$\therefore \quad \left(5 \times 9 \times \frac{1}{3} \times x\right) = \left(8 \times 10 \times \frac{1}{4} \times 6\right) \Leftrightarrow 15x = 120 \Leftrightarrow x = 8.$

40. Let the required number of hours be x.

Speeds of working of first and second type of men are $\frac{1}{2}$ and $\frac{1}{3}$.

More work, More time **(*Direct Proportion*)**
Less speed, More time **(*Indirect Proportion*)**

$$\left.\begin{array}{ll} \text{Work} & 1 : 2 \\ \text{Speed} & \frac{1}{3} : \frac{1}{2} \end{array}\right\} :: 25 : x$$

$\therefore \quad \left(1 \times \frac{1}{3} \times x\right) = \left(2 \times \frac{1}{2} \times 25\right) \Leftrightarrow x = 75.$

41. Let x men can do the work in 12 days and the required number of days be z.
More men, Less days **(*Indirect Proportion*)**
Less work, Less days **(*Direct Proportion*)**

$$\left.\begin{array}{ll} \text{Men} & 2x : x \\ \text{Work} & 1 : \frac{1}{2} \end{array}\right\} :: 12 : z$$

$\therefore \quad (2x \times 1 \times z) = \left(x \times \frac{1}{2} \times 12\right) \Leftrightarrow 2xz = 6x \Leftrightarrow z = 3.$

42. Originally, let there be x men.
Less men, More days **(*Indirect Proportion*)**
$\therefore \quad (x - 10) : x :: 100 : 110 \Leftrightarrow (x - 10) \times 110 = x \times 100 \Leftrightarrow 10x = 1100 \Leftrightarrow x = 110.$

43. Let the remaining food will last for x days.
95 men had provisions for 195 days. 65 men had provisions for x days.
Less men, More days **(*Indirect Proportion*)**

$\therefore \quad 65 : 95 :: 195 : x \Leftrightarrow (65 \times x) = (95 \times 195) \Leftrightarrow x = \frac{95 \times 195}{65} = 285.$

44. Let the remaining food will last for x days.
500 men had provisions for $(27 - 3) = 24$ days.
$(500 + 300)$ men had provisions for x days.
More men, Less days **(*Indirect Proportion*)**

$\therefore \quad 800 : 500 :: 24 : x \Leftrightarrow (800 \times x) = (500 \times 24) \Leftrightarrow x = \left(\frac{500 \times 24}{800}\right) = 15.$

45. Initially, let there be x men having food for y days.

After 10 days, x men had food for $(y - 10)$ days. Also, $\left(x - \frac{x}{5}\right)$ men had food for y days.

$\therefore \quad x(y - 10) = \frac{4x}{5} \times y \Leftrightarrow 5xy - 50x = 4xy \Leftrightarrow xy - 50x = 0$

$\Leftrightarrow x(y - 50) = 0 \Leftrightarrow y - 50 = 0 \Leftrightarrow y = 50.$

46. 3 women = 2 men. So, 21 women = 14 men.
Less men, More days **(*Indirect Proportion*)**
Less hours per day, More days **(*Indirect Proportion*)**

$$\left.\begin{array}{ll} \text{Men} & 14 : 15 \\ \text{Hours per day} & 6 : 8 \end{array}\right\} :: 21 : x$$

$\therefore \quad (14 \times 6 \times x) = (15 \times 8 \times 21) \quad \Leftrightarrow \quad x = \dfrac{(15 \times 8 \times 21)}{(14 \times 6)} = 30.$

$\therefore$ Required number of days = 30.

47. Let there be x men at the beginning.

Less men, More days **(*Indirect Proportion*)**

$\therefore \quad 15 : 9 :: x : (x - 6) \quad \Leftrightarrow \quad 15\,(x - 6) = 9x \quad \Leftrightarrow \quad 6x = 90 \quad \Leftrightarrow \quad x = 15.$

48. $[(100 \times 35) + (200 \times 5)]$ men can finish the work in 1 day.

$\therefore$ 4500 men can finish the work in 1 day. 100 men can finish it in $\dfrac{4500}{100} = 45$ days.

This is 5 days behind schedule.

49. After 25 days, 35 men complete the work in 12 days.

Thus, 35 men can finish the remaining work in 12 days.

$\therefore$ 30 men can do it in $\dfrac{(12 \times 35)}{30} = 14$ days, which is **1 day behind.**

50. 1 man $\equiv$ 2 boys $\Leftrightarrow$ (12 men + 18 boys) $\equiv (12 \times 2 + 18)$ boys = 42 boys.

Let required number of boys = x. 21 men + x boys $\equiv (21 \times 2 + x)$ boys $= (42 + x)$ boys.

Less days, More boys **(*Indirect Proportion*)**

More hrs per day, Less boys **(*Indirect Proportion*)**

$$\left.\begin{array}{ll} \text{Days} & 50 : 60 \\ \text{Hours per day} & 9 : \dfrac{15}{2} \\ \text{Work} & 1 : 2 \end{array}\right\} :: 42 : (42 + x)$$

$\therefore \quad [50 \times 9 \times 1 \times (42 + x)] = \left(60 \times \dfrac{15}{2} \times 2 \times 42\right)$

$\Leftrightarrow \quad (42 + x) = \dfrac{37800}{450} \quad \Leftrightarrow \quad 42 + x = 84 \quad \Leftrightarrow \quad x = 42.$

51. 3 men $\equiv$ 6 boys $\Leftrightarrow$ (6 men + 2 boys) $\equiv$ 14 boys.

More work, More days **(*Direct Proportion*)**

More boys, Less days **(*Indirect Proportion*)**

More hours per day, Less days **(*Indirect Proportion*)**

$$\left.\begin{array}{ll} \text{Work} & 1 : 2 \\ \text{Boys} & 14 : 6 \\ \text{Hours per day} & 8 : 7 \end{array}\right\} :: 10 : x$$

$\therefore \quad (1 \times 14 \times 8 \times x) = (2 \times 6 \times 7 \times 10) \quad \Leftrightarrow \quad x = \dfrac{840}{112} = 7\dfrac{1}{2}.$

52. (2×14) men + (7×14) boys $\equiv (3 \times 11)$ men + (8×11) boys.

$\Leftrightarrow$ 5 men $\equiv$ 10 boys $\Leftrightarrow$ 1 man $\equiv$ 2 boys.

$\therefore$ (2 men + 7 boys) $\equiv (2 \times 2 + 7)$ boys = 11 boys.

(8 men + 6 boys) $\equiv (8 \times 2 + 6)$ boys = 22 boys.

Let the required number of days be x.

Now, ***More boys, Less days*** **(*Indirect Proportion*)**

More work, More days **(*Direct Proportion*)**

$$\left.\begin{array}{ll} \text{Boys} & 22 : 11 \\ \text{Work} & 1 : 3 \end{array}\right\} :: 14 : x$$

$\therefore \quad (22 \times 1 \times x) = (11 \times 3 \times 14) \quad \therefore \quad x = \dfrac{462}{22} = 21.$

Hence, the required number of days = 21.

15. TIME AND WORK

IMPORTANT FACTS AND FORMULAE

1. If A can do a piece of work in n days, then A's 1 day's work $= \frac{1}{n}$.
2. If A's 1 day's work $= \frac{1}{n}$, then A can finish the work in n days.
3. If A is thrice as good a workman as B, then :
   Ratio of work done by A and B = 3 : 1.
   Ratio of times taken by A and B to finish a work = 1 : 3.

SOLVED EXAMPLES

Ex. 1. ***Worker A takes 8 hours to do a job. Worker B takes 10 hours to do the same job. How long should it take both A and B, working together but independently, to do the same job ?*** **(IGNOU, 2003)**

Sol. A's 1 hour's work $= \frac{1}{8}$, B's 1 hour's work $= \frac{1}{10}$.

(A + B)'s 1 hour's work $= \left(\frac{1}{8} + \frac{1}{10}\right) = \frac{9}{40}$.

$\therefore$ Both A and B will finish the work in $\frac{40}{9} = 4\frac{4}{9}$ days.

Ex. 2. ***A and B together can complete a piece of work in 4 days. If A alone can complete the same work in 12 days, in how many days can B alone complete that work?*** **(Bank P.O. 2003)**

Sol. (A + B)'s 1 day's work $= \frac{1}{4}$, A's 1 day's work $= \frac{1}{12}$.

$\therefore$ B's 1 day's work $= \left(\frac{1}{4} - \frac{1}{12}\right) = \frac{1}{6}$.

Hence, B alone can complete the work in 6 days.

Ex. 3. ***A can do a piece of work in 7 days of 9 hours each and B can do it in 6 days of 7 hours each. How long will they take to do it, working together $8\frac{2}{5}$ hours a day?***

Sol. A can complete the work in $(7 \times 9) = 63$ hours.
B can complete the work in $(6 \times 7) = 42$ hours.

$\therefore$ A's 1 hour's work $= \frac{1}{63}$ and B's 1 hour's work $= \frac{1}{42}$.

(A + B)'s 1 hour's work $= \left(\frac{1}{63} + \frac{1}{42}\right) = \frac{5}{126}$.

$\therefore$ Both will finish the work in $\left(\frac{126}{5}\right)$ hrs.

Number of days of $8\frac{2}{5}$ hrs each $= \left(\frac{126}{5} \times \frac{5}{42}\right) = 3$ days.

Ex. 4. ***A and B can do a piece of work in 18 days; B and C can do it in 24 days; A and C can do it in 36 days. In how many days will A, B and C finish it, working together and separately ?***

Sol. (A + B)'s 1 day's work $= \frac{1}{18}$, (B + C)'s 1 day's work $= \frac{1}{24}$,

and (A + C)'s 1 day's work $= \frac{1}{36}$.

Adding, we get : 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{18} + \frac{1}{24} + \frac{1}{36}\right) = \frac{9}{72} = \frac{1}{8}$.

$\therefore$ (A + B + C)'s 1 day's work $= \frac{1}{16}$.

Thus, A, B and C together can finish the work in 16 days.

Now, A's 1 day's work = [(A + B + C)'s 1 day's work] − [(B + C)'s 1 day's work]

$$= \left(\frac{1}{16} - \frac{1}{24}\right) = \frac{1}{48}.$$

$\therefore$ A alone can finish the work in 48 days.

Similarly, B's 1 day's work $= \left(\frac{1}{16} - \frac{1}{36}\right) = \frac{5}{144}$.

$\therefore$ B alone can finish the work in $\frac{144}{5} = 28\frac{4}{5}$ days.

And, C's 1 day's work $= \left(\frac{1}{16} - \frac{1}{18}\right) = \frac{1}{144}$.

$\therefore$ C alone can finish the work in 144 days.

Ex. 5. ***A is twice as good a workman as B and together they finish a piece of work in 18 days. In how many days will A alone finish the work ?***

Sol. (A's 1 day's work) : (B's 1 day's work) = 2 : 1.

(A + B)'s 1 day's work $= \frac{1}{18}$.

Divide $\frac{1}{18}$ in the ratio 2 : 1.

$\therefore$ A's 1 day's work $= \left(\frac{1}{18} \times \frac{2}{3}\right) = \frac{1}{27}$.

Hence, A alone can finish the work in 27 days.

Ex. 6. ***A can do a certain job in 12 days. B is 60% more efficient than A. How many days does B alone take to do the same job ?***

Sol. Ratio of times taken by A and B = 160 : 100 = 8 : 5.

Suppose B alone takes x days to do the job.

Then, 8 : 5 :: 12 : x $\Rightarrow$ $8x = 5 \times 12$ $\Rightarrow$ $x = 7\frac{1}{2}$ days.

Ex. 7. ***A can do a piece of work in 80 days. He works at it for 10 days and then B alone finishes the remaining work in 42 days. In how much time will A and B, working together, finish the work ?***

Sol. Work done by A in 10 days $= \left(\frac{1}{80} \times 10\right) = \frac{1}{8}$.

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

Now, $\frac{7}{8}$ work is done by B in 42 days.

Whole work will be done by B in $\left(42 \times \frac{8}{7}\right) = 48$ days.

$\therefore$ A's 1 day's work $= \frac{1}{80}$ and B's 1 day's work $= \frac{1}{48}$.

$\therefore$ (A + B)'s 1 day's work $= \left(\frac{1}{80} + \frac{1}{48}\right) = \frac{8}{240} = \frac{1}{30}$.

Hence, both will finish the work in 30 days.

Ex. 8. ***A and B undertake to do a piece of work for Rs. 600. A alone can do it in 6 days while B alone can do it in 8 days. With the help of C, they finish it in 3 days. Find the share of each.***

Sol. C's 1 day's work $= \frac{1}{3} - \left(\frac{1}{6} + \frac{1}{8}\right) = \frac{1}{24}$.

$\therefore$ A : B : C = Ratio of their 1 day's work $= \frac{1}{6} : \frac{1}{8} : \frac{1}{24} = 4 : 3 : 1$.

$\therefore$ A's share $=$ Rs. $\left(600 \times \frac{4}{8}\right) =$ Rs. 300, B's share $=$ Rs. $\left(600 \times \frac{3}{8}\right) =$ Rs. 225.

C's share $=$ Rs. $[600 - (300 + 225)] =$ Rs. 75.

Ex. 9. ***A and B working separately can do a piece of work in 9 and 12 days respectively. If they work for a day alternately, A beginning, in how many days, the work will be completed ?***

Sol. (A + B)'s 2 days' work $= \left(\frac{1}{9} + \frac{1}{12}\right) = \frac{7}{36}$.

Work done in 5 pairs of days $= \left(5 \times \frac{7}{36}\right) = \frac{35}{36}$.

Remaining work $= \left(1 - \frac{35}{36}\right) = \frac{1}{36}$.

On 11th day, it is A's turn. $\frac{1}{9}$ work is done by him in 1 day.

$\frac{1}{36}$ work is done by him in $\left(9 \times \frac{1}{36}\right) = \frac{1}{4}$ day.

$\therefore$ Total time taken $= \left(10 + \frac{1}{4}\right)$ days $= 10\frac{1}{4}$ days.

Ex. 10. ***45 men can complete a work in 16 days. Six days after they started working, 30 more men joined them. How many days will they now take to complete the remaining work ?***

Sol. (45 × 16) men can complete the work in 1 day.

$\therefore$ 1 man's 1 day's work $= \frac{1}{720}$.

45 men's 6 days' work $= \left(\frac{1}{16} \times 6\right) = \frac{3}{8}$. Remaining work $= \left(1 - \frac{3}{8}\right) = \frac{5}{8}$.

75 men's 1 day's work $= \frac{75}{720} = \frac{5}{48}$.

Now, $\frac{5}{48}$ work is done by them in 1 day.

$\therefore$ $\frac{5}{8}$ work is done by them in $\left(\frac{48}{5} \times \frac{5}{8}\right) = 6$ days.

Ex. 11. ***2 men and 3 boys can do a piece of work in 10 days while 3 men and 2 boys can do the same work in 8 days. In how many days can 2 men and 1 boy do the work?***

Sol. Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y.

Then, $2x + 3y = \frac{1}{10}$ and $3x + 2y = \frac{1}{8}$.

Solving, we get : $x = \frac{7}{200}$ and $y = \frac{1}{100}$.

$\therefore$ (2 men + 1 boy)'s 1 day's work $= \left(2 \times \frac{7}{200} + 1 \times \frac{1}{100}\right) = \frac{16}{200} = \frac{2}{25}$.

So, 2 men and 1 boy together can finish the work in $\frac{25}{2} = 12\frac{1}{2}$ days.

EXERCISE 15A

(OBJECTIVE TYPE QUESTIONS)

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

1. A does a work in 10 days and B does the same work in 15 days. In how many days they together will do the same work ? **(R.R.B. 2003)**

   (*a*) 5 days (*b*) 6 days (*c*) 8 days (*d*) 9 days

2. A can finish a work in 18 days and B can do the same work in half the time taken by A. Then, working together, what part of the same work they can finish in a day ?

   (*a*) $\frac{1}{6}$ (*b*) $\frac{1}{9}$ (*c*) $\frac{2}{5}$ (*d*) $\frac{2}{7}$

   (S.S.C. 2002)

3. A tyre has two punctures. The first puncture alone would have made the tyre flat in 9 minutes and the second alone would have done it in 6 minutes. If air leaks out at a constant rate, how long does it take both the punctures together to make it flat ?

   (*a*) $1\frac{1}{2}$ minutes (*b*) $3\frac{1}{2}$ minutes (*c*) $3\frac{3}{5}$ minutes (*d*) $4\frac{1}{4}$ minutes

   (D.M.R.C. 2003)

4. A, B and C can complete a piece of work in 24, 6 and 12 days respectively. Working together, they will complete the same work in : **(C.B.I. 2003)**

   (*a*) $\frac{1}{24}$ day (*b*) $\frac{7}{24}$ day (*c*) $3\frac{3}{7}$ days (*d*) 4 days

5. A man can do a job in 15 days. His father takes 20 days and his son finishes it in 25 days. How long will they take to complete the job if they all work together ?

   (*a*) Less than 6 days (*b*) Exactly 6 days

   (*c*) Approximately 6.4 days (*d*) More than 10 days

   (Hotel Management, 2003)

6. A man can do a piece of work in 5 days, but with the help of his son, he can do it in 3 days. In what time can the son do it alone ? **(S.S.C. 2004)**

   (*a*) $6\frac{1}{2}$ days (*b*) 7 days (*c*) $7\frac{1}{2}$ days (*d*) 8 days

7. A can lay railway track between two given stations in 16 days and B can do the same job in 12 days. With the help of C, they did the job in 4 days only. Then, C alone can do the job in : **(S.S.C. 2003)**

(a) $9\frac{1}{5}$ days (b) $9\frac{2}{5}$ days (c) $9\frac{3}{5}$ days (d) 10 days

8. A takes twice as much time as B or thrice as much time to finish a piece of work. Working together, they can finish the work in 2 days. B can do the work alone in : **(S.S.C. 2002)**

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

9. X can do $\frac{1}{4}$ of a work in 10 days, Y can do 40% of the work in 40 days and Z can do $\frac{1}{3}$ of the work in 13 days. Who will complete the work first ?

(a) X (b) Y (c) Z (d) X and Z both

10. P, Q and R are three typists who working simultaneously can type 216 pages in 4 hours. In one hour, R can type as many pages more than Q as Q can type more than P. During a period of five hours, R can type as many pages as P can during seven hours. How many pages does each of them type per hour ?

(a) 14, 17, 20 (b) 15, 17, 22 (c) 15, 18, 21 (d) 16, 18, 22

11. Ronald and Elan are working on an assignment. Ronald takes 6 hours to type 32 pages on a computer, while Elan takes 5 hours to type 40 pages. How much time will they take, working together on two different computers to type an assignment of 110 pages ?

(a) 7 hours 30 minutes (b) 8 hours
(c) 8 hours 15 minutes (d) 8 hours 25 minutes **(SCMHRD, 2002)**

12. Two workers A and B are engaged to do a work. A working alone takes 8 hours more to complete the job than if both worked together. If B worked alone, he would need $4\frac{1}{2}$ hours more to complete the job than they both working together. What time would they take to do the work together ?

(a) 4 hours (b) 5 hours (c) 6 hours (d) 7 hours

13. P can complete a work in 12 days working 8 hours a day. Q can complete the same work in 8 days working 10 hours a day. If both P and Q work together, working 8 hours a day, in how many days can they complete the work ? **(Bank P.O. 1999)**

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

14. A and B can do a work in 12 days, B and C in 15 days, C and A in 20 days. If A, B and C work together, they will complete the work in : **(S.S.C. 1999)**

(a) 5 days (b) $7\frac{5}{6}$ days (c) 10 days (d) $15\frac{2}{3}$ days

15. A and B can do a work in 8 days, B and C can do the same work in 12 days. A, B and C together can finish it in 6 days. A and C together will do it in :

(a) 4 days (b) 6 days (c) 8 days (d) 12 days **(R.R.B. 2001)**

16. A and B can do a piece of work in 72 days; B and C can do it in 120 days; A and C can do it in 90 days. In what time can A alone do it ?

(a) 80 days (b) 100 days (c) 120 days (d) 150 days

17. A and B can do a piece of work in 5 days; B and C can do it in 7 days; A and C can do it in 4 days. Who among these will take the least time if put to do it alone ?

(a) A (b) B (c) C (d) Data inadequate

18. A can do a piece of work in 4 hours; B and C together can do it in 3 hours, while A and C together can do it in 2 hours. How long will B alone take to do it ?
(*a*) 8 hours (*b*) 10 hours (*c*) 12 hours (*d*) 24 hours
(S.S.C. 2002)

19. A can do a certain work in the same time in which B and C together can do it. If A and B together could do it in 10 days and C alone in 50 days, then B alone could do it in :
(S.S.C. 2003)
(*a*) 15 days (*b*) 20 days (*c*) 25 days (*d*) 30 days

20. A works twice as fast as B. If B can complete a work in 12 days independently, the number of days in which A and B can together finish the work is :
(*a*) 4 days (*b*) 6 days (*c*) 8 days (*d*) 18 days
(Asstt. Grade, 1997)

21. A is twice as good a workman as B and together they finish a piece of work in 14 days. The number of days taken by A alone to finish the work is :
(*a*) 11 (*b*) 21 (*c*) 28 (*d*) 42

22. A is thrice as good a workman as B and therefore is able to finish a job in 60 days less than B. Working together, they can do it in :
(S.S.C. 1999)
(*a*) 20 days (*b*) $22\frac{1}{2}$ days (*c*) 25 days (*d*) 30 days

23. A and B can do a job together in 7 days. A is $1\frac{3}{4}$ times as efficient as B. The same job can be done by A alone in :
(S.S.C. 2003)
(*a*) $9\frac{1}{3}$ days (*b*) 11 days (*c*) $12\frac{1}{4}$ days (*d*) $16\frac{1}{3}$ days

24. Sakshi can do a piece of work in 20 days. Tanya is 25% more efficient than Sakshi. The number of days taken by Tanya to do the same piece of work is :
(*a*) 15 (*b*) 16 (*c*) 18 (*d*) 25
(Hotel Management, 2003)

25. A is 30% more efficient than B. How much time will they, working together, take to complete a job which A alone could have done in 23 days ?
(*a*) 11 days (*b*) 13 days (*c*) $20\frac{3}{17}$ days (*d*) None of these
(Hotel Management, 1998)

26. A does half as much work as B in three-fourth of the time. If together they take 18 days to complete the work, how much time shall B take to do it ?
(*a*) 30 days (*b*) 35 days (*c*) 40 days (*d*) None of these

27. A is 50% as efficient as B. C does half of the work done by A and B together. If C alone does the work in 40 days, then A, B and C together can do the work in :
(*a*) $13\frac{1}{3}$ days (*b*) 15 days (*c*) 20 days (*d*) 30 days

28. Two workers A and B working together completed a job in 5 days. If A worked twice as efficiently as he actually did and B worked $\frac{1}{3}$ as efficiently as he actually did, the work would have been completed in 3 days. A alone could complete the work in :
(*a*) $5\frac{1}{4}$ days (*b*) $6\frac{1}{4}$ days (*c*) $7\frac{1}{2}$ days (*d*) None of these

29. A can do a work in 15 days and B in 20 days. If they work on it together for 4 days, then the fraction of the work that is left is :
(S.S.C. 2000)
(*a*) $\frac{1}{4}$ (*b*) $\frac{1}{10}$ (*c*) $\frac{7}{15}$ (*d*) $\frac{8}{15}$

30. A can finish a work in 18 days and B can do the same work in 15 days. B worked for 10 days and left the job. In how many days, A alone can finish the remaining work ?

(*a*) 5 (*b*) $5\frac{1}{2}$ (*c*) 6 (*d*) 8

(Bank P.O. 2002)

31. A and B can complete a work in 15 days and 10 days respectively. They started doing the work together but after 2 days B had to leave and A alone completed the remaining work. The whole work was completed in : **(S.S.C. 2004)**

(*a*) 8 days (*b*) 10 days (*c*) 12 days (*d*) 15 days

32. A can finish a work in 24 days, B in 9 days and C in 12 days. B and C start the work but are forced to leave after 3 days. The remaining work was done by A in :

(*a*) 5 days (*b*) 6 days (*c*) 10 days (*d*) $10\frac{1}{2}$ days

(S.S.C. 2003)

33. A machine P can print one lakh books in 8 hours, machine Q can print the same number of books in 10 hours while machine R can print them in 12 hours. All the machines are started at 9 a.m. while machine P is closed at 11 a.m. and the remaining two machines complete the work. Approximately at what time will the work be finished ? **(Bank P.O. 2003)**

(*a*) 11:30 a.m. (*b*) 12 noon (*c*) 12:30 p.m. (*d*) 1 p.m.

34. A and B can do a piece of work in 30 days, while B and C can do the same work in 24 days and C and A in 20 days. They all work together for 10 days when B and C leave. How many days more will A take to finish the work ? **(C.B.I. 2003)**

(*a*) 18 days (*b*) 24 days (*c*) 30 days (*d*) 36 days

35. X and Y can do a piece of work in 20 days and 12 days respectively. X started the work alone and then after 4 days Y joined him till the completion of the work. How long did the work last ? **(Bank P.O. 2004)**

(*a*) 6 days (*b*) 10 days (*c*) 15 days (*d*) 20 days

36. A and B can together finish a work in 30 days. They worked together for 20 days and then B left. After another 20 days, A finished the remaining work. In how many days A alone can finish the job ? **(S.S.C. 2003)**

(*a*) 40 (*b*) 50 (*c*) 54 (*d*) 60

37. X can do a piece of work in 40 days. He works at it for 8 days and then Y finished it in 16 days. How long will they together take to complete the work ?

(*a*) $13\frac{1}{3}$ days (*b*) 15 days (*c*) 20 days (*d*) 56 days

(Hotel Management, 1999)

38. A, B and C together can complete a piece of work in 10 days. All the three started working at it together and after 4 days A left. Then B and C together completed the work in 10 more days. A alone could complete the work in :

(*a*) 15 days (*b*) 16 days (*c*) 25 days (*d*) 50 days

39. A does $\frac{4}{5}$ of a work in 20 days. He then calls in B and they together finish the remaining work in 3 days. How long B alone would take to do the whole work ?

(*a*) 23 days (*b*) 37 days (*c*) $37\frac{1}{2}$ days (*d*) 40 days

(S.S.C. 2002)

40. A and B together can do a piece of work in 30 days. A having worked for 16 days, B finishes the remaining work alone in 44 days. In how many days shall B finish the whole work alone ? **(C.B.I. 1997)**

(*a*) 30 days (*b*) 40 days (*c*) 60 days (*d*) 70 days

41. A and B together can do a piece of work in 12 days, which B and C together can do in 16 days. After A has been working at it for 5 days and B for 7 days, C finishes it in 13 days. In how many days C alone will do the work ?

(*a*) 16 (*b*) 24 (*c*) 36 (*d*) 48

42. A and B can do a piece of work in 45 days and 40 days respectively. They began to do the work together but A leaves after some days and then B completed the remaining work in 23 days. The number of days after which A left the work was :

(*a*) 6 (*b*) 8 (*c*) 9 (*d*) 12

(Bank P.O. 1998)

43. A can do a piece of work in 14 days which B can do in 21 days. They begin together but 3 days before the completion of the work, A leaves off. The total number of days to complete the work is : **(R.R.B. 2002)**

(*a*) $6\frac{3}{5}$ (*b*) $8\frac{1}{2}$ (*c*) $10\frac{1}{5}$ (*d*) $13\frac{1}{2}$

44. A, B and C can complete a work separately in 24, 36 and 48 days respectively. They started together but C left after 4 days of start and A left 3 days before the completion of the work. In how many days will the work be completed ?

(*a*) 15 days (*b*) 22 days (*c*) 25 days (*d*) 35 days

45. A, B and C together earn Rs. 300 per day, while A and C together earn Rs. 188 and B and C together earn Rs. 152. The daily earning of C is :

(*a*) Rs. 40 (*b*) Rs. 68 (*c*) Rs. 112 (*d*) Rs. 150

46. A, B and C are employed to do a piece of work for Rs. 529. A and B together are supposed to do $\frac{19}{23}$ of the work and B and C together $\frac{8}{23}$ of the work. What amount should A be paid ? **(C.B.I. 1997)**

(*a*) Rs. 315 (*b*) Rs. 345 (*c*) Rs. 355 (*d*) Rs. 375

47. Kim can do a work in 3 days while David can do the same work in 2 days. Both of them finish the work together and get Rs. 150. What is the share of Kim ?

(*a*) Rs. 30 (*b*) Rs. 60 (*c*) Rs. 70 (*d*) Rs. 75

(S.S.C. 1999)

48. If A can do $\frac{1}{4}$ of a work in 3 days and B can do $\frac{1}{6}$ of the same work in 4 days, how much will A get if both work together and are paid Rs. 180 in all ?

(*a*) Rs. 36 (*b*) Rs. 60 (*c*) Rs. 108 (*d*) Rs. 120

49. A alone can do a piece of work in 6 days and B alone in 8 days. A and B undertook to do it for Rs. 3200. With the help of C, they completed the work in 3 days. How much is to be paid to C ? **(S.S.C. 2004)**

(*a*) Rs. 375 (*b*) Rs. 400 (*c*) Rs. 600 (*d*) Rs. 800

50. A sum of money is sufficient to pay A's wages for 21 days and B's wages for 28 days. The same money is sufficient to pay the wages of both for :

(*a*) 12 days (*b*) $12\frac{1}{4}$ days (*c*) 14 days (*d*) $24\frac{1}{2}$ days

51. A can do a piece of work in 10 days; B in 15 days. They work for 5 days. The rest of the work was finished by C in 2 days. If they get Rs. 1500 for the whole work, the daily wages of B and C are :

(*a*) Rs. 150 (*b*) Rs. 225 (*c*) Rs. 250 (*d*) Rs. 300

52. A and B together can complete a work in 12 days. A alone can complete it in 20 days. If B does the work only for half a day daily, then in how many days A and B together will complete the work ? **(R.R.B. 2003)**

(*a*) 10 days (*b*) 11 days (*c*) 15 days (*d*) 20 days

53. A alone can complete a work in 16 days and B alone in 12 days. Starting with A, they work on alternate days. The total work will be completed in : **(S.S.C. 2004)**

(*a*) 12 days (*b*) 13 days (*c*) $13\frac{5}{7}$ days (*d*) $13\frac{3}{4}$ days

54. A, B and C can do a piece of work in 11 days, 20 days and 55 days respectively, working alone. How soon can the work be done if A is assisted by B and C on alternate days ?

(*a*) 7 days (*b*) 8 days (*c*) 9 days (*d*) 10 days

55. A, B and C can do a piece of work in 20, 30 and 60 days respectively. In how many days can A do the work if he is assisted by B and C on every third day ?

(*a*) 12 days (*b*) 15 days (*c*) 16 days (*d*) 18 days **(R.R.B. 2002)**

56. A and B can separately do a piece of work in 20 and 15 days respectively. They worked together for 6 days, after which B was replaced by C. If the work was finished in next 4 days, then the number of days in which C alone could do the work will be :

(*a*) 30 (*b*) 35 (*c*) 40 (*d*) 60

57. A, B and C can do a piece of work in 36, 54 and 72 days respectively. They started the work but A left 8 days before the completion of the work while B left 12 days before the completion. The number of days for which C worked is :

(*a*) 4 (*b*) 8 (*c*) 12 (*d*) 24

58. Twenty women can do a work in sixteen days. Sixteen men can complete the same work in fifteen days. What is the ratio between the capacity of a man and a woman ?

(*a*) 3 : 4 (*b*) 4 : 3 (*c*) 5 : 3 (*d*) Data inadequate **(B.S.R.B. 1998)**

59. 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days. If all the 10 men and 15 women work together, in how many days will the work get completed ? **(S.B.I.P.O. 1999)**

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

60. Seven men can complete a work in 12 days. They started the work and after 5 days, two men left. In how many days will the work be completed by the remaining men ?

(*a*) 5 (*b*) 6 (*c*) 7 (*d*) 8 (*e*) None of these

61. 12 men complete a work in 9 days. After they have worked for 6 days, 6 more men join them. How many days will they take to complete the remaining work ?

(*a*) 2 days (*b*) 3 days (*c*) 4 days (*d*) 5 days (*e*) None of these **(R.R.B. 2002)**

62. Three men, four women and six children can complete a work in seven days. A woman does double the work a man does and a child does half the work a man does. How many women alone can complete this work in 7 days ? **(S.B.I.P.O. 2003)**

(*a*) 7 (*b*) 8 (*c*) 12
(*d*) Cannot be determined (*e*) None of these

63. A man, a woman and a boy can complete a job in 3, 4 and 12 days respectively. How many boys must assist 1 man and 1 woman to complete the job in $\frac{1}{4}$ of a day ?

(*a*) 1 (*b*) 4 (*c*) 19 (*d*) 41 **(S.S.C. 2000)**

64. 10 men and 15 women together can complete a work in 6 days. It takes 100 days for one man alone to complete the same work. How many days will be required for one woman alone to complete the same work ? **(Bank P.O. 1999)**

(*a*) 90 (*b*) 125 (*c*) 145 (*d*) 150 (*e*) None of these

65. 12 men can complete a piece of work in 4 days, while 15 women can complete the same work in 4 days. 6 men start working on the job and after working for 2 days, all of them stopped working. How many women should be put on the job to complete the remaining work, if it is to be completed in 3 days ? **(S.B.I.P.O. 2000)**

(*a*) 15 (*b*) 18 (*c*) 22
(*d*) Data inadequate (*e*) None of these

66. Twelve children take sixteen days to complete a work which can be completed by eight adults in twelve days. Sixteen adults started working and after three days ten adults left and four children joined them. How many days will they take to complete the remaining work ?

(*a*) 3 (*b*) 4 (*c*) 6 (*d*) 8 (*e*) None of these

67. 10 women can complete a work in 7 days and 10 children take 14 days to complete the work. How many days will 5 women and 10 children take to complete the work ?

(*a*) 3 (*b*) 5 (*c*) 7
(*d*) Cannot be determined (*e*) None of these **(Bank P.O. 2003)**

68. Sixteen men can complete a work in twelve days. Twenty-four children can complete the same work in eighteen days. Twelve men and eight children started working and after eight days three more children joined them. How many days will they now take to complete the remaining work ?

(*a*) 2 days (*b*) 4 days (*c*) 6 days (*d*) 8 days (*e*) None of these

69. Twenty-four men can complete a work in sixteen days. Thirty-two women can complete the same work in twenty-four days. Sixteen men and sixteen women started working and worked for twelve days. How many more men are to be added to complete the remaining work in 2 days ? **(Bank P.O. 1999)**

(*a*) 16 (*b*) 24 (*c*) 36 (*d*) 48 (*e*) None of these

70. 5 men and 2 boys working together can do four times as much work as a man and a boy. Working capacities of a woman and a boy are in the ratio :

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

71. If 12 men and 16 boys can do a piece of work in 5 days; 13 men and 24 boys can do it in 4 days, then the ratio of the daily work done by a man to that of a boy is :

(*a*) 2 : 1 (*b*) 3 : 1 (*c*) 3 : 2 (*d*) 5 : 4 **(S.S.C. 1999)**

72. 4 men and 6 women can complete a work in 8 days, while 3 men and 7 women can complete it in 10 days. In how many days will 10 women complete it ?

(*a*) 35 (*b*) 40 (*c*) 45 (*d*) 50 **(S.S.C. 2004)**

73. One man, 3 women and 4 boys can do a piece of work in 96 hours, 2 men and 8 boys can do it in 80 hours, 2 men and 3 women can do it in 120 hours. 5 men and 12 boys can do it in :

(*a*) $39\frac{1}{11}$ hours (*b*) $42\frac{7}{11}$ hours (*c*) $43\frac{7}{11}$ hours (*d*) 44 hours

74. If 6 men and 8 boys can do a piece of work in 10 days while 26 men and 48 boys can do the same in 2 days, the time taken by 15 men and 20 boys in doing the same type of work will be : **(S.S.C. 1999)**

(*a*) 4 days (*b*) 5 days (*c*) 6 days (*d*) 7 days

ANSWERS

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

SOLUTIONS

1. A's 1 day's work $= \frac{1}{10}$ and B's 1 day's work $= \frac{1}{15}$.

   $\therefore$ (A + B)'s 1 day's work $= \left(\frac{1}{10} + \frac{1}{15}\right) = \frac{1}{6}$.

   So, both together will finish the work in 6 days.

2. A's 1 day's work $= \frac{1}{18}$ and B's 1 day's work $= \frac{1}{9}$.

   $\therefore$ (A + B)'s 1 day's work $= \left(\frac{1}{18} + \frac{1}{9}\right) = \frac{1}{6}$.

3. 1 minute's work of both the punctures $= \left(\frac{1}{9} + \frac{1}{6}\right) = \frac{5}{18}$.

   So, both the punctures will make the tyre flat in $\frac{18}{5} = 3\frac{3}{5}$ min.

4. (A + B + C)'s 1 day's work $= \left(\frac{1}{24} + \frac{1}{6} + \frac{1}{12}\right) = \frac{7}{24}$.

   So, A, B and C together will complete the job in $\frac{24}{7} = 3\frac{3}{7}$ days.

5. 1 day's work of the three persons $= \left(\frac{1}{15} + \frac{1}{20} + \frac{1}{25}\right) = \frac{47}{300}$.

   So, all the three together will complete the work in $\frac{300}{47} \simeq 6.4$ days.

6. Son's 1 day's work $= \left(\frac{1}{3} - \frac{1}{5}\right) = \frac{2}{15}$.

   $\therefore$ The son alone can do the work in $\frac{15}{2} = 7\frac{1}{2}$ days.

7. (A + B + C)'s 1 day's work $= \frac{1}{4}$, A's 1 day's work $= \frac{1}{16}$, B's 1 day's work $= \frac{1}{12}$.

   $\therefore$ C's 1 day's work $= \frac{1}{4} - \left(\frac{1}{16} + \frac{1}{12}\right) = \left(\frac{1}{4} - \frac{7}{48}\right) = \frac{5}{48}$.

   So, C alone can do the work in $\frac{48}{5} = 9\frac{3}{5}$ days.

8. Suppose A, B and C take x, $\frac{x}{2}$ and $\frac{x}{3}$ hours respectively to finish the work.

Then, $\left(\frac{1}{x}+\frac{2}{x}+\frac{3}{x}\right)=\frac{1}{2} \Rightarrow \frac{6}{x}=\frac{1}{2} \Rightarrow x=12$.

So, B takes 6 hours to finish the work.

9. Whole work will be done by X in $(10 \times 4) = 40$ days.

Whole work will be done by Y in $\left(40 \times \frac{100}{40}\right) = 100$ days.

Whole work will be done by Z in $(13 \times 3) = 39$ days.

$\therefore$ Z will complete the work first.

10. Let the number of pages typed in one hour by P, Q and R be x, y and z respectively. Then,

$$x+y+z=\frac{216}{4} \Rightarrow x+y+z=54 \quad ...(i)$$

$$z-y=y-x \Rightarrow 2y=x+z \quad ...(ii)$$

$$5z=7x \Rightarrow x=\frac{5}{7}z \quad ...(iii)$$

Solving (i), (ii) and (iii), we get $x = 15$, $y = 18$, $z = 21$.

11. Number of pages typed by Ronald in 1 hour $= \frac{32}{6}=\frac{16}{3}$.

Number of pages typed by Elan in 1 hour $= \frac{40}{5} = 8$.

Number of pages typed by both in 1 hour $= \left(\frac{16}{3}+8\right)=\frac{40}{3}$.

$\therefore$ Time taken by both to type 110 pages $= \left(110 \times \frac{3}{40}\right)$ hrs $= 8\frac{1}{4}$ hrs $= 8$ hrs 15 min.

12. Let A and B together take x hours to complete the work. Then,

A alone takes $(x + 8)$ hrs and B alone takes $\left(x+\frac{9}{2}\right)$ hrs to complete the work. Then,

$$\frac{1}{(x+8)}+\frac{1}{\left(x+\frac{9}{2}\right)}=\frac{1}{x} \Rightarrow \frac{1}{(x+8)}+\frac{2}{(2x+9)}=\frac{1}{x} \Rightarrow x(4x+25)=(x+8)(2x+9)$$

$$\Rightarrow 2x^2=72 \Rightarrow x^2=36 \Rightarrow x=6.$$

13. P can complete the work in (12×8) hrs. = 96 hrs.
Q can complete the work in (8×10) hrs. = 80 hrs.

$\therefore$ P's 1 hour's work $= \frac{1}{96}$ and Q's 1 hour's work $= \frac{1}{80}$.

(P + Q)'s 1 hour's work $= \left(\frac{1}{96}+\frac{1}{80}\right)=\frac{11}{480}$.

So, both P and Q will finish the work in $\left(\frac{480}{11}\right)$ hrs.

$\therefore$ Number of days of 8 hours each $= \left(\frac{480}{11} \times \frac{1}{8}\right)=\frac{60}{11}$ days $= 5\frac{5}{11}$ days.

14. (A + B)'s 1 day's work $= \frac{1}{12}$; (B + C)'s 1 day's work $= \frac{1}{15}$; (A + C)'s 1 day's work $= \frac{1}{20}$.

Adding, we get : 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{12} + \frac{1}{15} + \frac{1}{20}\right) = \frac{12}{60} = \frac{1}{5}$.

$\therefore$ (A + B + C)'s 1 day's work $= \frac{1}{10}$.

So, A, B and C together can complete the work in 10 days.

15. (A + B + C)'s 1 day's work $= \frac{1}{6}$; (A + B)'s 1 day's work $= \frac{1}{8}$;

(B + C)'s 1 day's work $= \frac{1}{12}$.

$\therefore$ (A + C)'s 1 day's work $= \left(2 \times \frac{1}{6}\right) - \left(\frac{1}{8} + \frac{1}{12}\right) = \left(\frac{1}{3} - \frac{5}{24}\right) = \frac{3}{24} = \frac{1}{8}$.

So, A and C together will do the work in 8 days.

16. (A + B)'s 1 day's work $= \frac{1}{72}$; (B + C)'s 1 day's work $= \frac{1}{120}$; (A + C)'s 1 day's work $= \frac{1}{90}$.

Adding, we get : 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{72} + \frac{1}{120} + \frac{1}{90}\right) = \frac{12}{360} = \frac{1}{30}$.

$\Rightarrow$ (A + B + C)'s 1 day's work $= \frac{1}{60}$.

So, A's 1 day's work $= \left(\frac{1}{60} - \frac{1}{120}\right) = \frac{1}{120}$.

$\therefore$ A alone can do the work in 120 days.

17. (A + B)'s 1 day's work $= \frac{1}{5}$; (B + C)'s 1 day's work $= \frac{1}{7}$; (A + C)'s 1 day's work $= \frac{1}{4}$.

Adding, we get : 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{5} + \frac{1}{7} + \frac{1}{4}\right) = \frac{83}{140}$.

(A + B + C)'s 1 day's work $= \frac{83}{280}$.

A's 1 day's work $= \left(\frac{83}{280} - \frac{1}{7}\right) = \frac{43}{280}$; B's 1 day's work $= \left(\frac{83}{280} - \frac{1}{4}\right) = \frac{13}{280}$;

C's 1 day's work $= \left(\frac{83}{280} - \frac{1}{5}\right) = \frac{27}{280}$.

Thus time taken by A, B, C is $\frac{280}{43}$ days, $\frac{280}{13}$ days, $\frac{280}{27}$ days respectively.

Clearly, the time taken by A is least.

18. A's 1 hour's work $= \frac{1}{4}$; (B + C)'s 1 hour's work $= \frac{1}{3}$; (A + C)'s 1 hour's work $= \frac{1}{2}$.

(A + B + C)'s 1 hour's work $= \left(\frac{1}{4} + \frac{1}{3}\right) = \frac{7}{12}$.

B's 1 hour's work $= \left(\frac{7}{12} - \frac{1}{2}\right) = \frac{1}{12}$.

$\therefore$ B alone will take 12 hours to do the work.

19. (A + B)'s 1 day's work $= \frac{1}{10}$; C's 1 day's work $= \frac{1}{50}$.

(A + B + C)'s 1 day's work $= \left(\frac{1}{10} + \frac{1}{50}\right) = \frac{6}{50} = \frac{3}{25}$ ...(*i*)

Also, A's 1 day's work = (B + C)'s 1 day's work ...(*ii*)

From (*i*) and (*ii*), we get : 2 × (A's 1 day's work) $= \frac{3}{25}$.

$\Rightarrow$ A's 1 day's work $= \frac{3}{50}$.

$\therefore$ B's 1 day's work $= \left(\frac{1}{10} - \frac{3}{50}\right) = \frac{2}{50} = \frac{1}{25}$.

So, B alone could do the work in 25 days.

20. Ratio of rates of working of A and B = 2 : 1. So, ratio of times taken = 1 : 2.

$\therefore$ A's 1 day's work $= \frac{1}{6}$; B's 1 day's work $= \frac{1}{12}$.

(A + B)'s 1 day's work $= \left(\frac{1}{6} + \frac{1}{12}\right) = \frac{3}{12} = \frac{1}{4}$.

So, A and B together can finish the work in 4 days.

21. (A's 1 day's work) : (B's 1 day's work) = 2 : 1.

(A + B)'s 1 day's work $= \frac{1}{14}$.

Divide $\frac{1}{14}$ in the ratio 2 : 1.

$\therefore$ A's 1 day's work $= \left(\frac{1}{14} \times \frac{2}{3}\right) = \frac{1}{21}$.

Hence, A alone can finish the work in 21 days.

22. Ratio of times taken by A and B = 1 : 3.

If difference of time is 2 days, B takes 3 days.

If difference of time is 60 days, B takes $\left(\frac{3}{2} \times 60\right) = 90$ days.

So, A takes 30 days to do the work.

A's 1 day's work $= \frac{1}{30}$; B's 1 day's work $= \frac{1}{90}$.

(A + B)'s 1 day's work $= \left(\frac{1}{30} + \frac{1}{90}\right) = \frac{4}{90} = \frac{2}{45}$.

$\therefore$ A and B together can do the work in $\frac{45}{2} = 22\frac{1}{2}$ days.

23. (A's 1 day's work) : (B's 1 day's work) $= \frac{7}{4} : 1 = 7 : 4$.

Let A's and B's 1 day's work be $7x$ and $4x$ respectively.

Then, $7x + 4x = \frac{1}{7} \Rightarrow 11x = \frac{1}{7} \Rightarrow x = \frac{1}{77}$.

$\therefore$ A's 1 day's work $= \left(\frac{1}{77} \times 7\right) = \frac{1}{11}$.

24. Ratio of times taken by Sakshi and Tanya = 125 : 100 = 5 : 4.
Suppose Tanya takes x days to do the work.

$5 : 4 :: 20 : x \Rightarrow x = \left(\frac{4 \times 20}{5}\right) \Rightarrow x = 16$ days.

Hence, Tanya takes 16 days to complete the work.

25. Ratio of times taken by A and B = 100 : 130 = 10 : 13.
Suppose B takes x days to do the work.

Then, $10 : 13 :: 23 : x \Rightarrow x = \left(\frac{23 \times 13}{10}\right) \Rightarrow x = \frac{299}{10}$.

A's 1 day's work $= \frac{1}{23}$; B's 1 days work $= \frac{10}{299}$.

(A + B)'s 1 day's work $= \left(\frac{1}{23} + \frac{10}{299}\right) = \frac{23}{299} = \frac{1}{13}$.

$\therefore$ A and B together can complete the job in 13 days.

26. Suppose B takes x days to do the work.

$\therefore$ A takes $\left(2 \times \frac{3}{4}x\right) = \frac{3x}{2}$ days to do it.

(A + B)'s 1 day's work $= \frac{1}{18}$.

$\therefore \frac{1}{x} + \frac{2}{3x} = \frac{1}{18}$ or $x = 30$.

27. (A's 1 day's work) : (B's 1 day's work) = 150 : 100 = 3 : 2.
Let A's and B's 1 day's work be $3x$ and $2x$ respectively.

Then, C's 1 day's work $= \left(\frac{3x + 2x}{2}\right) = \frac{5x}{2}$.

$\therefore \frac{5x}{2} = \frac{1}{40}$ or $x = \left(\frac{1}{40} \times \frac{2}{5}\right) = \frac{1}{100}$.

A's 1 day's work $= \frac{3}{100}$; B's 1 day's work $= \frac{1}{50}$; C's 1 day's work $= \frac{1}{40}$.

(A + B + C)'s 1 day's work $= \left(\frac{3}{100} + \frac{1}{50} + \frac{1}{40}\right) = \frac{15}{200} = \frac{3}{40}$.

So, A, B and C together can do the work in $\frac{40}{3} = 13\frac{1}{3}$ days.

28. Let A's 1 day's work = x and B's 1 day's work = y.

Then, $x + y = \frac{1}{5}$ and $2x + \frac{1}{3}y = \frac{1}{3}$.

Solving, we get : $x = \frac{4}{25}$ and $y = \frac{1}{25}$.

$\therefore$ A's 1 day's work $= \frac{4}{25}$.

So, A alone could complete the work in $\frac{25}{4} = 6\frac{1}{4}$ days.

29. A's 1 day's work $= \frac{1}{15}$; B's 1 day's work $= \frac{1}{20}$.

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

(A + B)'s 4 days' work $= \left(\frac{7}{60} \times 4\right) = \frac{7}{15}$.

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

30. B's 10 days' work $= \left(\frac{1}{15} \times 10\right) = \frac{2}{3}$. Remaining work $= \left(1 - \frac{2}{3}\right) = \frac{1}{3}$.

Now, $\frac{1}{18}$ work is done by A in 1 day.

$\therefore$ $\frac{1}{3}$ work is done by A in $\left(18 \times \frac{1}{3}\right) = 6$ days.

31. (A + B)'s 1 day's work $= \left(\frac{1}{15} + \frac{1}{10}\right) = \frac{1}{6}$.

Work done by A and B in 2 days $= \left(\frac{1}{6} \times 2\right) = \frac{1}{3}$. Remaining work $= \left(1 - \frac{1}{3}\right) = \frac{2}{3}$.

Now, $\frac{1}{15}$ work is done by A in 1 day.

$\therefore$ $\frac{2}{3}$ work will be done by A in $\left(15 \times \frac{2}{3}\right) = 10$ days.

Hence, total time taken = (10 + 2) = 12 days.

32. (B + C)'s 1 day's work $= \left(\frac{1}{9} + \frac{1}{12}\right) = \frac{7}{36}$.

Work done by B and C in 3 days $= \left(\frac{7}{36} \times 3\right) = \frac{7}{12}$.

Remaining work $= \left(1 - \frac{7}{12}\right) = \frac{5}{12}$.

Now, $\frac{1}{24}$ work is done by A in 1 day.

So, $\frac{5}{12}$ work is done by A in $\left(24 \times \frac{5}{12}\right) = 10$ days.

33. (P + Q + R)'s 1 hour's work $= \left(\frac{1}{8} + \frac{1}{10} + \frac{1}{12}\right) = \frac{37}{120}$.

Work done by P, Q and R in 2 hours $= \left(\frac{37}{120} \times 2\right) = \frac{37}{60}$.

Remaining work $= \left(1 - \frac{37}{60}\right) = \frac{23}{60}$.

(Q + R)'s 1 hour's work $= \left(\frac{1}{10} + \frac{1}{12}\right) = \frac{11}{60}$.

Now, $\frac{11}{60}$ work is done by Q and R in 1 hour.

So, $\frac{23}{60}$ work will be done by Q and R in $\left(\frac{60}{11} \times \frac{23}{60}\right) = \frac{23}{11}$ hours $\approx$ 2 hours.

So, the work will be finished approximately 2 hours after 11 a.m., *i.e.*, around 1 p.m.

34. 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{30}+\frac{1}{24}+\frac{1}{20}\right) = \frac{15}{120} = \frac{1}{8}$.

$\Rightarrow$ (A + B + C)'s 1 day's work $= \frac{1}{16}$.

Work done by A, B and C in 10 days $= \frac{10}{16} = \frac{5}{8}$. Remaining work $= \left(1-\frac{5}{8}\right) = \frac{3}{8}$.

A's 1 day's work $= \left(\frac{1}{16}-\frac{1}{24}\right) = \frac{1}{48}$.

Now, $\frac{1}{48}$ work is done by A in 1 day.

So, $\frac{3}{8}$ work will be done by A in $\left(48\times\frac{3}{8}\right)$ = 18 days.

35. Work done by X in 4 days $= \left(\frac{1}{20}\times 4\right) = \frac{1}{5}$. Remaining work $= \left(1-\frac{1}{5}\right) = \frac{4}{5}$.

(X + Y)'s 1 day's work $= \left(\frac{1}{20}+\frac{1}{12}\right) = \frac{8}{60} = \frac{2}{15}$.

Now, $\frac{2}{15}$ work is done by X and Y in 1 day.

So, $\frac{4}{5}$ work will be done by X and Y in $\left(\frac{15}{2}\times\frac{4}{5}\right)$ = 6 days.

Hence, total time taken = (6 + 4) days = 10 days.

36. (A + B)'s 20 days' work $= \left(\frac{1}{30}\times 20\right) = \frac{2}{3}$. Remaining work $= \left(1-\frac{2}{3}\right) = \frac{1}{3}$.

Now, $\frac{1}{3}$ work is done by A in 20 days.

Whole work will be done by A in (20 × 3) = 60 days.

37. Work done by X in 8 days $= \left(\frac{1}{40}\times 8\right) = \frac{1}{5}$. Remaining work $= \left(1-\frac{1}{5}\right) = \frac{4}{5}$.

Now, $\frac{4}{5}$ work is done by Y in 16 days.

Whole work will be done by Y in $\left(16\times\frac{5}{4}\right)$ = 20 days.

$\therefore$ X's 1 day's work $= \frac{1}{40}$, Y's 1 day's work $= \frac{1}{20}$.

(X + Y)'s 1 day's work $= \left(\frac{1}{40}+\frac{1}{20}\right) = \frac{3}{40}$.

Hence, X and Y will together complete the work in $\frac{40}{3} = 13\frac{1}{3}$ days.

38. Work done by A, B and C in 4 days $= \left(\frac{1}{10}\times 4\right) = \frac{2}{5}$. Remaining work $= \left(1-\frac{2}{5}\right) = \frac{3}{5}$.

Now, $\frac{3}{5}$ work is done by B and C in 10 days.

Whole work will be done by B and C in $\left(10\times\frac{5}{3}\right) = \frac{50}{3}$ days.

(A + B + C)'s 1 day's work $= \frac{1}{10}$, (B + C)'s 1 day's work $= \frac{3}{50}$.

A's 1 day's work $= \left(\frac{1}{10} - \frac{3}{50}\right) = \frac{2}{50} = \frac{1}{25}$.

$\therefore$ A alone could complete the work in 25 days.

39. Whole work is done by A in $\left(20 \times \frac{5}{4}\right) = 25$ days.

Now, $\left(1 - \frac{4}{5}\right)$ *i.e.*, $\frac{1}{5}$ work is done by A and B in 3 days.

Whole work will be done by A and B in $(3 \times 5) = 15$ days.

A's 1 day's work $= \frac{1}{25}$, (A + B)'s 1 day's work $= \frac{1}{15}$.

$\therefore$ B's 1 day's work $= \left(\frac{1}{15} - \frac{1}{25}\right) = \frac{4}{150} = \frac{2}{75}$.

So, B alone would do the work in $\frac{75}{2} = 37\frac{1}{2}$ days.

40. Let A's 1 day's work $= x$ and B's 1 day's work $= y$.

Then, $x + y = \frac{1}{30}$ and $16x + 44y = 1$.

Solving these two equations, we get : $x = \frac{1}{60}$ and $y = \frac{1}{60}$.

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

Hence, B alone shall finish the whole work in 60 days.

41. A's 5 days' work + B's 7 days' work + C's 13 days' work = 1

$\Rightarrow$ (A + B)'s 5 days' work + (B + C)'s 2 days' work + C's 11 days' work = 1

$\Rightarrow \frac{5}{12} + \frac{2}{16}$ + C's 11 days' work = 1

$\Rightarrow$ C's 11 days' work $= 1 - \left(\frac{5}{12} + \frac{2}{16}\right) = \frac{11}{24}$.

$\Rightarrow$ C's 1 day's work $= \left(\frac{11}{24} \times \frac{1}{11}\right) = \frac{1}{24}$.

$\therefore$ C alone can finish the work in 24 days.

42. (A + B)'s 1 day's work $= \left(\frac{1}{45} + \frac{1}{40}\right) = \frac{17}{360}$.

Work done by B in 23 days $= \left(\frac{1}{40} \times 23\right) = \frac{23}{40}$. Remaining work $= \left(1 - \frac{23}{40}\right) = \frac{17}{40}$.

Now, $\frac{17}{360}$ work was done by (A + B) in 1 day.

$\frac{17}{40}$ work was done by (A + B) in $\left(1 \times \frac{360}{17} \times \frac{17}{40}\right) = 9$ days.

$\therefore$ A left after 9 days.

43. B's 3 days' work $= \left(\frac{1}{21} \times 3\right) = \frac{1}{7}$. Remaining work $= \left(1 - \frac{1}{7}\right) = \frac{6}{7}$.

(A + B)'s 1 day's work $= \left(\frac{1}{14} + \frac{1}{21}\right) = \frac{5}{42}$.

Now, $\frac{5}{42}$ work is done by A and B in 1 day.

$\therefore$ $\frac{6}{7}$ work is done by A and B in $\left(\frac{42}{5} \times \frac{6}{7}\right) = \frac{36}{5}$ days.

Hence, total time taken $= \left(3 + \frac{36}{5}\right)$ days $= 10\frac{1}{5}$ days.

44. (A + B + C)'s 1 day's work $= \left(\frac{1}{24} + \frac{1}{36} + \frac{1}{48}\right) = \frac{13}{144}$.

Work done by (A + B + C) in 4 days $= \left(\frac{13}{144} \times 4\right) = \frac{13}{36}$.

Work done by B in 3 days $= \left(\frac{1}{36} \times 3\right) = \frac{1}{12}$. Remaining work $= \left[1 - \left(\frac{13}{36} + \frac{1}{12}\right)\right] = \frac{5}{9}$.

(A + B)'s 1 day's work $= \left(\frac{1}{24} + \frac{1}{36}\right) = \frac{5}{72}$.

Now, $\frac{5}{72}$ work is done by A and B in $\left(\frac{72}{5} \times \frac{5}{9}\right) = 8$ days.

Hence, total time taken = (4 + 3 + 8) days = 15 days.

45. B's daily earning = Rs. (300 − 188) = Rs. 112.

A's daily earning = Rs. (300 − 152) = Rs. 148.

C's daily earning = Rs. [300 − (112 + 148)] = Rs. 40.

46. Work done by A $= \left(1 - \frac{8}{23}\right) = \frac{15}{23}$.

$\therefore$ A : (B + C) $= \frac{15}{23} : \frac{8}{23} = 15 : 8$.

So, A's share $=$ Rs. $\left(\frac{15}{23} \times 529\right)$ $=$ Rs. 345.

47. Kim's wages : David's wages = Kim's 1 day's work : David's 1 day's work

$= \frac{1}{3} : \frac{1}{2} = 2 : 3$.

$\therefore$ Kim's share $=$ Rs. $\left(\frac{2}{5} \times 150\right)$ $=$ Rs. 60.

48. Whole work is done by A in (3 × 4) = 12 days.

Whole work is done by B in (4 × 6) = 24 days.

A's wages : B's wages = A's 1 day's work : B's 1 day's work $= \frac{1}{12} : \frac{1}{24} = 2 : 1$.

$\therefore$ A's share $=$ Rs. $\left(\frac{2}{3} \times 180\right)$ $=$ Rs. 120.

49. C's 1 day's work $= \frac{1}{3} - \left(\frac{1}{6} + \frac{1}{8}\right) = \frac{1}{3} - \frac{7}{24} = \frac{1}{24}$.

A's wages : B's wages : C's wages $= \frac{1}{6} : \frac{1}{8} : \frac{1}{24} = 4 : 3 : 1$.

$\therefore$ C's share $= \text{Rs.}\left(\frac{1}{8} \times 3200\right) = \text{Rs. } 400$.

50. Let total money be Rs. x.

A's 1 day's wages $= \text{Rs.}\ \frac{x}{21}$, B's 1 day's wages $= \text{Rs.}\ \frac{x}{28}$.

$\therefore$ (A + B)'s 1 day's wages $= \text{Rs.}\left(\frac{x}{21} + \frac{x}{28}\right) = \text{Rs.}\ \frac{x}{12}$.

$\therefore$ Money is sufficient to pay the wages of both for 12 days.

51. Part of the work done by A $= \left(\frac{1}{10} \times 5\right) = \frac{1}{2}$.

Part of the work done by B $= \left(\frac{1}{15} \times 5\right) = \frac{1}{3}$.

Part of the work done by C $= 1 - \left(\frac{1}{2} + \frac{1}{3}\right) = \frac{1}{6}$.

So, (A's share) : (B's share) : (C's share) $= \frac{1}{2} : \frac{1}{3} : \frac{1}{6} = 3 : 2 : 1$.

$\therefore$ A's share $= \text{Rs.}\left(\frac{3}{6} \times 1500\right) = \text{Rs. } 750$, B's share $= \text{Rs.}\left(\frac{2}{6} \times 1500\right) = \text{Rs. } 500$,

C's share $= \text{Rs.}\left(\frac{1}{6} \times 1500\right) = \text{Rs. } 250$.

A's daily wages $= \text{Rs.}\left(\frac{750}{5}\right) = \text{Rs. } 150$; B's daily wages $= \text{Rs.}\left(\frac{500}{5}\right) = \text{Rs. } 100$;

C's daily wages $= \text{Rs.}\left(\frac{250}{2}\right) = \text{Rs. } 125$.

$\therefore$ Daily wages of B and C $= \text{Rs. } (100 + 125) = \text{Rs. } 225$.

52. B's 1 day's work $= \left(\frac{1}{12} - \frac{1}{20}\right) = \frac{2}{60} = \frac{1}{30}$.

Now, (A + B)'s 1 day's work $= \left(\frac{1}{20} + \frac{1}{60}\right) = \frac{4}{60} = \frac{1}{15}$. [$\because$ B works for half day only]

So, A and B together will complete the work in 15 days.

53. (A + B)'s 2 days' work $= \left(\frac{1}{16} + \frac{1}{12}\right) = \frac{7}{48}$.

Work done in 6 pairs of days $= \left(\frac{7}{48} \times 6\right) = \frac{7}{8}$. Remaining work $= \left(1 - \frac{7}{8}\right) = \frac{1}{8}$.

Work done by A on 13th day $= \frac{1}{16}$. Remaining work $= \left(\frac{1}{8} - \frac{1}{16}\right) = \frac{1}{16}$.

On 14th day, it is B's turn.

$\frac{1}{12}$ work is done by B in 1 day. $\frac{1}{16}$ work is done by B in $\left(12 \times \frac{1}{16}\right) = \frac{3}{4}$ day.

$\therefore$ Total time taken $= 13\frac{3}{4}$ days.

54. (A + B)'s 1 day's work $= \left(\frac{1}{11} + \frac{1}{20}\right) = \frac{31}{220}$. (A + C)'s 1 day's work $= \left(\frac{1}{11} + \frac{1}{55}\right) = \frac{6}{55}$.

Work done in 2 days $= \left(\frac{31}{220} + \frac{6}{55}\right) = \frac{55}{220} = \frac{1}{4}$.

Now, $\frac{1}{4}$ work is done by A in 2 days.

$\therefore$ Whole work will be done in $(2 \times 4) = 8$ days.

55. A's 2 days' work $= \left(\frac{1}{20} \times 2\right) = \frac{1}{10}$.

(A + B + C)'s 1 day's work $= \left(\frac{1}{20} + \frac{1}{30} + \frac{1}{60}\right) = \frac{6}{60} = \frac{1}{10}$.

Work done in 3 days $= \left(\frac{1}{10} + \frac{1}{10}\right) = \frac{1}{5}$.

Now, $\frac{1}{5}$ work is done in 3 days.

$\therefore$ Whole work will be done in $(3 \times 5) = 15$ days.

56. (A + B)'s 6 days' work $= 6\left(\frac{1}{20} + \frac{1}{15}\right) = \frac{7}{10}$; (A + C)'s 4 days' work $= \frac{3}{10}$;

(A + C)'s 1 day's work $= \frac{3}{40}$. A's 1 day's work $= \frac{1}{20}$.

$\therefore$ C's 1 day's work $= \left(\frac{3}{40} - \frac{1}{20}\right) = \frac{1}{40}$.

Hence, C alone can finish the work in 40 days.

57. Suppose the work was finished in x days.

Then, A's $(x - 8)$ days' work + B's $(x - 12)$ days' work + C's x days' work = 1

$\Rightarrow \frac{(x-8)}{36} + \frac{(x-12)}{54} + \frac{x}{72} = 1 \Leftrightarrow 6(x-8) + 4(x-12) + 3x = 216$

$\therefore$ $13x = 312$ or $x = 24$.

58. (20×16) women can complete the work in 1 day.

$\therefore$ 1 woman's 1 day's work $= \frac{1}{320}$.

(16×15) men can complete the work in 1 day.

$\therefore$ 1 man's 1 day's work $= \frac{1}{240}$.

So, required ratio $= \frac{1}{240} : \frac{1}{320} = 4 : 3$.

59. 10 men's 1 day's work $= \frac{1}{15}$; 15 women's 1 day's work $= \frac{1}{12}$.

(10 men + 15 women)'s 1 day's work $= \left(\frac{1}{15} + \frac{1}{12}\right) = \frac{9}{60} = \frac{3}{20}$.

$\therefore$ 10 men and 15 women will complete the work in $\frac{3}{20} = 6\frac{2}{3}$ days.

60. (7×12) men can complete the work in 1 day.

$\therefore$ 1 man's 1 day's work $= \frac{1}{84}$.

7 men's 5 days' work $= \left(\frac{1}{12} \times 5\right) = \frac{5}{12}$. Remaining work $= \left(1 - \frac{5}{12}\right) = \frac{7}{12}$.

5 men's 1 day's work $= \left(\frac{1}{84} \times 5\right) = \frac{5}{84}$.

$\frac{5}{84}$ work is done by them in 1 day.

$\frac{7}{12}$ work is done by them in $\left(\frac{84}{5} \times \frac{7}{12}\right) = \frac{49}{5}$ days $= 9\frac{4}{5}$ days.

61. 1 man's 1 day's work $= \frac{1}{108}$.

12 men's 6 days' work $= \left(\frac{1}{9} \times 6\right) = \frac{2}{3}$. Remaining work $= \left(1 - \frac{2}{3}\right) = \frac{1}{3}$.

18 men's 1 day's work $= \left(\frac{1}{108} \times 18\right) = \frac{1}{6}$.

$\frac{1}{6}$ work is done by them in 1 day.

$\therefore$ $\frac{1}{3}$ work is done by them in $\left(6 \times \frac{1}{3}\right) = 2$ days.

62. Let 1 woman's 1 day's work $= x$.

Then, 1 man's 1 day's work $= \frac{x}{2}$ and 1 child's 1 day's work $= \frac{x}{4}$.

So, $\left(\frac{3x}{2} + 4x + \frac{6x}{4}\right) = \frac{1}{7} \Rightarrow \frac{28x}{4} = \frac{1}{7} \Rightarrow x = \left(\frac{1}{7} \times \frac{4}{28}\right) = \frac{1}{49}$.

$\therefore$ 1 woman alone can complete the work in 49 days.

So, to complete the work in 7 days, number of women required $= \left(\frac{49}{7}\right) = 7$.

63. (1 man + 1 woman)'s 1 day's work $= \left(\frac{1}{3} + \frac{1}{4}\right) = \frac{7}{12}$.

Work done by 1 man and 1 woman in $\frac{1}{4}$ day $= \left(\frac{7}{12} \times \frac{1}{4}\right) = \frac{7}{48}$.

Remaining work $= \left(1 - \frac{7}{48}\right) = \frac{41}{48}$.

Work done by 1 boy in $\frac{1}{4}$ day $= \left(\frac{1}{12} \times \frac{1}{4}\right) = \frac{1}{48}$.

$\therefore$ Number of boys required $= \left(\frac{41}{48} \times 48\right) = 41$.

64. 1 man's 1 day's work $= \frac{1}{100}$. (10 men + 15 women)'s 1 day's work $= \frac{1}{6}$.

15 women's 1 day's work $= \left(\frac{1}{6} - \frac{10}{100}\right) = \left(\frac{1}{6} - \frac{1}{10}\right) = \frac{1}{15}$.

1 woman's 1 day's work $= \frac{1}{225}$.

$\therefore$ 1 woman alone can complete the work in 225 days.

65. 1 man's 1 day's work $= \frac{1}{48}$; 1 woman's 1 day's work $= \frac{1}{60}$.

6 men's 2 days' work $= \left(\frac{6}{48} \times 2\right) = \frac{1}{4}$. Remaining work $= \left(1 - \frac{1}{4}\right) = \frac{3}{4}$.

Now, $\frac{1}{60}$ work is done in 1 day by 1 woman.

So, $\frac{3}{4}$ work will be done in 3 days by $\left(60 \times \frac{3}{4} \times \frac{1}{3}\right) = 15$ women.

66. 1 child's 1 day's work $= \frac{1}{192}$; 1 adult's 1 day's work $= \frac{1}{96}$.

Work done in 3 days $= \left(\frac{1}{96} \times 16 \times 3\right) = \frac{1}{2}$. Remaining work $= \left(1 - \frac{1}{2}\right) = \frac{1}{2}$.

(6 adults + 4 children)'s 1 day's work $= \left(\frac{6}{96} + \frac{4}{192}\right) = \frac{1}{12}$.

$\frac{1}{12}$ work is done by them in 1 day.

$\frac{1}{2}$ work is done by them $\left(12 \times \frac{1}{2}\right) = 6$ days.

67. 1 woman's 1 day's work $= \frac{1}{70}$; 1 child's 1 day's work $= \frac{1}{140}$.

(5 women + 10 children)'s 1 day's work $= \left(\frac{5}{70} + \frac{10}{140}\right) = \left(\frac{1}{14} + \frac{1}{14}\right) = \frac{1}{7}$.

$\therefore$ 5 women and 10 children will complete the work in 7 days.

68. 1 man's 1 day's work $= \frac{1}{192}$; 1 child's 1 day's work $= \frac{1}{432}$.

Work done in 8 days $= 8\left(\frac{12}{192} + \frac{8}{432}\right) = 8\left(\frac{1}{16} + \frac{1}{54}\right) = \frac{35}{54}$.

Remaining work $= \left(1 - \frac{35}{54}\right) = \frac{19}{54}$.

(12 men + 11 children)'s 1 day's work $= \left(\frac{12}{192} + \frac{11}{432}\right) = \frac{19}{216}$.

Now, $\frac{19}{216}$ work is done by them in 1 day.

$\therefore$ $\frac{19}{54}$ work will be done by them in $\left(\frac{216}{19} \times \frac{19}{54}\right) = 4$ days.

69. 1 man's 1 day's work $= \frac{1}{384}$; 1 woman's 1 day's work $= \frac{1}{768}$.

Work done in 12 days $= 12\left(\frac{16}{384} + \frac{16}{768}\right) = \left(12 \times \frac{3}{48}\right) = \frac{3}{4}$.

Remaining work $= \left(1 - \frac{3}{4}\right) = \frac{1}{4}$.

(16 men + 16 women)'s 2 days' work $= 2\left(\frac{16}{384}+\frac{16}{768}\right) = \left(2\times\frac{1}{16}\right) = \frac{1}{8}$.

Remaining work $= \left(\frac{1}{4}-\frac{1}{8}\right) = \frac{1}{8}$.

$\frac{1}{384}$ work is done in 1 day by 1 man.

$\therefore$ $\frac{1}{8}$ work will be done in 2 days by $\left(384\times\frac{1}{8}\times\frac{1}{2}\right) = 24$ men.

70. Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y.

Then, $5x+2y = 4(x+y) \Rightarrow x = 2y \Rightarrow \frac{x}{y} = \frac{2}{1}$.

71. Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y.

Then, $12x+16y = \frac{1}{5}$ and $13x+24y = \frac{1}{4}$.

Solving these two equations, we get : $x = \frac{1}{100}$ and $y = \frac{1}{200}$.

$\therefore$ Required ratio $= x:y = \frac{1}{100}:\frac{1}{200} = 2:1$.

72. Let 1 man's 1 day's work = x and 1 woman's 1 day's work = y.

Then, $4x+6y = \frac{1}{8}$ and $3x+7y = \frac{1}{10}$.

Solving these two equations, we get : $x = \frac{11}{400}$, $y = \frac{1}{400}$.

$\therefore$ 1 woman's 1 day's work $= \frac{1}{400}$.

$\Rightarrow$ 10 women's 1 day's work $= \left(\frac{1}{400}\times 10\right) = \frac{1}{40}$.

Hence, 10 women will complete the work in 40 days.

73. Let 1 man's 1 hour's work = x, 1 woman's 1 hour's work = y and 1 boy's 1 hour's work = z. Then,

$x+3y+4z = \frac{1}{96}$ ...(*i*) $2x+8z = \frac{1}{80}$ ...(*ii*) $2x+3y = \frac{1}{120}$ ...(*iii*)

Adding (*ii*) and (*iii*) and subtracting (*i*) from it, we get : $3x+4z = \frac{1}{96}$ ...(*iv*)

From (*ii*) and (*iv*), we get $x = \frac{1}{480}$. Substituting, we get : $y = \frac{1}{720}$, $z = \frac{1}{960}$.

(5 men + 12 boys)'s 1 hour's work $= \left(\frac{5}{480}+\frac{12}{960}\right) = \left(\frac{1}{96}+\frac{1}{80}\right) = \frac{11}{480}$.

$\therefore$ 5 men and 12 boys can do the work in $\frac{480}{11}$ *i.e.*, $43\frac{7}{11}$ hours.

74. Let 1 man's 1 day's work = x and 1 boy's 1 day's work = y.

Then, $6x+8y = \frac{1}{10}$ and $26x+48y = \frac{1}{2}$.

Solving these two equations, we get : $x = \frac{1}{100}$ and $y = \frac{1}{200}$.

(15 men + 20 boys)'s 1 day's work $= \left(\frac{15}{100} + \frac{20}{200}\right) = \frac{1}{4}$.

$\therefore$ 15 men and 20 boys can do the work in 4 days.

EXERCISE 15B

(DATA SUFFICIENCY TYPE QUESTIONS)

Directions (*Questions 1 to 4*) : ***Each of the questions given below consists of a statement and/or a question followed by two statements labelled I and II. 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 Machine Y, working alone, take to produce x candles ? **(M.B.A. 2002)**
   I. Machine X produces x candles in 5 minutes.
   II. Machine X and Machine Y working at the same time produce x candles in 2 minutes.
2. B alone can complete a work in 12 days. How many days will A, B and C together take to complete the work ?
   I. A and B together can complete the work in 3 days.
   II. B and C together can complete the work in 6 days.
3. Is it cheaper to employ X to do a certain job than to employ Y ?
   I. X is paid 20% more per hour than Y, but Y takes 2 hours longer to complete the job.
   II. X is paid Rs. 80 per hour.
4. A and B together can complete a task in 7 days. B alone can do it in 20 days. What part of the work was carried out by A ? **(M.B.A. 1998)**
   I. A completed the job alone after A and B worked together for 5 days.
   II. Part of the work done by A could have been done by B and C together in 6 days.

Directions (*Questions 5 to 9*) : ***Each of the following questions consists of a question followed by three statements I, II and III. You have to study the question and the statements and decide which of the statement(s) is/are necessary to answer the question.***

5. In how many days can A and B working together complete a job ?
   I. A alone can complete the job in 30 days.
   II. B alone can complete the job in 40 days.
   III. B takes 10 days more than A to complete the job.
   (*a*) I and II only (*b*) II and III only (*c*) I and III only
   (*d*) Any two of the three (*e*) All I, II and III

6. In how many days can the work be completed by A and B together ?
I. A alone can complete the work in 8 days.
II. If A alone works for 5 days and B alone works for 6 days, the work gets completed.
III. B alone can complete the work in 16 days. **(Bank P.O. 2003)**
(a) I and II only (b) II and III only (c) Any two of the three
(d) II and either I or III (e) None of these

7. How many workers are required for completing the construction work in 10 days ?
I. 20% of the work can be completed by 8 workers in 8 days.
II. 20 workers can complete the work in 16 days.
III. One-eighth of the work can be completed by 8 workers in 5 days. **(Bank P.O. 2003)**
(a) I only (b) II and III only (c) III only
(d) I and III only (e) Any one of the three

8. In how many days can the work be done by 9 men and 15 women ?
I. 6 men and 5 women can complete the work in 6 days.
II. 3 men and 4 women can complete the work in 10 days.
III. 18 men and 15 women can complete the work in 2 days.
(a) III only (b) All I, II and III (c) Any two of the three
(d) Any one of the three (e) None of these

9. In how many days can 10 women finish a work ? **(R.B.I. 2002)**
I. 10 men can complete the work in 6 days.
II. 10 men and 10 women together can complete the work in $3\frac{3}{7}$ days.
III. If 10 men work for 3 days and thereafter 10 women replace them, the remaining work is completed in 4 days.
(a) Any two of the three (b) I and II only (c) II and III only
(d) I and III only (e) None of these

Directions (*Questions 10-11*) : *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/are redundant and can be dispensed with while answering the given question.*

10. In how many days can the work be completed by A, B and C together ?
I. A and B together can complete the work in 6 days.
II. B and C together can complete the work in $3\frac{3}{4}$ days.
III. A and C together can complete the work in $3\frac{1}{3}$ days. **(S.B.I.P.O. 2001)**
(a) Any one of the three (b) I only
(c) II only (d) III only
(e) Information in all the three statements is necessary to answer the question.

11. 8 men and 14 women are working together in a field. After working for 3 days, 5 men and 8 women leave the work. How many more days will be required to complete the work ? **(S.B.I.P.O. 1999)**
I. 19 men and 12 women together can complete the work in 18 days.
II. 16 men can complete two-third of the work in 16 days.
III. In a day, the work done by three men is equal to the work done by four women.
(a) I only (b) II only (c) III only
(d) I or II or III (e) II or III only

ANSWERS

1. (e) 2. (e) 3. (d) 4. (a) 5. (d) 6. (c) 7. (e) 8. (c)
9. (a) 10. (e) 11. (d)

SOLUTIONS

1. I gives, Machine X produces $\frac{x}{5}$ candles in 1 min.

II gives, Machines X and Y produce $\frac{x}{2}$ candles in 1 min.

From I and II, Y produces $\left(\frac{x}{2}-\frac{x}{5}\right)=\frac{3x}{10}$ candles in 1 min.

$\frac{3x}{10}$ candles are produced by Y in 1 min.

x candles will be produced by Y in $\left(\frac{10}{3x}\times x\right)$ min $=\frac{10}{3}$ min.

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

$\therefore$ Correct answer is (e).

2. Given : B's 1 day's work $=\frac{1}{12}$.

I gives, (A + B)'s 1 day's work $=\frac{1}{3}$.

$\Rightarrow$ A's 1 day's work $=\left(\frac{1}{3}-\frac{1}{12}\right)=\frac{3}{12}=\frac{1}{4}$.

II gives, (B + C)'s 1 day's work $=\frac{1}{6}$ $\Rightarrow$ C's 1 day's work $=\left(\frac{1}{6}-\frac{1}{12}\right)=\frac{1}{12}$.

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

Hence, they all finish the work in $\frac{12}{5}=2\frac{2}{5}$ days.

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

$\therefore$ Correct answer is (e).

3. Suppose X takes x hours and Y takes $(x + 2)$ hours to complete the job.

II. X is paid Rs. 80 per hour.

Total payment to X = Rs. $(80x)$.

I. X = 120% of Y $=\frac{120}{100}Y=\frac{6}{5}Y$ $\Rightarrow$ $Y=\frac{5}{6}X$.

$\therefore$ Y is paid Rs. $\left(\frac{5}{6}\times 80\right)$ per hour $\Rightarrow$ Y is paid Rs. $\left[\frac{200}{3}(x+2)\right]$.

We cannot compare $(80x)$ and $\frac{200}{3}(x+2)$.

$\therefore$ Correct answer is (d).

4. B's 1 day's work $= \frac{1}{20}$. (A + B)'s 1 day's work $= \frac{1}{7}$.

I. (A + B)'s 5 day's work $= \frac{5}{7}$. Remaining work $= \left(1 - \frac{5}{7}\right) = \frac{2}{7}$.

$\therefore$ $\frac{2}{7}$ work was carried by A.

II. is irrelevant.

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

5. I. A can complete the job in 30 days.

$\therefore$ A's 1 day's work $= \frac{1}{30}$. Remaining work $= \left(1 - \frac{5}{7}\right) = \frac{2}{7}$.

II. B can complete the job in 40 days.

$\therefore$ B's 1 day's work $= \frac{1}{40}$.

III. B takes 10 days more than A to complete the job.

I and II gives, (A + B)'s 1 day's work $= \left(\frac{1}{30} + \frac{1}{40}\right) = \frac{7}{120}$.

$\therefore$ I and III also give the same answer.

II and III also give the same answer.

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

6. I. A can complete the job in 8 days. So, A's 1 day's work $= \frac{1}{8}$.

II. A works for 5 days, B works for 6 days and the work is completed.

III. B can complete the job in 16 days. So, B's 1 day's work $= \frac{1}{16}$.

I and III : (A + B)'s 1 day's work $= \left(\frac{1}{8} + \frac{1}{16}\right) = \frac{3}{16}$.

$\therefore$ Both can finish the work in $\frac{16}{3}$ days.

II and III : Suppose A takes x days to finish the work.

Then, $\frac{5}{x} + \frac{6}{16} = 1 \Rightarrow \frac{5}{x} = \left(1 - \frac{3}{8}\right) = \frac{5}{8} \Rightarrow x = 8$.

$\therefore$ (A + B)'s 1 day's work $= \left(\frac{1}{8} + \frac{1}{16}\right) = \frac{3}{16}$.

$\therefore$ Both can finish it in $\frac{16}{3}$ days.

I and II : A's 1 day's work $= \frac{1}{8}$. Suppose B takes x days to finish the work.

Then from II, $\left(5 \times \frac{1}{8} + 6 \times \frac{1}{x} = 1\right) \Rightarrow \frac{6}{x} = \left(1 - \frac{5}{8}\right) = \frac{3}{8} \Rightarrow x = \left(\frac{8 \times 6}{3}\right) = 16$.

$\therefore$ (A + B)'s 1 day's work $= \left(\frac{1}{8} + \frac{1}{16}\right) = \frac{3}{16}$.

$\therefore$ Both can finish it in $\frac{16}{3}$ days.

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

7. I. $\frac{20}{100}$ work can be completed by (8×8) workers in 1 day.

$\Rightarrow$ Whole work can be completed by $(8 \times 8 \times 5)$ workers in 1 day

$= \frac{8 \times 8 \times 5}{10}$ workers in 10 days = 32 workers in 10 days.

II. (20×16) workers can finish it in 1 day.

$\Rightarrow \frac{(20 \times 16)}{10}$ workers can finish it in 10 days.

$\Rightarrow$ 32 workers can finish it in 10 days.

III. $\frac{1}{8}$ work can be completed by (8×5) workers in 1 day.

$\Rightarrow$ Whole work can be completed by $(8 \times 5 \times 8)$ workers in 1 day

$= \frac{8 \times 5 \times 8}{10}$ workers in 10 days = 32 workers in 10 days.

$\therefore$ Any one of the three gives the answer.

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

8. Clearly, any two of the three will give two equations in x and y, which can be solved simultaneously.

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

[For example I and II together give $\left(6x + 5y = \frac{1}{6},\ 3x + 4y = \frac{1}{10}\right)$.]

9. I. (10×6) men can complete the work in 1 day.

$\Rightarrow$ 1 man's 1 day's work $= \frac{1}{60}$.

II. $\left(10 \times \frac{24}{7}\right)$ men + $\left(10 \times \frac{24}{7}\right)$ women can complete the work in 1 day.

$\Rightarrow \left(\frac{240}{7}\right)$ men's 1 day work + $\left(\frac{240}{7}\right)$ women's 1 day work = 1

$\Rightarrow \left(\frac{240}{7} \times \frac{1}{60}\right) + \left(\frac{240}{7}\right)$ women's 1 day's work = 1.

$\Rightarrow \left(\frac{240}{7}\right)$ women's 1 day's work $= \left(1 - \frac{4}{7}\right) = \frac{3}{7}$

$\Rightarrow$ 10 women's 1 day's work $= \left(\frac{3}{7} \times \frac{7}{240} \times 10\right) = \frac{1}{8}$.

So, 10 women can finish the work in 8 days.

III. (10 men's work for 3 days) + (10 women's work for 4 days) = 1

$\Rightarrow$ (10×3) men's 1 day's work + (10×4) women's 1 day's work = 1

$\Rightarrow$ 30 men's 1 day's work + 40 women's 1 day's work = 1.

Thus, I and III will give us the answer.

And, II and III will give us the answer.

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

10. I. (A + B)'s 1 day's work $= \frac{1}{6}$.

II. (B + C)'s 1 day's work $= \frac{4}{15}$.

III. (A + C)'s 1 day's work $= \frac{3}{10}$.

Adding, we get 2 (A + B + C)'s 1 day's work $= \left(\frac{1}{6} + \frac{4}{15} + \frac{3}{10}\right) = \frac{22}{30}$

$\Rightarrow$ (A + B + C)'s 1 day's work $= \left(\frac{1}{2} \times \frac{22}{30}\right) = \frac{11}{30}$.

Thus, A, B and C together can finish the work in $\frac{30}{11}$ days.

Hence I, II and III are necessary to answer the question.

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

11. Clearly, I only gives the answer.

Similarly, II only gives the answer.

And, III only gives the answer.

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

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.

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

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

$$\Leftrightarrow \quad x = 20. \qquad [\textit{neglecting the} - \textit{ve value of } x]$$

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

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

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

   $\therefore \quad \frac{2}{3} : \frac{1}{2} :: 1 : x \quad$ or $\quad x = \left(\frac{1}{2} \times 1 \times \frac{3}{2}\right) = \frac{3}{4}$ 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 $= \left(\frac{1}{6} - \frac{1}{10}\right) = \frac{1}{15}$.

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

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

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

$\Leftrightarrow \quad (x - 50)(x + 60) = 0 \quad \Leftrightarrow \quad x = 50.$ [*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

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

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

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

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

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,

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

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 $= \left(\frac{4}{x}\times 10\right)=\frac{40}{x}$.

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

$\therefore$ 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.

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

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

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

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

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

$\Rightarrow \frac{1}{5}$ 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