16. PIPES AND CISTERNS

IMPORTANT FACTS AND FORMULAE

1. **Inlet** : A pipe connected with a tank or a cistern or a reservoir, that fills it, is known as an inlet.

   Outlet : A pipe connected with a tank or a cistern or a reservoir, emptying it, is known as an outlet.

2. (*i*) If a pipe can fill a tank in x hours, then :

   part filled in 1 hour $= \frac{1}{x}$.

   (*ii*) If a pipe can empty a full tank in y hours, then :

   part emptied in 1 hour $= \frac{1}{y}$.

   (*iii*) If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $y > x$), then on opening both the pipes, the net part filled in 1 hour $= \left(\frac{1}{x} - \frac{1}{y}\right)$.

   (*iv*) If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours (where $x > y$), then on opening both the pipes, the net part emptied in 1 hour $= \left(\frac{1}{y} - \frac{1}{x}\right)$.

SOLVED EXAMPLES

Ex. 1. ***Two pipes A and B can fill a tank in 36 hours and 45 hours respectively. If both the pipes are opened simultaneously, how much time will be taken to fill the tank?***

Sol. Part filled by A in 1 hour $= \frac{1}{36}$; Part filled by B in 1 hour $= \frac{1}{45}$.

Part filled by (A + B) in 1 hour $= \left(\frac{1}{36} + \frac{1}{45}\right) = \frac{9}{180} = \frac{1}{20}$.

Hence, both the pipes together will fill the tank in 20 hours.

Ex. 2. ***Two pipes can fill a tank in 10 hours and 12 hours respectively while a third pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time will the tank be filled?***

Sol. Net part filled in 1 hour $= \left(\frac{1}{10} + \frac{1}{12} - \frac{1}{20}\right) = \frac{8}{60} = \frac{2}{15}$.

$\therefore$ The tank will be full in $\frac{15}{2}$ hrs = 7 hrs 30 min.

Ex. 3. ***If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours does it take the second pipe to fill the reservoir?***

Sol. Let the reservoir be filled by first pipe in x hours.
Then, second pipe will fill it in $(x + 10)$ hours.

$\therefore \quad \frac{1}{x} + \frac{1}{(x+10)} = \frac{1}{12} \quad \Leftrightarrow \quad \frac{x+10+x}{x(x+10)} = \frac{1}{12}$

$\Leftrightarrow \quad x^2 - 14x - 120 = 0 \quad \Leftrightarrow \quad (x-20)(x+6) = 0$

$\Leftrightarrow \quad x = 20.$ [*neglecting the – ve value of x*]

So, the second pipe will take (20 + 10) hrs *i.e.*, 30 hrs to fill the reservoir.

Ex. 4. ***A cistern has two taps which fill it in 12 minutes and 15 minutes respectively. There is also a waste pipe in the cistern. When all the three are opened, the empty cistern is full in 20 minutes. How long will the waste pipe take to empty the full cistern?***

Sol. Work done by the waste pipe in 1 minute

$$= \frac{1}{20} - \left(\frac{1}{12} + \frac{1}{15}\right) = -\frac{1}{10}$$ [*– ve sign means emptying*]

$\therefore$ Waste pipe will empty the full cistern in 10 minutes.

Ex. 5. ***An electric pump can fill a tank in 3 hours. Because of a leak in the tank, it took $3\frac{1}{2}$ hours to fill the tank. If the tank is full, how much time will the leak take to empty it?***

Sol. Work done by the leak in 1 hour $= \left[\frac{1}{3} - \frac{1}{\left(\frac{7}{2}\right)}\right] = \left(\frac{1}{3} - \frac{2}{7}\right) = \frac{1}{21}.$

$\therefore$ The leak will empty the tank in 21 hours.

Ex. 6. ***Two pipes can fill a cistern in 14 hours and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom it took 32 minutes more to fill the cistern. When the cistern is full, in what time will the leak empty it?***

Sol. Work done by the two pipes in 1 hour $= \left(\frac{1}{14} + \frac{1}{16}\right) = \frac{15}{112}.$

$\therefore$ Time taken by these pipes to fill the tank $= \frac{112}{15}$ hrs = 7 hrs 28 min.

Due to leakage, time taken = 7 hrs 28 min + 32 min = 8 hrs

$\therefore$ Work done by (two pipes + leak) in 1 hour $= \frac{1}{8}.$

Work done by the leak in 1 hour $= \left(\frac{15}{112} - \frac{1}{8}\right) = \frac{1}{112}.$

$\therefore$ Leak will empty the full cistern in 112 hours.

Ex. 7. ***Two pipes A and B can fill a tank in 36 min. and 45 min. respectively. A water pipe C can empty the tank in 30 min. First A and B are opened. After 7 minutes, C is also opened. In how much time, the tank is full?***

Sol. Part filled in 7 min. $= 7\left(\frac{1}{36} + \frac{1}{45}\right) = \frac{7}{20}.$

Remaining part $= \left(1 - \frac{7}{20}\right) = \frac{13}{20}.$

Net part filled in 1 min. when A, B and C are opened $= \left(\frac{1}{36} + \frac{1}{45} - \frac{1}{30}\right) = \frac{1}{60}$.

Now, $\frac{1}{60}$ part is filled in 1 min.

$\frac{13}{20}$ part is filled in $\left(60 \times \frac{13}{20}\right) = 39$ min.

Total time taken to fill the tank = (39 + 7) min. = 46 min.

Ex. 8. ***Two pipes A and B can fill a tank in 24 min. and 32 min. respectively. If both the pipes are opened simultaneously, after how much time B should be closed so that the tank is full in 18 minutes ?***

Sol. Let B be closed after x minutes. Then,

part filled by (A + B) in x min. + part filled by A in $(18 - x)$ min. = 1

$\therefore \quad x\left(\frac{1}{24} + \frac{1}{32}\right) + (18 - x) \times \frac{1}{24} = 1 \quad \Leftrightarrow \quad \frac{7x}{96} + \frac{18 - x}{24} = 1$

$\Leftrightarrow \quad 7x + 4(18 - x) = 96 \quad \Leftrightarrow \quad x = 8.$

Hence, B must be closed after 8 minutes.

EXERCISE 16A

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (✓) against the correct answer :***

1. Two pipes A and B can fill a tank in 20 and 30 minutes respectively. If both the pipes are used together, then how long will it take to fill the tank ? **(M.A.T. 2003)**
   (*a*) 12 min (*b*) 15 min (*c*) 25 min (*d*) 50 min
2. A cistern can be filled by a tap in 4 hours while it can be emptied by another tap in 9 hours. If both the taps are opened simultaneously, then after how much time will the cistern get filled ? **(Hotel Management, 1997)**
   (*a*) 4.5 hrs (*b*) 5 hrs (*c*) 6.5 hrs (*d*) 7.2 hrs
3. A tap can fill a tank in 6 hours. After half the tank is filled, three more similar taps are opened. What is the total time taken to fill the tank completely ?
   (*a*) 3 hrs 15 min (*b*) 3 hrs 45 min (*c*) 4 hrs (*d*) 4 hrs 15 min
   (S.S.C. 2003)
4. A water tank is two-fifth full. Pipe A can fill a tank in 10 minutes and pipe B can empty it in 6 minutes. If both the pipes are open, how long will it take to empty or fill the tank completely ? **(Bank P.O. 1999)**
   (*a*) 6 min. to empty (*b*) 6 min. to fill (*c*) 9 min. to empty
   (*d*) 9 min. to fill (*e*) None of these
5. Pipe A can fill a tank in 5 hours, pipe B in 10 hours and pipe C in 30 hours. If all the pipes are open, in how many hours will the tank be filled ? **(C.B.I. 1997)**
   (*a*) 2 (*b*) 2.5 (*c*) 3 (*d*) 3.5
6. Pipes A and B can fill a tank in 5 and 6 hours respectively. Pipe C can empty it in 12 hours. If all the three pipes are opened together, then the tank will be filled in :
   (*a*) $1\frac{13}{17}$ hours (*b*) $2\frac{8}{11}$ hours (*c*) $3\frac{9}{17}$ hours (*d*) $4\frac{1}{2}$ hours
   (Bank P.O. 2002)

7. Three pipes A, B and C can fill a tank from empty to full in 30 minutes, 20 minutes and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P, Q and R respectively. What is the proportion of solution R in the liquid in the tank after 3 minutes ? **(D.M.R.C. 2003)**

(*a*) $\frac{5}{11}$ (*b*) $\frac{6}{11}$ (*c*) $\frac{7}{11}$ (*d*) $\frac{8}{11}$

8. Two pipes A and B can separately fill a cistern in 60 minutes and 75 minutes respectively. There is a third pipe in the bottom of the cistern to empty it. If all the three pipes are simultaneously opened, then the cistern is full in 50 minutes. In how much time, the third pipe alone can empty the cistern ? **(S.S.C. 2003)**

(*a*) 90 min (*b*) 100 min (*c*) 110 min (*d*) 120 min

9. A pump can fill a tank with water in 2 hours. Because of a leak, it took $2\frac{1}{3}$ hours to fill the tank. The leak can drain all the water of the tank in : **(S.S.C. 2002)**

(*a*) $4\frac{1}{3}$ hrs (*b*) 7 hrs (*c*) 8 hrs (*d*) 14 hrs

10. Two taps A and B can fill a tank in 5 hours and 20 hours respectively. If both the taps are open then due to a leakage, it took 30 minutes more to fill the tank. If the tank is full, how long will it take for the leakage alone to empty the tank ?

(*a*) $4\frac{1}{2}$ hrs (*b*) 9 hrs (*c*) 18 hrs (*d*) 36 hrs

11. Two pipes A and B together can fill a cistern in 4 hours. Had they been opened separately, then B would have taken 6 hours more than A to fill the cistern. How much time will be taken by A to fill the cistern separately ? **(NABARD, 2001)**

(*a*) 1 hr (*b*) 2 hrs (*c*) 6 hrs (*d*) 8 hrs.

12. One pipe can fill a tank three times as fast as another pipe. If together the two pipes can fill the tank in 36 minutes, then the slower pipe alone will be able to fill the tank in : **(C.B.I. 2003)**

(*a*) 81 min (*b*) 108 min (*c*) 144 min (*d*) 192 min

13. A tank is filled in 5 hours by three pipes A, B and C. The pipe C is twice as fast as B and B is twice as fast as A. How much time will pipe A alone take to fill the tank ?

(*a*) 20 hrs (*b*) 25 hrs (*c*) 35 hrs

(*d*) Cannot be determined (*e*) None of these **(Bank P.O. 2003)**

14. A tank is filled by three pipes with uniform flow. The first two pipes operating simultaneously fill the tank in the same time during which the tank is filled by the third pipe alone. The second pipe fills the tank 5 hours faster than the first pipe and 4 hours slower than the third pipe. The time required by the first pipe is :

(*a*) 6 hrs (*b*) 10 hrs (*c*) 15 hrs (*d*) 30 hrs

(M.B.A. 2002)

15. 12 buckets of water fill a tank when the capacity of each tank is 13.5 litres. How many buckets will be needed to fill the same tank, if the capacity of each bucket is 9 litres ?

(*a*) 8 (*b*) 15 (*c*) 16 (*d*) 18

16. Bucket P has thrice the capacity as bucket Q. It takes 60 turns for bucket P to fill the empty drum. How many turns it will take for both the buckets P and Q, having each turn together to fill the empty drum ?

(*a*) 30 (*b*) 40 (*c*) 45 (*d*) 90

17. Two pipes A and B can fill a tank in 12 minutes and 15 minutes respectively. If both the taps are opened simultaneously, and the tap A is closed after 3 minutes, then how much more time will it take to fill the tank by tap B ?

(*a*) 7 min 15 sec (*b*) 7 min 45 sec (*c*) 8 min 5 sec (*d*) 8 min 15 sec

18. Two pipes A and B can fill a tank in 15 minutes and 20 minutes respectively. Both the pipes are opened together but after 4 minutes, pipe A is turned off. What is the total time required to fill the tank ? **(U.P.S.C. 2002)**

(*a*) 10 min 20 sec (*b*) 11 min 45 sec (*c*) 12 min 30 sec (*d*) 14 min 40 sec

19. Two pipes A and B can fill a tank in 15 hours and 20 hours respectively while a third pipe C can empty the full tank in 25 hours. All the three pipes are opened in the beginning. After 10 hours, C is closed. In how much time, will the tank be full ?

(*a*) 12 hrs (*b*) 13 hrs (*c*) 16 hrs (*d*) 18 hrs

20. A large tanker can be filled by two pipes A and B in 60 minutes and 40 minutes respectively. How many minutes will it take to fill the tanker from empty state if B is used for half the time and A and B fill it together for the other half ?

(*a*) 15 min (*b*) 20 min (*c*) 27.5 min (*d*) 30 min **(D.M.R.C. 2003)**

21. Two pipes A and B can fill a cistern in 12 minutes and 15 minutes respectively while a third pipe C can empty the full tank in 6 minutes. A and B are kept open for 5 minutes in the beginning and then C is also opened. In what time is the cistern emptied ?

(*a*) 30 min (*b*) 33 min (*c*) $37\frac{1}{2}$ min (*d*) 45 min

22. Two pipes A and B can fill a tank in 6 hours and 4 hours respectively. If they are opened on alternate hours and if pipe A is opened first, in how many hours, the tank shall be full ?

(*a*) 4 (*b*) $4\frac{1}{2}$ (*c*) 5 (*d*) $5\frac{1}{2}$

23. Three taps A, B and C can fill a tank in 12, 15 and 20 hours respectively. If A is open all the time and B and C are open for one hour each alternately, the tank will be full in : **(S.S.C. 1999)**

(*a*) 6 hrs (*b*) $6\frac{2}{3}$ hrs (*c*) 5 (*d*) $7\frac{1}{2}$ hrs

24. A booster pump can be used for filling as well as for emptying a tank. The capacity of the tank is 2400 m^3. The emptying capacity of the tank is 10 m^3 per minute higher than its filling capacity and the pump needs 8 minutes lesser to empty the tank than it needs to fill it. What is the filling capacity of the pump ?

(*a*) 50 m^3/min (*b*) 60 m^3/min (*c*) 72 m^3/min (*d*) None of these

25. A leak in the bottom of a tank can empty the full tank in 8 hours. An inlet pipe fills water at the rate of 6 litres a minute. When the tank is full, the inlet is opened and due to the leak, the tank is empty in 12 hours. How many litres does the cistern hold ?

(*a*) 7580 (*b*) 7960 (*c*) 8290 (*d*) 8640

26. Two pipes can fill a tank in 20 and 24 minutes respectively and a waste pipe can empty 3 gallons per minute. All the three pipes working together can fill the tank in 15 minutes. The capacity of the tank is : **(Bank P.O. 2001)**

(*a*) 60 gallons (*b*) 100 gallons (*c*) 120 gallons (*d*) 180 gallons

27. Two pipes A and B can fill a cistern in $37\frac{1}{2}$ minutes and 45 minutes respectively. Both pipes are opened. The cistern will be filled in just half an hour, if the pipe B is turned off after : **(S.S.C. 2004)**

(*a*) 5 min (*b*) 9 min (*c*) 10 min (*d*) 15 min

28. Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the tank is : **(L.I.C.A.A.O. 2003)**

(*a*) 10 (*b*) 12 (*c*) 14 (*d*) 16

ANSWERS

1. (*a*)	2. (*d*)	3. (*b*)	4. (*a*)	5. (*c*)	6. (*c*)	7. (*b*)	8. (*b*)
9. (*d*)	10. (*d*)	11. (*c*)	12. (*c*)	13. (*c*)	14. (*c*)	15. (*d*)	16. (*c*)
17. (*d*)	18. (*d*)	19. (*a*)	20. (*d*)	21. (*d*)	22. (*c*)	23. (*c*)	24. (*a*)
25. (*d*)	26. (*c*)	27. (*b*)	28. (*c*)				

SOLUTIONS

1. Part filled by A in 1 min. $= \frac{1}{20}$; Part filled by B in 1 min. $= \frac{1}{30}$.

Part filled by (A + B) in 1 min. $= \left(\frac{1}{20}+\frac{1}{30}\right) = \frac{1}{12}$.

$\therefore$ Both the pipes can fill the tank in 12 minutes.

2. Net part filled in 1 hour $= \left(\frac{1}{4}-\frac{1}{9}\right) = \frac{5}{36}$.

$\therefore$ The cistern will be filled in $\frac{36}{5}$ hrs *i.e.*, 7.2 hrs.

3. Time taken by one tap to fill half the tank = 3 hrs.

Part filled by the four taps in 1 hour $= \left(4\times\frac{1}{6}\right) = \frac{2}{3}$.

Remaining part $= \left(1-\frac{1}{2}\right) = \frac{1}{2}$.

$\therefore \frac{2}{3}:\frac{1}{2} :: 1 : x$ or $x = \left(\frac{1}{2}\times 1\times\frac{3}{2}\right) = \frac{3}{4}$ hrs *i.e.*, 45 mins.

So, total time taken = 3 hrs 45 min.

4. Clearly, pipe B is faster than pipe A and so, the tank will be emptied.

Part to be emptied $= \frac{2}{5}$.

Part emptied by (A + B) in 1 minute $= \left(\frac{1}{6}-\frac{1}{10}\right) = \frac{1}{15}$.

$\therefore \frac{1}{15}:\frac{2}{5} :: 1 : x$ or $x = \left(\frac{2}{5}\times 1\times 15\right) = 6$ min.

So, the tank will be emptied in 6 min.

5. Part filled by (A + B + C) in 1 hour $= \left(\frac{1}{5}+\frac{1}{10}+\frac{1}{30}\right) = \frac{1}{3}$.

$\therefore$ All the three pipes together will fill the tank in 3 hours.

6. Net part filled in 1 hour $= \left(\frac{1}{5}+\frac{1}{6}-\frac{1}{12}\right) = \frac{17}{60}$.

$\therefore$ The tank will be full in $\frac{60}{17}$ hrs *i.e.*, $3\frac{9}{17}$ hrs.

7. Part filled by (A + B + C) in 3 minutes $= 3\left(\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right) = \left(3\times\frac{11}{60}\right) = \frac{11}{20}$.

Part filled by C in 3 minutes $= \frac{3}{10}$.

$\therefore$ Required ratio $= \left(\frac{3}{10} \times \frac{20}{11}\right) = \frac{6}{11}$.

8. Work done by the third pipe in 1 min.

$$= \frac{1}{50} - \left(\frac{1}{60} + \frac{1}{75}\right) = \left(\frac{1}{50} - \frac{3}{100}\right) = -\frac{1}{100}. \quad \text{[– ve sign means emptying]}$$

$\therefore$ The third pipe alone can empty the cistern in 100 min.

9. Work done by the leak in 1 hour $= \left(\frac{1}{2} - \frac{3}{7}\right) = \frac{1}{14}$.

$\therefore$ Leak will empty the tank in 14 hrs.

10. Part filled by (A + B) in 1 hour $= \left(\frac{1}{5} + \frac{1}{20}\right) = \frac{1}{4}$.

So, A and B together can fill the tank in 4 hours.

Work done by the leak in 1 hour $= \left(\frac{1}{4} - \frac{2}{9}\right) = \frac{1}{36}$.

$\therefore$ Leak will empty the tank in 36 hrs.

11. Let the cistern be filled by pipe A alone in x hours.

Then, pipe B will fill it in $(x + 6)$ hours.

$\therefore \quad \frac{1}{x} + \frac{1}{(x+6)} = \frac{1}{4} \quad \Leftrightarrow \quad \frac{x+6+x}{x(x+6)} = \frac{1}{4}$

$\Leftrightarrow \quad x^2 - 2x - 24 = 0 \quad \Leftrightarrow \quad (x-6)(x+4) = 0$

$\Leftrightarrow \quad x = 6.$ [*neglecting the – ve value of x*]

12. Let the slower pipe alone fill the tank in x minutes.

Then, faster pipe will fill it in $\frac{x}{3}$ minutes.

$\therefore \quad \frac{1}{x} + \frac{3}{x} = \frac{1}{36} \quad \Leftrightarrow \quad \frac{4}{x} = \frac{1}{36} \quad \Leftrightarrow \quad x = 144$ min.

13. Suppose pipe A alone takes x hours to fill the tank.

Then, pipes B and C will take $\frac{x}{2}$ and $\frac{x}{4}$ hours respectively to fill the tank.

$\therefore \quad \frac{1}{x} + \frac{2}{x} + \frac{4}{x} = \frac{1}{5} \quad \Leftrightarrow \quad \frac{7}{x} = \frac{1}{5} \quad \Leftrightarrow \quad x = 35$ hrs.

14. Suppose, first pipe alone takes x hours to fill the tank. Then, second and third pipes will take $(x - 5)$ and $(x - 9)$ hours respectively to fill the tank.

$\therefore \quad \frac{1}{x} + \frac{1}{(x-5)} = \frac{1}{(x-9)} \quad \Leftrightarrow \quad \frac{x-5+x}{x(x-5)} = \frac{1}{(x-9)}$

$\Leftrightarrow \quad (2x-5)(x-9) = x(x-5) \quad \Leftrightarrow \quad x^2 - 18x + 45 = 0$

$\Leftrightarrow \quad (x-15)(x-3) = 0 \quad \Leftrightarrow \quad x = 15.$ [*neglecting x = 3*]

15. Capacity of the tank $= (12 \times 13.5)$ litres $= 162$ litres.

Capacity of each bucket = 9 litres.

Number of buckets needed $= \left(\frac{162}{9}\right) = 18$.

16. Let capacity of P be x litres. Then, capacity of Q $= \frac{x}{3}$ litres.

Capacity of the drum $= 60x$ litres.

Required number of turns $= \frac{60x}{\left(x + \frac{x}{3}\right)} = \left(60x \times \frac{3}{4x}\right) = 45.$

17. Part filled in 3 min. $= 3\left(\frac{1}{12} + \frac{1}{15}\right) = \left(3 \times \frac{9}{60}\right) = \frac{9}{20}.$

Remaining part $= \left(1 - \frac{9}{20}\right) = \frac{11}{20}.$

Part filled by B in 1 min. $= \frac{1}{15}.$

$\frac{1}{15} : \frac{11}{20} :: 1 : x$ or $x = \left(\frac{11}{20} \times 1 \times 15\right) = 8\frac{1}{4}$ min. = 8 min. 15 sec.

$\therefore$ Remaining part is filled by B in 8 min. 15 sec.

18. Part filled in 4 minutes $= 4\left(\frac{1}{15} + \frac{1}{20}\right) = \frac{7}{15}.$

Remaining part $= \left(1 - \frac{7}{15}\right) = \frac{8}{15}.$

Part filled by B in 1 minute $= \frac{1}{20}.$

$\frac{1}{20} : \frac{8}{15} :: 1 : x$ or $x = \left(\frac{8}{15} \times 1 \times 20\right) = 10\frac{2}{3}$ min. = 10 min. 40 sec.

$\therefore$ The tank will be full in (4 min. + 10 min. 40 sec) = 14 min. 40 sec.

19. Part filled in 10 hours $= 10\left(\frac{1}{15} + \frac{1}{20} - \frac{1}{25}\right) = \frac{23}{30}.$

Remaining part $= \left(1 - \frac{23}{30}\right) = \frac{7}{30}.$

(A + B)'s 1 hour's work $= \left(\frac{1}{15} + \frac{1}{20}\right) = \frac{7}{60}.$

$\frac{7}{60} : \frac{7}{30} :: 1 : x$ or $x = \left(\frac{7}{30} \times 1 \times \frac{60}{7}\right) = 2$ hours.

$\therefore$ The tank will be full in (10 + 2) hrs = 12 hrs.

20. Part filled by (A + B) in 1 minute $= \left(\frac{1}{60} + \frac{1}{40}\right) = \frac{1}{24}.$

Suppose the tank is filled in x minutes.

Then, $\frac{x}{2}\left(\frac{1}{24} + \frac{1}{40}\right) = 1 \Leftrightarrow \frac{x}{2} \times \frac{1}{15} = 1 \Leftrightarrow x = 30$ min.

21. Part filled in 5 min. $= 5\left(\frac{1}{12} + \frac{1}{15}\right) = \left(5 \times \frac{9}{60}\right) = \frac{3}{4}.$

Part emptied in 1 min. when all the pipes are opened

$$= \frac{1}{6} - \left(\frac{1}{12} + \frac{1}{15}\right) = \left(\frac{1}{6} - \frac{3}{20}\right) = \frac{1}{60}.$$

Now, $\frac{1}{60}$ part is emptied in 1 min.

$\therefore$ $\frac{3}{4}$ part will be emptied in $\left(60 \times \frac{3}{4}\right) = 45$ min.

22. A's work in 1 hour $= \frac{1}{6}$, B's work in 1 hour $= \frac{1}{4}$.

(A + B)'s 2 hour's work when opened alternately $= \left(\frac{1}{6} + \frac{1}{4}\right) = \frac{5}{12}$.

(A + B)'s 4 hour's work when opened alternately $= \frac{10}{12} = \frac{5}{6}$.

Remaining part $= \left(1 - \frac{5}{6}\right) = \frac{1}{6}$.

Now, it is A's turn and $\frac{1}{6}$ part is filled by A in 1 hour.

$\therefore$ Total time taken to fill the tank = (4 + 1) hrs = 5 hrs.

23. (A + B)'s 1 hour's work $= \left(\frac{1}{12} + \frac{1}{15}\right) = \frac{9}{60} = \frac{3}{20}$.

(A + C)'s 1 hour's work $= \left(\frac{1}{12} + \frac{1}{20}\right) = \frac{8}{60} = \frac{2}{15}$.

Part filled in 2 hrs $= \left(\frac{3}{20} + \frac{2}{15}\right) = \frac{17}{60}$; Part filled in 6 hrs $= \left(3 \times \frac{17}{60}\right) = \frac{17}{20}$.

Remaining part $= \left(1 - \frac{17}{20}\right) = \frac{3}{20}$.

Now, it is the turn of A and B and $\frac{3}{20}$ part is filled by A and B in 1 hour.

$\therefore$ Total time taken to fill the tank = (6 + 1) hrs = 7 hrs.

24. Let the filling capacity of the pump be x m^3/min.

Then, emptying capacity of the pump = $(x + 10)$ m^3/min.

So, $\frac{2400}{x} - \frac{2400}{(x+10)} = 8 \quad \Leftrightarrow \quad x^2 + 10x - 3000 = 0$

$\Leftrightarrow (x - 50)(x + 60) = 0 \quad \Leftrightarrow \quad x = 50.$ *[neglecting the – ve value of x]*

25. Work done by the inlet in 1 hour $= \left(\frac{1}{8} - \frac{1}{12}\right) = \frac{1}{24}$.

Work done by the inlet in 1 min. $= \left(\frac{1}{24} \times \frac{1}{60}\right) = \frac{1}{1440}$.

$\therefore$ Volume of $\frac{1}{1440}$ part = 6 litres.

$\therefore$ Volume of whole = (1440 × 6) litres = 8640 litres.

26. Work done by the waste pipe in 1 minute

$$= \frac{1}{15} - \left(\frac{1}{20} + \frac{1}{24}\right) = \left(\frac{1}{15} - \frac{11}{120}\right) = -\frac{1}{40}.$$ *[– ve sign means emptying]*

$\therefore$ Volume of $\frac{1}{40}$ part = 3 gallons.

Volume of whole = (3 × 40) gallons = 120 gallons.

27. Let B be turned off after x minutes. Then,
Part filled by (A + B) in x min. + Part filled by A in $(30 - x)$ min. = 1.

$$\therefore \quad x\left(\frac{2}{75}+\frac{1}{45}\right)+(30-x)\cdot\frac{2}{75}=1$$

$$\Leftrightarrow \quad \frac{11x}{225}+\frac{(60-2x)}{75}=1 \quad \Leftrightarrow \quad 11x+180-6x=225 \quad \Leftrightarrow \quad x=9.$$

28. Part filled in 2 hours $= \frac{2}{6} = \frac{1}{3}$, Remaining part $= \left(1-\frac{1}{3}\right) = \frac{2}{3}$.

$\therefore$ (A + B)'s 7 hour's work $= \frac{2}{3}$; (A + B)'s 1 hour's work $= \frac{2}{21}$.

$\therefore$ C's 1 hour's work = [(A + B + C)'s 1 hour's work − (A + B)'s 1 hour's work]

$$= \left(\frac{1}{6}-\frac{2}{21}\right) = \frac{1}{14}.$$

$\therefore$ C alone can fill the tank in 14 hours.

EXERCISE 16B

(DATA SUFFICIENCY TYPE QUESTIONS)

Directions (*Questions 1 to 4*) : ***Each of the questions given below consists of a statement and/or a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statement(s) is/are sufficient to answer the given question. Read both the statements and***

Give answer (a) if the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient to answer the question;

Give answer (b) if the data in Statement II alone are sufficient to answer the question, while the data in Statement I alone are not sufficient to answer the question;

Give answer (c) if the data either in Statement I or in Statement II alone are sufficient to answer the question;

Give answer (d) if the data even in both Statements I and II together are not sufficient to answer the question;

Give answer (e) if the data in both Statements I and II together are necessary to answer the question.

1. How long will it take to empty the tank if both the inlet pipe A and the outlet pipe B are opened simultaneously ?
   I. A can fill the tank in 16 minutes.
   II. B can empty the full tank in 8 minutes.
2. Two taps A and B, when opened together, can fill a tank in 6 hours. How long will it take for the pipe A alone to fill the tank ?
   I. B alone takes 5 hours more than A to fill the tank.
   II. The ratio of the time taken by A to that taken by B to fill the tank is 2 : 3.
3. A tank is fitted with two inlet pipes A and B. Both the pipes are kept open for 10 minutes so that the tank is two-thirds full and then pipe A is closed. How much time will B take to fill the remaining part of the tank ?
   I. Pipe A is thrice as fast as pipe B.
   II. Pipe B alone can fill the tank in 60 minutes.
4. How much time will the leak take to empty the full cistern ?
   I. The cistern is normally filled in 9 hours.
   II. It takes one hour more than the usual time to fill the cistern because of a leak in the bottom.

Directions (*Questions 5-6*) : *Each of the questions below consists of a question followed by three statements. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question*:

5. A tank is fitted with two taps A and B. In how much time will the tank be full if both the taps are opened together ?

   I. A is 50% more efficient than B.

   II. A alone takes 16 hours to fill the tank.

   III. B alone takes 24 hours to fill the tank.

   (*a*) II and III only (*b*) All I, II and III

   (*c*) I and II only (*d*) I and III only

   (*e*) Any two of the three

6. If both the pipes are opened, how many hours will be taken to fill the tank ?

   I. The capacity of the tank is 400 litres.

   II. The pipe A fills the tank in 4 hours.

   III. The pipe B fills the tank in 6 hours. **(R.B.I. 2003)**

   (*a*) Only I and II (*b*) Only II and III

   (*c*) All I, II and III (*d*) Any two of the three

   (*e*) Even with all the three statements, answer cannot be given.

ANSWERS

1. (*e*) 2. (*c*) 3. (*c*) 4. (*e*) 5. (*e*) 6. (*b*)

SOLUTIONS

1. I. A's 1 minute's filling work $= \frac{1}{16}$.

   II. B's 1 minute's emptying work $= \frac{1}{8}$.

   (A + B)'s 1 minute's emptying work $= \left(\frac{1}{8} - \frac{1}{16}\right) = \frac{1}{16}$.

   $\therefore$ Tank will be emptied in 16 minutes.

   Thus, both I and II are necessary to answer the question.

   $\therefore$ Correct answer is (*e*).

2. (A + B)'s 1 hour filling work $= \frac{1}{6}$.

   I. Suppose A takes x hours to fill the tank.

   Then, B takes $(x + 5)$ hours to fill the tank.

   $\therefore$ (A's 1 hour work) + (B's 1 hour work) = (A + B)'s 1 hour work

   $\Leftrightarrow \frac{1}{x} + \frac{1}{(x+5)} = \frac{1}{6} \quad \Leftrightarrow \frac{(x+5)+x}{x(x+5)} = \frac{1}{6}$

   $\Leftrightarrow x^2 - 5x = 12x + 30 \quad \Leftrightarrow x^2 - 7x - 30 = 0$

   $\Leftrightarrow x^2 - 10x + 3x - 30 = 0 \quad \Leftrightarrow x(x - 10) + 3(x - 10) = 0$

   $\Leftrightarrow (x - 10)(x + 3) = 0 \quad \Leftrightarrow x = 10.$

   So, A alone takes 10 hours to fill the tank.

II. Suppose A takes $2x$ hours and B takes $3x$ hours to fill the tank. Then,

$$\frac{1}{2x}+\frac{1}{3x}=\frac{1}{6} \Leftrightarrow \left(\frac{1}{2}+\frac{1}{3}\right)\cdot\frac{1}{x}=\frac{1}{6} \Leftrightarrow \frac{5}{6x}=\frac{1}{6} \Leftrightarrow x=5.$$

So, A alone takes $(2 \times 5) = 10$ hours to fill the tank.

Thus, each one of I and II gives the answer.

$\therefore$ Correct answer is (*c*).

3. I. Let B's 1 min. work $= \frac{1}{x}$. Then, A's 1 min. work $= \frac{3}{x}$.

(A + B)'s 1 min. work $= \left(\frac{1}{x}+\frac{3}{x}\right) = \frac{4}{x}$.

(A + B)'s 10 min. work $= \left(\frac{4}{x}\times 10\right) = \frac{40}{x}$.

$\therefore \quad \frac{40}{x} = \frac{2}{3} \quad \Leftrightarrow \quad x = 60.$

$\therefore$ B's 1 min. work $= \frac{1}{60}$.

$\frac{1}{60}$ part is filled by B in 1 min.

$\frac{1}{3}$ part is filled by B in $\left(60\times\frac{1}{3}\right)$ min. = 20 min.

II. B's 1 min. work $= \frac{1}{60}$.

$\frac{1}{60}$ part is filled by B in 1 min.

$\frac{1}{3}$ part is filled by B in $\left(60\times\frac{1}{3}\right)$ min. = 20 min.

Hence, the correct answer is (*c*).

4. I. Time taken to fill the cistern without leak = 9 hours.

Part of cistern filled without leak in 1 hour $= \frac{1}{9}$.

II. Time taken to fill the cistern in presence of leak = 10 hours.

Net filling in 1 hour $= \frac{1}{10}$.

Work done by leak in 1 hour $= \left(\frac{1}{9}-\frac{1}{10}\right) = \frac{1}{90}$.

$\therefore$ Leak will empty the full cistern in 90 hours.

Clearly, both I and II are necessary to answer the question.

$\therefore$ Correct answer is (*e*).

5. II. A's 1 hour work $= \frac{1}{16}$.

Suppose B fills the tank in x hours. Then, B's 1 hour work $= \frac{1}{x}$.

I. Work done by A in 1 hour = 150% of $\frac{1}{x} = \left(\frac{1}{x}\times\frac{150}{100}\right) = \frac{3}{2x}$.

$\therefore \quad \frac{3}{2x} = \frac{1}{16} \Leftrightarrow x = 24.$

So, B can fill the tank in 24 hours.

(A + B)'s 1 hour work $= \left(\frac{1}{16} + \frac{1}{24}\right) = \frac{5}{48}.$

$\therefore$ (A + B) can fill the tank in $\frac{48}{5}$ hrs.

Thus, I & II give the answer.

III. Work done by B in 1 hour $= \frac{1}{24}.$

From II & III, we get the same answer.

From III & I, we get :

A's 1 hour work = 150% of $\frac{1}{24} = \left(\frac{1}{24} \times \frac{150}{100}\right) = \frac{1}{16}.$

Thus, from III & I, we get the same answer.

$\therefore$ Correct answer is (*e*).

6. II. Part of the tank filled by A in 1 hour $= \frac{1}{4}.$

III. Part of the tank filled by B in 1 hour $= \frac{1}{6}.$

(A + B)'s 1 hour's work $= \left(\frac{1}{4} + \frac{1}{6}\right) = \frac{5}{12}.$

$\therefore$ When both A and B are opened together, they will fill the tank in $\frac{12}{5}$ hrs = 2 hrs 24 min.

So, II and III are needed.

$\therefore$ Correct answer is (*b*).

17. TIME AND DISTANCE

IMPORTANT FACTS AND FORMULAE

1. Speed $= \left(\frac{\text{Distance}}{\text{Time}}\right)$, Time $= \left(\frac{\text{Distance}}{\text{Speed}}\right)$, Distance = (Speed × Time)

2. x km/hr $= \left(x \times \frac{5}{18}\right)$ m/sec

3. x m/sec $= \left(x \times \frac{18}{5}\right)$ km/hr

4. If the ratio of the speeds of A and B is $a : b$, then the ratio of the times taken by them to cover the same distance is $\frac{1}{a} : \frac{1}{b}$ or $b : a$.

5. Suppose a man covers a certain distance at x km/hr and an equal distance at y km/hr. Then, the average speed during the whole journey is $\left(\frac{2xy}{x+y}\right)$ km/hr.

SOLVED EXAMPLES

Ex. 1. ***How many minutes does Aditya take to cover a distance of 400 m, if he runs at a speed of 20 km/hr ?*** **(Bank P.O. 2000)**

Sol. Aditya's speed = 20 km/hr $= \left(20 \times \frac{5}{18}\right)$ m/sec $= \frac{50}{9}$ m/sec.

$\therefore$ Time taken to cover 400 m $= \left(400 \times \frac{9}{50}\right)$ sec = 72 sec $= 1\frac{12}{60}$ min $= 1\frac{1}{5}$ min.

Ex. 2. ***A cyclist covers a distance of 750 m in 2 min 30 sec. What is the speed in km/hr of the cyclist ?*** **(R.R.B. 2002)**

Sol. Speed $= \left(\frac{750}{150}\right)$ m/sec = 5m/sec $= \left(5 \times \frac{18}{5}\right)$ km/hr = 18 km/hr.

Ex. 3. ***A dog takes 4 leaps for every 5 leaps of a hare but 3 leaps of a dog are equal to 4 leaps of the hare. Compare their speeds.***

Sol. Let the distance covered in 1 leap of the dog be x and that covered in 1 leap of the hare be y.

Then, $3x = 4y \Rightarrow x = \frac{4}{3}y \Rightarrow 4x = \frac{16}{3}y$.

$\therefore$ Ratio of speeds of dog and hare = Ratio of distances covered by them in the same time

$$= 4x : 5y = \frac{16}{3}y : 5y = \frac{16}{3} : 5 = 16 : 15.$$

Ex. 4. ***While covering a distance of 24 km, a man noticed that after walking for 1 hour and 40 minutes, the distance covered by him was $\frac{5}{7}$ of the remaining distance. What was his speed in metres per second ?*** **(R.R.B. 2002)**

Sol. Let the speed be x km/hr.

Then, distance covered in 1 hr. 40 min. *i.e.*, $1\frac{2}{3}$ hrs $= \frac{5x}{3}$ km.

Remaining distance $= \left(24 - \frac{5x}{3}\right)$ km.

$\therefore \frac{5x}{3} = \frac{5}{7}\left(24 - \frac{5x}{3}\right) \Leftrightarrow \frac{5x}{3} = \frac{5}{7}\left(\frac{72 - 5x}{3}\right) \Leftrightarrow 7x = 72 - 5x$

$\Leftrightarrow 12x = 72 \Leftrightarrow x = 6$

Hence, speed $= 6$ km/hr $= \left(6 \times \frac{5}{18}\right)$ m/sec $= \frac{5}{3}$ m/sec $= 1\frac{2}{3}$ m/sec.

Ex. 5. ***Peter can cover a certain distance in 1 hr. 24 min. by covering two-third of the distance at 4 kmph and the rest at 5 kmph. Find the total distance.***

Sol. Let the total distance be x km. Then,

$$\frac{\frac{2}{3}x}{4} + \frac{\frac{1}{3}x}{5} = \frac{7}{5} \Leftrightarrow \frac{x}{6} + \frac{x}{15} = \frac{7}{5} \Leftrightarrow 7x = 42 \Leftrightarrow x = 6.$$

$\therefore$ Total distance = 6 km.

Ex. 6. ***A man travelled from the village to the post-office at the rate of 25 kmph and walked back at the rate of 4 kmph. If the whole journey took 5 hours 48 minutes, find the distance of the post-office from the village.*** **(S.S.C. 2004)**

Sol. Average speed $= \left(\frac{2xy}{x+y}\right)$ km/hr $= \left(\frac{2 \times 25 \times 4}{25 + 4}\right)$ km/hr $= \frac{200}{29}$ km/hr.

Distance travelled in 5 hours 48 minutes *i.e.*, $5\frac{4}{5}$ hrs $= \left(\frac{200}{29} \times \frac{29}{5}\right)$ km $= 40$ km.

$\therefore$ Distance of the post-office from the village $= \left(\frac{40}{2}\right) = 20$ km.

Ex. 7. ***An aeroplane flies along the four sides of a square at the speeds of 200, 400, 600 and 800 km/hr. Find the average speed of the plane around the field.***

Sol. Let each side of the square be x km and let the average speed of the plane around the field be y km/hr. Then,

$$\frac{x}{200} + \frac{x}{400} + \frac{x}{600} + \frac{x}{800} = \frac{4x}{y} \Leftrightarrow \frac{25x}{2400} = \frac{4x}{y} \Leftrightarrow y = \left(\frac{2400 \times 4}{25}\right) = 384.$$

$\therefore$ Average speed = 384 km/hr.

Ex. 8. ***Walking at $\frac{5}{6}$ of its usual speed, a train is 10 minutes too late. Find its usual time to cover the journey.***

Sol. New speed $= \frac{5}{6}$ of the usual speed

$\therefore$ New time taken $= \frac{6}{5}$ of the usual time

So, $\left(\frac{6}{5} \text{ of the usual time}\right) - (\text{usual time}) = 10$ min.

$\Rightarrow \frac{1}{5}$ of the usual time = 10 min $\Rightarrow$ usual time = 50 min.

Ex. 9. ***If a man walks at the rate of 5 kmph, he misses a train by 7 minutes. However, if he walks at the rate of 6 kmph, he reaches the station 5 minutes before the arrival of the train. Find the distance covered by him to reach the station.***

Sol. Let the required distance be x km.

Difference in the times taken at two speeds = 12 min $= \frac{1}{5}$ hr.

$\therefore \quad \frac{x}{5} - \frac{x}{6} = \frac{1}{5} \Leftrightarrow 6x - 5x = 6 \Leftrightarrow x = 6.$

Hence, the required distance is 6 km.

Ex. 10. ***A and B are two stations 390 km apart. A train starts from A at 10 a.m. and travels towards B at 65 kmph. Another train starts from B at 11 a.m. and travels towards A at 35 kmph. At what time do they meet ?***

Sol. Suppose they meet x hours after 10 a.m. Then,

(Distance moved by first in x hrs) + [Distance moved by second in $(x-1)$ hrs] = 390.

$\therefore \quad 65x + 35(x-1) = 390 \Rightarrow 100x = 425 \Rightarrow x = 4\frac{1}{4}.$

So, they meet 4 hrs. 15 min. after 10 a.m. *i.e.*, at 2.15 p.m.

Ex. 11. ***A goods train leaves a station at a certain time and at a fixed speed. After 6 hours, an express train leaves the same station and moves in the same direction at a uniform speed of 90 kmph. This train catches up the goods train in 4 hours. Find the speed of the goods train.***

Sol. Let the speed of the goods train be x kmph.

Distance covered by goods train in 10 hours

= Distance covered by express train in 4 hours

$\therefore \quad 10x = 4 \times 90$ or $x = 36$.

So, speed of goods train = 36 kmph.

Ex. 12. ***A thief is spotted by a policeman from a distance of 100 metres. When the policeman starts the chase, the thief also starts running. If the speed of the thief be 8 km/hr and that of the policeman 10 km/hr, how far the thief will have run before he is overtaken ?***

Sol. Relative speed of the policeman = (10 – 8) km/hr = 2 km/hr.

Time taken by policeman to cover 100 m $= \left(\frac{100}{1000} \times \frac{1}{2}\right)$ hr $= \frac{1}{20}$ hr.

In $\frac{1}{20}$ hrs, the thief covers a distance of $\left(8 \times \frac{1}{20}\right)$ km $= \frac{2}{5}$ km = 400 m.

Ex. 13. ***I walk a certain distance and ride back taking a total time of 37 minutes. I could walk both ways in 55 minutes. How long would it take me to ride both ways?***

Sol. Let the distance be x km. Then,

(Time taken to walk x km) + (Time taken to ride x km) = 37 min.

$\Rightarrow$ (Time taken to walk $2x$ km) + (Time taken to ride $2x$ km) = 74 min.

But, time taken to walk $2x$ km = 55 min.

$\therefore$ Time taken to ride $2x$ km = (74 – 55) min = 19 min.

EXERCISE 17

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (✓) against the correct answer :***

1. A car moves at the speed of 80 km/hr. What is the speed of the car in metres per second ? **(Hotel Management, 2002)**

   (*a*) 8 m/sec (*b*) $20\frac{1}{9}$ m/sec (*c*) $22\frac{2}{9}$ m/sec (*d*) None of these

2. An athlete runs 200 metres race in 24 seconds. His speed is : **(S.S.C. 2002)**

   (*a*) 20 km/hr (*b*) 24 km/hr (*c*) 28.5 km/hr (*d*) 30 km/hr

3. Which of the following trains is the fastest ?
(a) 25 m / sec (b) 1500 m / min (c) 90 km / hr (d) None of these

4. A person crosses a 600 m long street in 5 minutes. What is his speed in km per hour ?
(a) 3.6 (b) 7.2 (c) 8.4 (d) 10
(R.R.B. 2003)

5. A man walking at the rate of 5 km / hr crosses a bridge in 15 minutes. The length of the bridge (in metres) is : (S.S.C. 2000)
(a) 600 (b) 750 (c) 1000 (d) 1250

6. How long will a boy take to run round a square field of side 35 metres, if he runs at the rate of 9 km / hr ? (S.S.C. 1999)
(a) 50 sec (b) 52 sec (c) 54 sec (d) 56 sec

7. A car is running at a speed of 108 kmph. What distance will it cover in 15 seconds ?
(a) 45 metres (b) 55 metres (c) 450 metres
(d) Cannot be determined (e) None of these (R.B.I. 2003)

8. One of the two buses completes a journey of 300 km in $7\frac{1}{2}$ hours and the other a journey of 450 km in 9 hours. The ratio of their average speeds is : (R.R.B. 2001)
(a) 2 : 3 (b) 3 : 4 (c) 4 : 5 (d) 8 : 9

9. A truck covers a distance of 550 metres in 1 minute whereas a bus covers a distance of 33 kms in 45 minutes. The ratio of their speeds is : (S.S.C. 2004)
(a) 3 : 4 (b) 4 : 3 (c) 3 : 5 (d) 50 : 3

10. The ratio between the speeds of two trains is 7 : 8. If the second train runs 400 kms in 4 hours, then the speed of the first train is : (I.M.T. 2002)
(a) 70 km / hr (b) 75 km / hr (c) 84 km / hr (d) 87.5 km / hr

11. A train travels at an average of 50 miles per hour for $2\frac{1}{2}$ hours and then travels at a speed of 70 miles per hour for $1\frac{1}{2}$ hours. How far did the train travel in the entire 4 hours ? (IGNOU, 2003)
(a) 120 miles (b) 150 miles (c) 200 miles (d) 230 miles

12. A man in a train notices that he can count 21 telephone posts in one minute. If they are known to be 50 metres apart, then at what speed is the train travelling ?
(a) 55 km / hr (b) 57 km / hr (c) 60 km / hr (d) 63 km / hr

13. Sound is said to travel in air at about 1100 feet per second. A man hears the axe striking the tree, $\frac{11}{5}$ seconds after he sees it strike the tree. How far is the man from the wood chopper ? (M.B.A. 2002)
(a) 2197 ft (b) 2420 ft (c) 2500 ft (d) 2629 ft

14. An express train travelled at an average speed of 100 km / hr, stopping for 3 minutes after every 75 km. How long did it take to reach its destination 600 km from the starting point ? (M.A.T. 2003)
(a) 6 hrs 21 min (b) 6 hrs 24 min (c) 6 hrs 27 min (d) 6 hrs 30 min

15. A certain distance is covered by a cyclist at a certain speed. If a jogger covers half the distance in double the time, the ratio of the speed of the jogger to that of the cyclist is :
(a) 1 : 2 (b) 2 : 1 (c) 1 : 4 (d) 4 : 1

16. A motor car starts with the speed of 70 km / hr with its speed increasing every two hours by 10 kmph. In how many hours will it cover 345 kms ? (Bank P.O. 2003)
(a) $2\frac{1}{4}$ hrs (b) 4 hrs 5 min (c) $4\frac{1}{2}$ hrs
(d) Cannot be determined (e) None of these

17. The speed of a car increases by 2 kms after every one hour. If the distance travelled in the first one hour was 35 kms, what was the total distance travelled in 12 hours ?
(*a*) 456 kms (*b*) 482 kms (*c*) 552 kms
(*d*) 556 kms (*e*) None of these **(Bank P.O. 2003)**

18. A train covers a distance of 10 km in 12 minutes. If its speed is decreased by 5 km / hr, the time taken by it to cover the same distance will be : **(S.S.C. 1999)**
(*a*) 10 min (*b*) 11 min 20 sec (*c*) 13 min (*d*) 13 min 20 sec

19. Anna left for city A from city B at 5.20 a.m. She travelled at the speed of 80 km / hr for 2 hours 15 minutes. After that the speed was reduced to 60 km / hr. If the distance between two cities is 350 kms, at what time did Anna reach city A ?
(*a*) 9.20 a.m. (*b*) 9.25 a.m. (*c*) 9.35 a.m.
(*d*) 10.05 a.m. (*e*) None of these **(Bank P.O. 1999)**

20. An aeroplane covers a certain distance at a speed of 240 kmph in 5 hours. To cover the same distance in $1\frac{2}{3}$ hours, it must travel at a speed of : **(S.S.C. 2000)**
(*a*) 300 kmph (*b*) 360 kmph (*c*) 600 kmph (*d*) 720 kmph

21. A salesman travels a distance of 50 km in 2 hours and 30 minutes. How much faster, in kilometres per hour, on an average, must he travel to make such a trip in $\frac{5}{6}$ hour less time ? **(Hotel Management, 2002)**
(*a*) 10 (*b*) 20 (*c*) 30 (*d*) None of these

22. A person has to cover a distance of 6 km in 45 minutes. If he covers one-half of the distance in two-thirds of the total time; to cover the remaining distance in the remaining time, his speed (in km / hr) must be : **(S.S.C. 1999)**
(*a*) 6 (*b*) 8 (*c*) 12 (*d*) 15

23. A man performs $\frac{3}{5}$ of the total journey by rail, $\frac{17}{20}$ by bus and the remaining 6.5 km on foot. His total journey is :
(*a*) 65 km (*b*) 100 km (*c*) 120 km (*d*) 130 km

24. A can complete a journey in 10 hours. He travels first half of the journey at the rate of 21 km / hr and second half at the rate of 24 km / hr. Find the total journey in km.
(*a*) 220 km (*b*) 224 km (*c*) 230 km (*d*) 234 km
(Assistant Grade, 1997)

25. A person travels equal distances with speeds of 3 km / hr, 4 km / hr and 5 km / hr and takes a total time of 47 minutes. The total distance (in km) is : **(R.R.B. 2001)**
(*a*) 2 (*b*) 3 (*c*) 4 (*d*) 5

26. A farmer travelled a distance of 61 km in 9 hours. He travelled partly on foot @ 4 km / hr and partly on bicycle @ 9 km / hr. The distance travelled on foot is :
(*a*) 14 km (*b*) 15 km (*c*) 16 km (*d*) 17 km
(U.P.S.C. 2002)

27. A is faster than B. A and B each walk 24 km. The sum of their speeds is 7 km / hr and the sum of times taken by them is 14 hours. Then, A's speed is equal to :
(*a*) 3 km / hr (*b*) 4 km / hr (*c*) 5 km / hr (*d*) 7 km / hr
(I.A.F. 2002)

28. A person travels from P to Q at a speed of 40 kmph and returns by increasing his speed by 50%. What is his average speed for both the trips ? **(M.B.A. 2003)**
(*a*) 36 kmph (*b*) 45 kmph (*c*) 48 kmph (*d*) 50 kmph

29. A car driver travels from the plains to the hill station, which are 200 km apart at an average speed of 40 km / hr. In the return trip, he covers the same distance at an average speed of 20 km / hr. The average speed of the car over the entire distance of 400 km is :

(*a*) 25 km / hr (*b*) 26.67 km / hr (*c*) 28.56 km / hr (*d*) 30 km / hr

30. Mac travels from A to B a distance of 250 miles in $5\frac{1}{2}$ hours. He returns to A in 4 hours 30 minutes. His average speed is :

(*a*) 44 mph (*b*) 46 mph (*c*) 48 mph (*d*) 50 mph

31. A boy goes to his school from his house at a speed of 3 km / hr and returns at a speed of 2 km / hr. If he takes 5 hours in going and coming, the distance between his house and school is : **(S.S.C. 2004)**

(*a*) 5 km (*b*) 5.5 km (*c*) 6 km (*d*) 6.5 km

32. The average speed of a train in the onward journey is 25% more than that in the return journey. The train halts for one hour on reaching the destination. The total time taken for the complete to and fro journey is 17 hours, covering a distance of 800 km. The speed of the train in the onward journey is :

(*a*) 45 km / hr (*b*) 47.5 km / hr (*c*) 52 km / hr (*d*) 56.25 km / hr

33. I started on my bicycle at 7 a.m. to reach a certain place. After going a certain distance, my bicycle went out of order. Consequently, I rested for 35 minutes and came back to my house walking all the way. I reached my house at 1 p.m. If my cycling speed is 10 kmph and my walking speed is 1 kmph, then on my bicycle I covered a distance of :

(*a*) $4\frac{61}{66}$ km (*b*) $13\frac{4}{9}$ km (*c*) $14\frac{3}{8}$ km (*d*) $15\frac{10}{21}$ km

34. A, B and C are on a trip by a car. A drives during the first hour at an average speed of 50 km / hr. B drives during the next 2 hours at an average speed of 48 km / hr. C drives for the next 3 hours at an average speed of 52 km / hr. They reached their destination after exactly 6 hours. Their mean speed was :

(*a*) 50 km / hr (*b*) $50\frac{1}{3}$ km / hr (*c*) $51\frac{1}{3}$ km / hr (*d*) 52 km / hr

35. A man on tour travels first 160 km at 64 km / hr and the next 160 km at 80 km / hr. The average speed for the first 320 km of the tour is : **(R.R.B. 2003)**

(*a*) 35.55 km / hr (*b*) 36 km / hr (*c*) 71.11 km / hr (*d*) 71 km / hr

36. A boy rides his bicycle 10 km at an average speed of 12 km / hr and again travels 12 km at an average speed of 10 km / hr. His average speed for the entire trip is approximately : **(S.S.C. 1999)**

(*a*) 10.4 km / hr (*b*) 10.8 km / hr (*c*) 11 km / hr (*d*) 12.2 km / hr

37. A man travels 600 km by train at 80 km / hr, 800 km by ship at 40 km / hr, 500 km by aeroplane at 400 km / hr and 100 km by car at 50 km / hr. What is the average speed for the entire distance ? **(S.S.C. 2000)**

(*a*) 60 km / hr (*b*) $60\frac{5}{123}$ km / hr (*c*) 62 km / hr (*d*) $65\frac{5}{123}$ km / hr

38. A car travels the first one-third of a certain distance with a speed of 10 km / hr, the next one-third distance with a speed of 20 km / hr, and the last one-third distance with a speed of 60 km / hr. The average speed of the car for the whole journey is :

(*a*) 18 km / hr (*b*) 24 km / hr (*c*) 30 km / hr (*d*) 36 km / hr

(Civil Services, 2003)

39. A motorist covers a distance of 39 km in 45 minutes by moving at a speed of x kmph for the first 15 minutes, then moving at double the speed for the next 20 minutes and then again moving at his original speed for the rest of the journey. Then, x is equal to :

(*a*) 31.2 (*b*) 36 (*c*) 40 (*d*) 52

40. Mary jogs 9 km at a speed of 6 km per hour. At what speed would she need to jog during the next 1.5 hours to have an average of 9 km per hour for the entire jogging session ?

(*a*) 9 kmph (*b*) 10 kmph (*c*) 12 kmph (*d*) 14 kmph

41. A car travelling with $\frac{5}{7}$ of its actual speed covers 42 km in 1 hr 40 min 48 sec. Find the actual speed of the car. **(S.S.C. 2002)**

(*a*) $17\frac{6}{7}$ km/hr (*b*) 25 km/hr (*c*) 30 km/hr (*d*) 35 km/hr

42. A train running at $\frac{7}{11}$ of its own speed reached a place in 22 hours. How much time could be saved if the train would have run at its own speed ?

(*a*) 7 hours (*b*) 8 hours (*c*) 14 hours (*d*) 16 hours

43. A man can reach a certain place in 30 hours. If he reduces his speed by $\frac{1}{15}$th, he goes 10 km less in that time. Find his speed. **(S.S.C. 2002)**

(*a*) 4 km/hr (*b*) 5 km/hr (*c*) $5\frac{1}{2}$ km/hr (*d*) 6 km/hr

44. Walking $\frac{6}{7}$th of his usual speed, a man is 12 minutes too late. The usual time taken by him to cover that distance is : **(R.R.B. 2001)**

(*a*) 1 hour (*b*) 1 hr 12 min. (*c*) 1 hr 15 min. (*d*) 1 hr 20 min

45. Starting from his house one day, a student walks at a speed of $2\frac{1}{2}$ kmph and reaches his school 6 minutes late. Next day he increases his speed by 1 kmph and reaches the school 6 minutes early. How far is the school from his house ? **(S.S.C. 2004)**

(*a*) 1 km (*b*) $1\frac{1}{2}$ km (*c*) $1\frac{3}{4}$ km (*d*) 2 km

46. A train when moves at an average speed of 40 kmph, reaches its destination on time. When its average speed becomes 35 kmph, then it reaches its destination 15 minutes late. Find the length of journey. **(Bank P.O. 2003)**

(*a*) 30 km (*b*) 40 km (*c*) 70 km (*d*) 80 km

47. Robert is travelling on his cycle and has calculated to reach point A at 2 P.M. if he travels at 10 kmph; he will reach there at 12 noon if he travels at 15 kmph. At what speed must he travel to reach A at 1 P.M. ? **(D.M.R.C. 2003)**

(*a*) 8 kmph (*b*) 11 kmph (*c*) 12 kmph (*d*) 14 kmph

48. If a train runs at 40 kmph, it reaches its destination late by 11 minutes but if it runs at 50 kmph, it is late by 5 minutes only. The correct time for the train to complete its journey is :

(*a*) 13 min. (*b*) 15 min. (*c*) 19 min. (*d*) 21 min

49. A man covered a certain distance at some speed. Had he moved 3 kmph faster, he would have taken 40 minutes less. If he had moved 2 kmph slower, he would have taken 40 minutes more. The distance (in km) is : **(S.S.C. 2003)**

(*a*) 35 (*b*) $36\frac{2}{3}$ (*c*) $37\frac{1}{2}$ (*d*) 40

50. A car travels from P to Q at a constant speed. If its speed were increased by 10 km / hr, it would have taken one hour lesser to cover the distance. It would have taken further 45 minutes lesser if the speed was further increased by 10 km / hr. What is the distance between the two cities ?

(*a*) 420 km (*b*) 540 km (*c*) 600 km (*d*) 650 km

51. A train can travel 50% faster than a car. Both start from point A at the same time and reach point B 75 kms away from A at the same time. On the way, however, the train lost about 12.5 minutes while stopping at the stations. The speed of the car is :

(*a*) 100 kmph (*b*) 110 kmph (*c*) 120 kmph (*d*) 130 kmph

(M.A.T. 2003)

52. Excluding stoppages, the speed of a bus is 54 kmph and including stoppages, it is 45 kmph. For how many minutes does the bus stop per hour ? **(N.I.F.T. 2002)**

(*a*) 9 (*b*) 10 (*c*) 12 (*d*) 20

53. A car covers a distance of 715 km at a constant speed. If the speed of the car would have been 10 km / hr more, then it would have taken 2 hours less to cover the same distance. What is the original speed of the car ?

(*a*) 45 km / hr (*b*) 50 km / hr (*c*) 55 km / hr (*d*) 65 km / hr

54. In covering a certain distance, the speeds of A and B are in the ratio of 3 : 4. A takes 30 minutes more than B to reach the destination. The time taken by A to reach the destination is : **(S.S.C. 1999)**

(*a*) 1 hour (*b*) $1\frac{1}{2}$ hours (*c*) 2 hours (*d*) $2\frac{1}{2}$ hours

55. In covering a distance of 30 km, Abhay takes 2 hours more than Sameer. If Abhay doubles his speed, then he would take 1 hour less than Sameer. Abhay's speed is :

(*a*) 5 kmph (*b*) 6 kmph (*c*) 6.25 kmph (*d*) 7.5 kmph

(M.A.T. 2003)

56. Three persons are walking from a place A to another place B. Their speeds are in the ratio of 4 : 3 : 5. The time ratio to reach B by these persons will be :

(*a*) 4 : 3 : 5 (*b*) 5 : 3 : 4 (*c*) 15 : 9 : 20 (*d*) 15 : 20 : 12

57. With a uniform speed a car covers the distance in 8 hours. Had the speed been increased by 4 km / hr, the same distance could have been covered in $7\frac{1}{2}$ hours. What is the distance covered ? **(Bank P.O. 2003)**

(*a*) 420 km (*b*) 480 km (*c*) 640 km

(*d*) Cannot be determined (*e*) None of these

58. Two men start together to walk to a certain destination, one at 3 kmph and another at 3.75 kmph. The latter arrives half an hour before the former. The distance is :

(*a*) 6 km (*b*) 7.5 km (*c*) 8 km (*d*) 9.5 km

59. If a person walks at 14 km / hr instead of 10 km / hr, he would have walked 20 km more. The actual distance travelled by him is : **(R.R.B. 2000)**

(*a*) 50 km (*b*) 56 km (*c*) 70 km (*d*) 80 km

60. In a flight of 600 km, an aircraft was slowed down due to bad weather. Its average speed for the trip was reduced by 200 km / hr and the time of flight increased by 30 minutes. The duration of the flight is : **(M.A.T. 2002)**

(*a*) 1 hour (*b*) 2 hours (*c*) 3 hours (*d*) 4 hours

61. It takes eight hours for a 600 km journey, if 120 km is done by train and the rest by car. It takes 20 minutes more, if 200 km is done by train and the rest by car. The ratio of the speed of the train to that of the car is : **(M.B.A. 2001)**

(*a*) 2 : 3 (*b*) 3 : 2 (*c*) 3 : 4 (*d*) 4 : 3

62. A is twice as fast as B and B is thrice as fast as C is. The journey covered by C in 54 minutes will be covered by B in :
(a) 18 min (b) 27 min (c) 38 min (d) 9 min

63. Two men starting from the same place walk at the rate of 5 kmph and 5.5 kmph respectively. What time will they take to be 8.5 km apart, if they walk in the same direction ?
(a) 4 hrs 15 min (b) 8 hrs 30 min (c) 16 hrs (d) 17 hrs

64. A walks around a circular field at the rate of one round per hour while B runs around it at the rate of six rounds per hour. They start in the same direction from the same point at 7.30 a.m. They shall first cross each other at : **(Civil Services, 2003)**
(a) 7.42 a.m. (b) 7.48 a.m. (c) 8.10 a.m. (d) 8.30 a.m.

65. A walks at 4 kmph and 4 hours after his start, B cycles after him at 10 kmph. How far from the start does B catch up with A ?
(a) 16.7 km (b) 18.6 km (c) 21.5 km (d) 26.7 km

66. A thief is noticed by a policeman from a distance of 200 m. The thief starts running and the policeman chases him. The thief and the policeman run at the rate of 10 km and 11 km per hour respectively. What is the distance between them after 6 minutes ?
(a) 100 m (b) 150 m (c) 190 m (d) 200 m
(S.S.C. 2000)

67. A thief steals a car at 2.30 p.m. and drives it at 60 kmph. The theft is discovered at 3 p.m. and the owner sets off in another car at 75 kmph. When will he overtake the thief ? **(R.R.B. 2002)**
(a) 4.30 p.m. (b) 4.45 p.m. (c) 5 p.m. (d) 5.15 p.m.

68. Two guns were fired from the same place at an interval of 10 minutes and 30 seconds, but a person in the train approaching the place hears the second shot 10 minutes after the first. The speed of the train (in km / hr), supposing that speed travels at 330 metres per second, is :
(a) 19.8 (b) 58.6 (c) 59.4 (d) 111.80

69. Two cyclists start from the same place in opposite directions. One goes towards north at 18 kmph and the other goes towards south at 20 kmph. What time will they take to be 47.5 km apart ?
(a) $1\frac{1}{4}$ hrs (b) $2\frac{1}{4}$ hrs (c) 2 hrs. 23 min. (d) $2\frac{1}{2}$ hrs

70. The distance between two cities A and B is 330 km. A train starts from A at 8 a.m. and travels towards B at 60 km / hr. Another train starts from B at 9 a.m. and travels towards A at 75 km / hr. At what time do they meet ? **(L.I.C.A.A.O. 2003)**
(a) 10 a.m. (b) 10.30 a.m. (c) 11 a.m. (d) 11.30 a.m.

71. The jogging track in a sports complex is 726 metres in circumference. Deepak and his wife start from the same point and walk in opposite directions at 4.5 km / hr and 3.75 km / hr respectively. They will meet for the first time in : **(M.A.T. 2003)**
(a) 4.9 min (b) 5.28 min (c) 5.5 min (d) 6 min

72. A and B walk around a circular track. They start at 8 a.m. from the same point in the opposite directions. A and B walk at a speed of 2 rounds per hour and 3 rounds per hour respectively. How many times shall they cross each other before 9.30 a.m. ?
(a) 5 (b) 6 (c) 7 (d) 8
(U.P.S.C. 2002)

73. Two cars P and Q start at the same time from A and B which are 120 km apart. If the two cars travel in opposite directions, they meet after one hour and if they travel in same direction (from A towards B), then P meets Q after 6 hours. What is the speed of car P ? **(S.B.I.P.O. 2000)**
(a) 60 kmph (b) 70 kmph (c) 120 kmph
(d) Data inadequate (e) None of these

74. Two trains starting at the same time from two stations 200 km apart and going in opposite directions cross each other at a distance of 110 km from one of the stations. What is the ratio of their speeds ?

(*a*) 9 : 20 (*b*) 11 : 9 (*c*) 11 : 20 (*d*) None of these

75. Two trains start from P and Q respectively and travel towards each other at a speed of 50 km / hr and 40 km / hr respectively. By the time they meet, the first train has travelled 100 km more than the second. The distance between P and Q is :

(*a*) 500 km (*b*) 630 km (*c*) 660 km (*d*) 900 km

(S.S.C. 2000)

76. Bombay Express left Delhi for Bombay at 14.30 hrs, travelling at a speed of 60 kmph and Rajdhani Express left Delhi for Bombay on the same day at 16.30 hrs, travelling at a speed of 80 kmph. How far away from Delhi will the two trains meet ?

(*a*) 120 km (*b*) 360 km (*c*) 480 km (*d*) 500 km

77. A train M leaves Meerut at 5 a.m. and reaches Delhi at 9 a.m. Another train leaves Delhi at 7 a.m. and reaches Meerut at 10.30 a.m. At what time do the two trains cross each other ?

(*a*) 7.36 a.m. (*b*) 7.56 a.m. (*c*) 8 a.m. (*d*) 8.26 a.m.

78. A man takes 5 hours 45 min. in walking to a certain place and riding back. He would have gained 2 hours by riding both ways. The time he would take to walk both ways, is :

(*a*) 3 hrs 45 min (*b*) 7 hrs 30 min
(*c*) 7 hrs 45 min (*d*) 11 hrs 45 min

ANSWERS

1. (*c*)	2. (*d*)	3. (*d*)	4. (*b*)	5. (*d*)	6. (*d*)	7. (*c*)	8. (*c*)
9. (*a*)	10. (*a*)	11. (*d*)	12. (*c*)	13. (*b*)	14. (*a*)	15. (*c*)	16. (*c*)
17. (*c*)	18. (*d*)	19. (*e*)	20. (*d*)	21. (*a*)	22. (*c*)	23. (*d*)	24. (*b*)
25. (*b*)	26. (*c*)	27. (*b*)	28. (*c*)	29. (*b*)	30. (*d*)	31. (*c*)	32. (*d*)
33. (*a*)	34. (*b*)	35. (*c*)	36. (*b*)	37. (*d*)	38. (*a*)	39. (*d*)	40. (*c*)
41. (*d*)	42. (*b*)	43. (*c*)	44. (*b*)	45. (*c*)	46. (*c*)	47. (*c*)	48. (*c*)
49. (*d*)	50. (*a*)	51. (*c*)	52. (*b*)	53. (*c*)	54. (*c*)	55. (*a*)	56. (*d*)
57. (*b*)	58. (*a*)	59. (*a*)	60. (*a*)	61. (*c*)	62. (*a*)	63. (*d*)	64. (*a*)
65. (*d*)	66. (*a*)	67. (*e*)	68. (*c*)	69. (*a*)	70. (*c*)	71. (*b*)	72. (*c*)
73. (*b*)	74. (*b*)	75. (*d*)	76. (*c*)	77. (*e*)	78. (*d*)		

SOLUTIONS

1. Speed $= \left(80 \times \frac{5}{18}\right)$ m / sec $= \frac{200}{9}$ m / sec $= 22\frac{2}{9}$ m / sec.

2. Speed $= \frac{200}{24}$ m / sec $= \frac{25}{3}$ m / sec $= \left(\frac{25}{3} \times \frac{18}{5}\right)$ km / hr = 30 km / hr.

3. 25 m / sec $= \left(25 \times \frac{18}{5}\right)$ km / hr = 90 km / hr.

And, 25 m / sec = (25 × 60) m / min = 1500 m / min.

So, all the three speeds are equal.

4. Speed $= \left(\frac{600}{5 \times 60}\right)$ m / sec = 2 m / sec $= \left(2 \times \frac{18}{5}\right)$ km / hr = 7.2 km / hr.

5. Speed $= \left(5 \times \frac{5}{18}\right)$ m/sec $= \frac{25}{18}$ m/sec.

Distance covered in 15 minutes $= \left(\frac{25}{18} \times 15 \times 60\right)$ m = 1250 m.

6. Speed = 9 km/hr $= \left(9 \times \frac{5}{18}\right)$ m/sec $= \frac{5}{2}$ m/sec.

Distance = (35 × 4) m = 140 m.

∴ Time taken $= \left(140 \times \frac{2}{5}\right)$ sec = 56 sec.

7. Speed = 108 kmph $= \left(108 \times \frac{5}{18}\right)$ m/sec = 30 m/sec.

∴ Distance covered in 15 sec. = (30 × 15) m = 450 m.

8. Ratio of speeds $= \left(300 \times \frac{2}{15}\right) : \left(\frac{450}{9}\right) = 40 : 50 = 4 : 5.$

9. Ratio of speeds $= \left(\frac{550}{60} \times \frac{18}{5}\right) : \left(\frac{33}{45} \times 60\right) = 33 : 44 = 3 : 4.$

10. Let the speeds of two trains be $7x$ and $8x$ km/hr.

Then, $8x = \frac{400}{4} = 100 \Rightarrow x = \left(\frac{100}{8}\right) = 12.5.$

∴ Speed of first train = (7 × 12.5) km/hr = 87.5 km/hr.

11. Total distance travelled $= \left[\left(50 \times 2\frac{1}{2}\right) + \left(70 \times 1\frac{1}{2}\right)\right]$ miles = (125 + 105) miles = 230 miles.

12. Number of gaps between 21 telephone posts = 20.

Distance travelled in 1 minute = (50 × 20) m = 1000 m = 1 km.

∴ Speed = 60 km/hr.

13. Distance $= \left(1100 \times \frac{11}{5}\right)$ feet = 2420 feet.

14. Time taken to cover 600 km $= \left(\frac{600}{100}\right)$ hrs = 6 hrs.

Number of stoppages $= \frac{600}{75} - 1 = 7.$

Total time of stoppage = (3 × 7) min = 21 min.

Hence, total time taken = 6 hrs 21 min.

15. Let the distance covered by the cyclist be x and the time taken be y. Then,

Required ratio $= \frac{\frac{1}{2}x}{2y} : \frac{x}{y} = \frac{1}{4} : 1 = 1 : 4.$

16. Distance covered in first 2 hours = (70 × 2) km = 140 km.

Distance covered in next 2 hours = (80 × 2) km = 160 km.

Remaining distance = 345 − (140 + 160) = 45 km.

Speed in the fifth hour = 90 km/hr.

Time taken to cover 45 km $= \left(\frac{45}{90}\right)$ hr $= \frac{1}{2}$ hr.

∴ Total time taken $= \left(2 + 2 + \frac{1}{2}\right) = 4\frac{1}{2}$ hrs.

17. Total distance travelled in 12 hours = (35 + 37 + 39 + ... upto 12 terms).
This is an A.P. with first term, $a = 35$, number of terms, $n = 12$, common difference, $d = 2$.

$\therefore$ Required distance $= \frac{12}{2}[2 \times 35 + (12-1) \times 2] = 6(70+22) = 552$ km.

18. Speed $= \left(10 \times \frac{60}{12}\right)$ km/hr $= 50$ km/hr.

New speed $= (50 - 5)$ km/hr $= 45$ km/hr.

$\therefore$ Time taken $= \left(\frac{10}{45}\right)$ hr $= \left(\frac{2}{9} \times 60\right)$ min $= 13\frac{1}{3}$ min $= 13$ min 20 sec.

19. Distance covered in 2 hrs 15 min *i.e.*, $2\frac{1}{4}$ hrs $= \left(80 \times \frac{9}{4}\right)$ hrs $= 180$ hrs.

Time taken to cover remaining distance $= \left(\frac{350-180}{60}\right)$ hrs $= \frac{17}{6}$ hrs

$= 2\frac{5}{6}$ hrs $= 2$ hrs 50 min.

Total time taken = (2 hrs 15 min + 2 hrs 50 min) = 5 hrs 5 min.

So, Anna reached city A at 10.25 a.m.

20. Distance = (240 × 5) km = 1200 km.

$\therefore$ Required speed $= \left(1200 \times \frac{3}{5}\right)$ km/hr $= 720$ km/hr.

21. Time required = (2 hrs 30 min − 50 min) = 1 hr 40 min $= 1\frac{2}{3}$ hrs.

$\therefore$ Required speed $= \left(50 \times \frac{3}{5}\right)$ km/hr $= 30$ km/hr.

Original speed $= \left(50 \times \frac{2}{5}\right)$ km/hr $= 20$ km/hr.

$\therefore$ Difference in speed = (30 − 20) km/hr = 10 km/hr.

22. Remaining distance = 3 km and Remaining time $= \left(\frac{1}{3} \times 45\right)$ min $= 15$ min $= \frac{1}{4}$ hour.

$\therefore$ Required speed = (3 × 4) km/hr = 12 km/hr.

23. Let the total journey be x km.

Then, $\frac{3x}{5} + \frac{7x}{20} + 6.5 = x \Leftrightarrow 12x + 7x + 20 \times 6.5 = 20x \Leftrightarrow x = 130$ km.

24. Let the total distance be x km. Then,

$$\frac{\frac{1}{2}x}{21} + \frac{\frac{1}{2}x}{24} = 10 \Rightarrow \frac{x}{21} + \frac{x}{24} = 20$$

$$\Rightarrow 15x = 168 \times 20 \Rightarrow x = \left(\frac{168 \times 20}{15}\right) = 224 \text{ km.}$$

25. Let the total distance be $3x$ km.

Then, $\frac{x}{3} + \frac{x}{4} + \frac{x}{5} = \frac{47}{60} \Leftrightarrow \frac{47x}{60} = \frac{47}{60} \Leftrightarrow x = 1.$

$\therefore$ Total distance = (3 × 1) km = 3 km.

26. Let the distance travelled on foot be x km.
Then, distance travelled on bicycle = $(61 - x)$ km.

So, $\frac{x}{4} + \frac{(61-x)}{9} = 9 \Leftrightarrow 9x + 4(61 - x) = 9 \times 36 \Leftrightarrow 5x = 80 \Leftrightarrow x = 16$ km.

27. Let A's speed = x km / hr. Then, B's speed = $(7 - x)$ km / hr.

So, $\frac{24}{x} + \frac{24}{(7-x)} = 14 \Leftrightarrow 24(7 - x) + 24x = 14x(7 - x)$

$\Leftrightarrow 14x^2 - 98x + 168 = 0 \Leftrightarrow x^2 - 7x + 12 = 0$

$\Leftrightarrow (x - 3)(x - 4) = 0 \Leftrightarrow x = 3$ or $x = 4$.

Since, A is faster than B, so A's speed = 4 km / hr and B's speed = 3 km / hr.

28. Speed on return trip = 150% of 40 = 60 kmph.

$\therefore$ Average speed $= \left(\frac{2 \times 40 \times 60}{40 + 60}\right)$ km / hr $= \left(\frac{4800}{100}\right)$ km / hr = 48 km / hr.

29. Average speed $= \left(\frac{2 \times 40 \times 20}{40 + 60}\right)$ km / hr $= \left(\frac{80}{3}\right)$ km / hr = 26.67 km / hr.

30. Speed from A to B $= \left(250 \times \frac{2}{11}\right)$ mph $= \left(\frac{500}{11}\right)$ mph.

Speed from B to A $= \left(250 \times \frac{2}{9}\right)$ mph $= \left(\frac{500}{9}\right)$ mph.

$\therefore$ Average speed $= \left(\frac{2 \times \frac{500}{11} \times \frac{500}{9}}{\frac{500}{11} + \frac{500}{9}}\right)$ mph $= \left(\frac{500000}{4500 + 5500}\right)$ mph = 50 mph.

31. Average speed $= \left(\frac{2 \times 3 \times 2}{3 + 2}\right)$ km / hr $= \frac{12}{5}$ km / hr.

Distance travelled $= \left(\frac{12}{5} \times 5\right)$ km = 12 km.

$\therefore$ Distance between house and school $= \left(\frac{12}{2}\right)$ km = 6 km.

32. Let the speed in return journey be x km / hr.

Then, speed in onward journey $= \frac{125}{100}x = \left(\frac{5}{4}x\right)$ km / hr.

Average speed $= \left(\frac{2 \times \frac{5}{4}x \times x}{\frac{5}{4}x + x}\right)$ km / hr $= \frac{10x}{9}$ km / hr.

$\therefore \left(800 \times \frac{9}{10x}\right) = 16 \Leftrightarrow x = \left(\frac{800 \times 9}{16 \times 10}\right) = 45.$

So, speed in onward journey $= \left(\frac{5}{4} \times 45\right)$ km / hr = 56.25 km / hr.

33. Time taken = 5 hrs 25 min $= \frac{65}{12}$ hrs.

Let the required distance be x km.

Then, $\frac{x}{10} + \frac{x}{1} = \frac{65}{12} \Leftrightarrow 11x = \frac{650}{12} \Leftrightarrow x = \frac{325}{66} = 4\frac{61}{66}$ km.

34. Total distance travelled = (50 × 1 + 48 × 2 + 52 × 3) km = 302 km.

Total time taken = 6 hrs.

$\therefore$ Mean speed $= \left(\frac{302}{6}\right)$ km/hr $= 50\frac{1}{3}$ km/hr.

35. Total time taken $= \left(\frac{160}{64} + \frac{160}{8}\right)$ hrs $= \frac{9}{2}$ hrs.

$\therefore$ Average speed $= \left(320 \times \frac{2}{9}\right)$ km/hr = 71.11 km/hr.

36. Total distance travelled = (10 + 12) km/hr = 22 km/hr.

Total time taken $= \left(\frac{10}{12} + \frac{12}{10}\right)$ hrs $= \frac{61}{30}$ hrs.

$\therefore$ Average speed $= \left(22 \times \frac{30}{61}\right)$ km/hr = 10.8 km/hr.

37. Total distance travelled = (600 + 800 + 500 + 100) km = 2000 km.

Total time taken $= \left(\frac{600}{80} + \frac{800}{40} + \frac{500}{400} + \frac{100}{50}\right)$ hrs $= \frac{123}{4}$ hrs.

$\therefore$ Average speed $= \left(2000 \times \frac{4}{123}\right)$ km/hr $= \left(\frac{8000}{123}\right)$ km/hr $= 65\frac{5}{123}$ km/hr.

38. Let the whole distance travelled be x km and the average speed of the car for the whole journey be y km/hr.

Then, $\frac{(x/3)}{10} + \frac{(x/3)}{20} + \frac{(x/3)}{60} = \frac{x}{y} \Leftrightarrow \frac{x}{30} + \frac{x}{60} + \frac{x}{180} = \frac{x}{y}$

$\Leftrightarrow \frac{1}{18}y = 1 \Leftrightarrow y = 18$ km/hr.

39. $x \times \frac{15}{60} + 2x \times \frac{20}{60} + x \times \frac{10}{60} = 39 \Rightarrow \frac{x}{4} + \frac{2x}{3} + \frac{x}{6} = 39$

$\Rightarrow 3x + 8x + 2x = 468 \Rightarrow x = 36.$

40. Let speed of jogging be x km/hr.

Total time taken $= \left(\frac{9}{6}\text{ hrs} + 1.5\text{ hrs}\right) = 3$ hrs.

Total distance covered = $(9 + 1.5x)$ km.

$\therefore \frac{9 + 1.5x}{3} = 9 \Leftrightarrow 9 + 1.5x = 27 \Leftrightarrow \frac{3}{2}x = 18 \Leftrightarrow x = \left(18 \times \frac{2}{3}\right) = 12$ kmph.

41. Time taken = 1 hr 40 min 48 sec = 1 hr $40\frac{4}{5}$ min $= 1\frac{51}{75}$ hrs $= \frac{126}{75}$ hrs.

Let the actual speed be x km/hr.

Then, $\frac{5}{7}x \times \frac{126}{75} = 42$ or $x = \left(\frac{42 \times 7 \times 75}{5 \times 126}\right) = 35$ km/hr.

42. New speed $= \frac{7}{11}$ of usual speed.

$\therefore$ New time $= \frac{11}{7}$ of usual time.

So, $\frac{11}{7}$ of usual time = 22 hrs $\Rightarrow$ usual time $= \left(\frac{22 \times 7}{11}\right) = 14$ hrs.

Hence, time saved = (22 − 14) = 8 hrs.

43. Let the speed be x km / hr. Then,

$$30x - 30 \times \frac{14}{15}x = 10 \Leftrightarrow 2x = 10 \Leftrightarrow x = 5 \text{ km/hr.}$$

44. New speed $= \frac{6}{7}$ of usual speed.

New time $= \frac{7}{6}$ of usual time

$$\therefore \left(\frac{7}{6} \text{ of usual time}\right) - (\text{usual time}) = \frac{1}{5} \text{ hr.}$$

$$\Rightarrow \frac{1}{6} \text{ of usual time} = \frac{1}{5} \text{ hr} \Rightarrow \text{usual time} = \frac{6}{5} \text{ hr} = 1 \text{ hr } 12 \text{ min.}$$

45. Let the distance be x km.

Difference in timings $= 12 \text{ min} = \frac{12}{60} \text{ hr} = \frac{1}{5} \text{ hr.}$

$$\therefore \frac{2x}{5} - \frac{2x}{7} = \frac{1}{5} \Leftrightarrow 14x - 10x = 7 \Leftrightarrow x = 1\frac{3}{4} \text{ km.}$$

46. Difference between timings $= 15 \text{ min} = \frac{1}{4}$ hr.

Let the length of journey be x km.

Then, $\frac{x}{35} - \frac{x}{40} = \frac{1}{4} \Leftrightarrow 8x - 7x = 70 \Leftrightarrow x = 70$ km.

47. Let the distance travelled be x km.

Then, $\frac{x}{10} - \frac{x}{15} = 2 \Leftrightarrow 3x - 2x = 60 \Leftrightarrow x = 60$ km.

Time taken to travel 60 km at 10 km / hr $= \left(\frac{60}{10}\right)$ hrs $= 6$ hrs.

So, Robert started 6 hours before 2 P.M. *i.e.*, at 8 A.M.

$\therefore$ Required speed $= \left(\frac{60}{5}\right)$ kmph $= 12$ kmph.

48. Let the correct time to complete the journey be x min.

Distance covered in $(x + 11)$ min. at 40 kmph

= Distance covered in $(x + 5)$ min. at 50 kmph

$$\therefore \frac{(x+11)}{60} \times 40 = \frac{(x+5)}{60} \times 50 \Leftrightarrow x = 19 \text{ min.}$$

49. Let distance $= x$ km and usual rate $= y$ kmph.

$$\frac{x}{y} - \frac{x}{y+3} = \frac{40}{60} \text{ or } 2y(y+3) = 9x \quad ...(i)$$

$$\text{And, } \frac{x}{y-2} - \frac{x}{y} = \frac{40}{60} \text{ or } y(y-2) = 3x \quad ...(ii)$$

On dividing (i) by (ii), we get $x = 40$ km.

50. Let distance $= x$ km and usual rate $= y$ kmph. Then,

$$\frac{x}{y} - \frac{x}{y+10} = 1 \text{ or } y(y+10) = 10x \quad ...(i)$$

$$\text{And, } \frac{x}{y} - \frac{x}{y+20} = \frac{7}{4} \text{ or } y(y+20) = \frac{80x}{7} \quad ...(ii)$$

On dividing (i) by (ii), we get $y = 60$.

Substituting $y = 60$ in (i), we get : $x = 420$ km.

51. Let speed of the car be x kmph.

Then, speed of the train $= \frac{150}{100}x = \left(\frac{3}{2}x\right)$ kmph.

$$\therefore \quad \frac{75}{x} - \frac{75}{\frac{3}{2}x} = \frac{125}{10 \times 60} \Leftrightarrow \frac{75}{x} - \frac{50}{x} = \frac{5}{24} \Leftrightarrow x = \left(\frac{25 \times 24}{5}\right) = 120 \text{ kmph.}$$

52. Due to stoppages, it covers 9 km less.

Time taken to cover 9 km $= \left(\frac{9}{54} \times 60\right)$ min $= 10$ min.

53. Let the original speed be x km / hr. Then,

$$\frac{715}{x} - \frac{715}{x+10} = 2 \Leftrightarrow 2x(x+10) = 7150 \Leftrightarrow x^2 + 10x - 3575 = 0$$

$$\Leftrightarrow (x+65)(x-55) = 0 \Leftrightarrow x = 55 \text{ km / hr.}$$

54. Ratio of speeds = 3 : 4. Ratio of times taken = 4 : 3.

Suppose A takes $4x$ hrs and B takes $3x$ hrs to reach the destination. Then,

$$4x - 3x = \frac{30}{60} = \frac{1}{2} \text{ or } x = \frac{1}{2}.$$

$\therefore$ Time taken by A $= 4x$ hrs $= \left(4 \times \frac{1}{2}\right)$ hrs $= 2$ hrs.

55. Let Abhay's speed be x km / hr.

Then, $\frac{30}{x} - \frac{30}{2x} = 3 \Leftrightarrow 6x = 30 \Leftrightarrow x = 5$ km / hr.

56. Ratio of speeds = 4 : 3 : 5.

$\therefore$ Ratio of times taken $= \frac{1}{4} : \frac{1}{3} : \frac{1}{5} = 15 : 20 : 12.$

57. Let the distance be x km. Then,

$$\frac{x}{7\frac{1}{2}} - \frac{x}{8} = 4 \Leftrightarrow \frac{2x}{15} - \frac{x}{8} = 4 \Leftrightarrow x = 480 \text{ km.}$$

58. Let the distance be x km. Then,

$$\frac{x}{3} - \frac{x}{3.75} = \frac{1}{2} \Leftrightarrow 2.5x - 2x = 3.75 \Leftrightarrow x = \frac{3.75}{0.50} = \frac{15}{2} = 7.5 \text{ km.}$$

59. Let the actual distance travelled be x km. Then,

$$\frac{x}{10} = \frac{x+20}{14} \Leftrightarrow 14x = 10x + 200 \Leftrightarrow 4x = 200 \Leftrightarrow x = 50 \text{ km.}$$

60. Let the duration of the flight be x hours. Then,

$$\frac{600}{x} - \frac{600}{x + \frac{1}{2}} = 200 \Leftrightarrow \frac{600}{x} - \frac{1200}{2x+1} = 200 \Leftrightarrow x(2x+1) = 3$$

$$\Leftrightarrow 2x^2 + x - 3 = 0 \Leftrightarrow (2x+3)(x-1) = 0$$

$$\Leftrightarrow x = 1 \text{ hr.} \quad [\textit{neglecting the} - \textit{ve value of } x]$$

61. Let the speed of the train be x km / hr and that of the car be y km / hr.

Then, $\frac{120}{x} + \frac{480}{y} = 8$ or $\frac{1}{x} + \frac{4}{y} = \frac{1}{15}$ ...(*i*)

And, $\frac{200}{x} + \frac{400}{y} = \frac{25}{3}$ or $\frac{1}{x} + \frac{2}{y} = \frac{1}{24}$ ...(*ii*)

Solving (*i*) and (*ii*), we get $x = 60$ and $y = 80$.

$\therefore$ Ratio of speeds = 60 : 80 = 3 : 4.

62. Let C's speed = x km / hr. Then, B's speed = $3x$ km / hr and A's speed = $6x$ km / hr.

$\therefore$ Ratio of speeds of A, B, C = $6x : 3x : x = 6 : 3 : 1$.

Ratio of times taken $= \frac{1}{6} : \frac{1}{3} : 1 = 1 : 2 : 6$.

If C takes 6 min., then B takes 2 min.

If C takes 54 min., then B takes $\left(\frac{2}{6} \times 54\right)$ min. = 18 min.

63. To be 0.5 km apart, they take 1 hour.

To be 8.5 km apart, they take $\left(\frac{1}{0.5} \times 8.5\right)$ hrs = 17 hrs.

64. Since A and B move in the same direction along the circle, so they will first meet each other when there is a difference of one round between the two.

Relative speed of A and B = (6 – 1) = 5 rounds per hour.

Time taken to complete one round at this speed $= \frac{1}{5}$ hr = 12 min.

65. Suppose after x km from the start B catches up with A. Then, the difference in the time taken by A to cover x km and that taken by B to cover x km is 4 hours.

$\therefore \quad \frac{x}{4} - \frac{x}{10} = 4$ or $x = 26.7$ km.

66. Relative speed of the thief and p\
oliceman = (11 – 10) km / hr = 1 km / hr.

Distance covered in 6 minutes $= \left(\frac{1}{60} \times 6\right)$ km $= \frac{1}{10}$ km = 100 m.

$\therefore$ Distance between the thief and policeman = (200 – 100) m = 100 m.

67. Suppose the thief is overtaken x hrs after 2.30 p.m.

Then, distance covered by the thief in x hrs

= distance covered by the owner in $\left(x - \frac{1}{2}\right)$ hrs.

$\therefore \quad 60x = 75\left(x - \frac{1}{2}\right) \Leftrightarrow 15x = \frac{75}{2} \Leftrightarrow x = \frac{5}{2}$ hrs.

So, the thief is overtaken at 5 p.m.

68. Let the speed of the train be x m / sec. Then,

Distance travelled by the train in 10 min. = Distance travelled by sound in 30 sec.

$\Leftrightarrow \quad x \times 10 \times 60 = 330 \times 30 \Leftrightarrow x = 16.5$.

$\therefore$ Speed of the train = 16.5 m/ sec $= \left(16.5 \times \frac{18}{5}\right)$ km/ hr = 59.4 km/ hr

69. To be (18 + 20) km apart, they take 1 hour.

To be 47.5 km apart, they take $\left(\frac{1}{38} \times 47.5\right)$ hrs $= 1\frac{1}{4}$ hrs.

70. Suppose they meet x hrs after 8 a.m. Then,

(Distance moved by first in x hrs) + [Distance moved by second in $(x - 1)$ hrs] = 330

$\therefore \quad 60x + 75(x - 1) = 330 \quad \Rightarrow \quad x = 3$.

So, they meet at (8 + 3), *i.e.* 11 a.m.

71. Clearly, the two will meet when they are 726 m apart.

To be (4.5 + 3.75) = 8.25 km apart, they take 1 hour.

To be 726 m apart, they take $\left(\frac{100}{825} \times \frac{726}{1000}\right)$ hrs = $\left(\frac{242}{2750} \times 60\right)$ min = 5.28 min.

72. Relative speed = (2 + 3) = 5 rounds per hour.

So, they cross each other 5 times in an hour and 2 times in half an hour.

Hence, they cross each other 7 times before 9.30 a.m.

73. Let their speeds be x kmph and y kmph respectively.

Then, $\frac{120}{x+y} = 1 \Rightarrow x + y = 120$ ...(*i*)

Now, when they move in same direction :

(Distance travelled by P in 6 hrs) – (Distance travelled by Q in 6 hrs) = 120 km

$\Rightarrow 6x - 6y = 120 \Rightarrow x - y = 20$ ...(*ii*)

Solving (*i*) and (*ii*), $x = 70$, $y = 50$.

∴ P's speed = 70 kmph.

74. In the same time, they cover 110 km and 90 km respectively.

∴ Ratio of their speeds = 110 : 90 = 11 : 9.

75. At the time of meeting, let the distance travelled by the second train be x km.

Then, distance covered by the first train is $(x + 100)$ km.

$\therefore \frac{x}{40} = \frac{x+100}{50} \Leftrightarrow 50x = 40x + 4000 \Leftrightarrow x = 400.$

So, distance between P and Q = $(x + x + 100)$ km = 900 km.

76. Suppose they meet x hours after 14.30 hrs.

Then, $60x = 80(x - 2)$ or $x = 8$.

∴ Required distance = (60 × 8) km = 480 km.

77. Let the distance between Meerut and Delhi be x km and let the trains meet y hours after 7 a.m.

Clearly, M covers x km in 4 hrs and N covers x km in (7/2) hrs.

∴ Speed of M = $\frac{x}{4}$ kmph, Speed of N = $\frac{2x}{7}$ kmph.

Distance covered by M in $(y + 2)$ hrs + Distance covered in y hrs = x.

$\therefore \frac{x}{4}(y+2) + \frac{2x}{7} \times y = x \Leftrightarrow \frac{(y+2)}{4} + \frac{2y}{7} = 1$

$\Leftrightarrow y = \frac{14}{15}$ hrs = $\left(\frac{14}{15} \times 60\right)$ min. = 56 min.

Hence, the trains meet at 7.56 a.m.

78. Let the distance be x km. Then,

(Time taken to walk x km) + (Time taken to ride x km) = $\frac{23}{4}$ hrs.

⇒ (Time taken to walk $2x$ km) + (Time taken to ride $2x$ km) = $\frac{23}{2}$ hrs.

But, time taken to ride $2x$ km = $\frac{15}{4}$ hrs.

∴ Time taken to walk $2x$ km = $\left(\frac{23}{2} - \frac{15}{4}\right)$ hrs = $\frac{31}{4}$ hrs = 7 hrs 45 min.

EXERCISE 17B

(DATA SUFFICIENCY TYPE QUESTIONS)

Directions (*Questions 1 to 7*) : ***Each of the questions below consists of a statement and/or a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statements is/are sufficient to answer the question. Read both the statements and***

Give answer (a) if the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient to answer the question;

Give answer (b) if the data in Statement II alone are sufficient to answer the question, while the data in Statement I alone are not sufficient to answer the question;

Give answer (c) if the data either in Statement I or in Statement II alone are sufficient to answer the question;

Give answer (d) if the data even in both Statements I and II together are not sufficient to answer the question; and

Give answer (e) if the data in both Statements I and II together are necessary to answer the question.

1. How much time did X take to reach the destination ?
   I. The ratio between the speeds of X and Y is 3 : 4.
   II. Y takes 36 minutes to reach the same destination.
2. What is the usual speed of the train ? **(M.B.A. 2002)**
   I. The speed of the train is increased by 25 km / hr to reach the destination 150 km away in time.
   II. The train is late by 30 minutes.
3. Two towns are connected by railway. Can you find the distance between them ?
   I. The speed of mail train is 12 km / hr more than that of an express train.
   II. A mail train takes 40 minutes less than an express train to cover the distance. **(M.B.A. 2001)**
4. The towns A, B and C are on a straight line. Town C is between A and B. The distance from A to B is 100 km. How far is A from C ? **(M.B.A. 2003)**
   I. The distance from A to B is 25% more than the distance from C to B.
   II. The distance from A to C is $\frac{1}{4}$ of the distance from C to B.
5. What is the average speed of the car over the entire distance ?
   I. The car covers the whole distance in four equal stretches at speeds of 10 kmph, 20 kmph, 30 kmph and 60 kmph respectively.
   II. The total time taken is 36 minutes.
6. A car and a bus start from city A at the same time. How far is the city B from city A ?
   I. The car travelling at an average speed of 40 km / hr reaches city B at 4:35 p.m.
   II. The bus reaches city B at 6:15 p.m. at an average speed of 60 km / hr.
7. Two cars pass each other in opposite direction. How long would they take to be 500 km apart ? **(M.A.T. 1998)**
   I. The sum of their speeds is 135 km / hr.
   II. The difference of their speeds is 25 km / hr.

ANSWERS

1. (*e*) **2.** (*e*) **3.** (*d*) **4.** (*c*) **5.** (*a*) **6.** (*e*) **7.** (*a*)

SOLUTIONS

1. I. If Y takes 4 min., then X takes 3 min.

   II. If Y takes 36 min., then X takes $\left(\frac{3}{4} \times 36\right)$ min = 27 min.

   Thus, I and II together give the answer.

   ∴ Correct answer is (*e*).

2. Let the usual speed of the train be x kmph.

   Time taken to cover 150 km at usual speed = $\frac{150}{x}$ hrs.

   I. Time taken at increased speed = $\frac{150}{(x+25)}$ hrs.

   II. $\frac{150}{x} - \frac{150}{(x+25)} = \frac{30}{60}$

   $\Leftrightarrow \frac{1}{x} - \frac{1}{(x+25)} = \frac{1}{300} \quad \Leftrightarrow \quad [(x + 25) - x] \times 300 = x(x + 25)$

   $\Leftrightarrow x^2 + 25x - 7500 = 0 \quad \Leftrightarrow \quad (x + 100)(x - 75) = 0 \quad \Leftrightarrow \quad x = 75.$

   Thus, I and II together give the answer.

   ∴ Correct answer is (*e*).

3. Let the distance between the two stations be x km.

   I. Let the speed of the express train be y km / hr.

   Then, speed of the mail train = $(y + 12)$ km / hr.

   II. $\frac{x}{y} - \frac{x}{(y+12)} = \frac{40}{60}$.

   Thus, even I and II together do not give x.

   ∴ Correct answer is (*d*).

4. Let AC = x km. Then, CB = $(100 - x)$ km.

   I. AB = 125% of CB

   $\Leftrightarrow 100 = \frac{125}{100} \times (100 - x) \quad \Leftrightarrow \quad 100 - x = \frac{100 \times 100}{125} = 80 \quad \Leftrightarrow \quad x = 20$ km.

   ∴ AC = 20 km.

   Thus, I alone gives the answer.

   II. $AC = \frac{1}{4} CB \Leftrightarrow x = \frac{1}{4}(100 - x) \Leftrightarrow 5x = 100 \Leftrightarrow x = 20.$

   ∴ AC = 20 km.

   Thus, II alone gives the answer.

   ∴ Correct answer is (*c*).

5. Let the whole distance be $4x$ km.

   I. Total time taken = $\left(\frac{x}{10} + \frac{x}{20} + \frac{x}{30} + \frac{x}{60}\right) = \frac{(6x + 3x + 2x + x)}{60} = \frac{12x}{60} = \frac{x}{5}$.

   ∴ Speed = $\frac{\text{Distance}}{\text{Time}} = \frac{4x}{(x/5)}$ kmph = 20 km / hr.

   ∴ I alone is sufficient to answer the question.

   II alone does not give the answer.

   ∴ Correct answer is (*a*).

6. Let AB = x km. From I and II, we get :

$$\frac{x}{40} - \frac{x}{60} = 1\frac{40}{60} \qquad [(6{:}15\ p.m.) - (4{:}35\ p.m.) = 1\ hr\ 40\ min]$$

$$\Leftrightarrow \quad \frac{x}{40} - \frac{x}{60} = \frac{100}{60}.$$ This gives x.

$\therefore$ Correct answer is (*e*).

7. I gives, relative speed = 135 km / hr.

$\therefore$ Time taken $= \frac{500}{135}$ hrs.

II does not give the relative speed.

$\therefore$ I alone gives the answer and II is irrelevant.

$\therefore$ Correct answer is (*a*).

18. PROBLEMS ON TRAINS

IMPORTANT FACTS AND FORMULAE

1. a km/hr $= \left(a \times \frac{5}{18}\right)$ m/s.
2. a m/s $= \left(a \times \frac{18}{5}\right)$ km/hr.
3. Time taken by a train of length l metres to pass a pole or a standing man or a signal post is equal to the time taken by the train to cover l metres.
4. Time taken by a train of length l metres to pass a stationary object of length b metres is the time taken by the train to cover $(l + b)$ metres.
5. Suppose two trains or two bodies are moving in the same direction at u m/s and v m/s, where $u > v$, then their relatives speed $= (u - v)$ m/s.
6. Suppose two trains or two bodies are moving in opposite directions at u m/s and v m/s, then their relative speed is $= (u + v)$ m/s.
7. If two trains of length a metres and b metres are moving in opposite directions at u m/s and v m/s, then time taken by the trains to cross each other $= \frac{(a+b)}{(u+v)}$ sec.
8. If two trains of length a metres and b metres are moving in the same direction at u m/s and v m/s, then the time taken by the faster train to cross the slower train $= \frac{(a+b)}{(u-v)}$ sec.
9. If two trains (or bodies) start at the same time from points A and B towards each other and after crossing they take a and b sec in reaching B and A respectively, then ***(A's speed) : (B's speed)*** $= (\sqrt{b} : \sqrt{a})$.

SOLVED EXAMPLES

Ex. 1. ***A train 100 m long is running at the speed of 30 km/hr. Find the time taken by it to pass a man standing near the railway line.*** **(S.S.C. 2001)**

Sol. Speed of the train $= \left(30 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{25}{3}\right)$ m/sec.

Distance moved in passing the standing man = 100 m.

Required time taken $= \frac{100}{\left(\frac{25}{3}\right)} = \left(100 \times \frac{3}{25}\right)$ sec = 12 sec.

Ex. 2. ***A train is moving at a speed of 132 km/hr. If the length of the train is 110 metres, how long will it take to cross a railway platform 165 metres long?*** **(Section Officers', 2003)**

Sol. Speed of train $= \left(132 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{110}{3}\right)$ m/sec.

Distance covered in passing the platform = (110 + 165) m = 275 m.

$\therefore$ Time taken $= \left(275 \times \frac{3}{110}\right)$ sec $= \frac{15}{2}$ sec $= 7\frac{1}{2}$ sec.

Ex. 3. ***A man is standing on a railway bridge which is 180 m long. He finds that a train crosses the bridge in 20 seconds but himself in 8 seconds. Find the length of the train and its speed.***

Sol. Let the length of the train be x metres.

Then, the train covers x metres in 8 seconds and $(x + 180)$ metres in 20 seconds.

$\therefore \quad \frac{x}{8} = \frac{x+180}{20} \Leftrightarrow 20x = 8(x+180) \Leftrightarrow x = 120.$

$\therefore$ Length of the train = 120 m.

Speed of the train $= \left(\frac{120}{8}\right)$ m/sec = m/sec $= \left(15 \times \frac{18}{5}\right)$ kmph = 54 kmph.

Ex. 4. ***A train 150 m long is running with a speed of 68 kmph. In what time will it pass a man who is running at 8 kmph in the same direction in which the train is going ?***

Sol. Speed of the train relative to man = (68 – 8) kmph

$$= \left(60 \times \frac{5}{18}\right) \text{m/sec} = \left(\frac{50}{3}\right) \text{m/sec.}$$

Time taken by the train to cross the man

$= \text{Time taken by it to cover 150 m at } \left(\frac{50}{3}\right) \text{m/sec} = \left(150 \times \frac{3}{50}\right) \text{sec} = 9 \text{ sec.}$

Ex. 5. ***A train 220 m long is running with a speed of 59 kmph. In what time will it pass a man who is running at 7 kmph in the direction opposite to that in which the train is going ?***

Sol. Speed of the train relative to man = (59 + 7) kmph

$$= \left(66 \times \frac{5}{18}\right) \text{m/sec} = \left(\frac{55}{3}\right) \text{m/sec.}$$

Time taken by the train to cross the man

$= \text{Time taken by it to cover 220 m at } \left(\frac{55}{3}\right) \text{m/sec} = \left(220 \times \frac{3}{55}\right) \text{sec} = 12 \text{ sec.}$

Ex. 6. ***Two trains 137 metres and 163 metres in length are running towards each other on parallel lines, one at the rate of 42 kmph and another at 48 kmph. In what time will they be clear of each other from the moment they meet ?***

Sol. Relative speed of the trains = (42 + 48) kmph = 90 kmph

$$= \left(90 \times \frac{5}{18}\right) \text{m/sec} = 25 \text{ m/sec.}$$

Time taken by the trains to pass each other

$= \text{Time taken to cover (137 + 163) m at 25 m/sec} = \left(\frac{300}{25}\right) \text{sec} = 12 \text{ seconds.}$

Ex. 7. ***Two trains 100 metres and 120 metres long are running in the same direction with speeds of 72 km/hr and 54 km/hr. In how much time will the first train cross the second ?*** **(C.B.I. 1997)**

Sol. Relative speed of the trains = (72 – 54) km/hr = 18 km/hr

$$= \left(18 \times \frac{5}{18}\right) \text{m/sec} = 5 \text{ m/sec.}$$

Time taken by the trains to cross each other

$= \text{Time taken to cover (100 + 120) m at 5 m/sec} = \left(\frac{220}{5}\right) \text{sec} = 44 \text{ sec.}$

Ex. 8. ***A train 100 metres long takes 6 seconds to cross a man walking at 5 kmph in a direction opposite to that of the train. Find the speed of the train.***

Sol. Let the speed of the train be x kmph.

Speed of the train relative to man $= (x + 5)$ kmph $= (x+5) \times \frac{5}{18}$ m/sec.

$\therefore \quad \frac{100}{(x+5) \times \frac{5}{18}} = 6 \Leftrightarrow 30(x+5) = 1800 \Leftrightarrow x = 55.$

$\therefore$ Speed of the train is 55 kmph.

Ex. 9. ***A train running at 54 kmph takes 20 seconds to pass a platform. Next it takes 12 seconds to pass a man walking at 6 kmph in the same direction in which the train is going. Find the length of the train and the length of the platform.***

Sol. Let the length of train be x metres and length of platform be y metres.

Speed of the train relative to man $= (54 - 6)$ kmph $= 48$ kmph

$= \left(48 \times \frac{5}{18}\right)$ m/sec $= \frac{40}{3}$ m/sec.

In passing a man, the train covers its own length with relative speed.

$\therefore$ Length of train = (Relative speed × Time) $= \left(\frac{40}{3} \times 12\right)$ m $= 160$ m.

Also, speed of the train $= \left(54 \times \frac{5}{18}\right)$ m/sec $= 15$ m/sec.

$\therefore \quad \frac{x+y}{15} = 20 \Leftrightarrow x + y = 300 \Leftrightarrow y = (300 - 160)$ m $= 140$ m.

Ex. 10. ***A man sitting in a train which is travelling at 50 kmph observes that a goods train, travelling in opposite direction, takes 9 seconds to pass him. If the goods train is 280 m long, find its speed.***

Sol. Relative speed $= \left(\frac{280}{9}\right)$ m/sec $= \left(\frac{280}{9} \times \frac{18}{5}\right)$ kmph $= 112$ kmph.

$\therefore$ Speed of goods train $= (112 - 50)$ kmph $= 62$ kmph.

EXERCISE 18A

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (✓) against the correct answer :***

1. A train moves with a speed of 108 kmph. Its speed in metres per second is :
   (*a*) 10.8 (*b*) 18 (*c*) 30 (*d*) 38.8
2. A speed of 14 metres per second is the same as :
   (*a*) 28 km/hr (*b*) 46.6 km/hr (*c*) 50.4 km/hr (*d*) 70 km/hr
3. In what time will a train 100 metres long cross an electric pole, if its speed be 144 km/hr ? **(S.S.C. 2003)**
   (*a*) 2.5 seconds (*b*) 4.25 seconds (*c*) 5 seconds (*d*) 12.5 seconds
4. A train 280 m long, running with a speed of 63 km/hr will pass a tree in :
   (*a*) 15 sec (*b*) 16 sec (*c*) 18 sec (*d*) 20 sec **(S.S.C. 2003)**
5. How long does a train 110 metres long running at the speed of 72 km/hr take to cross a bridge 132 metres in length ? **(R.R.B. 1998)**
   (*a*) 9.8 sec (*b*) 12.1 sec (*c*) 12.42 sec (*d*) 14.3 sec

6. A train 360 m long is running at a speed of 45 km / hr. In what time will it pass a bridge 140 m long ? **(B.S.F. 2001)**
(*a*) 40 sec (*b*) 42 sec (*c*) 45 sec (*d*) 48 sec

7. A train travelling at a speed of 75 mph enters a tunnel $3\frac{1}{2}$ miles long. The train is $\frac{1}{4}$ mile long. How long does it take for the train to pass through the tunnel from the moment the front enters to the moment the rear emerges ?
(*a*) 2.5 min (*b*) 3 min (*c*) 3.2 min (*d*) 3.5 min

8. A train running at the speed of 60 km / hr crosses a pole in 9 seconds. What is the length of the train ? **(Bank P.O. 2003)**
(*a*) 120 metres (*b*) 180 metres (*c*) 324 metres
(*d*) Cannot be determined (*e*) None of these

9. A train 132 m long passes a telegraph pole in 6 seconds. Find the speed of the train.
(*a*) 70 km / hr (*b*) 72 km / hr (*c*) 79.2 km / hr (*d*) 80 km / hr

10. A train covers a distance of 12 km in 10 minutes. If it takes 6 seconds to pass a telegraph post, then the length of the train is : **(Bank P.O. 2000)**
(*a*) 90 m (*b*) 100 m (*c*) 120 m (*d*) 140 m

11. A train 240 m long passed a pole in 24 seconds. How long will it take to pass a platform 650 m long ? **(R.R.B. 1998)**
(*a*) 65 sec (*b*) 89 sec (*c*) 100 sec (*d*) 150 sec

12. The length of the bridge, which a train 130 metres long and travelling at 45 km / hr can cross in 30 seconds, is : **(Section Officers', 2001)**
(*a*) 200 m (*b*) 225 m (*c*) 245 m (*d*) 250 m

13. A train 800 metres long is running at a speed of 78 km / hr. If it crosses a tunnel in 1 minute, then the length of the tunnel (in metres) is : **(S.S.C. 2003)**
(*a*) 130 (*b*) 360 (*c*) 500 (*d*) 540

14. A goods train runs at the speed of 72 kmph and crosses a 250 m long platform in 26 seconds. What is the length of the goods train ? **(Bank P.O. 2003)**
(*a*) 230 m (*b*) 240 m (*c*) 260 m (*d*) 270 m

15. The length of a train and that of a platform are equal. If with a speed of 90 km / hr, the train crosses the platform in one minute, then the length of the train (in metres) is :
(*a*) 500 (*b*) 600 (*c*) 750 (*d*) 900

16. A train of length 150 metres takes 40.5 seconds to cross a tunnel of length 300 metres. What is the speed of the train in km / hr ?
(*a*) 13.33 (*b*) 26.67 (*c*) 40 (*d*) 66.67

17. A train crosses a platform 100 m long in 60 seconds at a speed of 45 km / hr. The time taken by the train to cross an electric pole is :
(*a*) 8 sec (*b*) 52 sec (*c*) 1 minute (*d*) Data inadequate

18. A train passes a station platform in 36 seconds and a man standing on the platform in 20 seconds. If the speed of the train is 54 km / hr, what is the length of the platform ? **(G.INDOMAT, 1997)**
(*a*) 120 m (*b*) 240 m (*c*) 300 m (*d*) None of these

19. A 300 metre long train crosses a platform in 39 seconds while it crosses a signal pole in 18 seconds. What is the length of the platform ?
(*a*) 320 m (*b*) 350 m (*c*) 650 m
(*d*) Data inadequate (*e*) None of these **(Bank P.O. 2002)**

20. A train speeds past a pole in 15 seconds and a platform 100 m long in 25 seconds. Its length is : **(R.R.B. 2003)**
(*a*) 50 m (*b*) 150 m (*c*) 200 m (*d*) Data inadequate

21. A train moves past a telegraph post and a bridge 264 m long in 8 seconds and 20 seconds respectively. What is the speed of the train ? **(S.S.C. 2004)**
(*a*) 69.5 km / hr (*b*) 70 km / hr (*c*) 79 km / hr (*d*) 79.2 km / hr

22. A train takes 18 seconds to pass completely through a station 162 m long and 15 seconds through another station 120 m long. The length of the train is :
(*a*) 70 m (*b*) 80 m (*c*) 90 m (*d*) 100 m

23. How many seconds will a 500 metre long train take to cross a man walking with a speed of 3 km / hr in the direction of the moving train if the speed of the train is 63 km / hr ? **(S.S.C. 2000)**
(*a*) 25 (*b*) 30 (*c*) 40 (*d*) 45

24. A jogger running at 9 kmph alongside a railway track is 240 metres ahead of the engine of a 120 metre long train running at 45 kmph in the same direction. In how much time will the train pass the jogger ? **(IGNOU, 2003)**
(*a*) 3.6 sec (*b*) 18 sec (*c*) 36 sec (*d*) 72 sec

25. A train 110 metres long is running with a speed of 60 kmph. In what time will it pass a man who is running at 6 kmph in the direction opposite to that in which the train is going ? **(M.A.T. 2002)**
(*a*) 5 sec (*b*) 6 sec (*c*) 7 sec (*d*) 10 sec

26. Two trains 200 m and 150 m long are running on parallel rails at the rate of 40 kmph and 45 kmph respectively. In how much time will they cross each other, if they are running in the same direction ?
(*a*) 72 sec (*b*) 132 sec (*c*) 192 sec (*d*) 252 sec

27. Two trains 140 m and 160 m long run at the speed of 60 km / hr and 40 km / hr respectively in opposite directions on parallel tracks. The time (in seconds) which they take to cross each other, is : **(S.S.C. 2004)**
(*a*) 9 (*b*) 9.6 (*c*) 10 (*d*) 10.8

28. Two trains are moving in opposite directions @ 60 km / hr and 90 km / hr. Their lengths are 1.10 km and 0.9 km respectively. The time taken by the slower train to cross the faster train in seconds is : **(M.B.A. 2002)**
(*a*) 36 (*b*) 45 (*c*) 48 (*d*) 49

29. A train 125 m long passes a man, running at 5 kmph in the same direction in which the train is going, in 10 seconds. The speed of the train is : **(A.A.O. Exam, 2003)**
(*a*) 45 km / hr (*b*) 50 km / hr (*c*) 54 km / hr (*d*) 55 km / hr

30. A train 110 m long passes a man, running at 6 kmph in the direction opposite to that of the train, in 6 seconds. The speed of the train is :
(*a*) 54 km / hr (*b*) 60 km / hr (*c*) 66 km / hr (*d*) 72 km / hr

31. Two goods train each 500 m long, are running in opposite directions on parallel tracks. Their speeds are 45 km / hr and 30 km / hr respectively. Find the time taken by the slower train to pass the driver of the faster one. **(M.A.T. 2000)**
(*a*) 12 sec (*b*) 24 sec (*c*) 48 sec (*d*) 60 sec

32. Two trains of equal length are running on parallel lines in the same direction at 46 km / hr and 36 km / hr. The faster train passes the slower train in 36 seconds. The length of each train is : **(M.A.T. 2003)**
(*a*) 50 m (*b*) 72 m (*c*) 80 m (*d*) 82 m

33. A 270 metres long train running at the speed of 120 kmph crosses another train running in opposite direction at the speed of 80 kmph in 9 seconds. What is the length of the other train ? **(S.B.I.P.O. 1999)**
(*a*) 230 m (*b*) 240 m (*c*) 260 m
(*d*) 320 m (*e*) None of these

34. Two trains are running in opposite directions with the same speed. If the length of each train is 120 metres and they cross each other in 12 seconds, then the speed of each train (in km / hr) is : **(S.S.C. 2003)**
(*a*) 10 (*b*) 18 (*c*) 36 (*d*) 72

35. Two trains of equal lengths take 10 seconds and 15 seconds respectively to cross a telegraph post. If the length of each train be 120 metres, in what time (in seconds) will they cross each other travelling in opposite direction ? **(S.S.C. 2004)**

(*a*) 10 (*b*) 12 (*c*) 15 (*d*) 20

36. A train 108 m long moving at a speed of 50 km / hr crosses a train 112 m long coming from opposite direction in 6 seconds. The speed of the second train is

(*a*) 48 km / hr (*b*) 54 km / hr (*c*) 66 km / hr (*d*) 82 km / hr

37. A train X speeding with 120 kmph crosses another train Y, running in the same direction, in 2 minutes. If the lengths of the trains X and Y be 100 m and 200 m respectively, what is the speed of train Y ?

(*a*) 111 km / hr (*b*) 123 km / hr (*c*) 127 km / hr (*d*) 129 km / hr

38. Two trains travel in opposite directions at 36 kmph and 45 kmph and a man sitting in slower train passes the faster train in 8 seconds. The length of the faster train is :

(*a*) 80 m (*b*) 100 m (*c*) 120 m (*d*) 180 m

39. Two trains are running at 40 km / hr and 20 km / hr respectively in the same direction. Fast train completely passes a man sitting in the slower train in 5 seconds. What is the length of the fast train ? **(R.R.B. 2001)**

(*a*) 23 m (*b*) $23\frac{2}{9}$ m (*c*) 27 m (*d*) $27\frac{7}{9}$ m

40. A train overtakes two persons who are walking in the same direction in which the train is going, at the rate of 2 kmph and 4 kmph and passes them completely in 9 and 10 seconds respectively. The length of the train is :

(*a*) 45 m (*b*) 50 m (*c*) 54 m (*d*) 72 m

41. A train overtakes two persons walking along a railway track. The first one walks at 4.5 km / hr. The other one walks at 5.4 km / hr. The train needs 8.4 and 8.5 seconds respectively to overtake them. What is the speed of the train if both the persons are walking in the same direction as the train ?

(*a*) 66 km / hr (*b*) 72 km / hr (*c*) 78 km / hr (*d*) 81 km / hr

42. Two trains, each 100 m long, moving in opposite directions, cross each other in 8 seconds. If one is moving twice as fast the other, then the speed of the faster train is :

(*a*) 30 km / hr (*b*) 45 km / hr (*c*) 60 km / hr (*d*) 75 km / hr

(C.D.S. 2001)

43. A train 150 m long passes a km stone in 15 seconds and another train of the same length travelling in opposite direction in 8 seconds. The speed of the second train is :

(*a*) 60 km / hr (*b*) 66 km / hr (*c*) 72 km / hr (*d*) 99 km / hr

44. A train travelling at 48 kmph completely crosses another train having half its length and travelling in opposite direction at 42 kmph, in 12 seconds. It also passes a railway platform in 45 seconds. The length of the platform is

(*a*) 400 m (*b*) 450 m (*c*) 560 m (*d*) 600 m

45. Two trains running in opposite directions cross a man standing on the platform in 27 seconds and 17 seconds respectively and they cross each other in 23 seconds. The ratio of their speeds is : **(Hotel Management, 1997)**

(*a*) 1 : 3 (*b*) 3 : 2 (*c*) 3 : 4 (*d*) None of these

46. Two stations A and B are 110 km apart on a straight line. One train starts from A at 7 a.m. and travels towards B at 20 kmph. Another train starts from B at 8 a.m. and travels towards A at a speed of 25 kmph. At what time will they meet ?

(*a*) 9 a.m. (*b*) 10 a.m. (*c*) 10.30 a.m. (*d*) 11 a.m.

47. A train X starts from Meerut at 4 p.m. and reaches Ghaziabad at 5 p.m. while another train Y starts from Ghaziabad at 4 p.m. and reaches Meerut at 5.30 p.m. The two trains will cross each other at :

(*a*) 4.36 p.m. (*b*) 4.42 p.m. (*c*) 4.48 p.m. (*d*) 4.50 p.m.

48. Two trains, one from Howrah to Patna and the other from Patna to Howrah, start simultaneously. After they meet, the trains reach their destinations after 9 hours and 16 hours respectively. The ratio of their speeds is : **(R.R.B. 2001)**

(*a*) 2 : 3 (*b*) 4 : 3 (*c*) 6 : 7 (*d*) 9 : 16

ANSWERS

1. (*c*)	**2.** (*c*)	**3.** (*a*)	**4.** (*b*)	**5.** (*b*)	**6.** (*a*)	**7.** (*b*)	**8.** (*e*)
9. (*c*)	**10.** (*c*)	**11.** (*b*)	**12.** (*c*)	**13.** (*c*)	**14.** (*d*)	**15.** (*c*)	**16.** (*c*)
17. (*b*)	**18.** (*b*)	**19.** (*b*)	**20.** (*b*)	**21.** (*d*)	**22.** (*c*)	**23.** (*b*)	**24.** (*c*)
25. (*b*)	**26.** (*d*)	**27.** (*d*)	**28.** (*c*)	**29.** (*b*)	**30.** (*b*)	**31.** (*c*)	**32.** (*a*)
33. (*a*)	**34.** (*c*)	**35.** (*b*)	**36.** (*d*)	**37.** (*a*)	**38.** (*d*)	**39.** (*d*)	**40.** (*b*)
41. (*d*)	**42.** (*c*)	**43.** (*d*)	**44.** (*a*)	**45.** (*b*)	**46.** (*b*)	**47.** (*a*)	**48.** (*b*)

SOLUTIONS

1. 108 kmph $= \left(108 \times \frac{5}{18}\right)$ m/sec = 30 m/sec.

2. 14 m/sec $= \left(14 \times \frac{18}{5}\right)$ km/hr = 50.4 km/hr.

3. Speed $= \left(144 \times \frac{5}{18}\right)$ m/sec = 40 m/sec.

Time taken $= \left(\frac{100}{40}\right)$ sec = 2.5 sec.

4. Speed $= \left(63 \times \frac{5}{18}\right)$ m/sec $= \frac{35}{2}$ m/sec.

Time taken $= \left(280 \times \frac{2}{35}\right)$ sec = 16 sec.

5. Speed $= \left(72 \times \frac{5}{18}\right)$ m/sec = 20 m/sec.

Total distance covered = (110 + 132) m = 242 m.

$\therefore$ Required time $= \left(\frac{242}{20}\right)$ sec = 12.1 sec.

6. Speed $= \left(45 \times \frac{5}{18}\right)$ m/sec $= \frac{25}{2}$ m/sec.

Total distance covered = (360 + 140) m = 500 m.

$\therefore$ Required time $= \left(500 \times \frac{2}{25}\right)$ sec = 40 sec.

7. Total distance covered $= \left(\frac{7}{2} + \frac{1}{4}\right)$ miles $= \frac{15}{4}$ miles.

$\therefore$ Time taken $= \left(\frac{15}{4 \times 75}\right)$ hrs $= \frac{1}{20}$ hrs $= \left(\frac{1}{20} \times 60\right)$ min. = 3 min.

8. Speed $= \left(60 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{50}{3}\right)$ m/sec.

Length of the train = (Speed × Time) $= \left(\frac{50}{3} \times 9\right)$ m = 150 m.

9. Speed $= \left(\frac{132}{6}\right)$ m/sec $= \left(22 \times \frac{18}{5}\right)$ km/hr = 79.2 km/hr.

10. Speed $= \left(\frac{12}{10} \times 60\right)$ km/hr $= \left(72 \times \frac{5}{18}\right)$ m/sec = 20 m/sec.

Length of the train = (Speed × Time) = (20 × 6) m = 120 m.

11. Speed $= \left(\frac{240}{24}\right)$ m/sec = 10 m/sec.

$\therefore$ Required time $= \left(\frac{240 + 650}{10}\right)$ sec = 89 sec.

12. Speed $= \left(45 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{25}{2}\right)$ m/sec; Time = 30 sec.

Let the length of bridge be x metres.

Then, $\frac{130 + x}{30} = \frac{25}{2} \Leftrightarrow 2(130 + x) = 750 \Leftrightarrow x = 245$ m.

13. Speed $= \left(78 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{65}{3}\right)$ m/sec.

Time = 1 minute = 60 sec.

Let the length of the tunnel be x metres.

Then, $\frac{800 + x}{60} = \frac{65}{3} \Leftrightarrow 3(800 + x) = 3900 \Leftrightarrow x = 500$.

14. Speed $= \left(72 \times \frac{5}{18}\right)$ m/sec = 20 m/sec; Time = 26 sec.

Let the length of the train be x metres.

Then, $\frac{x + 250}{26} = 20 \Leftrightarrow x + 250 = 520 \Leftrightarrow x = 270$.

15. Speed $= \left(90 \times \frac{5}{18}\right)$ m/sec = 25 m/sec; Time = 1 min. = 60 sec.

Let the length of the train and that of the platform be x metres.

Then, $\frac{2x}{60} = 25 \Leftrightarrow x = \frac{25 \times 60}{2} = 750$.

16. Speed $= \left(\frac{150 + 300}{40.5}\right)$ m/sec $= \left(\frac{450}{40.5} \times \frac{18}{5}\right)$ km/hr = 40 km/hr.

17. Speed $= \left(45 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{25}{2}\right)$ m/sec.

Let the length of the train be x metres.

Then, $\frac{x + 100}{\left(\frac{25}{2}\right)} = 60$ or $x = 650$ m

$\therefore$ Time taken by the train to cross an electric pole $= \left(650 \times \frac{2}{25}\right)$ sec = 52 sec.

18. Speed $= \left(54 \times \frac{5}{18}\right)$ m/sec = 15 m/sec.

Length of the train = (15 × 20) m = 300 m.

Let the length of the platform be x metres.

Then, $\frac{x+300}{36} = 15 \Leftrightarrow x + 300 = 540 \Leftrightarrow x = 240$ m.

19. Speed $= \left(\frac{300}{18}\right)$ m/sec $= \frac{50}{3}$ m/sec.

Let the length of the platform be x metres.

Then, $\frac{x+300}{39} = \frac{50}{3} \Leftrightarrow 3(x+300) = 1950 \Leftrightarrow x = 350$ m.

20. Let the length of the train be x metres and its speed be y m/sec.

They, $\frac{x}{y} = 15 \Rightarrow y = \frac{x}{15}$.

$\therefore \quad \frac{x+100}{25} = \frac{x}{15} \Leftrightarrow x = 150$ m.

21. Let the length of the train be x metres and its speed by y m/sec.

They, $\frac{x}{y} = 8 \Rightarrow x = 8y$

Now, $\frac{x+264}{20} = y \Leftrightarrow 8y + 264 = 20y \Leftrightarrow y = 22$.

$\therefore$ Speed = 22 m/sec $= \left(22 \times \frac{18}{5}\right)$ km/hr = 79.2 km/hr.

22. Let the length of the train be x metres.

$\therefore \quad \frac{x+162}{18} = \frac{x+120}{15} \Leftrightarrow 15(x+162) = 18(x+120) \Leftrightarrow x = 90$ m.

23. Speed of train relative to man = (63 − 3) km/hr = 60 km/hr

$= \left(60 \times \frac{5}{18}\right)$ m/sec $= \frac{50}{3}$ m/sec.

$\therefore$ Time taken to pass the man $= \left(500 \times \frac{3}{50}\right)$ sec = 30 sec.

24. Speed of train relative to jogger = (45 − 9) km/hr = 36 km/hr

$= \left(36 \times \frac{5}{18}\right)$ m/sec = 10 m/sec.

Distance to be covered = (240 + 120) m = 360 m.

$\therefore$ Time taken $= \left(\frac{360}{10}\right)$ sec = 36 sec.

25. Speed of train relative to man = (60 + 6) km/hr = 66 km/hr

$= \left(66 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{55}{3}\right)$ m/sec.

$\therefore$ Time taken to pass the man $= \left(110 \times \frac{3}{55}\right)$ sec = 6 sec.

26. Relative speed = (45 − 40) kmph = 5 kmph $= \left(5 \times \frac{5}{18}\right)$ m/sec $= \left(\frac{25}{18}\right)$ m/sec.

Total distance covered = Sum of lengths of trains = 350 m.

$\therefore$ Time taken $= \left(350 \times \frac{18}{25}\right)$ sec = 252 sec.

27. Relative speed = (60 + 40) km / hr $= \left(100 \times \frac{5}{18}\right)$ m / sec $= \left(\frac{250}{9}\right)$ m / sec.

Distance covered in crossing each other = (140 + 160) m = 300 m

Required time $= \left(300 \times \frac{9}{250}\right)$ sec $= \frac{54}{5}$ sec = 10.8 sec.

28. Relative speed = (60 + 90) km / hr

$= \left(150 \times \frac{5}{18}\right)$ m / sec $= \left(\frac{125}{3}\right)$ m / sec.

Distance covered = (1.10 + 0.9) km = 2 km = 2000 m.

Required time $= \left(2000 \times \frac{3}{125}\right)$ sec = 48 sec.

29. Speed of the train relative to man $= \left(\frac{125}{10}\right)$ m / sec $= \left(\frac{25}{2}\right)$ m / sec.

$= \left(\frac{25}{2} \times \frac{18}{5}\right)$ km / hr = 45 km / hr.

Let the speed of the train be x kmph. Then, relative speed = $(x - 5)$ kmph.

$\therefore$ $x - 5 = 45$ or $x = 50$ kmph.

30. Speed of the train relative to man

$= \left(\frac{110}{6}\right)$ m / sec $= \left(\frac{110}{6} \times \frac{18}{5}\right)$ km / hr = 66 km / hr.

Let the speed of the train be x kmph. Then, relative speed = $(x + 6)$ = kmph.

$\therefore$ $x + 6 = 66$ or $x = 60$ kmph.

31. Relative speed = (45 + 30) km / hr $= \left(75 \times \frac{5}{18}\right)$ m / sec $= \left(\frac{125}{6}\right)$ m / sec.

Distance covered = (500 + 500) m = 1000 m.

Required time $= \left(1000 \times \frac{6}{125}\right)$ sec = 48 sec.

32. Let the length of each train be x metres.

Then, distance covered = $2x$ metres.

Relative speed = (46 − 36) km / hr $= \left(10 \times \frac{5}{18}\right)$ m / sec $= \left(\frac{25}{9}\right)$ m / sec.

$\therefore$ $\frac{2x}{36} = \frac{25}{9} \Leftrightarrow 2x = 100 \Leftrightarrow x = 50.$

33. Relative speed = (120 + 80) km / hr $= \left(200 \times \frac{5}{18}\right)$ m / sec $= \left(\frac{500}{9}\right)$ m / sec.

Let the length of the other train be x metres.

Then, $\frac{x + 270}{9} = \frac{500}{9} \Leftrightarrow x + 270 = 500 \Leftrightarrow x = 230.$

34. Let the speed of each train be x m / sec.

Then, relative speed of the two trains = $2x$ m / sec.

So, $2x = \frac{(120+120)}{12} \Leftrightarrow 2x = 20 \Leftrightarrow x = 10.$

$\therefore$ Speed of each train = 10 m / sec = $\left(10 \times \frac{18}{5}\right)$ km / hr = 36 km / hr.

35. Speed of the first train = $\left(\frac{120}{10}\right)$ m / sec = 12 m / sec.

Speed of the second train = $\left(\frac{120}{15}\right)$ m / sec = 8 m / sec.

Relative speed = (12 + 8) = m / sec = 20 m / sec.

$\therefore$ Required time = $\frac{(120+120)}{20}$ sec = 12 sec.

36. Let the speed of the second train be x km / hr.

Relative speed = $(x + 50)$ km / hr = $\left[(x+50) \times \frac{5}{18}\right]$ m / sec = $\left(\frac{250+5x}{18}\right)$ m / sec.

Distance covered = (108 + 112) = 220 m.

$\therefore \frac{220}{\left(\frac{250+5x}{18}\right)} = 6 \Leftrightarrow 250 + 5x = 660 \Leftrightarrow x = 82$ km / hr.

37. Let the speed of train Y be x km / hr.

Speed of X relative to Y = $(120 - x)$ km / hr

$= \left[(120-x) \times \frac{5}{18}\right]$ m / sec = $\left(\frac{600-5x}{18}\right)$ m / sec.

$\therefore \frac{300}{\left(\frac{600-5x}{18}\right)} = 120 \Leftrightarrow 5400 = 120(600 - 5x) \Leftrightarrow x = 111.$

38. Relative speed = (36 + 45) km / hr = $\left(81 \times \frac{5}{18}\right)$ m / sec = $\left(\frac{45}{2}\right)$ m / sec.

Length of train = $\left(\frac{45}{2} \times 8\right)$ m = 180 m.

39. Relative speed = (40 – 20) km / hr = $\left(20 \times \frac{5}{18}\right)$ m / sec = $\left(\frac{50}{9}\right)$ m / sec.

Length of faster train = $\left(\frac{50}{9} \times 5\right)$ m = $\frac{250}{9}$ m = $27\frac{7}{9}$ m.

40. 2 kmph = $\left(2 \times \frac{5}{18}\right)$ m / sec = $\frac{5}{9}$ m / sec and 4 kmph = $\frac{10}{9}$ m / sec.

Let the length of the train be x metres and its speed be y m / sec.

Then, $\frac{x}{\left(y - \frac{5}{9}\right)} = 9$ and $\frac{x}{\left(y - \frac{10}{9}\right)} = 10.$

$\therefore$ $9y - 5 = x$ and $10(9y - 10) = 9x \Rightarrow 9y - x = 5$ and $90y - 9x = 100.$

On solving, we get : $x = 50$

$\therefore$ Length of the train is 50 m.

41. $4.5 \text{ km/hr} = \left(4.5 \times \frac{5}{18}\right) \text{m/sec} = \frac{5}{4} \text{ m/sec} = 1.25 \text{ m/sec}$, and

$5.4 \text{ km/hr} = \left(5.4 \times \frac{5}{18}\right) \text{m/sec} = \frac{3}{2} \text{ m/sec} = 1.5 \text{ m/sec}.$

Let the speed of the train be x m/sec.

Then, $(x - 1.25) \times 84 = (x - 1.5) \times 8.5$

$\Leftrightarrow 8.4x - 10.5 = 8.5x - 12.75 \Leftrightarrow 0.1x = 2.25 \Leftrightarrow x = 22.5.$

$\therefore$ Speed of the train $= \left(22.5 \times \frac{18}{5}\right) \text{km/hr} = 81 \text{ km/hr}.$

42. Let the speed of the slower train be x m/sec.

Then, speed of the faster train $= 2x$ m/sec.

Relative speed $= (x + 2x)$ m/sec $= 3x$ m/sec.

$\therefore \frac{(100 + 100)}{8} = 3x \Leftrightarrow 24x = 200 \Leftrightarrow x = \frac{25}{3}.$

So, speed of the faster train $= \frac{50}{3} \text{ m/sec} = \left(\frac{50}{3} \times \frac{18}{5}\right) \text{km/hr} = 60 \text{ km/hr}.$

43. Speed of first train $= \left(\frac{150}{15}\right) \text{ m/sec} = 10 \text{ m/sec}.$

Let the speed of second train be x m/sec.

Relative speed $= (10 + x)$ m/sec.

$\therefore \frac{300}{10 + x} = 8 \Leftrightarrow 300 = 80 + 8x \Leftrightarrow x = \frac{220}{8} = \frac{55}{2} \text{ m/sec}.$

So, speed of second train $= \left(\frac{55}{2} \times \frac{18}{5}\right)$ kmph $= 99$ kmph.

44. Let the length of the first train be x metres.

Then, the length of second train is $\left(\frac{x}{2}\right)$ metres.

Relative speed $= (48 + 42)$ kmph $= \left(90 \times \frac{5}{18}\right) \text{m/sec} = 25 \text{ m/sec}.$

$\therefore \frac{\left(x + \frac{x}{2}\right)}{25} = 12$ or $\frac{3x}{2} = 300$ or $x = 200.$

$\therefore$ Length of first train $= 200$ m.

Let the length of platform be y metres.

Speed of the first train $= \left(48 \times \frac{5}{18}\right) \text{m/sec} = \frac{40}{3} \text{ m/sec}.$

$\therefore (200 + y) \times \frac{3}{40} = 45 \Leftrightarrow 600 + 3y = 1800 \Leftrightarrow y = 400$ m.

45. Let the speeds of the two trains be x m/sec and y m/sec respectively. Then, length of the first train $= 27x$ metres, and length of the second train $= 17y$ metres.

$\therefore \frac{27x + 17y}{x + y} = 23 \Leftrightarrow 27x + 17y = 23x + 23y \Leftrightarrow 4x = 6y \Leftrightarrow \frac{x}{y} = \frac{3}{2}.$

46. Suppose they meet x hours after 7 a.m.
Distance covered by A in x hours = $20x$ km.
Distance covered by B in $(x-1)$ hours = $25(x-1)$ km.
$\therefore\ 20x + 25(x-1) = 110 \Leftrightarrow 45x = 135 \Leftrightarrow x = 3.$
So, they meet at 10 a.m.

47. Suppose, the distance between Meerut and Ghaziabad is x km.
Time taken by X to cover x km = 1 hour.
Time taken by Y to cover x km $= \frac{3}{2}$ hours.
$\therefore$ Speed of X = x kmph, Speed of Y $= \left(\frac{2x}{3}\right)$ kmph.
Let them meet y hours after 4 p.m. Then,
$$xy + \frac{2xy}{3} = x \Leftrightarrow y\left(1+\frac{2}{3}\right) = 1 \Leftrightarrow y = \frac{3}{5} \text{ hours} = \left(\frac{3}{5}\times 60\right) \text{ min} = 36 \text{ min.}$$
So, the two trains meet at 4.36 p.m.

48. Let us name the trains as A and B. Then,
(A's speed) : (B's speed) $= \sqrt{b} : \sqrt{a} = \sqrt{16} : \sqrt{9} = 4 : 3.$

EXERCISE 18B

(DATA SUFFICIENCY TYPE QUESTIONS)

1. A train running at a certain speed crosses a stationary engine in 20 seconds. To find out the speed of the train, which of the following information is necessary ?
   (*a*) Only the length of the train
   (*b*) Only the length of the engine
   (*c*) Either the length of the train or the length of the engine
   (*d*) Both the length of the train and the length of the engine
2. A train running at a certain speed crosses another train running in the opposite direction in 4.8 seconds. To find out the speed of the first train, which of the following information P and Q is sufficient ?
   P : The length of the first train Q : The length of the second train
   (*a*) Only P is sufficient (*b*) Only Q is sufficient
   (*c*) Either P or Q is sufficient (*d*) Both P and Q are needed
   (*e*) Both P and Q are not sufficient

Directions (*Questions 3 to 12*) : ***Each of the questions given below consists of a statement and/or a question and two statements numbered I and II given below it. You have to decide whether the data provided in the statement(s) is/are sufficient to answer the given question. Read both the statements and***

Give answer (a) if the data in Statement I alone are sufficient to answer the question, while the data in Statement II alone are not sufficient to answer the question;

Give answer (b) if the data in Statement II alone are sufficient to answer the question, while the data in Statement I alone are not sufficient to answer the question;

Give answer (c) if the data either in Statement I or in Statement II alone are sufficient to answer the question;

Give answer (d) if the data even in both Statements I and II together are not sufficient to answer the question;

Give answer (e) if the data in both Statements I and II together are necessary to answer the question.

3. A train crosses a signal post in x seconds. What is the length of the train ?
   I. The train crosses a platform of 100 metres in y seconds.
   II. The train is running at the speed of 80 km / hr. **(NABARD, 2002)**
4. What was the speed of the running train ? **(Bank P.O. 2000)**
   I. Length of the train was 120 metres.
   II. The train crossed the other stationary train whose length was 180 m in 4 seconds.
5. What is the speed of a running train which takes 9 seconds to cross a signal post ?
   I. The length of the train is 90 metres.
   II. The train takes 27 seconds to cross a platform of 180 metres. **(Bank P.O. 1999)**
6. What is the length of a running train ? **(S.B.I.P.O. 1998)**
   I. The train crosses a man in 9 seconds.
   II. The train crosses a 240 metre long platform in 24 seconds.
7. What is the speed of the train ? **(Bank P.O. 2003)**
   I. 280 metres long train crosses a signal pole in 18 seconds.
   II. 280 metres long train crosses a platform in 45 seconds.
8. What was the speed of a running train X ?
   I. The relative speed of train X and another train Y running in opposite direction is 160 kmph.
   II. The train Y crosses a signal post in 9 seconds.
9. What was the length of a running train crossing another 180 metre long train running in the opposite direction ? **(Bank P.O. 1998)**
   I. The relative speed of the two trains was 150 kmph.
   II. The trains took 9 seconds to cross each other.
10. A train crosses another train running in the opposite direction in x seconds. What is the speed of the train ? **(S.B.I.P.O. 2003)**
   I. Both the trains have the same length and are running at the same speed.
   II. One train crosses a pole in 5 seconds.
11. A train crosses a pole in 10 seconds. What is the length of the train ?
   I. The train crosses another train running in opposite direction with a speed of 80 km / hr in 22 seconds.
   II. The speed of the train is 108 km / hr. **(Bank P.O. 2003)**
12. What is the speed of the train whose length is 210 metres ? **(Bank P.O. 2003)**
   I. The train crosses another train of 300 metres length running in opposite direction in 10 seconds.
   II. The train crosses another train running in the same direction at the speed of 60 km / hr in 30 seconds.

Directions ***(Questions 13 to 17) : Each of the questions given below consists of a question followed by three statements. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question.***

13. What is the speed of the train ? **(S.B.I.P.O. 2002)**
   I. The train crosses a tree in 13 seconds.
   II. The train crosses a platform of length 250 metres in 27 seconds.
   III. The train crosses another train running in the same direction in 32 seconds.
   (*a*) I and II only (*b*) II and III only (*c*) I and III only
   (*d*) Any two of the three (*e*) None of these

(M.B.A. 2002)

14. What is the speed of the train ?
I. The train crosses 300 metres long platform in 21 seconds.
II. The train crosses another stationary train of equal length in $19\frac{1}{2}$ seconds.
III. The train crosses a signal pole in $9\frac{3}{4}$ seconds.
(a) I and II only (b) I and either II or III only
(c) II and either I or II only (d) III and either I or II only
(e) None of these

(Bank P.O. 2003)

15. What is the speed of the train ?
I. The train crosses a signal pole in 18 seconds.
II. The train crosses a platform of equal length in 36 seconds.
III. Length of the train is 330 metres.
(a) I and II only (b) II and III only (c) I and III only
(d) III and either I or II only (e) Any two of the three

16. What is the length of the train X ?
I. Train X crosses a telegraph post in 20 seconds.
II. Train X crosses a platform of length 800 m in 100 seconds.
III. Train X passes through a tunnel 400 m long in 60 seconds.
(a) I and either II or III only (b) II and III only
(c) II and either I or III only (d) III and either I or II only
(e) Any two of the three

17. What is the speed of the train ?
I. The train passes a man walking at the rate of 3 kmph in 9 seconds.
II. The train passes a man walking at the rate of 6 kmph in 10 seconds.
III. The train is moving in the same direction in which the two men are moving.
(a) I and III only (b) II and III only
(c) I and II only (d) All I, II and III
(e) Question cannot be answered even with information in all the three statements.

Directions (*Questions 18 to 20*) : *Each of these questions is followed by three statements. You have to study the question and all the three statements given to decide whether any information provided in the statement(s) is redundant and can be dispensed with while answering the given question.*

18. How much time will the train A take to cross another train B running in opposite direction ?
I. Train A crosses a signal pole in 6 seconds.
II. Ratio of the speeds of trains A and B is 3 : 2.
III. Length of the two trains together is 500 metres.
(a) I only (b) II only
(c) III only (d) I or II only
(e) Question cannot be answered even with the information in all the three statements.

19. What is the length of a running train P crossing another running train Q ?
I. These two trains take 18 seconds to cross each other.
II. These trains are running in opposite directions.
III. The length of train Q is 180 metres.

(S.B.I.P.O. 1997)

(a) I only (b) II only
(c) III only (d) All I, II and III are required
(e) Even with I, II and III, the answer cannot be obtained.