Time & Work and Pipes & Cisterns

CONCEPT OF EFFICIENCY

Efficiency means rate of doing work. This means that more the efficiency, less will be the number of days required to complete a certain work and less the efficiency, more will be the number of days required to complete a certain work.

Aliza is twice as efficient as Binny.

$\Rightarrow$ Aliza does twice as much work as Binny in the same time interval

$\Rightarrow$ Aliza will require half the time as required by Binny to do the same work.

CONCEPT OF NEGATIVE WORK

Suppose two persons A and B are working to build a wall while C is working to demolish the wall. If we consider the work as the construction of the wall, then breaking the wall (by C) is negative work.

The concept of negative work generally appears in the problems based on pipes and cisterns, where there are inlet pipes and outlet pipes/leaks, which are working against each other.

If we consider the work of filling a tank, the inlet pipe does positive work while the outlet pipe/leak does negative work.

CONCEPT OF MAN-DAYS

If 'M' men working together can complete a work in 'D' days, then the product of number of men (M) and number of days (D) i.e. $M \times D$ is known as the number of MAN-DAYS. Number of man days to complete a specific task always remains constant.

Suppose 30 persons working together for 20 days to complete a job, then the total work done is equal to ($30 \times 20 = 600$) man-days. If we change the number of days (D) in which the work is to be completed, then the other factor i.e. the number of persons (M) will change accordingly, so that the product ($M \times D$) of the factors becomes equal to 600 man-days.

WORK DONE

Consider a whole work as the unit work.

1. Work Done by Two Persons

Let A can do a whole work in x days and B can do the same work in y days.

Hence work done by A in one day $= \frac{1}{x}$.

and work done by B in one day $= \frac{1}{y}$

Then work done in one day when A and B work together

$$= \frac{1}{x} + \frac{1}{y} = \frac{y+x}{xy} \quad \text{or} \quad \frac{x+y}{xy}$$

Whole work = (Work done in one day) × (Number of days required to complete the whole work)

Hence, number of days required to complete the whole work

$$= \frac{\text{Whole work}}{\text{Work done in one day}}$$

$\Rightarrow$ Number of days required to complete the whole work when A and B are working together

$$= \frac{1}{\frac{x+y}{xy}} = \frac{xy}{x+y},$$

because a whole work is considered as one unit of work.

2. Work Done by Three Persons

As we derived the formula for two persons, you can also derived the formula for three persons in the same way.

If A, B, C can do a work in x, y and z days respectively, then all of them working together can finish the work in $\frac{xyz}{xy+yz+zx}$ days.

Work Done Equation

If M_1 men each of efficiency E_1 can do W_1 works in D_1 days working T_1 hours per day and M_2 men each of efficiency E_2 can do W_2 works in D_2 days working T_2 hours per day, then

$$M_1D_1T_1E_1W_2 = M_2D_2T_2E_2W_1$$

This is the general equation in two work situations. Suffix 1 indicate first work situation while the suffix 2 indicate the second work situation.

If one or more items in both work situations are same, then no need to write them in the general equation in two work situations.

For examples :

(i) If E_1 and E_2 are same, then $M_1D_1T_1W_2 = M_2D_2T_2W_1$

(ii) If E_1 & E_2 and T_1 & T_2 are same, then $M_1D_1W_2 = M_2D_2W_1$

(iii) If E_1 & E_2, T_1 & T_2 and W_1 & W_2 are same, then $M_1D_1 = M_2D_2$

Remember...

- If A can do a piece of work in x days, then A's one day's work = $\frac{1}{x}$th part of whole work.
- If A's one day's work = $\frac{1}{x}$th part of whole work, then A can finish the work in x days.
- If A and B together can do a piece of work in x days and A alone can do it in y days, then B alone can do the work in $\frac{xy}{y-x}$ days.
- If A, B and C can complete a work in x days and B & C can complete the same work in y days, then A alone will complete the same work in $\frac{xy}{y-x}$ days
- If 'A' is 'a' times efficient than B and A can finish a work in x days, then working together, they can finish the work in $\frac{ax}{a+1}$ days.
- If A is 'a' times efficient than B and working together they finish a work in z days then, time taken by A = $\frac{z(a+1)}{a}$ days and time taken by $B = z(a+1)$ days.
- If A working alone takes 'x' days more than A and B together, and B working along takes 'y' days more than A and B together then the number of days taken by A and B working together is given by $\sqrt{xy}$ days.
- If the number of men to do a job is changed in the ratio $a : b$, then the time required to do the work will be in the ratio $b : a$, assuming the amount of work done by each of them in the given time is the same, or they are identical.
- If A is n times as efficient than B, i.e. A has n times as much capacity to do work as B, A will take $\frac{1}{n}$ of the time taken by B to do the same amount of work.

WORK AND WAGES

Wages are distributed in proportion to the work done and in indirect proportion to the time taken by the individual to complete a work.

PIPES AND CISTERNS

The same principle of Time and Work is employed to solve the problems on pipes and cisterns. The only difference is that in this case, the work done is in terms of filling or emptying a cistern (tank) and the time taken is the time taken by a pipe or a leak (crack) to fill or empty a cistern respectively.

Inlet pipe : A pipe connected with a tank (or a cistern or a reservoir) is called an inlet, if it fills it.

Outlet pipe : A pipe connected with a tank is called an outlet, if it empties it.

Remember...

- If a pipe can fill a tank in x hours, then the part of the tank filled in 1 hour $= \frac{1}{x}$
- If a pipe can empty a tank in y hours, then the part of the full tank emptied in 1 hour $= \frac{1}{y}$.
- A pipe can fill a tank in x hrs. Due to a leak in the bottom it is filled in y hrs. If the tank is full, the time taken by the leak to empty the tank $= \frac{xy}{y-x}$ hrs.
- A cistern is filled by three pipes whose diameters are x cm., y cm. and z cm. respectively (where $x < y < z$). Three pipes are running together. If the largest pipe alone will fill it in P minutes and the amount of water flowing in by each pipe is proportional to the square of its diameter, then the time in which the cistern will be filled by the three pipes is $\left[\frac{Pz^2}{x^2+y^2+z^2}\right]$ minutes.
- If one filling pipe A is n times faster and takes x minutes less time than the other filling pipe B, then the time they will take to fill a cistern, if both the pipes are opened together, is $\left[\frac{nx}{(n^2-1)}\right]$ minutes. A will fill the cistern in $\left(\frac{x}{n-1}\right)$ minutes and B will take to fill the cistern $\left(\frac{nx}{n-1}\right)$ minutes.
- Two filling pipes A and B opened together can fill a cistern in t minutes. If the first filling pipe A alone takes x minutes more or less than t and the second fill pipe B along takes y minutes more or less than t minutes, then t is given by $t = \sqrt{xy}$ minutes.

EXERCISE

1. B and C together can complete a work in 8 days, A and B together can complete the same work in 12 days and A and C together can complete the same work in 16 days. In how many days can A, B and C together complete the same work?

(a) $3\frac{9}{13}$ days (b) $7\frac{5}{13}$ days

(c) $7\frac{5}{12}$ days (d) $3\frac{5}{12}$ days

(e) None of these

2. Three men, four women and six children can complete a work in 7 days. A women does double the work a man does and a child does half the work a men does. How many women alone can complete this work in 7 days?

(a) 8 (b) 7

(c) 12 (d) Cannot be determined

(e) None of these

3. 12 men take 36 days to do a work while 12 women complete $\frac{3}{4}$th of the same work in 36 days. In how many days 10 men and 8 women together will complete the same work?

(a) 6 days (b) 27 days

(c) 12 days (d) Data inadequate

(e) None of these

4. A man and a woman working together can do a certain work in 18 days. Their skills in doing the work are in the ratio 3 : 2. How many days will the woman take to finish the work alone ?

(a) 45 days (b) 36 days (c) 27 days (d) 30 days

5. A particular job can be completed by a team of 10 men in 12 days, The same job can be completed by a team of 10 women in 6 days. How many days are needed to complete the job if the two teams work together ?

(a) 4 days (b) 6 days (c) 9 days (d) 18 days

6. A man undertakes to do a certain work in 150 days. He employees 200 men. He finds that only a quarter of the work is done in 50 days. The number of additional men that should be appointed so that the whole work will be finished in time is :

(a) 75 (b) 100 (c) 125 (d) 50

7. A, B and C completed a work costing ₹1,800. A worked for 6 days, B for 4 days and C for 9 days. If their daily wages are in the ratio of 5 : 6 : 4, how much amount will be received by A?

(a) ₹ 800 (b) ₹ 600 (c) ₹ 900 (d) ₹ 750

8. A man is twice as fast as a woman and a woman is twice as fast as a boy in doing a work. If all of them, a man, a woman and a boy can finish the work in 7 days, A boy will do it alone ?

(a) 49 (b) 47 (c) 46 (d) 42

9. If 4 men and 6 women can complete a work in 8 days while 3 men and 7 women can complete it in 10 days, then 10 women complete it in

(a) 35 days (b) 50 days (c) 45 days (d) 40 days

10. A can do a job in 10 days and B can do the same job in 15 days. They start working together, but B leaves after 5 days. In how many more days A will finish the remaining work ?

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

11. Pipes P and Q can fill a tank in 10 hours and 12 hours respectively and C can empty it in 6 hours. If all the three are opened at 7 am, at what time will one-fourth of the tank be filled ?

(a) 10 am (b) 10 pm (c) 11 pm (d) 11 am

12. A water tank can be filled by a tap in 30 minutes and another tap can fill it in 60 minutes. If both the taps are kept open for 5 minutes and then the first tap is closed, how long will it take for the tank to be full ?

(a) 20 minutes (b) 25 minutes

(c) 30 minutes (d) 45 minutes

13. Two pipes A and B can fill a tank in 36 min. and 45 min. respectively. Another pipe C can empty the tank in 30 min. First A and B are opened. After 7 minutes, C is also opened. The tank is filled up in

(a) 39 minutes. (b) 46 minutes

(c) 40 minutes (d) 45 minutes

14. A contractor was engaged to construct a road in 16 days. After working for 12 days with 20 labours it was found that only 5/8th of the road had been constructed. To complete the work in stipulated time the number of extra labours required is :

(a) 12 (b) 10 (c) 18 (d) 16

15. A water reservoir has two inlets and one outlet. Through the inlet it can be filled in 3 hours and 3 hours 45 minutes respectively. It can be emptied completely in 1 hour by the outlet. If the two inlets are opened at 01:00 pm and 02:00 pm respectively and the outlet at 03:00 pm then it will be emptied at.

(a) 05:55 pm (b) 05:00 pm

(c) 05:20 pm (d) 05:30 pm

16. Two pipes can independently fill a bucket in 20 minutes and 25 minutes. Both are opened together for 5 minutes after which the second pipe is turned off. What is the time taken by the first pipe alone to fill the remaining portion of the bucket?

(a) 11 min (b) 16 min (c) 20 min (d) 15 min

17. 8 men can complete a place of work in 4 days. 12 women can complete the same piece of work in 4 days whereas 8 children can complete the same piece of work in 8 days. 2 men, 8 children and 3 women work together for 2 days. If only women were to finish the remaining work in 2 days, how many total women would be required?

(a) 12 (b) 18 (c) 24 (d) 20

(e) None of these

18. 8 men and 4 women together can complete a piece of work in 6 days. Work done by a man in one day is double the work done by a woman in one day. If 8 men and 4 women started working and after 2 days, 4 men left and 4 new women joined, in how many more days will the work be completed?
(a) 5 days (b) 8 days (c) 6 days (d) 4 days
(e) 9 days

19. 24 workers working 13 hours daily make a wall of dimensions 224 m × 16 m × 52 m in 32 days. In how many days will 36 workers working 18 hours daily make a wall of dimensions 432 m × 21 m × 64 m?
(a) 58 days (b) 42 days
(c) 48 days (d) 60 days
(e) None of these

20. 28 men can complete a piece of work in 15 days and 15 women can complete the same piece of work in 24 days. What is the respective ratio between the amount of work done by 30 men in 1 day and the amount of work done by 18 women in 1 day?
(a) 10 : 7 (b) 3 : 5
(c) 5 : 4 (d) 9 : 5
(e) None of these

21. The time taken by 24 children to complete a project is twice the time taken by 16 women to complete the same project. If 28 women complete the project in 8 days, how many days will 28 women and 24 children together take to complete the project?
(a) $6\frac{2}{9}$ days (b) $5\frac{2}{9}$ days
(c) $5\frac{1}{3}$ days (d) $6\frac{1}{3}$ days
(e) None of these

22. B is $\frac{4}{3}$ times as efficient as A. If A can complete $\frac{5}{8}$ th of a given task in 15 days, what fraction of the same task would remain incomplete if B works on it independently for 10 days only?
(a) $\frac{3}{4}$ (b) $\frac{2}{3}$ (c) $\frac{5}{8}$ (d) $\frac{4}{9}$
(e) $\frac{2}{3}$

23. 10 men can finish a piece of work in 15 days. 8 women can finish the same piece of work in 25 days. Only 10 women started working and in few days completed certain amount of work. After that 3 men joined them. The remaining work was completed by 10 women and 3 men together in 5 days. After how many days 3 men joined 10 women?
(a) 11 (b) 13 (c) 15 (d) 10
(e) 12

24. A and B can complete a piece of work in 80 days and 120 days respectively. They started working together but A left after 20 days. After another 12 days C joined B and they completed the remaining work in 28 more days. In how many days can C alone complete the work?
(a) 110 days (b) 112 days
(c) 114 days (d) 120 days
(e) None of these

25. Time taken by A alone to finish a piece of work is 60% more than that taken by A and B together to finish the same piece of work. C is twice as efficient as B. If B and C together can complete the same piece of work in $13\frac{1}{3}$ days, in how many days can A alone finish the same piece of work?
(a) 36 (b) 24 (c) 16 (d) 28
(e) Other than those given as options

26. 8 men can finish a piece of work in 21 days. 14 men started working and after 3 days they were replaced by 9 women. These 9 women finished the remaining work in 24 days. In how many days 9 women can finish the whole work?
(a) 24 (b) 26 (c) 36 (d) 32
(e) 30

27. A and B together can complete a piece of work in 8 days and B and C together in 12 days. All of the three together can complete the work in 6 days. A and C together complete the work in ?
(a) 8 days (b) 10 days
(c) 12 days (d) 20 days

28. Three persons undertake to complete a piece of work for ₹1200. The first person can complete the work in 8 days, second person in 12 days and third person in 16 days. They complete the work with the help of a fourth person in 3 days. What does the fourth person get ?
(a) ₹ 180 (b) ₹ 200 (c) ₹ 225 (d) ₹ 250

29. A 10 hectare field is reaped by 2 men, 3 women and 4 children together in 10 days . If working capabilities of a man, a woman and a child are in the ratio 5 : 4 : 2, then a 16 hectare field will be reaped by 6 men, 4 women and 7 children in
(a) 5 days (b) 6 days (c) 7 days (d) 8 days

30. A and B together can complete a job in 8 days. Both B and C, working alone can finish the same job in 12 days, A and B commence work on the job and work for 4 days, where upon A leaves, B continues for 2 more days, and then he leaves too, C now starts working, and finishes the job. How many days will C require ?
(a) 5 days (b) 8 days
(c) 3 days (d) 4 days

31. A, B and C can complete a piece of work in 10, 12 and 15 days respectively. A left the work 5 days before the work was completed and B left 2 days after A had left. Number of days required to complete the whole work was :
(a) $8\frac{2}{3}$ days (b) 6 days
(c) $6\frac{2}{3}$ days (d) 7 days

32. Amit, Bhawna and Chandan can do a piece of work, working together in one day only. Amit is 5 times efficient than Bhawna and Chandan takes half of the number of days taken by Bhawna to do the same work. What is the difference between the number of days taken by Amit and Chandan when they work alone ?

(a) 4 (b) 5

(c) 3 (d) $2\frac{2}{5}$

33. *A* can do a piece of work in 12 days and *B* in 20 days. If they together work on it for 5 days and remaining work is completed by *C* in 3 days, then in how many days can *C* do the same work alone ?

(a) 10 days (b) 9 days

(c) 12 days (d) 15 days

34. *A* and *B* work together to complete the rest of a job in 7 days, when 37/100 of the job was already done. Also the work done by *A* in 5 days is equal to the work done by *B* in 4 days. How many days would be required by the fastest worker to complete the entire work ?

(a) 20 (b) 25 (c) 30 (d) 10

35. A group of workers can complete a piece of work in 50 days, when they are working individually. On the first day one person works, on the second day another person joins him, on the third day one more person joins them and this process continues till the works completed. How many approximate days are needed to complete the work?

(a) 8 days (b) 9 days

(c) 10 days (d) 11 days

36. A boy and girl together fill a cistern with water. The boy pours 4 litres of water every 3 minutes and the girl pours 3 litres of water every 4 minutes. How much time will it take to fill 100 litres of water in the cistern?

(a) 36 minutes (b) 42 minutes

(c) 48 minutes (d) 44 minutes

37. A tap can fill a cistern in 40 minutes and a second tap can empty the filled cistern in 60 minutes. By mistake without closing the second tap, the first tap was opened. In how many minutes will the empty cistern be filled ?

(a) 72 (b) 84 (c) 108 (d) 120

38. A tank can be filled by pipe *A* in 2 hours and pipe *B* in 6 hours. At 10 A.M. pipe A was opened. At what time will the tank be filled if pipe B is opened at 11 A.M.?

(a) 12.45 A.M. (b) 5 P.M.

(c) 11.45 A.M. (d) 12 P.M.

39. Three pipes, *A*, *B* and *C* can fill a tank in 6 hours, 9 hours and 12 hours respectively. *B* and *C* are opened for half an hour, then *A* is also opened. The time taken by the three pipes together to fill the remaining part of the tank is :

(a) 3 hours (b) 2 hours

(c) $2\frac{1}{2}$ hours (d) $3\frac{1}{2}$ hours

40. Two pipes *A* and *B* can fill a tank with water in 30 minutes and 45 minutes respectively. The third pipe *C* can empty the tank in 36 minutes. First *A* and *B* are opened. After 12 minutes *C* is opened. Total time (in minutes) in which the tank will be filled up is :

(a) 12 (b) 24

(c) 30 (d) 36

Hints & Solutions

1. (b) $(B + C)$'s 1 day's work $= \frac{1}{8}$ ...(i)

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

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

On adding all these three equations,

$2(A + B + C)$'s 1 day's work

$$= \frac{1}{8}+\frac{1}{12}+\frac{1}{16} = \frac{6+4+3}{48} = \frac{13}{48}$$

$\Rightarrow$ $(A + B + C)$'s 1 day's work $= \frac{13}{96}$

$\therefore$ A, B and C together can complete the work in $\frac{96}{13} = 7\frac{5}{13}$ days

2. (b) 2 men = 1 woman

$\Rightarrow$ 1 man $= \frac{1}{2}$ woman

$\Rightarrow$ 3 men $= \frac{3}{2}$ women

Again, 2 children = 1 man $= \frac{1}{2}$ woman

$\Rightarrow$ 1 child $= \frac{1}{4}$ woman

$\Rightarrow$ 6 children $= \frac{6}{4} = \frac{3}{2}$ women

Now, three men, four women and six children

$$= \frac{3}{2}+4+\frac{3}{2} = 7 \text{ women}$$

Hence, 7 women complete the work in 7 days.

3. (b) In 36 days, 12 men can do 1 complete work.

In 36 days, 12 women can do $\frac{3}{4}$th of the work

Since time and the no. of persons is the same is both cases,

$\therefore$ 1 woman's daily work

$= \frac{3}{4}$th of 1 man's daily work

8 women's daily work

$= \frac{3}{4} \times 8 = 6$ men's daily work

(10 men + 8 womens daily work)

= (10 men + 6 men) = 16 men's daily work.

12 men can do the work is 36 days

$\therefore$ 16 men can do the work in

$36 \times \frac{12}{16} = 27$ days

4. (a)

	Man	:	Woman
efficiency	3	:	2

one day's work of a man and a woman

(3 + 2) = 5 units

Total work = 18 × 5 = 90 units

a woman can complete the whole work in

$\frac{90}{2} = 45$ days

5. (a) $10M \times 12$ days $= 10W \times 6$ days

$2M = 1W$

$\frac{M}{W} = \frac{1}{2}$

$1M$ work = 1 unit/day

$1W$ work = 2 unit/day

Total work = $10M \times 12$ days = $10 \times 1 \times 12 = 120$ unit

Time required $(10M + 10W)$

$$= \frac{\text{Total work}}{\text{eff.}} = \frac{120}{10\times1+10\times2} = \frac{120}{30} = 4 \text{ days}$$

6. (b) Let 'n' number of men are required.

$$\frac{200_{men} \times 50_{days}}{\frac{1}{4}} = \frac{(200+n)_{men} \times 100_{days}}{\frac{3}{4}}$$

$3 \times 100 = 200 + n$

$n = 100$

7. (b) If their daily wages are in ratio

$(A : B : C) = 5 : 6 : 4$.

So wages of A for 6 days $= 6 \times 5 = 30$

So wages of B for 4 days $= 4 \times 6 = 24$

So wages of C for 9 days $= 9 \times 4 = 36$

	A	:	B	:	C	Total
$\Rightarrow$	30	:	24	:	36	$\downarrow$
$\Rightarrow$	5	:	4	:	6	= 15

Amount received by $A = \frac{5}{15} \times 1800 = ₹600$

8. (a)

	Man		Woman		Boy
efficiency	4	:	2	:	1

total work = time × (Efficiency of man + woman + boy)

$\Rightarrow$ 7 days × (4 + 2 + 1) = 49 units

Boy can do this work in $= \frac{49}{1} = 49$ day

9. (d) According to the question

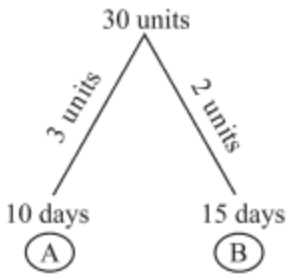
4m + 6w = 8 days or 32m + 48w = 1 day

3m + 7w = 10 days or 30 m + 70w = 1 day

$\therefore$ 32 m + 48w = 30m + 70w

$2m = 22w$
$m = 11w$
$4m = 44w$
$\therefore \quad (44w + 6w) \times 8 = 10w \times x$
$50w \times 8 = 10w \times x$
$x = 40$ days

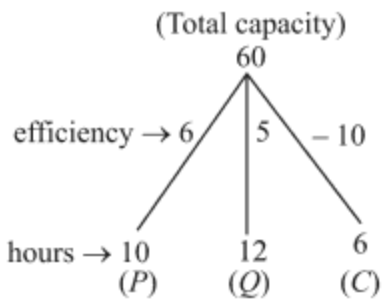
10. (b) According to question,



$(A + B) = 5$ days work $= 5 \times 5 = 25$ units
Remaining work $= 30 - 25 = 5$ units

A will finish the remaining work $= \frac{5}{3} = 1\frac{2}{3}$ days

11. (b)



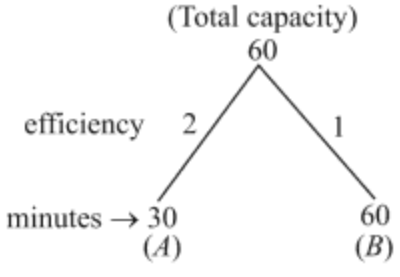
$(P + Q)$ fills $(6 + 5) = 11$ units/hr
C empties $= 10$ units/hr
If all pipes are open
So, only $11 - 10 = 1$ unit of water can be filled in tank

$\frac{1}{4}$ of tank will be filled in

$$\frac{\text{T.C.}}{\text{Efficiency}} = \frac{\left(\frac{1}{4} \times 60\right)}{1} = \frac{15}{1} = 15\,\text{hrs}$$

$= 7$ am $+ 15$ hr $= 10$ pm

12. (d)



$(A + B)$'s filling $(2 + 1) = 3$ units/min)
In 5 minutes, they will fill $3 \times 5 = 15$ units
Capacity left $= 60 - 15 = 45$ units
Second pipe (B) fills it in

$$\frac{\text{T.C}}{\text{efficiency of B}} = \frac{45}{} \quad 45 \text{ minutes}$$

13. (a) In one minute $(A + B)$ can together fill $\frac{1}{36} + \frac{1}{45} = \frac{1}{20}$ part.

In 7 minutes part of tank filled $= \frac{7}{20}$

Remaining part $= 1 - \frac{7}{20} = \frac{13}{20}$

In 8th minutes, part filled by A, B and C altogether

$$= \frac{1}{36} + \frac{1}{45} - \frac{1}{30} = \frac{1}{20} - \frac{1}{30} = \frac{1}{60}$$

$\frac{13}{20}$ part of tank filled by $(A + B + C)$

$$= 60 \times \frac{13}{20} = 39 \text{ minutes}$$

14. (d)

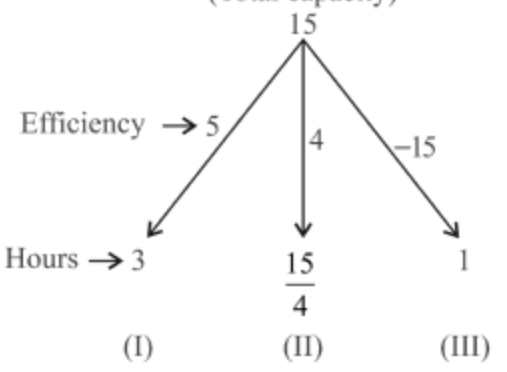
Days	No. of Labourers	Work done
12	20	5/8
4	?	$1 - \frac{5}{8} = \frac{3}{8}$

$M_1 D_1 W_2 = M_2 D_2 W_1$

$$20 \times 12 \times \frac{3}{8} = M_2 \times 4 \times \frac{5}{8} \Rightarrow M_2 = \frac{20 \times 12 \times 3 \times 8}{4 \times 5 \times 8} = 36$$

Hence, $36 - 20 = 16$ more men needed to complete the remaining work in 4 days.

15. (c)

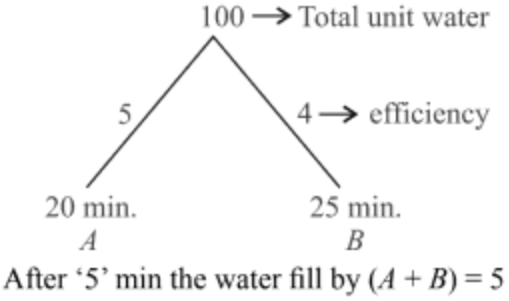


I[st] pipe fills till 3pm $= 5 \times 2 = 10$ units
II[nd] pipe fills till 3pm $= 4 \times 1 = 4$ units
Total filled $= 10 + 4 = 14$ units
Net pipe (III) efficiency $= 15 - 9 = 6$ units/hrs

Tank will be empty in $= \frac{14}{6} = 2$ hr 20 min.

3hr + 2hr 20min = 5:20 pm

16. (a)



After '5' min the water fill by $(A + B) = 5 \times 9$

= 45 unit water

Then remaining water unit = 100 – 45 = 55

Remaining unit water fill by $A = \frac{55}{5} = 11$ minutes

17. (a) As per given information,

8×4 men = 12×4 women = 8×8 children

$\Rightarrow$ 32 men = 48 women = 64 children

$\Rightarrow$ 2 men = 3 women = 4 children

$\therefore$ 2 men + 8 children + 3 women

= (3 + 6 + 3) women = 12 women

12 women's 2 day's work = $\frac{1}{2}$

Remaining work = $\frac{1}{2}$

$\therefore$ Required number of women = 12

18. (a) According to the question,

1 man = 2 women

$\therefore$ 8 men + 4 women

= (16 + 4) women = 20 women

4 men + 8 women = 16 women

20 women's 2 days' work = $\frac{2}{6} = \frac{1}{3}$

Remaining work = $1 - \frac{1}{3} = \frac{2}{3}$

$\because$ 20 women complete 1 work in 6 days.

$\therefore$ 16 women will do $\frac{2}{3}$ work in

$= \frac{20 \times 6}{16} \times \frac{2}{3} = 5$ days

19. (c)

Workers	Working hours	Length	Width	Height	Days
24 ↑	13 ↑	224	16	52	32
36	18	432 ↓	21 ↓	64 ↓	x ↓

$\left.\begin{array}{l} 36:24 \\ 18:13 \\ 224:432 \\ 16:21 \\ \therefore\ 52:64 \end{array}\right\} :: 32 : x$

$\therefore$ $36 \times 18 \times 224 \times 16 \times 52 \times x$

$= 24 \times 13 \times 432 \times 21 \times 64 \times 32$

$\Rightarrow x = \frac{24 \times 13 \times 432 \times 21 \times 64 \times 32}{36 \times 18 \times 224 \times 16 \times 52} = 48$ days

20. (a) $\because$ 28 men do 1 work in 15 days.

$\therefore$ Time taken by 30 men = $\frac{15 \times 28}{30} = 14$ days

$\because$ 15 women do the work in 24 days.

$\therefore$ Time taken by 18 women = $\frac{15 \times 24}{18} = 20$ days

$\therefore$ Required ratio

$= \frac{1}{14} : \frac{1}{20} = 20 : 14 = 10 : 7$

21. (a) According to the question,

48 children $\equiv$ 16 women

$\Rightarrow$ 3 children $\equiv$ 1 woman

$\therefore$ 28 women + 24 children

$\equiv$ (28 + 8) women $\equiv$ 36 women

$\therefore$ $M_1D_1 = M_2D_2$

$\Rightarrow$ $28 \times 8 = 36 \times D_2$

$\Rightarrow D_2 = \frac{28 \times 8}{36} = \frac{56}{9}$ days $= 6\frac{2}{9}$ days

22. (d) B is $\frac{4}{3}$ times as efficient as A

$\because$ A completes $\frac{5}{8}$th work in 15 days.

$\therefore$ Time taken by A in doing 1 work

$= \frac{15 \times 8}{5} = 24$ days

$\therefore$ Time taken by B in doing whole work

$= 24 \times \frac{3}{4} = 18$ days

$\because$ B's 1 day's work = $\frac{1}{18}$

$\therefore$ B's 10 days' work = $\frac{10}{18} = \frac{5}{9}$

$\therefore$ Remaining work = $1 - \frac{5}{9} = \frac{4}{9}$

23. (b) 10×15 men $\equiv 8 \times 25$ women

$\Rightarrow$ 3 men $\equiv$ 4 women

3 men + 10 women $\equiv$ (10 + 4) women $\equiv$ 14 women

8 women's 1 day's work = $\frac{1}{25}$

$\therefore$ 10 women's 1 day's work = $\frac{10}{25 \times 8} = \frac{1}{20}$ part

$\therefore$ $\frac{M_1D_1}{W_1} = \frac{M_2D_2}{W_2} \Rightarrow \frac{10 \times 20}{W_1} = \frac{14 \times 5}{W_2}$

$\Rightarrow W_2 = \frac{14 \times 5}{10 \times 20} = \frac{7}{20}$ part

Remaining work = $1 - \frac{7}{20} = \frac{13}{20}$

$\therefore$ This part of work is done by 10 women.

$\therefore$ Required time $= \frac{13}{20} \times 20 = 13$ days.

24. (b) Work done by A and B is 20 days

$$= 20\left(\frac{1}{80}+\frac{1}{120}\right) = 20\left(\frac{3+2}{240}\right) = \frac{5}{12}$$

Work done by B in 12 days $= \frac{12}{120} = \frac{1}{10}$

Remaining work $= 1 - \frac{5}{12} - \frac{1}{10} = \frac{60-25-6}{60} = \frac{29}{60}$

Let C alone do the work in x days.

$\therefore \quad \frac{28}{120} + \frac{28}{x} = \frac{29}{60}$

$\Rightarrow \quad \frac{28}{x} = \frac{29}{60} - \frac{28}{120} = \frac{58-28}{120} = \frac{30}{120}$

$\Rightarrow \quad \frac{28}{x} = \frac{1}{4} \quad \Rightarrow \quad x = 28 \times 4 = 112$ days

25. (b) C is twice as good as B.

$\therefore$ If time taken by B be $2x$ days,

Time taken by $C = x$ days

$\therefore \quad \frac{1}{2x} + \frac{1}{x} = \frac{3}{40} \quad \Rightarrow \quad \frac{1+2}{2x} = \frac{3}{40}$

$\Rightarrow \quad \frac{3}{2x} = \frac{3}{40} \quad \Rightarrow \quad 2x = 40 \quad \Rightarrow \quad x = 20$

$\therefore$ Time taken by $B = 40$ days

If A takes y days, then

$$y = \left(\frac{1}{\frac{1}{y}+\frac{1}{40}}\right) \times \frac{160}{100} \quad \Rightarrow \quad y = \left(\frac{1}{\frac{40+y}{40y}}\right) \times \frac{8}{5}$$

$\Rightarrow \quad \frac{5}{8}y = \frac{40y}{40+y} \quad \Rightarrow \quad \frac{1}{8} = \frac{8}{40+y}$

$\Rightarrow \quad 40 + y = 64 \quad \Rightarrow \quad y = 64 - 40 = 24$ days.

26. (d) Part of work done by 14 men in 3 days $= W_2$

$W_1 = 1$

$\therefore \quad \frac{M_1D_1}{W_1} = \frac{M_2D_2}{W_2} \quad \Rightarrow \quad \frac{8\times21}{1} = \frac{14\times3}{W_2}$

$\Rightarrow \quad 8 \times 21 \times W_2 = 14 \times 3 \quad \Rightarrow \quad W_2 = \frac{14\times3}{8\times21} = \frac{1}{4}$

$\therefore$ Remaining work $= 1 - \frac{1}{4} = \frac{3}{4}$

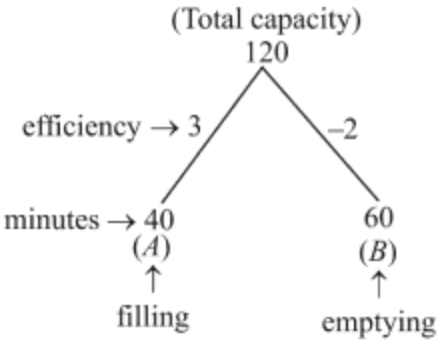
$\because$ Time taken by 9 women in doing $\frac{3}{4}$th work

$= 24$ days

$\therefore$ Time taken by them in doing whole work

$= \frac{24\times4}{3} = 32$ days

27. (a)



A's one day work $= 4 - 2 = 2$ units

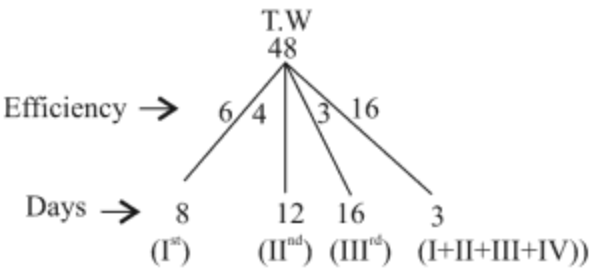
B's one day work $= 3 - 2 = 1$ unit

C's one day work $= 2 - 1 = 1$ unit

A and C complete the whole work in

$\frac{\text{T.W.}}{\text{eff. of } A + C} = \frac{24}{2+1} = 8$ days

28. (c)



$\Rightarrow$ IVth person efficiency $= 16 - 6 - 4 - 3 = 3$ units

16 units $\rightarrow$ 1200

1 unit $\rightarrow$ 75

3 units $\rightarrow$ 225

29. (d) According to question,

efficiency of a man, a woman and a child are 5 : 4 : 2. units/days.

one day work of 2 men $= 2 \times 5 = 10$ units

one day work of 3 women $= 3 \times 4 = 12$ units

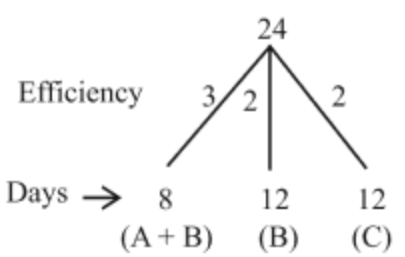
one day work of 4 children $= 4 \times 2 = 8$ units.

Applying formula, let time taken is 'D'days.

$$\frac{(10+12+8)\times10_{\text{days}}}{10_{\text{hectare}}} = \left[\frac{(6_{men}\times5)+(4_{women}\times4)+(7_{children}\times2)\times D}{16_{hectare}}\right]$$

$\frac{(30)\times10}{10} = \frac{[60]\times D}{16} \Rightarrow \quad D = 8$ days

30. (d)



A and B work for 4 days

they completed

$3 \times 4 = 12$ units

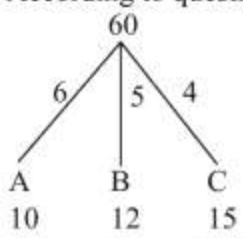
work left $= 24 - 12 = 12$ units

B's 2 days work $= 2 \times 2 = 4$ units

work left = 12 – 4 = 8 units

Now C's complete the work in $\frac{8}{2} = 4$ days

31. (d) According to question,



A leave the work 5 days before completion and B after 2 days when A leave. So C work alone for the last three days.

$C = 4 \times 3 = 12$ unit

Before it $(B + C)$ work for 2 days $= 9 \times 2 = 18$ unit

Remaining $= (60 - 30) = 30$ unit done by $(A + B + C)$

No. of days taken by them $(A + B + C)$

$\frac{30}{15} = 2$ days $\quad \{\because (6 + 5 + 4 = 15)\}$

Total days = 3 + 2 + 2 = 7 days.

32. (d)

	Amit	Bhawana	Chandan
Efficiency →	$5x$	x	$2x$

Let total work = 1

Efficiency of $(A + B + C) = 1$

Then $5x + x + 2x = 1$

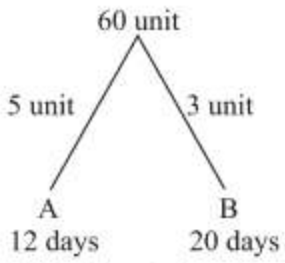
$$x = \frac{1}{8}$$

Days taken by Amit $= \frac{1}{5/8} = \frac{8}{5}$

Days taken by Chandan $= \frac{1}{2/8} = 4$

Difference of days $= 4 - \frac{8}{5} = \frac{20-8}{5} = 2\frac{2}{5}$ days.

33. (b)



$5(A + B) + 3C = 60$ units

$5 \times 8 + 3C = 60$

$3C = 20$

$C = \frac{20}{3}$ unit

Time taken by $C = \frac{60}{\frac{20}{3}} = \frac{60 \times 3}{20} = 9$ days

34. (a) Total work = 100

Remaining work = 100 – 37 = 63

$5A = 4B$

$\frac{A}{B} = \frac{4}{5}$ ← efficiency

Total efficiency of $(A + B) = 9$

Work done by them in 7 days $= 9 \times 7 = 63$

Time taken by B to complete entire work

$= \frac{100}{5} = 20$ days

35. (c) Let a man complete '1' piece of work in a day.

Then total work = 50 units

Then by statement 1st day

= one man × 1 work/per day = 1

2nd day = two man × 1 work/per day = 2

3rd day = 3 man × 1 work/per day = 3

Let the whole work will be completed in N day.

then total work $= 1 + 2 + 3 \ldots\ldots + N = 50$

$\frac{N(N+1)}{2} = 50$

$N(N + 1) = 100$

Then $N = 10$ days (approx)

36. (c)

Quantity	Time (in minutes)
Boy → 4 litres	3
Girl → 3 litres	4

Boy → (4 3) × 4 = 16 litres in 12 minutes

Girl → (3 4) × 3 = 9 litres in 12 minutes

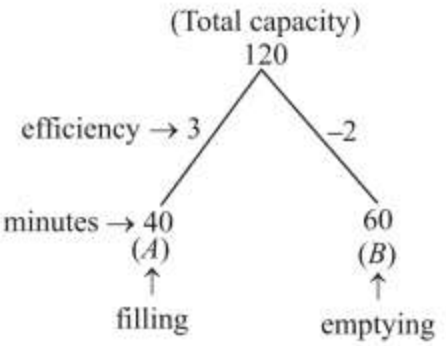
(Boy + Girl) pour

25 litres 12 minutes

×4↓ ×4↓

100 litres **48 minutes**

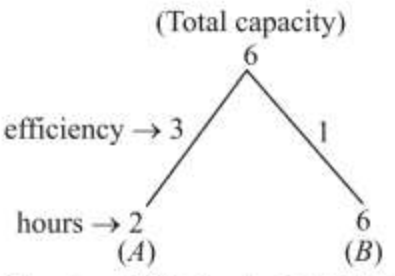
37. (d)



Total unit of water filled is = 3 – 2 = 1 unit/min.

Tank will be filled in $= \frac{120}{1} =$ **120 minutes**

38. (c)



Pipe A will fill 3 units till 11 A.M.

Capacity left = 6 – 3 = 3 units

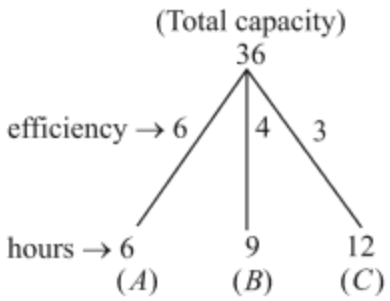
Now both pipes will fill and they will take

$\frac{\text{T.C.}}{\text{Efficiency}} = \frac{3}{(3+1)} = \frac{3}{4}$ hours

So, $\left(11+\frac{3}{4}\right)$A.M., tank will be filled

$= 11 : 45$ A.M.

39. (c)



In half an hour $(B + C)$ must have filled

$=\frac{4}{2}+\frac{3}{2}=\frac{7}{2}$ units

Capacity left $=36-\frac{7}{2}=\frac{65}{2}$ units

Now, all pipes will fill the remaining tank

$=\frac{65}{2\times(6+4+3)}=\frac{65}{2\times13}=\frac{5}{2}=2\frac{1}{2}$ hrs

40. (b) According to question,

A ..... (+) 30 minutes

B ..... (+) 45 minutes

C ..... (–) 36 minutes

Filled water by $(A + B)$ in 12 min.

$= 12 \times (6 + 4) = 12 \times 10 = 120$ litre

$\Rightarrow$ Remaining capacity $= 180 – 120 = 60$ litre

$\Rightarrow$ After 12 min. emptied pipe C is also opened

$\Rightarrow$ Total capacity $(A + B – C) = (6 + 4 – 5) = 5\ l./\text{m}.$

$\Rightarrow$ Time taken by $(A + B – C)$ with capacity $5\ l./\text{m}.$ to fill the remaining part

$=\frac{60l.}{5l./m.}=12\text{min}$

$\Rightarrow$ Therefore, total time in which the tank will be filled up is = 12 + 12 = 24 minutes