15 BOATS AND STREAMS

Importance : 'Boats and Streams' questions are special type of 'Time & distance' questions but as there are special 'tricks' and 'methods' to solve these questions hence it is easy and convenient to study them in separate chapter. Questions from this chapter have been asked in different competitive examinations.

Scope of questions : Questions specifically based on still water, down stream and upstream conditions are asked to calculate speed of boat/current swimmer, time in crossing and distance between two places.

Way to success : Ensure that you have understood the concept of downstream and upstream and also got expertise in solving questions from different 'formulae' and 'rules'.

SOME POINTS

If the speed of certain swimmer (or boat or ship) in still water is v km/h and the speed of stream is u km/h., then

(i) The speed of swimmer or boat or ship in the direction of stream (down stream) = (u + v) km/h.

(ii) The speed of swimmer or boat or ship in the opposite direction of stream (upstream)

=(v – u) km/h.

RULE 1 : If the speed of a swimmer/boat/ship in the direction of stream (downstream) is x km/h and in the opposite direction of stream (upstream) is y km/h, then,

(i) Speed of swimmer/boat/ship = $\frac{x+y}{2}$ km/h

(ii) Speed of stream = $\frac{x-y}{2}$ km/h

RULE 2 : Let the speed of boat is x km/h and speed of stream is y km/h. To travel d_1 km downstream and d_2 km upstream, the time taken is 't' hours, then

$$\frac{d_1}{x+y}+\frac{d_2}{x-y}=t$$

RULE 3 : Let the speed of stream be y km/h and speed of boat be x km/h. A boat travels equal distance upstream as well as down stream in 't' hours, then

$\frac{d}{x+y}+\frac{d}{x-y}=t$, d is the fixed distance or, $d=\frac{t(x^2-y^2)}{2x}$

RULE 4 : If a boat travels in downstream and upstream, then,

$$\text{Speed of boat} = \frac{\text{Sum of distances}}{2\times\text{time}}$$

$$= \frac{d_1+d_2}{2\times\text{time}} \text{ and}$$

$$\text{Speed of stream} = \frac{\text{Difference of distances}}{2\times\text{time}}$$

$$= \frac{d_1-d_2}{2\times\text{time}}$$

RULE 5 : A swimmer or a boat travels a certain distance upstream in t_1 hours, while it takes t_2 hours to travel same distance down stream, then,

$$\frac{\text{Speed of swimmer}}{\text{Speed of stream}} = \frac{t_1+t_2}{t_1-t_2}$$

RULE 6 : If a swimmer takes same time to travel d_1 km downstream and d_2 km upstream, then,

$$\frac{\text{Speed of swimmer or boat}}{\text{Speed of stream}} = \frac{d_1+d_2}{d_1-d_2}$$

RULE 7 : If a man or a boat covers x km distance in t_1 hours along the direction of stream (downstream) and covers the same distance in t_2 hours against the stream i.e. upstream, then

speed of man/boat = $\frac{x}{2}\left(\frac{1}{t_1}+\frac{1}{t_2}\right)$ km/hr

speed of stream = $\frac{x}{2}\left(\frac{1}{t_1}-\frac{1}{t_2}\right)$ km/hr

RULE 8 : If the speed of a boat or swimmer in still water is a km/hr and river is flowing with a speed of b km/hr, then average speed in going to a certain place and coming back to starting point is given by = $\frac{(a+b)(a-b)}{a}$ km/hr

❑❑❑

QUESTIONS ASKED IN PREVIOUS SSC EXAMS

TYPE–I

1. 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
(SSC CGL Prelim Exam. 11.05.2003 (First Sitting) & (SSC Section Officer (Commercial Audit) Exam. 25.09.2005)

2. A motorboat in still water travels at a speed of 36 kmph. It goes 56 km upstream in 1 hour 45 minutes. The time taken by it to cover the same distance down the stream will be :
(1) 2 hours 25 minutes
(2) 3 hours
(3) 1 hour 24 minutes
(4) 2 hours 21 minutes
(SSC CPO S.I. Exam. 16.12.2007)

3. A boat running downstream covers a distance of 20km in 2 hrs while it covers the same distance upstream in 5 hrs. Then speed of the boat in still water is
(1) 7 km/hr (2) 8 km/hr
(3) 9 km/hr (4) 10 km/hr
(SSC CPO S.I. Exam. 06.09.2009)

4. A boatman rows 1 km in 5 minutes, along the stream and 6 km in 1 hour against the stream. The speed of the stream is
(1) 3 kmph (2) 6 kmph
(3) 10 kmph (4) 12 kmph
(SSC CGL Tier-I Exam. 16.05.2010 (Second Sitting)

5. 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 speed of the current is
(1) 1 km/hr (2) 2 km/hr
(3) 1.5 km/hr (4) 2.5 km/hr
(SSC CPO S.I. Exam. 12.12.2010 (Paper-I)

6. The speed of a boat in still water is 10 km/hr. It covers (upstream) a distance of 45 km in 6 hours. The speed (in km/hr) of the stream is
(1) 2.5 (2) 3
(3) 3.5 (4) 4
(SSC CHSL DEO & LDC Exam. 28.11.2010 (IInd Sitting)

7. A man rows 40 km upstream in 8 hours and a distancec of 36 km downstream in 6 hours. Then speed of stream is
(1) 0.5 km/hr (2) 1.5 km/hr
(3) 1 km/hr (4) 3 km/hr
(SSC CHSL DEO & LDC Exam. 04.12.2011 (Ist Sitting (North Zone)

8. A boat travels 24 km upstream in 6 hours and 20 km downstream in 4 hours. Then the speed of boat in still water and the speed of water current are respectively
(1) 4 kmph and 3 kmph
(2) 4.5 kmph and 0.5 kmph
(3) 4 kmph and 2 kmph
(4) 5 kmph and 2 kmph
(SSC CHSL DEO & LDC Exam. 04.12.2011 (Ist Sitting (East Zone)

9. If a boat goes 100 km downstream in 10 hours and 75 km upstream in 15 hours, then the speed of the stream is
(1) 2 km/hour (2) 2·5 km/hour
(3) 3 km/hour (4) 3·5 km/hour
(SSC CHSL DEO & LDC Exam. 04.12.2011 (IInd Sitting (East Zone)

10. 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 ?
(1) 1.5 km/hr (2) 1 km/hr
(3) 2 km/hr (4) 2.5 km/hr
(SSC Graduate Level Tier-II Exam.16.09.2012)

11. A boy can swim in still water at a speed of 10 km/hr. If the speed of the current would have been 5 kmph, then the boy could swim 60km
(1) upstream in 4 hour
(2) downstream in 12 hours
(3) upstream in 6 hours
(4) downstream in 4 hours
(SSC CHSL DEO & LDC Exam. 28.10.2012, Ist Sitting)

12. A man can swim at the rate of 4 km/hr in still water. If the speed of the water is 2 km/hr, then the time taken by him to swim 10 km upstream is
(1) $2\frac{1}{2}$ hrs (2) $3\frac{1}{2}$ hrs
(3) 5 hrs (4) 4 hrs
(SSC CHSL DEO & LDC Exam. 04.11.2012, IInd Sitting)

13. Speed of a boat along and against the current are 12 km/hr and 8 km/hr respectively. Then the speed of the current in km/hr is
(1) 5 (2) 4
(3) 3 (4) 2
(SSC Multi-Tasking Staff Exam. 17.03.2013 (Kolkata Region)

14. A man can swim 3 km/hr. in still water. If the velocity of the stream is 2 km/hr., the time taken by him to swim to a place 10 km upstream and back is :
(1) $9\frac{1}{3}$ hr. (2) 10 hr.
(3) 12 hr. (4) $8\frac{1}{3}$ hr
(SSC Graduate Level Tier-I Exam. 21.04.2013, Ist Sitting)

15. A swimmer swims from a point A against a current for 5 minutes and then swims backwards in favour of the current for next 5 minutes and comes to the point B. If AB is 100 metres, the speed of the current (in km per hour) is :
(1) 0.4 (2) 0.2
(3) 1 (4) 0.6
(SSC Graduate Level Tier-I Exam. 21.04.2013)

16. A person can row a distance of one km upstream in ten minutes and downstream in four minutes. What is the speed of the stream ?
(1) 4.5 km/h (2) 4 km/h
(3) 9 km/h (4) 5.6 km/h
(SSC Graduate Level Tier-I Exam. 19.05.2013 Ist Sitting)

17. A boat goes 20 km downstream in one hour and the same distance upstream in two hours. The speed of the boat in still water is
(1) 15 km/hr. (2) 10 km/hr.
(3) 5 km/hr. (4) 7.5 km/hr.
(SSC CPO S.I. Exam. 12.01.2003

18. A man rows 750 m in 675 seconds against the stream and returns in $7\frac{1}{2}$ minutes. Find his rowing speed in still water.
(1) 3 kmph (2) 4 kmph
(3) 5 kmph (4) 6 kmph
(SSC Section Officer (Commercial Audit) Exam. 16.11.2003)

19. A boat goes 40 km upstream in 8 hours and 36 km downstream in 6 hours. The speed of the boat in still water is :
(1) 6.5 km/hour (2) 5.5 km/hour
(3) 6 km/hour (4) 5 km/hour
(SSC CGL Prelim Exam. 08.02.2004 (Second Sitting)

20. A boat goes 12 km downstream and comes back to the starting point in 3 hours. If the speed of the current is 3 km/hr, then the speed (in km/hr) of the boat in still water is
(1) 12 (2) 9
(3) 8 (4) 6
(SSC CISF ASI Exam. 29.08.2010 (Paper-1)

21. The speed of the current is 5 km/hour. A motorboat goes 10 km upstream and back again to the starting point in 50 minutes. The speed (in km/hour) of the motorboat in still water is
(1) 20 (2) 26
(3) 25 (4) 28
(SSC CPO (SI, ASI & Intelligence Officer) Exam. 28.08.2011 (Paper-I)

22. A man can row 15km/ hr downstream and 9 km/hr upstream. The speed of the boat in still water is
(1) 8 km/hr. (2) 10 km/hr.
(3) 15 km/hr. (4) 12 km/ hr.
(SSC CGL Prelim Exam. 27.07.2008 (Second Sitting)

23. A sailor goes 12 km downstream in 48 minutes and returns in 1 hour 20 minutes. The speed of the sailor in still water is :
(1) 12 km/hr (2) 12.5 km/ hr
(3) 13 km/hr (4) 15 km/hr
(SSC CHSL DEO & LDC Exam. 27.11.2010)

24. 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 km/hour (2) 8 km/hour
(3) 7.5 km/hour
(4) 6·8 km/hour
(SSC CHSL DEO & LDC Exam. 04.12.2011 (IInd Sitting (North Zone)

25. A man swims downstream a distance of 15 km in 1 hour. If the speed of the current is 5 km/ hour, 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
(SSC CHSL DEO & LDC Exam. 11.12.2011 (Ist Sitting (East Zone)

26. The speed of a stream is 3 km/ hr. and the speed of a man in still water is 5 km/hr. The time taken by the man to swim 26 km downstream is :
(1) $8\frac{2}{3}$ hrs. (2) $3\frac{1}{4}$ hrs.
(3) 13 hrs. (4) $5\frac{1}{5}$ hrs.
(SSC CHSL DEO & LDC Exam. 21.10.2012 (IInd Sitting)

27. A man rows down a river 15 km in 3 hrs. with the stream and returns in $7\frac{1}{2}$ hrs, The rate at which he rows in still water is
(1) 2.5 km/hr (2) 1.5 km/hr
(3) 3.5 km/hr (4) 4.5 km/hr
(SSC Graduate Level Tier-I Exam. 21.04.2013)

28. A boat takes half time in moving a certain distance downstream than upstream. The ratio of the speed of the boat in still water and that of the current is
(1) 2 : 1 (2) 1 : 2
(3) 4 : 3 (4) 3 : 1
(SSC CGL Tier-II Exam. 12.04.2015 TF No. 567 TL 9)

29. A man rows upstream 36 km and downstream 48 km taking 6 hours each time. The speed of the current is
(1) 0.5 kmph (2) 2 kmph
(3) 1 kmph (4) 1.5 kmph
(SSC CGL Tier-II Exam. 12.04.2015 TF No. 567 TL 9)

30. A man rows 750 m in 600 seconds against the stream and returns in $7\frac{1}{2}$ minutes. Its rowing speed in still water is (in km/ hr).
(1) 5.5 (2) 5.75
(3) 5 (4) 5.25
(SSC Constable (GD) Exam, 04.10.2015, IInd Sitting)

31. A boat moves downstream at the rate of 1 km in $7\frac{1}{2}$ minutes and upstream at the rate of 5 km an hour. What is the speed of the boat in the still water?
(1) $3\frac{1}{2}$ km/hour
(2) $6\frac{1}{2}$ km/hour
(3) 4 km/hour
(4) 8 km/hour
(SSC CGL Tier-II Exam, 25.10.2015, TF No. 1099685)

32. A boat goes 75 km upstream in 3 hours and 60 km downstream in 1.5 hours. The speed of the boat in still water is :
(1) 32.5 kmph (2) 30 kmph
(3) 65 kmph (4) 60 kmph
(SSC CPO Exam. 06.06.2016) (Ist Sitting)

33. A man rows to a place 35 km in distant and back in 10 hours 30 minutes. He found that he could row 5 km with the stream in the same time as he can row 4 km against the stream. Find the rate of flow of the stream.:
(1) 1 km/hr (2) 0.5 km/hr
(3) 0.75 km/hr (4) 1.5 km/hr
(SSC CAPFs (CPO) SI & ASI, Delhi Police Exam. 05.06.2016) (Ist Sitting)

34. A man can row upstream at 12 km/hr and downstream at 18 km/hr. The man's rowing speed in still water is
(1) 15 km/hr (2) 5 km/hr
(3) 3 km/hr (4) 10 km/hr
(SSC CGL Tier-I (CBE) Exam. 27.08.2016) (Ist Sitting)

35. A boat moves downstream at the rate of 8 km per hour and upstream at 4 km per hour. The speed of the boat in still waters is :
(1) 4.5 km per hour
(2) 5 km per hour
(3) 6 km per hour
(4) 6.4 km per hour
(SSC CGL Tier-I (CBE) Exam. 07.09.2016 (IIIrd Sitting)

TYPE–II

1. A boat goes 6 km an hour in still water, but takes thrice as much time in going the same distance against the current. The speed of the current (in km/hour) is :
(1) 4 (2) 5
(3) 3 (4) 2
(SSC CGL Prelim Exam. 11.05.2003 (Second Sitting)

2. In a fixed time, a boy swims double the distance along the current that he swims against the current. If the speed of the current is 3 km/hr, the speed of the boy in still water is
(1) 6 km/hr (2) 9 km/hr
(3) 10 km/hr (4) 12 km/hr
(SSC CGL Prelim Exam. 27.07.2008 (Second Sitting)

3. 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
(SSC CHSL DEO & LDC Exam. 11.12.2011 (Ist Sitting (Delhi Zone)

4. A person can row $7\frac{1}{2}$ km an hour in still water and he finds that it takes him twice as long to row up as to row down the river. The speed of the stream is :
(1) 2 km/hr (2) 3 km/hr
(3) $2\frac{1}{2}$ km/hr (4) $3\frac{1}{2}$ km/hr
(SSC CHSL DEO & LDC Exam. 11.12.2011 (IInd Sitting (East Zone)

5. A man can row at a speed of $4\frac{1}{2}$ km/hr in still water. If he takes 2 times as long to row a distance upstream as to row the same distance downstream, then, the speed of stream (in km/hr) is
(1) 1 (2) 1.5
(3) 2 (4) 2.5
(SSC CGL Prelim Exam. 04.02.2007 (IInd Sitting) and SSC CGL Prelim Exam. 27.07.2008)

6. A boat can travel with a speed of 13 km/hr in still water. If the speed of stream is 4 km/hr in the same direction, time taken by boat to go 63 km in opposite direction is
(1) 9 hrs (2) 4 hrs
(3) 7 hrs (4) $3\frac{9}{17}$ hrs
(SSC CGL Tier-I Exam, 09.08.2015 (IInd Sitting) TF No. 4239378)

7. The speed of a boat in still water is 6 kmph and the speed of the stream is 1.5 kmph. A man rows to a place at a distance of 22.5 km and comes back to the starting point. The total time taken by him is :
(1) 10 hours
(2) 4 hours 10 minutes
(3) 6 hours 10 minutes
(4) 8 hours
(SSC CGL Tier-I Exam, 16.08.2015 (IInd Sitting) TF No. 2176783)

8. A motor boat covers a certain distance downstream in a river in 3 hours. It covers the same distance upstream in 3 hours and a half. If the speed of water is 1.5 km/h, then the speed of the boat in still water is :
(1) 17 km/h (2) 19.5 km/h
(3) 17.5 km/h (4) 19 km/h
(SSC CHSL (10+2) LDC, DEO & PA/SA Exam, 06.12.2015 (Ist Sitting) TF No. 1375232)

TYPE–III

1. A man can row at 5 kmph. in still water. If the velocity of current is 1 kmph. and it takes him 1 hour to row to a place and come back, how far is the place ?
(1) 2.5 km (2) 3 km
(3) 2.4 km (4) 3.6 km
(SSC CGL Prelim Exam. 08.02.2004 (First Sitting)

2. The speed of a motor-boat is 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
(1) 5 hours 50 minutes
(2) 6 hours
(3) 6 hours 50 minutes
(4) 12 hours 10 minutes
(SSC CGL Prelim Exam. 04.02.2007 (First Sitting)

3. A man goes downstream with a boat to some destination and returns upstream to his original place in 5 hours. If the speed of the boat in still water and the stream are 10 km/hr and 4 km/hr respectively, the distance of the destination from the starting place is
(1) 16 km (2) 18 km
(3) 21 km (4) 25 km
(SSC CGL Prelim Exam. 27.07.2008 (First Sitting)

4. Two boats A and B start towards each other from two places, 108 km apart. Speed of the boat A and B in still water are 12km/hr and 15km/hr respectively. If A proceeds down and B up the stream, they will meet after.
(1) 4.5 hours (2) 4 hours
(3) 5.4 hours (4) 6 hours
(SSC CGL Prelim Exam. 27.07.2008 (Second Sitting)

5. A man can row 6 km/h in still water. If the speed of the current is 2 km/h, it takes 3 hours more in upstream than in the downstream for the same distance. The distance is
(1) 30 km (2) 24 km
(3) 20 km (4) 32 km
(SSC CGL Tier-1 Exam 26.06.2011 (First Sitting)

6. Speed of motorboat in still water is 45kmph. If the motorboat travels 80 km along the stream in 1 hour 20 minutes, then the time taken by it to cover the same distance against the stream will be
(1) 3 hours
(2) 1 hour 20 minutes
(3) 2 hours 40 minutes
(4) 2 hours 55 minutes
(SSC CPO S.I. Exam. 09.11.2008)

7. Speed of a boat is 5 km per hour in still water and the speed of the stream is 3 km per hour. If the boat takes 3 hours to go to a place and come back, the distance of the place is :
(1) 3.75 km (2) 4 km
(3) 4.8 km (4) 4.25 km
(SSC CHSL DEO & LDC Exam. 11.12.2011 (IInd Sitting (Delhi Zone)

8. The speed of a boat along the stream is 12 km/h and against the stream is 8 km/h. The time taken by the boat to sail 24 km in still water is
(1) 2 hours (2) 3 hours
(3) 2.4 hours (4) 1.2 hours
(SSC Constable (GD) & Rifleman (GD) Exam. 22.04.2012 (Ist Sitting)

9. On a river, Q is the mid-point between two points P and R on the same bank of the river. A boat can go from P to Q and back in 12 hours, and from P to R in 16 hours 40 minutes. How long would it take to go from R to P ?
(1) $3\frac{1}{3}$ hours (2) 5 hours
(3) $6\frac{2}{3}$ hours (4) $7\frac{1}{3}$ hours
(SSC CGL Tier-II Online Exam.01.12.2016)

10. A boat goes at 14 kmph along the stream and 8 kmph against the stream. The speed of the boat (in kmph) in still water is :
(1) 12 kmph (2) 11 kmph
(3) 10 kmph (4) 8 kmph
(SSC CGL Tier-I (CBE) Exam. 02.09.2016) (IInd Sitting)

11. Speed of a boat along and against the current are 14 kms/hr and 8 kms/hr respectively. The speed of the current is
(1) 11 km/hr (2) 6 km/hr
(3) 5.5 km/hr (4) 3 km/hr
(SSC CGL Tier-I (CBE) Exam. 07.09.2016) (Ist Sitting)

12. If the speed of a boat in still water is 20 km/hr and the speed of the current is 5 km/hr, then the time taken by the boat to travel 100 km with the current is :
(1) 2 hours (2) 3 hours
(3) 4 hours (4) 7 hours
(SSC CGL Tier-I (CBE) Exam. 10.09.2016 (IIIrd Sitting)

SHORT ANSWERS

TYPE-I

1. (2)	**2.** (3)	**3.** (1)	**4.** (1)
5. (2)	**6.** (1)	**7.** (1)	**8.** (2)
9. (2)	**10.** (3)	**11.** (4)	**12.** (3)
13. (4)	**14.** (3)	**15.** (4)	**16.** (1)
17. (1)	**18.** (3)	**19.** (2)	**20.** (2)
21. (3)	**22.** (4)	**23.** (1)	**24.** (2)
25. (4)	**26.** (2)	**27.** (3)	**28.** (4)
29. (3)	**30.** (4)	**31.** (2)	**32.** (1)
33. (3)	**34.** (1)	**35.** (3)	

TYPE-II

1. (1)	**2.** (2)	**3.** (2)	**4.** (3)
5. (2)	**6.** (3)	**7.** (4)	**8.** (2)

TYPE-III

1. (3)	**2.** (3)	**3.** (3)	**4.** (2)
5. (2)	**6.** (3)	**7.** (3)	**8.** (3)
9. (4)	**10.** (2)	**11.** (4)	**12.** (3)

EXPLANATIONS

TYPE-I

1. (2) Tricky Approach
Rate downstream
$= \frac{18}{4} = \frac{9}{2}$ kmph
Rate upstream $= \frac{18}{12} = \frac{3}{2}$ kmph.
Now, speed of the stream
$= \frac{\text{Rate downstream} - \text{Rate upstream}}{2}$
$= \frac{\frac{9}{2} - \frac{3}{2}}{2} = \frac{6}{4} = \frac{3}{2} = 1.5$ kmph.
Aliter : Using Rule 7,
Here, x = 18, t_1 = 4, t_2 = 12
Speed of stream $= \frac{x}{2}\left(\frac{1}{t_1} - \frac{1}{t_2}\right)$
$= \frac{18}{2}\left(\frac{1}{4} - \frac{1}{12}\right)$
$= 9\left(\frac{3-1}{12}\right)$
= 1.5 km/hr

2. (3) Speed of the motorboat upstream
$= \frac{56\,\text{km}}{1\frac{3}{4}\,\text{hours}} = \frac{56 \times 4}{7} = 32$ kmph
Let the speed of the current be x kmph
$\therefore$ 36 – x = 32
$\Rightarrow$ x = 36 – 32 = 4 kmph
Speed of motor boat downstream = 36 + 4 = 40 kmph
$\therefore$ Time taken to cover 56 km at 40 kmph = $\frac{56}{40} = \frac{7}{5}$ hours
or 1 hour 24 minutes

3. (1) Let the speed of boat in still water be x kmph and that of stream be y kmph.
$\therefore$ $\frac{20}{x+y} = 2$
$\Rightarrow$ $x + y = 10$ ...(i)
$\frac{20}{x-y} = 5$
$\Rightarrow$ $x - y = 4$ ...(ii)
On adding, $2x$ = 14 kmph
= 7 kmph
Aliter : Using Rule 7,
Here, x = 20, t_1 = 2, t_2 = 5
Speed of Boat $= \frac{x}{2}\left(\frac{1}{t_1} + \frac{1}{t_2}\right)$
$= \frac{20}{2}\left(\frac{1}{2} + \frac{1}{5}\right) = 7$ km/hr

4. (1) Tricky Approach
Speed of current
$= \frac{1}{2}$ (Rate downstream – Rate upstream) $= \frac{1}{2}$ (12 – 6) kmph
= 3 kmph [Rate downstream
$= \frac{1}{5} \times 60 = 12$ kmph]
Aliter : Using Rule 1,
Here, x = $\frac{1}{5} \times 60 = 12$ km/hr
y = 6 km/hr
Speed of Stream $= \left(\frac{x-y}{2}\right)$
$= \left(\frac{12-6}{2}\right)$
= 3km/hr

5. (2) Let speed of boat in still water = x kmph
and speed of current = y kmph
$\therefore$ $\frac{24}{x-y} + \frac{36}{x+y} = 6$ .....(i)

and, $\frac{24}{x+y}+\frac{36}{x-y}=\frac{13}{2}$ .....(ii)

By equation (i) × 2 – equation (ii) × 3, we have

$\frac{48}{x-y}-\frac{108}{x-y}=12-\frac{39}{2}$

$\Rightarrow \frac{60}{x-y}=\frac{15}{2}$

$\Rightarrow x-y=8$ ..... (iii)

By equation (i) × 3 – equation (ii) × 2, we have

$\frac{108}{x+y}-\frac{48}{x+y}=18-13$

$\Rightarrow \frac{60}{x+y}=5$

$\Rightarrow x+y=12$ ..... (iv)

From equation (iv) – (iii), we have

$x + y - x + y = 12 - 8$

$\Rightarrow 2y = 4 \Rightarrow y = 2$ kmph

6. (1) Upstream speed of boat

$=\frac{\text{Distance}}{\text{Time}}=\frac{45}{6}=\frac{15}{2}$

=7.5 kmph

∴ Speed of current = 10 – 7.5

= 2.5 kmph

Aliter : Using Rule 1,

Speed of Boat = 10 km/hr

Let, x = Speed of Boat (Down Stream)

y = Speed of Boat (Up Stream)

$= \frac{45}{6}$ km/hr

Speed of Boat = $\frac{x+y}{2}$

$10=\frac{x+\frac{45}{6}}{2}$

120 = 6x + 45

6x = 75

$x = \frac{75}{6} = \frac{25}{2}$ km/hr

Speed of Stream = $\frac{x-y}{2}$

$=\frac{1}{2}\left[\frac{25}{2}-\frac{45}{6}\right]$

$=\frac{1}{2}\left[\frac{75-45}{6}\right]$

= 2.5 km/hr

7. (1) Speed of stream

$=\frac{1}{2}\left(\frac{36}{6}-\frac{40}{8}\right)$

$=\frac{1}{2}$ = 0.5 kmph

Aliter : Using Rule 1,

Here, $x = \frac{36}{6}$ = 6 km/hr

$y = \frac{40}{8}$ = 5 km/hr

Speed of Stream

$=\frac{x-y}{2}=\frac{6-5}{2}$

= 0.5 km/hr

8. (2) Rate upstream = 4 kmph

Rate downstream = 5 kmph

∴ Speed of boat in still water

$=\frac{1}{2}(4+5)$

= 4.5 kmph

Speed of current = $\frac{1}{2}$ (5 – 4)

= 0.5 kmph

Aliter : Using Rule 1,

Here, $x = \frac{20}{4}$ = 5 km/hr

$y = \frac{24}{6}$ = 4 km/hr

Speed of Boat = $\frac{x+y}{2}=\frac{5+4}{2}$

= 4.5 km/hr

Speed of Stream = $\frac{x-y}{2}=\frac{5-4}{2}$

= 0.5 km/hr

9. (2) Rate downstream = 10 kmph

Rate upstream = 5 kmph

∴ Speed of current

$=\frac{1}{2}(10-5)$ kmph

= 2.5 kmph

Aliter : Using Rule 1,

Here, $x = \frac{100}{10}$ = 10 km/hr

$y = \frac{75}{15}$ = 5 km/hr

Speed of Stream

$=\left(\frac{x-y}{2}\right)=\left(\frac{10-5}{2}\right)$

= 2.5 km/hr

10. (3) Let the speed of boat in still water be x kmph and that of current be y kmph, then

$\frac{12}{x-y}+\frac{18}{x+y}=3$ ....(i)

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

By equation (i) × 3 – equation (ii),

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

$\Rightarrow \frac{30}{x+y}=\frac{5}{2} \Rightarrow x+y=12$... (iii)

From equation (i),

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

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

$\Rightarrow x-y=\frac{12\times 2}{3}=8$ ..... (iii)

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

= 2 kmph

11. (4) Rate downstream

= 10 + 5 = 15 kmph

Rate upstream = 10 – 5 = 5 kmph

Time taken in swimming 60km downstream

$= \frac{60}{15}$ = 4 hours

Time taken in swimming 60km upstream

$= \frac{60}{5}$ =12 hours

From, given options, boy can swim 60km downstream in 4 hrs.

12. (3) Rate upstream
= 4 – 2 = 2 kmph

$\therefore$ Required time $= \frac{10}{2} = 5$ hours

13. (4) Using Rule 1,
Speed of current

$= \frac{1}{2}$ (Rate downstream – rate upstream)

$= \frac{1}{2}(12-8) = 2$ kmph

14. (3) Rate downstream = 5 kmph
Rate upstream = 1 kmph
$\therefore$ Required time

$= \frac{10}{5} + \frac{10}{1} = 12$ hours

15. (4)

The distance covered upstream
= AC = d
AB = 100
BC = 100 + d
Rate upstream
= $(x - y)$ m/minute
Rate downstream
= $(x + y)$ m/minute

$\therefore \frac{d}{x-y} = 5$

$\Rightarrow d = 5(x-y)$ ....(i)
Again,

$\frac{100+d}{x+y} = 5$

$\Rightarrow \frac{100+5(x-y)}{x+y} = 5$ (By (i))

$\Rightarrow 100 + 5x - 5y = 5x + 5y$
$\Rightarrow 10y = 100$
$\Rightarrow y = 10$ m/minute

$= \frac{10}{1000} \times 60$ kmph
= 0.6kmph

16. (1) Using Rule 1,
Speed in still water = x km/h
Speed of current = y km/h

$\therefore x + y = \frac{1}{\frac{4}{60}} = 15$

$x - y = \frac{1}{\frac{10}{60}} = 6$

$\therefore$ Speed of current

$= \frac{1}{2}[(x+y)-(x-y)]$

$= \frac{1}{2}(15-6) = \frac{9}{2} = 4.5$ km/h

17. (1) Let the speed of boat in still water be x kmph and the rate of stream be y kmph.
$\therefore$ Downstream rate
= (x + y) kmph and upstream rate
= (x – y) kmph.

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

$\Rightarrow$ x + y = 20 ..(i)

and $\frac{20}{x-y} = 2$

$\Rightarrow$ x – y = 10 ...(ii)
From (i) and (ii) we have
x = 15 kmph.

Aliter : Using Rule 7,

Here, x = 20, $t_1 = 1$, $t_2 = 2$

Speed of Boat $= \frac{x}{2}\left(\frac{1}{t_1} + \frac{1}{t_2}\right)$

$= \frac{20}{2}\left(\frac{1}{1} + \frac{1}{2}\right)$

= 15 km/hr

18. (3) Let the speed of man in still water be x kmph and rate of stream be y kmph

$\therefore$ Distance $= \frac{750}{1000}$ km $= \frac{3}{4}$ km.
Time = 675 seconds

$= \frac{675}{60} = 11\frac{1}{4}$ minutes

$\therefore x - y = \frac{\frac{3}{4}}{\frac{45}{4}} = \frac{3}{45} = \frac{1}{15}$ km/min

and $x + y = \frac{\frac{3}{4}}{\frac{15}{2}}$

$= \frac{3}{4} \times \frac{2}{15} = \frac{1}{10}$ km/min
$\therefore$ Speed in still water

$= \frac{1}{2}\left(\frac{1}{10} + \frac{1}{15}\right) = \frac{1}{2}\left(\frac{3+2}{30}\right)$

$= \frac{1}{12}$ km/min

$= \frac{1}{12} \times 60$ kmph = 5 kmph

Aliter : Using Rule 1,

Here, x = $\frac{750\text{m}}{\frac{15}{2}\text{min}}$

$= \frac{750}{1000} \times \frac{2 \times 60}{15}$

= 6 km/hr

y = $\frac{750\text{m}}{675\,\text{min}}$

$= \frac{750}{1000} \times \frac{3600}{675} = 4$hrs

Speed of Boat = $\frac{1}{2}(x+y)$

$= \frac{1}{2}(6+4) = 5$km/hrs

19. (2) Speed upstream $= \frac{40}{8}$

= 5 kmph

Speed downstream $= \frac{36}{6}$

= 6 kmph
$\therefore$ Speed of boat in still water

$= \frac{1}{2}(5+6) = 5.5$ kmph

Aliter : Using Rule 1,

Here, x $= \frac{36}{6} = 6$ km/hr

y $= \frac{40}{8} = 5$ km/hr

Speed of Boat $= \frac{1}{2}(x+y)$

$= \frac{1}{2}(6+5) = 5.5$ km/hr

20. (2) Using Rule 3,

Tricky Approach

Let the speed of boat in still water be x kmph, then

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

$\Rightarrow 12\left(\frac{x-3+x+3}{(x+3)(x-3)}\right) = 3$

$\Rightarrow 4 \times 2x = x^2 - 9$
$\Rightarrow x^2 - 8x - 9 = 0$
$\Rightarrow x^2 - 9x + x - 9 = 0$

$\Rightarrow x(x-9)+1(x-9)=0$
$\Rightarrow (x-9)(x+1)=0$
$\Rightarrow x=9$ because $x\neq -1$
$\therefore$ Speed can't be negetive.
Hence, speed of boat in still water = 9 kmph

21. (3) Using Rule 3,
Let the speed of motorboat in still water be x kmph.

$$\therefore \frac{10}{x-5}+\frac{10}{x+5}=\frac{50}{60}$$

$$\Rightarrow 10\left(\frac{x+5+x-5}{(x+5)(x-5)}\right)=\frac{5}{6}$$

$\Rightarrow 20x\times 6=(x^2-25)\times 5$
$\Rightarrow x^2-24x-25=0$
$\Rightarrow x^2-25x+x-25=0$
$\Rightarrow x(x-25)+1(x-25)=0$
$\Rightarrow (x-25)(x+1)=0$
$\Rightarrow x=25$ because $x\neq -1$
Speed of motorboat in still water = 25 kmph

22. (4) Using Rule 1,
Speed of boat in still water

$$=\frac{1}{2}\text{ (Rate downstream + Rate upstream)}=\frac{1}{2}(15+9)$$

$$=\frac{1}{2}\times 24=12\text{ kmph}$$

23. (1) Let the speed of sailor in still water be x kmph.
and Speed of current = y kmph

$$\therefore x+y=\frac{12}{\frac{48}{60}}=\frac{12}{48}\times 60=15\text{ kmph}$$

$$\text{and, } x-y=\frac{12}{\frac{80}{60}}=\frac{12\times 60}{80}$$

= 9 kmph
Adding these equations,
$2x = 15 + 9 = 24$
$\Rightarrow x = 12$ kmph
Aliter : Using Rule 1,

$$\text{Here, x}=\frac{12}{48}\times 60\text{ km/hr}$$

$$=15\text{ km/hr}$$

$$\text{y}=\frac{12}{1\frac{1}{3}}=9\text{ km/hr}$$

$$\text{Speed of Boat}=\frac{1}{2}(\text{x}+\text{y})$$

$$=\frac{1}{2}(15+9)=12\text{ km/hr}$$

24. (2) Using Rule 3,
Let the speed of boat in still water be x kmph.

$$\therefore \frac{6}{x+4}+\frac{6}{x-4}=2$$

$$\Rightarrow 6\left(\frac{x-4+x+4}{(x+4)(x-4)}\right)=2$$

$\Rightarrow 6x=x^2-16$
$\Rightarrow x^2-6x-16=0$
$\Rightarrow x^2-8x+2x-16=0$
$\Rightarrow x(x-8)+2(x-8)=0$
$\Rightarrow (x+2)(x-8)=0$
$\Rightarrow x=8$ kmph and $x\neq -2$ kmph

25. (4) Let the speed of man in still water be x kmph.

$$\therefore \frac{15}{x+5}=1$$

$\Rightarrow x+5=15 \Rightarrow x=10$ kmph
$\therefore$ Time taken in swimming upstream

$$=\frac{15}{10-5}=3\text{ hours}$$

26. (2) $\text{Time}=\dfrac{\text{Distance}}{\text{Rate downstream}}$

$$=\frac{26}{5+3}=\frac{13}{4}=3\frac{1}{4}\text{ hours}$$

27. (3) Let speed of person in still water = x kmph and speed of current = y kmph

$$\therefore x+y=\frac{15}{3}=5\text{ kmph}$$

$$\&\ x-y=\frac{15}{\frac{15}{2}}=2\text{ kmph}$$

On adding,

$$2x=7\Rightarrow x=\frac{7}{2}=3.5\text{ kmph}$$

Aliter : Using Rule 1,

$$\text{Here, x}=\frac{15}{3}=5\text{ km/hr}$$

$$\text{y}=\frac{15}{\frac{15}{2}}=2\text{ km/hr}$$

$$\text{Speed of Boat}=\frac{1}{2}(\text{x}+\text{y})$$

$$=\frac{1}{2}(5+2)=3.5\text{ km/hr}$$

28. (4) Speed of boat in still water = x kmph (let)
Speed of current = y kmph
Rate downstream = $(x+y)$ kmph
Rate upstream = $(x-y)$ kmph
Distance = Speed × Time
$\therefore (x-y)\times 2t=(x+y)\times t$
$\Rightarrow 2x-2y=x+y$
$\Rightarrow 2x-x=2y+y \Rightarrow x=3y$

$$\Rightarrow \frac{x}{y}=\frac{3}{1}=3:1$$

29. (3) Rate downstream of boat

$$=\frac{48}{6}=8\text{ kmph}$$

$$\text{Rate upstream}=\frac{36}{6}=6\text{ kmph}$$

$$\therefore \text{ Speed of current}=\frac{1}{2}\text{ (Rate down stream – rate upstream)}$$

$$=\frac{1}{2}(8-6)=1\text{ kmph}$$

Aliter : Using Rule 1,

$$\text{Here, x}=\frac{48}{6}=8\text{ km/hr}$$

$$\text{y}=\frac{36}{6}=6\text{ km/hr}$$

$$\text{Speed of Current}=\frac{1}{2}(\text{x}-\text{y})$$

$$=\frac{1}{2}(8-6)=1\text{ km/hr}$$

30. (4) Rate downstream

$$=\left(\frac{750}{\frac{15}{2}}\right)\text{m/minute}$$

= 100 m/minute

$$=\frac{100\times 60}{1000}\text{ kmph}=6\text{ kmph}$$

Rate upstream

$$=\left(\frac{750}{600}\times\frac{18}{5}\right)\text{ kmph}$$

= 4.5 kmph
$\therefore$ Rowing speed in still water

$$=\frac{1}{2}(6+4.5)=\frac{10.5}{2}$$

= 5.25 kmph

Aliter : Using Rule 1,

Here, $x = \frac{750\,m}{\frac{15}{2}\,min}$

$= \frac{750 \times 2 \times 60}{1000 \times 15} = 6$ km/hr

$y = \frac{750\,m}{600\,s} = \frac{750 \times 3600}{1000 \times 600}$

$= 4.5$ km/hr

Speed of Boat $= \frac{1}{2}(x + y)$

$= \frac{1}{2}(6 + 4.5)$

$= 5.25$ km/hr

31. (2) Rate downstream of boat

$= \left(\frac{1}{\frac{15}{2 \times 60}}\right)$ kmph

$= \frac{2 \times 60}{15} = 8$ kmph

Rate upstream of boat

$= 5$ kmph

$\therefore$ Speed of boat in still water

$= \frac{1}{2}$ (Rate downstream + Rate upstream)

$= \frac{1}{2}(8 + 5) = \frac{13}{2}$ kmph

$= 6\frac{1}{2}$ kmph

Aliter : Using Rule 1,

Here, $x = \frac{1\,km}{\frac{15}{2}\,min}$

$= \frac{2 \times 60}{15}$ km/hr

$= 8$ km/hr

$y = 5$ km/hr

Speed of Boat $= \frac{1}{2}(x + y)$

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

$= 6\frac{1}{2}$ km/hr

32. (1) Rate upstream of boat

$= \frac{75}{3} = 25$ kmph

Rate downstream of boat

$= \frac{60}{1.5} = 40$ kmph

$\therefore$ Speed of boat in still water

$= \frac{1}{2}(25 + 40)$

$= \left(\frac{1}{2} \times 65\right)$ kmph

$= 32.5$ kmph

33. (3) Speed of man in still water = x kmph.

Speed of current = y kmph

Rate downstream

$= (x + y)$ kmph

Rate upstream $= (x - y)$ kmph

According to the question,

$\frac{5}{x+y} = \frac{4}{x-y}$

$\Rightarrow 5x - 5y = 4x + 4y$

$\Rightarrow x = 5y + 4y = 9y$

Again, $\frac{35}{x+y} + \frac{35}{x-y} = 10\frac{1}{2} = \frac{21}{2}$

$\Rightarrow \frac{35}{9y+y} + \frac{35}{9y-y} = \frac{21}{2}$

$\Rightarrow \frac{5}{10y} + \frac{5}{8y} = \frac{3}{2}$

$\Rightarrow \frac{1}{y} + \frac{5}{4y} = 3$

$\Rightarrow \frac{4+5}{4y} = 3$

$\Rightarrow 9 = 12y$

$\Rightarrow y = \frac{9}{12} = \frac{3}{4}$ kmph

34. (1) Rate downstream

$= 18$ kmph

Rate upstream $= 12$ kmph

$\therefore$ Speed of boat in still water

$= \frac{1}{2}$ (rate downstream + rate upstream)

$= \frac{1}{2}(18 + 12) = 15$ kmph

35. (3) Speed of boat in still water = $\frac{1}{2}$ (Rate downstream + rate upstream)

$= \frac{1}{2}(8 + 4)$ kmph $= \left(\frac{12}{2}\right)$ kmph

$= 6$ kmph

TYPE-II

1. (1) Let the speed of the current be x kmph.

According to the question,

$\frac{6}{6-x} = 3$

$\Rightarrow 18 - 3x = 6 \Rightarrow 3x = 18 - 6$

$\Rightarrow x = \frac{12}{3} = 4$ kmph.

Aliter : Using Rule 5,

Here, Speed of boat $= 6$ km/hr

$t_1 = 3x$, $t_2 = x$

$\frac{\text{Speed of Boat}}{\text{Speed of Stream}} = \frac{t_1 + t_2}{t_1 - t_2}$

$\frac{6}{\text{Speed of Stream}} = \frac{3x + x}{3x - x}$

Speed of current $= 3$ km/hr

2. (2) Let the rate of swimming in still water be x kmph

$\therefore$ Rate down-stream

$= (x + 3)$ kmph

$\therefore$ Rate up-stream $= (x - 3)$ kmph

According to the question,

$(x + 3)\ t = 2\ (x - 3) \times t$

$\Rightarrow x + 3 = 2x - 6$

$\Rightarrow x = 9$ kmph

Aliter : Using Rule 5,

Here, $t_1 = 2x$, $t_2 = x$

Speed of Stream $= 3$ km/hr

$\frac{\text{Speed of Boat}}{\text{Speed of Stream}} = \frac{t_1 + t_2}{t_1 - t_2}$

$\frac{\text{Speed of Boat}}{3} = \frac{2x + x}{2x - x}$

Speed of Boy $= 9$ km/hr

3. (2) Let the speed of stream be x kmph, then speed of boat in still water $= 4x$ kmph

$\therefore$ Rate downstream

$= 4x + x = 5x$ kmph

Rate upstream $= 4x - x$

$= 3x$ kmph

$\therefore \frac{30}{3x} + \frac{30}{5x} = 8 \Rightarrow \frac{10}{x} + \frac{6}{x} = 8$

$\Rightarrow \frac{16}{x} = 8 \Rightarrow x = \frac{16}{8} = 2$ kmph

4. (3) Let the speed of current be x kmph.

$\therefore\ 2\left(\frac{15}{2}-x\right)=\frac{15}{2}+x$

$\Rightarrow 15-2x=\frac{15}{2}+x$

$\Rightarrow 3x=15-\frac{15}{2}=\frac{15}{2}$

$\Rightarrow x=\frac{5}{2}=2\frac{1}{2}$ kmph

Aliter : Using Rule 5,

Here, Speed of Boat= $\frac{15}{2}$ km/hr

$t_1 = 2x,\ t_2 = x$

$\frac{\text{Speed of Boat}}{\text{Speed of Stream}}=\frac{t_1+t_2}{t_1-t_2}$

$\left(\frac{15}{2}\right)$ Speed of Stream

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

Speed of Stream = 2.5 km/hr

5. (2) Let the speed of stream be x kmph

$\therefore$ Rate upstream $=\frac{9}{2}-x$

Rate downstream $=\frac{9}{2}+x$

Then,

$\frac{2}{\frac{9}{2}+x}=\frac{1}{\frac{9}{2}-x}$

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

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

$\Rightarrow x=\frac{9}{2\times 3}=\frac{3}{2}=1.5$ kmph

Aliter : Using Rule 5,

Here, Speed of Boat= $\frac{9}{2}$ km/hr

$t_1 = 2x,\ t_2 = x$

$\frac{\text{Speed of Boat}}{\text{Speed of Stream}}=\frac{t_1+t_2}{t_1-t_2}$

$\frac{9}{2\times\text{Speed of stream}}=\frac{2x+x}{2x-x}$

Speed of Stream = 1.5 km/hr

6. (3) Rate upstream of boat
= 13 – 4 = 9 kmph

$\therefore$ Required time = $\frac{\text{Distance}}{\text{Speed}}$

$=\frac{63}{9}=7$ hours

Aliter : Using Basic Formula,

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

7. (4) Rate downstream
= (6 + 1.5) kmph = 7.5 kmph
Rate upstream = (6 – 1.5) kmph
= 4.5 kmph
According to the question,

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

$\therefore$ Required time = $\frac{22.5}{7.5}+\frac{22.5}{4.5}$

= 3 + 5 = 8 hours.

Aliter : Using Basic Formula,

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

8. (2) Let the speed of boat in still water be x kmph and the distance be y km.

$\therefore$ Rate downstream
= (x + 1.5) kmph
Rate upstream
= (x – 1.5) kmph
According to the question,

$\frac{y}{x+1.5}=3$ --- (i)

$\frac{y}{x-1.5}=\frac{7}{2}$ --- (ii)

On dividing equation (i) by (ii),

$\frac{x-1.5}{x+1.5}=\frac{3\times 2}{7}=\frac{6}{7}$

$\Rightarrow 7x-10.5=6x+9$

$\Rightarrow x = 10.5 + 9 = 19.5$ kmph.

Aliter : Using Rule 5,

Here, $t_1 = 3.5,\ t_2 = 3$

Speed of Stream = 1.5 km/hr

$\frac{\text{Speed of Boat}}{\text{Speed of Stream}}=\frac{t_1+t_2}{t_1-t_2}$

$\frac{\text{Speed of Boat}}{1.5}=\frac{3.5+3}{3.5-3}$

Speed of Boat = $\frac{6.5\times 1.5}{0.5}$

= 19.5 km/hr

TYPE-III

1. (3) Let the distance be x km.
Speed upstream = 5 – 1
= 4 kmph
Speed downstream
= 5 + 1 = 6 kmph

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

$\Rightarrow\frac{2x+3x}{12}=1$

$\Rightarrow 5x = 12$

$\Rightarrow x=\frac{12}{5}=2.4$ km

Aliter : Using Rule 8,

Here, a = 5, b = 1

Average Speed = $\frac{(a+b)(a-b)}{a}$

$=\frac{(5+1)(5-1)}{5}$

$=\frac{24}{5}=4.8$ km/hr

Distance = $\frac{1}{2}\times 4.8 = 2.4$ km

2. (3) Let the speed of motor-boat be 36 x kmph and
and Speed of current = 5x kmph
The boat goes along with the current in 5 hours 10 minutes i.e.

$\frac{31}{6}$ hours.

$\therefore$ Distance = $\frac{31}{6}\times(36x+5x)$

$=\frac{41x\times 31}{6}$ km.

Rate upstream = 36x – 5x
= 31x kmph

$\therefore$ Time taken = $\frac{41x\times\frac{31}{6}}{31x}$

$=\frac{41}{6}$ hours

or 6 hours 50 minutes

3. (3) Let the distance of the destination from the starting point be x km.
Rate downstream= (10 + 4) kmph
= 14 kmph
Rate upstream = (10 – 4) kmph
= 6 kmph

According to the question,

$$\frac{x}{14}+\frac{x}{6}=5$$

$$\Rightarrow \frac{3x+7x}{42}=5$$

$$\Rightarrow 10x = 42 \times 5$$

$$\Rightarrow x = \frac{42\times 5}{10} = 21 \text{ km}$$

Aliter : Using Rule 3,
Here, x = 10, y = 4, t = 5

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

$$= \frac{5(10^2-4^2)}{2\times 10}$$

$$= \frac{84}{4} = 21 \text{ km}$$

4. (2) Let the speed of the stream be x kmph and both the boats meet after t hours
According to the question ,
$(12 + x)\ t + (15 - x)\ t = 108$
$\Rightarrow 12t + 15t = 108$
$\Rightarrow 27t = 108$

$$\Rightarrow t = \frac{108}{27} = 4 \text{ hours}$$

5. (2) Let the required distance be x km.

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

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

$$\Rightarrow \frac{2x-x}{8}=3$$

$\Rightarrow x = 3 \times 8 = 24$ km.
Aliter : Using Rule 5,
Here, Speed of Boat = 6 km/hr
Speed of Current = 2 km/hr

$$t_1 = 3 + t_2$$

$$\frac{\text{Speed of Boat}}{\text{Speed of Current}} = \frac{t_1+t_2}{t_1-t_2}$$

$$\frac{6}{2} = \frac{3+2t_2}{3}$$

$$9 = 3 + 2t_2$$

$$t_2 = 3 \text{ hrs}$$

Distance = Speed × time
= (6 + 2) × 3 = 24 km

6. (3) Let the speed of the current be x kmph
$\therefore$ Rate downstream
= $(x + 45)$ kmph.
According to the question,

$$\frac{80}{x+45} = 1 \text{ hour } 20 \text{ minutes}$$

$$= \frac{4}{3} \text{ hours}$$

$\Rightarrow 4x + 180 = 240$
$\Rightarrow 4x = 240 - 180 = 60$

$$\Rightarrow x = \frac{60}{4} \text{ kmph} = 15 \text{ kmph}$$

Rate upstream
= 45 – 15 = 30 kmph

$$\therefore \text{Required time} = \frac{80}{30} \text{ hours}$$

$$= \frac{8}{3} = 2 \text{ hours } 40 \text{ minutes}$$

7. (3) Let the required distance be x km, then

$$\frac{x}{5+3}+\frac{x}{5-3}=3$$

$$\Rightarrow \frac{x}{8}+\frac{x}{2}=3$$

$$\Rightarrow \frac{x+4x}{8}=3$$

$$\Rightarrow 5x = 24$$

$$\Rightarrow x = \frac{24}{5} = 4.8 \text{ km}$$

Aliter : Using Rule 3,
Here, x = 5, y = 3, t = 3

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

$$= \frac{3(5^2-3^2)}{2\times 5} = \frac{3\times 16}{10}$$

= 4.8 km

8. (3) Let the speed of boat in still water be x kmph and that of current be y kmph., then

$x + y = 12$
$x - y = 8$

$\Rightarrow 2x = 20$
$\Rightarrow x = 10$ kmph.

$$\therefore \text{Required time} = \frac{24}{10} = 2.4 \text{ hours}$$

Aliter : Using Rule 1,
Here, x = 12, y = 8

$$\text{Speed of Boat} = \left(\frac{x+y}{2}\right)$$

$$= \left(\frac{12+8}{2}\right) = 10 \text{ km/hr}$$

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

$$= \frac{24}{10} = 2.4 \text{ hrs.}$$

9. (4) Let PQ = QR = z km.
Let speed of boat in still water be x kmph. and speed of current be y kmph.
According to the question,

$$\frac{z}{x+y}+\frac{z}{x-y}=12 \quad \text{... (i)}$$

$$\text{and } \frac{2z}{x-y} = 16\frac{40}{60}$$

$$\Rightarrow \frac{2z}{x-y} = 16\frac{2}{3} = \frac{50}{3} \quad \text{..(ii)}$$

By equation (i) × 2 – (ii),

$$\frac{2z}{x+y}+\frac{2z}{x-y}-\frac{2z}{x-y}$$

$$= 24 - \frac{50}{3}$$

$$\Rightarrow \frac{2z}{x+y} = \frac{72-50}{3}$$

$$= \frac{22}{3} = 7\frac{1}{3} \text{ hours}$$

10. (2) Speed of boat in still water = $\frac{1}{2}$ (rate downstream + rate upstream)

$$= \frac{1}{2}(14 + 8) = 11 \text{ kmph.}$$

11. (4) Speed of current

$$= \frac{1}{2} \text{ (rate downstream – rate upstream)}$$

$$= \frac{1}{2}(14 - 8) \text{ kmph} = 3 \text{ kmph}$$

12. (3) Rate downstream of boat
= (20 + 5) kmph
= 25 kmph

$$\text{Required time} = \frac{100}{25} = 4 \text{ hours}$$

TEST YOURSELF

1. 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 ?

(1) 1.5 km/hr (2) 1 km/hr

(3) 2 km/hr (4) 2.5 km/hr

2. A boat running downstream covers a distance of 30 km in 2 hours. While coming back the boat takes 6 hours to cover the same distance. If the speed of the current is half of that of the boat, then what is the speed of the boat in kmph?

(1) 15 kmph

(2) 5 kmph

(3) 10 kmph

(4) cannot be determined

3. A boat covers 20 km in 4 hours along the current and 9 km in 3 hours against the current. What is the speed of the current ?

(1) 2 kmph (2) 1 kmph

(3) 1.5 kmph (4) 1.75 kmph

4. A boat running down stream 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 ?

(1) 4 kmph

(2) 6 kmph

(3) 8 kmph

(4) Data inadequate

5. River is running at 2 kmph. It took a man twice as long to row up as to row down the river. The rate (in km ph) of the man in still water is :

(1) 8 (2) 10

(3) 4 (4) 6

6. A person can row a boat d km upstream and the same distance downstream in $5\frac{1}{4}$ hours. Also he can row the boat $2d$ km upstream in 7 hours. He will row the same distance downstream in

(1) $3\frac{1}{2}$ hours (2) $3\frac{1}{4}$ hours

(3) $4\frac{1}{4}$ hours (4) 4 hours

SHORT ANSWERS

1. (3)	**2.** (3)	**3.** (2)	**4.** (2)
5. (4)	**6.** (1)		

EXPLANATIONS

1. (3) Using Rule 2,
Let the speed of boat in still water be x kmph and that of current be y kmph, then

$$\frac{12}{x-y}+\frac{18}{x+y}=3 \quad \text{....(i)}$$

$$\frac{36}{x-y}+\frac{24}{x+y}=\frac{13}{2} \quad \text{.....(ii)}$$

By equation (i) × 3 – equation (ii),

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

$$\Rightarrow \frac{30}{x+y}=\frac{5}{2}\Rightarrow x+y=12 \text{ ... (iii)}$$

From equation (i),

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

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

$$\Rightarrow x-y=\frac{12\times 2}{3}=8 \quad \text{..... (iii)}$$

$$\therefore \text{ Speed of current } = \frac{1}{2}(12-8)$$

= 2 kmph

2. (3) Using Rule 1,
Downstream speed
= 30/2 = 15 kmph
Upstream speed = 30/6 = 5 kmph
Let speed of the boat be x, then speed of the current = $x/2$.

$$x+\frac{x}{2}=15 \quad \text{...(1)}$$

$$x-\frac{x}{2}=5 \quad \text{...(2)}$$

From either of the two equations, we can find the value of x, x = 10 kmph
Another set of formula which can serve as **shortcut** in above case is
Speed of the boat =

$$\frac{\text{Downstream Speed + Upstream Speed}}{2}$$

Speed of the stream =

$$\frac{\text{Downstream Speed – Upstream Speed}}{2}$$

Putting these in the above example,
Speed of the boat

$$= \frac{15+5}{2}=10 \text{ kmph}$$

& Speed of the stream

$$= \frac{15-5}{2}=5 \text{ kmph}$$

3. (2) Using Rule 1,
Rate downstream

$$= \frac{20}{4}=5 \text{ kmph}$$

$$\text{Rate upstream } = \frac{9}{3}=3 \text{ kmph}$$

$\therefore$ Speed of current

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

4. (2) Using Rule 1,
Rate upstream

$$= \frac{16}{2} \text{ kmph} = 8 \text{ kmph}$$

$$\text{Rate downs tream } = \frac{16}{4}$$

= 4 kmph
$\therefore$ Rate in still water

$$= \frac{1}{2}(8+4) \text{ kmph} = 6 \text{ kmph}$$

5. (4) Using Rule 1,
Let rate upstream be x kmph.
Then, rate downstream
= $2x$ kmph
$\therefore$ Rate of current

$$\frac{1}{2}(2x-x)=\frac{x}{2} \text{ kmph}$$

$$\therefore \frac{x}{2}=2 \Rightarrow x=4$$

$\therefore$ Rate upstream = 4 kmph
Rate downstream = 8 kmph
$\therefore$ Rate in still water

$$= \frac{1}{2}(8+4)=6 \text{ kmph}$$

6. (1) Using Rule 3,
Let the speed of boat in still water be x kmph and that of current by y kmph.
According to the question,

$$\therefore \quad \frac{d}{x+y}+\frac{d}{x-y}=\frac{21}{4} \text{ .....(i)}$$

and,

$$\frac{2d}{x-y}=7\Rightarrow \frac{d}{x-y}=\frac{7}{2} \text{ ....(ii)}$$

By equation (ii) – (i),

$$\frac{d}{x+y}=\frac{21}{4}-\frac{7}{2}=\frac{21-14}{4}=\frac{7}{4}$$

$$\Rightarrow \frac{2d}{x+y}=\frac{7}{2}=3\frac{1}{2} \text{ hours.}$$