(c) 1:5 (d) 5:1

[SSC, 2010]

Directions (Q. 18-19): Each of the following questions consists of a question followed by three statements I, II and III. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question.

18. What is the speed of a boat in still water?

I. The boat covers 12 Km in 2 hours downstream.
II. The boat covers the same distance in 4 hoursupstream.
III. The speed of the stream is $\frac{1}{3}$ that of the boatin still water.

(a) Both I and II
(b) I and either II or III
(c) All I, II and III
(d) The question cannot be answered even with the information in all three statements.
(e) None of these

[IBPS PO/MT, 2013]

19. What is the speed of a train?

I. The length of the train is 240 meters.
II. The train crosses a pole in 24 seconds.
III. The train crosses a platform in 48 seconds.

(a) Both I and III (b) Both I and II
(c) Both II and III (d) Any two of the three
(e) None of these

[IBPS PO/MT, 2013]

ANSWER KEYS

Exercise-1

1. (a)	**2.** (b)	**3.** (a)	**4.** (c)	**5.** (b)	**6.** (c)	**7.** (c)	**8.** (a)	**9.** (b)	**10.** (b)	**11.** (a)	**12.** (c)	**13.** (b)
14. (c)	**15.** (b)	**16.** (a)	**17.** (d)	**18.** (d)	**19.** (b)	**20.** (d)	**21.** (c)	**22.** (b)	**23.** (a)	**24.** (c)	**25.** (a)	

Exercise-2

1. (c)	**2.** (b)	**3.** (b)	**4.** (d)	**5.** (a)	**6.** (d)	**7.** (a)	**8.** (b)	**9.** (d)	**10.** (b)	**11.** (d)	**12.** (e)	**13.** (b)
14. (c)	**15.** (a)	**16.** (c)	**17.** (d)	**18.** (b)	**19.** (b)							

EXPLANATORY ANSWERS

EXERCISE-I

1. (a) Speed of the boat upstream

$= \frac{13 \times 60}{39} = 20$ Km/h

Speed of the stream = 3 Km/h

Let, the speed of the boat in still water = x Km/h.

We have, $x - 3 = 20$

$\therefore \quad x = 20 + 3 = 23$ Km/h.

2. (b) Speed of the boat downstream = 15 Km/h.

Speed of the boat in still water = 8 Km/h.

Let the speed of the stream = y Km/h.

We have, $15 = 8 + y \quad \therefore \quad y = 15 - 8 = 7$ Km/h.

3. (a) Speed of man in still water = 10 Km/h

Speed of current = 3 Km/h $\therefore$ Speed of man upstream $= 10 - 3 = 7$ Km/h.

4. (c) Speed of the man upstream = 7 Km/h.

Speed of the man downstream = 3 Km/h.

$\therefore$ Speed of the man in still water

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

$= \frac{1}{2}(7 + 3) = 5$ Km/h.

5. (b) Speed of the swimmer upstream

$= \frac{28}{4} = 7$ Km/h.

Speed of the swimmer downstream

$= \frac{40}{4} = 10$ Km/h.

$\therefore$ Speed of the stream

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

$= \frac{1}{2}(10 - 7) = \frac{3}{5} = 1{\cdot}5$ Km/h.

6. (c) Speed of the boat downstream

$= \frac{60}{10} = 6$ Km/h.

Speed of the boat upstream = 4 Km/h

$\therefore$ Velocity of the current

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

$= \frac{1}{2}(6 - 4) = 1$ Km/h.

7. (c) Speed of the man downstream = 12 Km/h.

Speed of the stream $= \frac{3}{2}$ Km/h.

Let, the speed of the man upstream = x Km/h.

We have,

Speed of the stream

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

$\Rightarrow \quad \frac{3}{2} = \frac{1}{2}(12 - x)$.

$\therefore \quad x = 12 - 3 = 9$ Km/h.

8. (a) Speed of the boatman upstream

$= \frac{2}{20} \times 60 = 6$ Km/h.

Speed of the boatman downstream

$= \frac{2}{18} \times 60 = \frac{20}{3}$ Km/h.

$\therefore$ Rate of the current

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

$= \frac{1}{2}\left(\frac{20}{3} - 6\right) = \frac{1}{3}$ Km/h.

9. (b) Speed of the boatman downstream

$= \frac{48}{4} = 12$ Km/h.

Speed of the current = 5 Km/h.

Let, the boatman takes t hours to cover 8 Km upstream.

Then, speed of the current

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

$\Rightarrow \quad 5 = \frac{1}{2}\left(12 - \frac{8}{t}\right)$

$\therefore \quad t = 4$ hours.

10. (b) Average Speed

$= \frac{\text{Upstream} \times \text{Downstream}}{\text{Man's rate in still water}}$

$= \frac{(10-4)(10+4)}{10} = 8\frac{2}{5}$ Km/h.

11. (a) The required distance

$= \frac{(x^2 - y^2)t}{2y} = \frac{(36-4)3}{2 \times 2} = 24$ Km.

12. (c) Speed of the boat in still water

$= y\left(\frac{t_2 + t_1}{t_2 - t_1}\right)$ Km/h

$= 3\left(\frac{4+2}{4-2}\right) = 9$ Km/h.

13. (b) Let, the total journey time be t hours.

Then, we have $d = \frac{t(x^2 - y^2)}{2x}$

$\Rightarrow \quad 32 = \frac{t(36-4)}{2 \times 6}$

$\therefore \quad t = 12$ hours.

14. **(c)** The distance between A and B is

$= \frac{t(x^2 - y^2)}{2x}$ Km

$= \frac{3(81-9)}{2\times 9} = 12$ Km.

15. **(b)** Let, the speed of the boat be x Km/h.

We have,

$d = \frac{t(x^2 - y^2)}{2x}$

$\Rightarrow \quad 2 = \frac{1/2(x^2-9)}{2x}$, i.e., $2 = \frac{x^2-9}{4x}$

or, $x^2 - 8x - 9 = 0$

or, $(x - 9)(x + 1) = 0$

or, $x = -1$ or 9.

Since the speed cannot be negative, we neglect -1.

Therefore, speed of the boat in still water = 9 Km/h.

16. **(a)** Speed of the man

$= \left(\frac{n+1}{n-1}\right)$ speed of stream

$= \left(\frac{2+1}{2-1}\right)\times\frac{3}{2} = \frac{9}{2}$ or $4\frac{1}{2}$ Km/h.

17. **(d)** Speed downstream = (9 + 3) Km/h

= 12 Km/h

Speed upstream = (9 − 3) Km/h = 6 Km/h

Let, the distance AB = x Km

Then, $\frac{x}{6} + \frac{x}{12} = 3 \quad \Rightarrow \quad 2x + x = 36$

$\Rightarrow \quad x = 12$

$\therefore$ Distance AB = 12 Km.

18. **(d)** Let, the man's rowing speed in still water = x Km/h and speed of the current = y Km/h

Speed upstream = $(x - y)$ Km/h

and, speed downstream = $(x + y)$ Km/h

$\therefore \quad 5(x - y) = 12$ and $5(x + y) = 28$

Subtracting $10y = 16$

$\therefore \quad y = \frac{8}{5} = 1\frac{3}{5}$ Km/h.

19. **(b)** Let, speed in still water = x Km/h.

Speed of current = y Km/h.

Speed downstream = $(x + y)$ Km/h.

Speed upstream = $(x - y)$ Km/h.

$\therefore \quad 2(x + y) = 3(x - y)$

$\therefore \quad x = 5y$

or, $\frac{x}{y} = \frac{5}{1}$ or 5:1.

20. **(d)** Speed upstream = (3 − 2) Km/h = 1 Km/h.

Speed downstream = (3 + 2) Km/h = 5 Km/h.

Total time taken $= \left(\frac{10}{1} + \frac{10}{5}\right)$ hours

= 12 hours.

21. **(c)** Let, the speed upstream be x Km/h and the speed downstream by y Km/h. Then,

$\frac{24}{x} + \frac{36}{y} = 6 \quad \Rightarrow \quad 24u + 36v = 6$

where, $\frac{1}{x} = u$ and $\frac{1}{y} = v$

And, $\frac{36}{x} + \frac{24}{y} = \frac{13}{2} \quad \Rightarrow \quad 36u + 24v = \frac{13}{2}$

Adding these equations, we get

$60(u + v) = \frac{25}{2}$ or $u + v = \frac{5}{24}$

By subtracting, we get $12(u - v) = \frac{1}{2}$ or, $u - v = \frac{1}{24}$

Solving, $u + v = \frac{5}{24}$ and $u - v = \frac{1}{24}$, we get

$u = \frac{1}{8}$ and $v = \frac{1}{12}$

$\therefore \quad x = 8$ Km/h and $y = 12$ Km/h

$\therefore$ Velocity of current $= \frac{1}{2}(12 - 8) = 2$ Km/h.

22. **(b)** Upstream speed = 2 Km/h

Downstream speed = 6 Km/h

$\therefore$ Speed in still water $= \frac{2+6}{2} = 4$ Km/h

$\therefore$ Time required to go 5 Km in still water

$= \frac{5}{4}$ hours = 1 hours 15 minutes.

23. **(a)** Let, the speed of man in still water = x Km/h

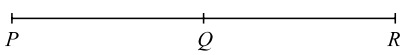
Speed of the current = y Km/h

Speed downstream = $(x + y)$ Km/h

Speed upstream = $(x - y)$ Km/h

Let, the river be flowing from P to R and $PQ = QR = a$.

Then, $PR = 2a$



$\therefore \quad \frac{a}{x+y} + \frac{a}{x-y} = 10.$ ...(1)

and, $\frac{2a}{x+y} = 4$

$\therefore \quad \frac{a}{x+y} = 2$ ...(2)

$\therefore \quad (1) \Rightarrow \quad \frac{a}{x-y} = 8$ ...(3)

By dividing Eqs. (2) and (3), we get $\frac{x-y}{x+y} = \frac{1}{4}$

$\therefore \quad 4x - 4y = x + y$

or, $3x = 5y$

or, $\frac{x}{y} = \frac{5}{3}$ or 5:3.

24. **(c)** Let, the speed of the motorboat in still water be x Km/h

$\frac{10}{x+2}+\frac{10}{x-2}=\frac{55}{60}$

or, $240x = 11x^2 - 44$

or, $11x^2 - 240x - 44 = 0$

$\therefore$ $(x - 22)(11x + 2) = 0$

So, $x = 22$ Km/h (neglecting the –ve value)

$\therefore$ Speed of the motorboat in still water = 22 Km/h.

25. **(a)** Let, upstream speed = x Km/h and downstream speed = y Km/h

Then, $\frac{30}{x}+\frac{44}{y} = 10$, and $\frac{40}{x}+\frac{55}{y} = 13$

or, $30u + 44v = 10$, and $40u + 55v = 13$,

where $u = \frac{1}{x}$ and $v = \frac{1}{y}$

Solving, we get $u = \frac{1}{5}$ and $v = \frac{1}{11}$ $\therefore$ $x = 5$ and $y = 11$

$\therefore$ Rate in still water = $\frac{5+11}{2} = 8$ Km/h

Rate of current = $\frac{11-5}{2} = 3$ Km/h.

EXERCISE-2
(BASED ON MEMORY)

2. **(b)** Let, the speed of the stream be y Km/h, and speed of the boat in still water be x Km/h.

$\therefore$ $x + y = 8$ and $x - y = 2$ $\Rightarrow$ $y = 3$, $x = 5$.

3. **(b)** Let, x Km/h and y Km/h be respective speeds of boat and stream, then

$x + y = \frac{18}{4} = 4.50$ ...(1)

$x - y = \frac{18}{12} = 1.50$ ...(2)

Solving Eqs. (1) and (2), we get $x = 3$, $y = 1.5$.

4. **(d)** Total time = 6 hours

Speed of the boat in still water = 4 Km/h

Let, the distance between M and N be D kms.

Let, speed of the stream be x Km/h

$D\left[\frac{1}{4+x}+\frac{1}{4-x}\right] = 6$

or, $D\left[\frac{4-x+4+x}{4^2-x^2}\right] = 6$ or, $\frac{8D}{16-x^2} = 6$

or, $D = \frac{6}{8}(16 - x^2) = \frac{3}{4}(16 - x^2)$

Since, the speed of the stream (x) is not given, the distance D cannot be determined.

5. **(a)** Speed in still water, S = 7.5 Km/h

Speed of current, Z = 1.5 Km/h

Upstream speed = S – Z = 6 Km/h

Downstream speed = S + Z = 9 Km/h

Let, the distance between the two points be x Km

$\therefore$ Total journey time = $\frac{x}{6}+\frac{x}{9}=\frac{50}{60}$

or, $x\left(\frac{3+2}{18}\right)=\frac{5}{6}$ or $x = \frac{5}{6}\times\frac{18}{5} = 3$ Km.

6. **(a)** Let, the distance one way be x Km and stream speed be Z Km/h.

Then, $x = 9(4 - Z) = 3(4 + Z)$

or, $3(4 - Z) = 4 + Z$ or, $12 - 3Z = 4 + Z$

or, $4Z = 8$ or, $Z = 2$ Km/h.

7. **(a)** Let, the speed of the boat in still water = x Km/h, and the rate of stream = y Km/h.

$\therefore$ Downstream rate = $(x + y)$ Km/h

Upstream rate = $(x - y)$ Km/h

Now, $\frac{20}{x+y} = 1$

or, $x + y = 20$ ...(1)

and, $\frac{20}{x-y} = 2$ or, $x - y = 10$ ...(2)

Solving (1) and (2), we get $x = 15$ Km/h.

8. **(b)** Let, the distance between A and B be x Km

Rate upstream = 4 – 2 = 2 Km/h

Rate downstream = 4 + 2 = 6 Km/h

As per the question, $\frac{x}{2}+\frac{x}{6} = 4$ or, $\frac{3x+x}{6} = 6$

or, $x = 9$ Km.

9. **(d)** Let, the velocity of the stream be x Km/h.

Then, the speed downstream = $(4 + x)$ Km/h, and the speed upstream = $(4 - x)$ Km/h.

$\because$ Distance covered downstream and upstream is equal

$\therefore$ $3(4 + x) = 9(4 - x)$

or, $12 + 3x = 36 - 9x$

or, $12x = 24$ or, $x = 2$.

10. (b) Rate upstream = $\frac{16}{2}$ Km/h = 8 Km/h.

Rate downstream = $\frac{16}{4}$ = 4 Km/h.

∴ Rate in still water = $\frac{1}{2}(8 + 4) = 6$ Km/h.

11. (d) Let, x be the speed of the boat, and y be the speed of the current.

$$\therefore \quad \frac{20}{x-y}+\frac{20}{x+y}=\frac{25}{36}$$

In the equation, there are two variables, but only one equation, so, the value of 'x' cannot be determined.

13. (b) Let, the required distance be x Km.

$$\therefore \quad \frac{x}{6-2}-\frac{x}{6+2} = 3$$

$$\Rightarrow \quad \frac{x}{4}-\frac{x}{8} = 3$$

$$\Rightarrow \quad \frac{x}{8} = 3$$

$$\therefore \quad x = 24 \text{ km}$$

14. (c) Let, the speed of boat in still water be x Km/h and that of current be y Km/h.

Now, according to the question,

$$\frac{12}{x-y}+\frac{18}{x+y}=3 \qquad \cdots(1)$$

$$\frac{36}{x-y}+\frac{24}{x+y}=\frac{13}{2} \qquad \cdots(2)$$

By equation (1) × 3 − equation (2),

$$\frac{54}{x+y}-\frac{24}{x+y}=9-\frac{13}{2}$$

$$\Rightarrow \quad \frac{30}{x+y}=\frac{5}{2} \quad \Rightarrow \quad x+y=12 \qquad \cdots(3)$$

From equation (1),

$$\frac{12}{x-y}+\frac{18}{12}=3$$

$$\Rightarrow \quad \frac{12}{x-y}=3-\frac{3}{2}=\frac{3}{2}$$

$$x-y=\frac{12\times 2}{3}=8 \qquad \cdots(4)$$

∴ Speed of current $=\frac{1}{2}(12-8)=2$ Km/h

15. (a) Let, the rate of stream be x Km/h.

∴ Rate downstream = $(10 + x)$ Km/h

Rate upstream $(10 - x)$ Km/h

Now, according to the question,

$$\frac{91}{10+x}+\frac{91}{10-x}=20$$

$$\Rightarrow \quad 91\left(\frac{10-x+10+x}{(10+x)(10-x)}\right)=20$$

$$\Rightarrow \quad (10+x)(10-x)=91$$

$$\Rightarrow \quad 100-x^2=91$$

$$\Rightarrow \quad x^2=100-91=9$$

$$\therefore \quad x=\sqrt{9}=3 \text{ Km/h}$$

16. (c) Let, speed of motorboat in still water be x Km/h and speed of stream be y Km/h.

Now, according to the question,

$$\frac{25}{x-y}+\frac{39}{x+y}=8 \qquad \cdots(1)$$

$$\frac{35}{x-y}+\frac{52}{x+y}=11 \qquad \cdots(2)$$

By equation $(1)\times 4-(2)\times 3$, we have $\frac{100}{x-y}-\frac{105}{x-y}=32-33$

$$\Rightarrow \quad \frac{-5}{x-y}=-1 \Rightarrow \quad x-y=5 \qquad \cdots(3)$$

Form equation (1),

$$\frac{25}{5}+\frac{39}{x+y}=8$$

$$\Rightarrow \quad \frac{39}{x+y}=8-5=3$$

$$\Rightarrow \quad x+y=13 \qquad \cdots(4)$$

By equation (4) − (5)

$$x+y-x+y=13-5=8$$

$$\Rightarrow \quad 2y=8$$

$$\Rightarrow \quad y=\left(\frac{8}{2}\right)=4 \text{ Km/h}$$

17. (d) ∴ The distance covered in $\frac{1}{4}$ hours (opposite to current) $=\frac{3}{4}$ Km

∴ Speed opposite to current (x) = 3 Km/h.

The distance covered in $\frac{1}{6}$ hours (with the current) $=\frac{3}{4}$ Km.

∴ Speed (with the current) (y) = 4.5 Km/h.

∴ Speed of boat $=\frac{x+y}{2}=\frac{3+4.5}{2}=3.75$ Km/h

∴ Speed of current $=\frac{y-x}{2}=\frac{4.5-3}{2}$ = 0.75 Km/h.

∴ Required ratio = 3.75:0.75 = 5:1

18. (b) Let, the speed of the boat be u and that of the streambe v.

Then speed of boat downstream = $u + v$

From statement I.

$$u+v=\frac{12}{2}=6 \text{ Km/h} \qquad \cdots(1)$$

And speed of boat upstream = $u - v$

From statement II.

$$u - v = \frac{12}{4} = 3 \text{ Km/h} \quad \cdots(2)$$

From statement III

$$v = \frac{u}{3} \quad \cdots(3)$$

From statement I and II

$u + v = 6$

$$\frac{u - v = 3}{2u = 9}$$

$$\therefore \quad u = \frac{9}{2} = 4.5 \text{ Km/h}$$

From statement I and III

$$u + \frac{u}{3} = 6 \quad \text{or,} \quad 4u = 18$$

$$u = \frac{18}{4} = 4.5 \text{ Km/h}$$

Hence, statement I and either II or III is sufficient to answer the question.

19. (b) From statement I. The length of the train = 240 m. Again, time is not given in the statement.

Hence, I alone is not sufficient.

From II. Time taken by the train to cross a pole is 24 seconds.

But the length (distance) is not given in the statement.

Hence, statement II alone is not sufficient.

From III. Time taken by the train to cross the platform is 48 seconds.

But the lengths of the train and the platform are not given.

Therefore, statement III alone is not sufficient.

Now, on combining statements I and II,we get

$$\text{Speed of the train} = \frac{240}{24} = 10 \text{ m/s}$$

Hence, both I and II together are sufficient to answer the question.