CHAPTER 8

Time & Work

TIME AND WORK

In most of the problems on time and work, either of the following basic parameters are to be calculated :

Shortcut Approach

- 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 can do a piece of work in X days and B can do it in Y days then A and B working together will do the same work in $\frac{XY}{X+Y}$ days.
- If A, B and C can do a work in X, Y and Z days respectively then all of them working together can finish the work in $\frac{XYZ}{XY+YZ+XZ}$ days.
- If (A + B) can do a piece of work in X days, (B + C) can do a place of work in Y days and (C + A) can do a piece of work in Z days.
  Then,
  (A + B + C) can do a piece of work in $\frac{2XYZ}{XY+YZ+ZX}$ days

EXAMPLE 1. A can do a piece of work in 5 days, and B can do it in 6 days. How long will they take if both work together?

Sol. A's 1 day's work = $\frac{1}{5}$th part of whole work and

B's 1 day's work = $\frac{1}{6}$th part of whole work

$\therefore$ (A + B)'s one day's work = $\frac{1}{5}+\frac{1}{6}=\frac{11}{30}$th part of whole work. So, both together will finish the work in $\frac{30}{11}$days $= 2\frac{8}{11}$days.

By Direct Formula :

A + B can do the work in $\frac{5\times 6}{5+6}$ days $=\frac{30}{11}=2\frac{8}{11}$ days.

EXAMPLE 2. Two men, Vikas and Vishal, working separately can mow a field in 8 and 12 hours respectively. If they work in stretches of one hour alternately, Vikas beginning at 8 a.m, when will the mowing be finished?

Sol. In the first hour, Vikas mows $\frac{1}{8}$ of the field.

In the second hour, Vishal mows $\frac{1}{12}$ of the field.

$\therefore$ In the first 2 hours, $\left(\frac{1}{8}+\frac{1}{12}=\frac{5}{24}\right)$ of the field is mown.

$\therefore$ In 8 hours, $\frac{5}{24}\times 4=\frac{5}{6}$ of the field is mown.

Now, $\left(1-\frac{5}{6}\right)=\frac{1}{6}$ of the field remains to be mown.

In the 9th hour, Vikas mows $\frac{1}{8}$ of the field.

Remaining work $=\frac{1}{6}-\frac{1}{8}=\frac{1}{24}$

$\therefore$ Vishal will finish the remaining work in $\left(\frac{1}{24}\div\frac{1}{12}\right)$ or $\frac{1}{2}$ of an hour.

$\therefore$ The total time required is $\left(8+1+\frac{1}{2}\right)$ or $9\frac{1}{2}$ hours.

Thus, the work will be finished at $8+9\frac{1}{2}=17\frac{1}{2}$ or 5.30 pm.

EXAMPLE 3. A can do a piece of work in 36 days, B in 54 days and C in 72 days. All the three began the work together on the Dec. 15, 2014, but A left 8 days and B 12 days before the completion of the work. If C took the rest for a week then in how many days, the work was finished from the day it started ?

Sol. Let the total time taken be x days.

According to the given condition

$$\Rightarrow \frac{x-8}{36}+\frac{x-12}{54}+\frac{x}{72}=1$$

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

$$\Rightarrow \frac{6x-48+4x-48+3x}{216}=1 \Rightarrow \frac{13x-96}{216}=1$$

$$\Rightarrow 13x-96=216 \Rightarrow 13x=216+96=312$$

$$\Rightarrow x=\frac{312}{13}=24$$

Since, C takes the rest for a week, so the number of days in which the work was finished from one day it started = 31 i.e. on 14.01.2015.

EXAMPLE 4. A and B can do a certain piece of work in 18 days, B and C can do it in 12 days and C and A can do it in 24 days. How long would each take separately to do it ?

Sol. (A + B)'s one days's work = 1/18,
(A + C)'s one days's work = 1/24,
(B + C)'s one days's work = 1/12,
Now add up all three equations :

$$2\,(A+B+C)\text{'s one days's work} = \frac{1}{18}+\frac{1}{24}+\frac{1}{12}=\frac{13}{72}$$

$$(A+B+C)\text{'s one days's work} = \frac{13}{144}$$

A's one days's work = (A + B + C)'s one days's work

$$-(B+C)\text{'s one days's work} = \frac{13}{144}-\frac{1}{12}=\frac{1}{144}$$

Since A completes of the work in 1 day, he will complete 1 work in $\frac{144}{1}=144$ days

By similar logic we can find that B needs $\frac{144}{7}$ days and C will require $\frac{144}{5}$ days.

Shortcut Approach

- 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 + C) can do a piece of work in X days and (B + C) can do a piece of work in Y days then A can do a piece of work $\frac{XY}{Y-X}$ days

EXAMPLE 5. A and B together can do a piece of work in 6 days and A alone can do it in 9 days. In how many days can B alone do it?

Sol. (A + B)'s 1 day's work = $\frac{1}{6}$th part of the whole work.

A's 1 day's work = $\frac{1}{9}$th part of the whole work.

$\therefore$ B's 1 day's work = $\frac{1}{6}-\frac{1}{9}=\frac{3-2}{18}=\frac{1}{18}$th part of the whole work.

$\therefore$ B alone can do the work in 18 days.

SHORTCUT METHOD

B alone can do the whole work in

$$\frac{6\times 9}{9-6}=\frac{54}{3}=18 \text{ days}$$

Shortcut Approach

- A and B can do a work in 'X' and 'Y' days respectively. They started the work together but A left 'a' days before completion of the work. Then, time taken to finish the work is $\frac{Y(X+a)}{X+Y}$
- 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.

EXAMPLE 6. A and B can do alone a job in 6 days and 12 days. They began the work together but 3 days before the completion of job, A leaves off. In how many days will the work be completed?

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

Sol. (a) Let work will be completed in x days. Then,
work done by A in (x – 3) days + work done by B in x days = 1

i.e. $\frac{x-3}{6}+\frac{x}{12}=1$

$$\Rightarrow \frac{3x-6}{12}=1 \Rightarrow x=6 \text{ days}$$

SHORTCUT METHOD

$$\text{Required time} = \frac{12(6+3)}{12+6}=6 \text{ days}$$

EXAMPLE **7. A is half good a workman as B and together they finish a job in 14 days. In how many days working alone will B finish the job.**

(a) 20 days **(b) 21 days**

(c) 22 days **(d) None of these**

Sol. (b) Let B can do the work in x days
and A can do the work in 2x days

Then, $\frac{1}{x}+\frac{1}{2x}=\frac{1}{14}$ (given)

$\Rightarrow x=\frac{3}{2}\times 14=21$ days

SHORTCUT METHOD

$$\text{Time taken by B}=14\left(\frac{1}{2}+1\right)=21 \text{ days}$$

Shortcut Approach

If a_1 men and b_1 boys can complete a work in x days, while a_2 men and b_2 boys can complete the same work in y days, then

$$\frac{\text{One day work of 1 man}}{\text{One day work of 1 boy}}=\frac{(yb_2-xb_1)}{(xa_1-ya_2)}$$

EXAMPLE **8. If 12 men and 16 boys can finish a work in 5 days, while 13 men and 24 boys can finish the same work in 4 days. Compare the one day work of 1 man and 1 boy.**

Sol. Here, $a_1=12, b_1=16, x=5, a_2=13, b_2=24$ and $y=4$

$$\frac{\text{One day work of 1 man}}{\text{One day work of 1 boy}}=\frac{(yb_2-xb_1)}{(xa_1-ya_2)}$$

$$=\frac{4\times 24-5\times 16}{5\times 12-4\times 13}$$

$$=\frac{96-80}{60-52}=\frac{16}{8}=\frac{12}{1}$$

Shortcut Approach

If n men or m women can do a piece of work in X days, then N men and M women together can finish the work in $\frac{nmX}{nM+mN}$ days.

EXAMPLE **9. 10 men can finish a piece of work in 10 days, where as it takes 12 women to finish it in 10 days. If 15 men and 6 women undertake to complete the work, how many days they will take to complete it?**

(a) 7 days **(b) 5 days**

(c) 4 days **(d) 6 days**

Sol. (b) It is clear that 10 men = 12 women or 5 men = 6 women
$\Rightarrow$ 15 men + 6 women = (18 + 6) i.e. 24 women
Now 12 women can complete the work in 10 days
$\therefore$ 24 women will do it in 5 days.

SHORTCUT METHOD

$$\text{Required time}=\frac{10\times 12\times 10}{10\times 6+12\times 15}=5 \text{ days}$$

EXAMPLE **10. If 3 men or 4 women can reap a field in 43 days, how long will 7 men and 5 women take to reap it ?**

Sol. First Method : 3 men reap $\frac{1}{43}$ of the field in 1 day.

$\therefore$ 1 men reaps $\frac{1}{43\times 3}$ of the field in 1 day.

4 women reap $\frac{1}{43}$ of the field in 1 day.

$\therefore$ 1 woman reaps $\frac{1}{43\times 4}$ of the field in 1 day.

$\therefore$ 7 men and 5 women reap $\left(\frac{7}{43\times 3}+\frac{5}{43\times 4}\right)=\frac{1}{12}$ of the field in 1 day.

$\therefore$ 7 men and 5 women will reap the whole field in 12 days.

Second Method : 3 men = 4 women

$\therefore$ 1 man = $\frac{4}{3}$ women $\therefore$ 7 men = $\frac{28}{3}$ women

$\therefore$ 7 men + 5 women = $\frac{28}{3}+5=\frac{43}{3}$ women now, the question becomes :

If 4 women can reap a field in 43 days, how long will $\frac{43}{3}$ women take to reap it ?

The basic-formula gives

$$4\times 43=\frac{43}{3}\times D_2 \quad \text{or,} \quad D_2=\frac{4\times 43\times 3}{43}=12 \text{ days.}$$

SHORTCUT METHOD

$$\text{Required number of days}=\frac{1}{\left[\frac{7}{43\times 3}+\frac{5}{43\times 4}\right]}$$

$$=\frac{43\times 3\times 4}{7\times 4+5\times 3}=12 \text{ days.}$$

EXAMPLE **11. If 12 men and 16 boys can do a piece of work in 5 days and 13 men and 24 boys can do it in 4 days, how long will 7 men and 10 boys take to do it ?**

Sol. 12 men and 16 boys can do the work in 5 days ..... (1)

13 men and 24 boys can do the work in 4 days ..... (2)

Now it is easy to see that if the no. of workers be multiplied by any number, the time must be divided by the same number (derived from : more worker less time).

Hence multiplying the no. of workers in (1) and (2) by 5 and 4 respectively, we get 5 (12 men + 16 boys) can do the work in 5/5 = 1 day

4 (13 men + 24 boys) can do the work in $\frac{4}{4}$ = 1 day

or, $5(12m+16b)=4(13m+24b)$

or, $60m+80b=52m+96b$

or, $60m-52m=96b-80b$

or, $8m=16b$

$\therefore$ 1 men = 2 boys.

Thus, 12 men + 16 boys = 24 boys + 16 boys = 40 boys

and 7 men + 10 boys = 14 boys + 10 boys = 24 boys

The question now becomes :

"If 40 boys can do a piece of work in 6 days how long will 24 boys take to do it ?"

Using basic formula, we have

$40 \times 5 = 24 \times D_2$

or, $D_2 = \frac{40\times 5}{24} = 8\frac{1}{3}$ days

EXAMPLE 12. Two men and 7 boys can do a piece of work in 14 days. 3 men and 8 boys can do it in 11 days. In how many days can 8 men and 6 boys do a work 3 times as big as the first ?

Sol. 2 men + 7 boys in 14 days $\Rightarrow$ 28 men + 98 boys in 1 day

3 men + 8 boys in 11 days $\Rightarrow$ 33 men + 88 boys in 1 day

$\therefore$ 28 men + 98 boys = 33 men + 88 boys

$\therefore$ 2 boys $\equiv$ 1 man

Now, 2 men + 7 boys = 11 boys; 8 men + 6 boys = 22 boys

More boys, fewer days; more work, more days

Boys	Days	Work
11 ↓	14 ↑	1 ↑
22	x	3

$\therefore \frac{x}{14} = \frac{11}{22} \times \frac{3}{1}$ $\therefore$ Number of days = 21 days.

EXAMPLE 13. Kaberi takes twice as much time as Kanti and thrice as much as Kalpana to finish a place of work. They together finish the work in one day. Find the time taken by each of them to finish the work.

Sol. Here, the alone time of kaberi is related to the alone times of other two persons, so assume the alone time of kaberia = x,

Then, alone time of kanti = $\frac{x}{2}$ and of kalpana = $\frac{x}{3}$

Kaberi's 1 day work + kanti's 1 day work + kalpana's 1 day work = combined 1 days work

$$\Rightarrow \frac{1}{x}+\frac{1}{x/2}+\frac{1}{x/3}=\frac{1}{1} \Rightarrow \quad x=6$$

$\therefore$ Alone time for kaberi = 6 days, for kanti = 6/2 = 3 days, kalpana =6/3 = 2 days,

EXAMPLE 14. 1 man or 2 women or 3 boys can do a work in 44 days. Then in how many days will 1 man, 1 woman and 1 boy do the work?

Sol. Number of required days

$$= \frac{1}{\frac{1}{44\times 1}+\frac{1}{44\times 2}+\frac{1}{44\times 3}} = \frac{44\times 1\times 2\times 3}{6+3+2} = 24 \text{ days}$$

Shortcut Approach

A and B do a piece of work in a and b days, respectively. Both begin together but after some days, A leaves off and the remaining work is completed by B in x days. Then, the time after which A left, is given by

$$T = \frac{(b-x)a}{a+b}$$

EXAMPLE 15. A and B can do a piece of work in 40 days and 50 days, respectively. Both begin together but after a certain time, A leaves off. In this case B finishes the remaining work in 20 days. After how many days did A leave?

Sol. Here, a = 40 days, b = 50 days, x = 20 and T = ?

$$\therefore \text{Required time} = \frac{(b-x)a}{a+b} = \frac{(50-20)\times 40}{(40+50)}$$

$$= \frac{30\times 40}{90} = \frac{40}{3} = 13\frac{1}{3} \text{ days}$$

Shortcut Approach

If 'M_1' persons can do 'W_1' works in 'D_1' days and 'M_2' persons can do 'W_2' works in 'D_2' days then

$M_1D_1W_2 = M_2D_2W_1$

If T_1 and T_2 are the working hours for the two groups then

$M_1D_1W_2T_1 = M_2D_2W_1T_2$

Similarly,
$M_1D_1W_2T_1E_1 = M_2D_2W_1T_2E_2$, where E_1 and E_2 are the efficiencies of the two groups.

- 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.
- A is K times as good a worker as B and takes X days less than B to finish the work. Then the amount of time required by A and B working together is $\frac{K \times X}{K^2 - 1}$ days.
- If A is n times as efficient as B, i.e. A has n times as much capacity to do work as B, then A will take $\frac{1}{n}$ of the time taken by B to do the same amount of work.

EXAMPLE 16. 5 men prepare 10 toys in 6 days working 6 hrs a day. Then in how many days can 12 men prepare 16 toys working 8 hrs a day ?

Sol. $M_1 D_1 T_1 W_2 = M_2 D_2 T_2 W_1$

Here, $5 \times 6 \times 6 \times 16 = 12 \times D_2 \times 8 \times 10$

$\therefore D_2 = \frac{5 \times 6 \times 6 \times 16}{12 \times 8 \times 10} = 3$ days.

EXAMPLE 17. A and B can do a work in 45 days and 40 days respectively. They began the work together, but A left after some time and B finished the remaining work in 23 days. After how many days did A leave ?

Sol. B works alone for 23 days.

$\therefore$ Work done by B in 23 days $= \frac{23}{40}$ work

$\therefore$ Work done by A + B together $= 1 - \frac{23}{40} = \frac{17}{40}$ work

Now, A + B do 1 work in $\frac{40 \times 45}{40 + 45} = \frac{40 \times 45}{85}$ days

$\therefore$ A + B do $\frac{17}{40}$ work in $\frac{40 \times 45}{85} \times \frac{17}{40} = 9$ days.

SHORTCUT METHOD

If we ignore the intermediate steps, we can write a direct formula as : $\frac{40 \times 45}{40 + 45}\left(\frac{40 - 23}{40}\right) = 9$ days.

EXAMPLE 18. Two friends take a piece of work for ₹ 960. One alone could do it in 12 days, the other in 16 days with the assistance of an expert they finish it in 4 days. How much remuneration the expert should get ?

Sol. First friend's 4 day's work $= \frac{4}{12} = \frac{1}{3}$ (Since, the work is finished in 4 days, when expert assists)

Second friends's 4 day's work $= \frac{4}{16} = \frac{1}{4}$

The expert's 4 day's work $= 1 - \left(\frac{1}{3} + \frac{1}{4}\right) = \frac{5}{12}$

Now, total wages of ₹ 960 is to be distributed among two friends and the expert in proportion to the amount of work done by each of them.

So, 960 is to be divided in the proportion of

$\frac{1}{3} : \frac{1}{4} : \frac{5}{12}$ or 4 : 3 : 5

$\therefore$ Share of expert $= \frac{5}{12} \times 960 =$ ₹ 400

Hence, the expert should get ₹ 400.

EXAMPLE 19. A certain number of men can do a work in 60 days. If there were 8 men more it could be finished in 10 days less. How many men are there ?

Sol. Let there be x men originally.

(x + 8) men can finish the work in (60 – 10) = 50 days.

Now, 8 men can do in 50 days what x men do in 10 days, then by basic formula we have

$\therefore x = \frac{8 \times 50}{10} = 40$ men.

SHORTCUT METHOD (1) :

We have :

x men to the work in 60 days and (x + 8) men do th work in (60 – 10 =) 50 days.

Then by "basic formula", 60x = 50(x + 8)

$\therefore x = \frac{50 \times 8}{10} = 40$ men.

SHORTCUT METHOD (2) :

There exists a relationship :

Original number of workers

$= \frac{\text{No. of more worker} \times \text{Number of days taken by the second group}}{\text{No. of less days}}$

$= \frac{8 \times (60 - 10)}{10} = \frac{8 \times 50}{10} = 40$ man

EXAMPLE 20. Two coal loading machines each working 12 hours per day for 8 days handles 9,000 tonnes of coal with an efficiency of 90%. While 3 other coal loading machines at an efficiency of 80 % set to handle 12,000 tonnes of coal in 6 days. Find how many hours per day each should work.

Sol. Here $\frac{N_1 \times D_1 \times R_1 \times E_1}{W_1} = \frac{N_2 \times D_2 \times R_2 \times E_2}{W_2}$

$N_1 = R_1 = 12h/\text{ day} : N_2 = 3R_2 = ?$

$E_1 = \frac{90}{100}\ W_1 = 9{,}000\ ;$

$E_2 = \frac{80}{100}\ W_2 = 12{,}000$

$\Rightarrow \frac{2 \times 8 \times 12 \times 90}{9{,}000 \times 100}\ \frac{3 \times 6 \times R_2\ 80}{12{,}000 \times 100}$

$\Rightarrow R_2 = 16\text{ h / day.}$

$\therefore$ Each machine should work 16 h/ day.

WORK AND WAGES

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

EXAMPLE 21. A, B and C can do a work in 6, 8 and 12 days respectively. Doing that work together they get an amount of ₹ 1350. What is the share of B in that amount?

Sol. A's one day's work $= \frac{1}{6}$

B's one day's work $= \frac{1}{8}$

C's one day's work $= \frac{1}{12}$

A's share : B's share : C's share

$= \frac{1}{6} : \frac{1}{8} : \frac{1}{12}$

Multiplying each ratio by the L.C.M. of their denominators, the ratios become 4 : 3 : 2

$\therefore$ B's share $= \frac{1350 \times 3}{9} = ₹450$

EXAMPLE 22. If 6 men working 8 hours a day earn ₹1680 per week, then how much will 9 men working 6 hours a day earn per week ?

Sol.

6m	8 hours	₹1680
9m	6 hours	?

$1680 \times \frac{6}{8} \times \frac{9}{6} = ₹1890$

SHORTCUT METHOD

As earnings are proportional to the work done, we have

$\frac{M_1 D_1}{W_1} = \frac{M_2 D_2}{W_2} \Rightarrow \frac{6 \times 8}{1680} = \frac{9 \times 6}{W_2} \Rightarrow W_2 = ₹1890$

EXAMPLE 23. A can do a piece of work in 15 days and B in 20 days. They finished the work with the assistance of C in 5 days and got ₹ 45 as their wages, find the share for each in the wages.

Sol. A did in 5 days 1/3 of the work,

B did in 5 days 1/4 of the work.

C did in 5 days $1 - \frac{1}{3} + \frac{1}{4} = \frac{5}{12}$ of the work

Since A, B, C did in 5 days 1/3, 1/4, 5/12 of the work respectively.

A's share $= ₹\ 45 \times \frac{1}{3} = ₹\ 15$

B's share $= ₹\ 45 \times \frac{1}{4} = ₹\ 11.25$

C's share $= ₹\ 45 \times \frac{5}{12} = ₹\ 18.75$

EXAMPLE 24. If 8 men, working 9 hours per day can build a wall 18 meter long, 2 meters wide and 12 meters high in 10 days, how many men will be required to build a wall 32 meters long, 3 meters wide and 9 meters high by working 6 hours a day in 8 days ?

Sol. This method is a substitute for the conventional method and can be safely employed for most of the problems.

Step 1 : Assume the thing to be found as 'X'

Step 2 : In the first place look for X's counterpart.

e.g. in the above example, X = no. of men

So X's counterpart = No. of men, given = 8.

So write X = 8x.....

Now see the direct and indirect variation or simply see by which operation more men will be required & by which fewer:

We have $X = 8 \times \frac{32}{18} \times \frac{3}{2} \times \frac{9}{12} \times \frac{10}{8} \times \frac{9}{6} = 30$ men

SHORTCUT METHOD

Given that

$M_1 = 8$ men	$M_2 = x$ (Let)
$t_1 = 9$ hour	$t_2 = 6$ hour
$D_1 = 10$ days	$D_2 = 8$ days
$W_1 = 18 \times 2 \times 12\ m^3$	$W_2 = 32 \times 3 \times 9\ m^3$

Now, $\frac{M, t, d,}{w} = \frac{M_2 d_2 t_2}{w^2}$

$= \frac{8 \times 9 \times 10}{18 \times 2 \times 12} = \frac{x \times 6 \times 8}{32 \times 3 \times 9} = \boxed{x = 30\text{ men}}$

EXAMPLE 25. If 5 engines consume 6 tonnes of coal when each runs 9 hours per day, how much coal will be needed for 8 engines, each running 10 hours. per day, it being given that 3 engines of the former type consume as much as 4 engines of latter type ?

Sol. We have $X = 6 \times \frac{8}{5} \times \frac{10}{9} \times \frac{3}{4} = 8$ tons

Explanation : (1) More engines more coal (> 1)

(2) More time, more coal (> 1)

(3) Latter consumes less coal than former (< 1).

In case of men working we have more time, less men (< 1) but here we have more time, more coal (> 1).

Here let W = 6 tonnes $\equiv 5 \times 9 \times 4/3$ engine hours

and let $X \equiv 8 \times 10 \times 1$ engine hours.

or $X = 6\text{ tons} \times \frac{8 \times 10 \times 1}{5 \times 9 \times (4/3)} = 8\text{ tons}$

SHORTCUT METHOD

Given that

$M_1 = 5$ engines $\quad M_2 = 8$ engines
$t_1 = 9$ hour $\quad t_2 = 10$ hour
$w_1 = 6$ tones $\quad n_2 =$ (efficiency)
n_1 (efficiency) $= 4$ $\quad w_2 = x$ (let)

Now, $\dfrac{m_1 t_1 n_1}{w_1} = \dfrac{m_2 t_2 n_2}{w_2}$

$\therefore \quad \dfrac{5 \times 9 \times 4}{6} = \dfrac{8 \times 10 \times 3}{x}$

$x = 8$ tonnes

EXAMPLE 26. A garrison of 1500 men is provisioned for 60 days. After 25 days the garrison is reinforced by 500 men, how long will the remaining provisions last ?

Sol. Since the garrison is reinforced by 500 men therefore then are (1500 + 500) or 2000 men now,
since $60 - 25 = 35$ days.
$\Rightarrow$ The provisions left would last 1500 men 35 days
$\Rightarrow$ Provisions left would last 1 man 35×1500 days
$\Rightarrow$ Provisions left would last 2000 men

$$35 \times \frac{1500}{2000} = 26.25 \text{ days}$$

By work equivalence method
$1500 \times 60 = (1500 \times 25) + (2000 \times X)$
Solve to get $X = 26.25$ days.

EXAMPLE 27. 40 men can cut 60 trees is 8 hours. If 8 men leaves the job how many trees will be cut in 12 hours ?

Sol. 40 men – working 8 hours – cut 60 trees

or, 1 man – working 1 hour – cuts $\dfrac{60}{40 \times 8}$ trees

Thus, 32 men – working 12 hours – cuts $\dfrac{60 \times 32 \times 12}{40 \times 8} = 73$ trees.

Using basic concepts :

$M_1 = 40$, $D_1 = 8$ (As days and hrs both denote time)
$W_1 = 60$ (cutting of trees is taken as work)
$M_2 = 40 - 8 = 32$, $D_2 = 12$, $W_2 = ?$
Putting the values in the formula
$M_1 D_1 W_2 = M_2 D_2 W_1$
We have, $40 \times 8 \times W_2 = 32 \times 12 \times 60$

or, $W_2 = \dfrac{32 \times 12 \times 60}{40 \times 8} = 72$ trees.

EXAMPLE 28. I can finish a work in 15 days at 8 hours a day. You can finish it in $6\frac{2}{3}$ days at 9 hrs a day. Find in how many days we can finish it working together 10 hrs a day.

Sol. First suppose each of us works for only one hr a day.
Then I can finish the work in $15 \times 8 = 120$ days and you can finish the work in $\dfrac{20}{3} \times 9 = 60$ days.

But here we are given that we do the work 10 hrs a day. Then clearly we can finish the work in 4 days.

EXAMPLE 29. A can do a work in 6 days. B takes 8 days to complete it. C takes as long as A and B would take working together. How long will it take B and C to complete the work together ?

Sol. (A + B) can do the work in $\dfrac{6 \times 8}{6 + 8} = \dfrac{24}{7}$ days.

$\therefore$ C takes $\dfrac{24}{7}$ days to complete the work.

$\therefore$ (B + C) takes $\dfrac{\frac{24}{7} \times 8}{\frac{24}{7} + 8} = \dfrac{24 \times 8}{24 + 56} = 2\dfrac{2}{5}$ days.

EXAMPLE 30. A group of 20 cows can graze a field 3 acres in size in 10 days. How many cows can graze a field twice as large in 8 days ?

Sol. Here, first of all, let us see how work can be defined. It is obvious that work can be measured as "acres grazed".
In the first case, there were 20 cows in the group.
They had to work for 10 days to do the work which we call W (which = 3)
$\Rightarrow \quad 20 \times 10 = 3$ ..... (1)
Do not be worried about the numerical values on either side. The point is that logically this equation is consistent as the LHS indicates "Cowdays" and the RHS indicates "Acres", both of which are correct ways of measuring work done.
Now the field is twice as large. Hence the new equation is
$\Rightarrow \quad C \times 8 = 6$ ..... (2)
Just divide (2) by (1) to get the answer.

$$\frac{8C}{200} = \frac{6}{3}$$

$\Rightarrow \quad 8C = 2 \times 200 \Rightarrow \quad C = \dfrac{400}{8} = 50$ cows.

Hence, there were 50 cows in the second group.

SHORTCUT METHOD

No. of cows $(M_1) = 20$ $\quad$ No. of cows $(m_2) = 2$
No. of dogs $(D_1) = 10$ $\quad$ No. of dogs $(d_2) = 8$
Field graze $(w_1) = 3$ $\quad$ Field graze $= 3 \times 2 = 6$
Now, By formula

$$\frac{M_1 d_1}{W_1} = \frac{M_2 d_2}{W_2}$$

$$\Rightarrow \quad \frac{20 \times 10}{3} = \frac{n_2 \times 8}{6}$$

$n_2 = 50$ cows

EXAMPLE 31. 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.

(a) I and II only **(b) II and III only**
(c) Any two of the three **(d) II and either I or III**

Sol. (c) I. A can complete the job in 8 days. So, A's 1 days' 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 days's work $= \frac{1}{16}$

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

Suppose B takes x days to finish the work

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

$\Rightarrow \frac{6}{x}=\left(1-\frac{5}{8}\right)=\frac{3}{8} \Rightarrow x=\left(\frac{8\times6}{3}\right)=16$

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

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

EXAMPLE 32. 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 of the three**

Sol. (c) Clearly, any two of the three will give two equations in x and y, which can be solved simultaneously.
Foir example I and II together give

$\left(6x+5y=\frac{1}{6}, 3x+4y=\frac{1}{10}\right)$

EXAMPLE 33. 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 ?

I. 19 men and 12 women together can complete the work in 18 days.
II. 16 men 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**

Sol. (d) Clearly, I only gives the answer
Similarly, II only gives the answer
And, III only gives the answer

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

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

Shortcut Approach

- If a pipe can fill a tank in x hours, then the part 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 $= \frac{1}{y}$.
- If a pipe can fill a tank in x hours and another pipe can empty the full tank in y hours, then the net part filled in 1 hour, when both the pipes are opened $= \left(\frac{1}{x}-\frac{1}{y}\right)$.
  $\therefore$ Time taken to fill the tank, when both the pipes are opened $= \frac{xy}{y-x}$.
- If a pipe can fills or empties tank in x hours and another can fill or empties the same tank in y hours, then time taken to fill or empty the tank $= \frac{xy}{y+x}$, when both the pipes are opened
- If a pipe fills a tank in x hours and another fills the same tank is y hours, but a third one empties the full tank in z hours, and all of them are opened together, then net part filled in 1 hr $= \left[\frac{1}{x}+\frac{1}{y}-\frac{1}{z}\right]$
  $\therefore$ Time taken to fill the tank $= \frac{xyz}{yz+xz-xy}$ hours.
- 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 has a leak which can empty it in X hours. A pipe which admits Y litres of water per hour into the cistern is turned on and now the cistern is emptied in Z hours. Then the capacity of the cistern is $\frac{X+Y+Z}{Z-X}$ litres.
- 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.

  Here, A is the faster filling pipe and B is the slower one.
- 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.

EXAMPLE 34. A pipe can fill a cistern in 6 hours. Due to a leak in its bottom, it is filled in 7 hours. When the cistern is full, in how much time will it be emptied by the leak?

(a) 42 hours (b) 40 hours
(c) 43 hours (d) 45 hours

Sol. (a) Part of the capacity of the cistern emptied by the leak

in one hour $= \left(\frac{1}{6}-\frac{1}{7}\right) = \frac{1}{42}$ of the cistern.

The whole cistern will be emptied in 42 hours.

EXAMPLE 35. Three pipes A, B and C can fill a cistern in 6 hrs. After working together for 2 hrs, C is closed and A and B fill the cistern in 8 hrs. Then find the time in which the cistern can be filled by pipe C.

Sol. A + B + C can fill in 1 hr $= \frac{1}{6}$ of cistern.

A + B + C can fill in 2 hrs $= \frac{2}{6} = \frac{1}{3}$ of cistern.

Remaining part $= \left(1-\frac{1}{3}\right) = \frac{2}{3}$ is filled by A + B in 8 hrs.

$\therefore$ (A + B) can fill the cistern in $\frac{8\times 3}{2} = 12$ hrs.

Since (A + B + C) can fill the cistern in 6 hrs.

$\therefore$ C = (A + B + C) – (A + B) can fill the cistern in

$\frac{12\times 6}{12-6}$ hours = 12 hours.

EXAMPLE 36. Pipe A can fill a tank in 20 hours while pipe B alone can fill it in 30 hours and pipe C can empty the full tank in 40 hours. If all the pipes are opened together, how much time will be needed to make the tank full?

Sol. By direct formula,

The tank will be fill in $= \frac{20\times 30\times 40}{30\times 40+20\times 40-20\times 30}$

$= \frac{120}{7} = 17\frac{1}{7}$ hrs.

EXAMPLE 37. Three pipes A, B and C can fill a tank in 6 minutes, 8 minutes and 12 minutes, respectively. The pipe C is closed 6 minutes before the tank is filled. In what time will the tank be full ?

(a) 4 min (b) 6 min
(c) 5 min (d) Data inadequate

Sol. (a) Let it takes t minutes to completely fill the tank.

Now, $\frac{t}{6}+\frac{t}{8}+\frac{t-6}{12} = 1$

or $\frac{4t+3t+2t-12}{24} = 1$

or $9t - 12 = 24$

or $9t = 36 \Rightarrow t = 4$ min.

EXAMPLE 38. If three taps are opened together, a tank is filled in 12 hrs. One of the taps can fill it in 10 hrs and another in 15 hrs. How does the third tap work ?

Sol. We have to find the nature of the third tap, whether it is a filler or a waste pipe.

Let it be a filler pipe which fills in x hrs.

Then, $\frac{10\times 15\times x}{10\times 15+10x+15x} = 12$

or, $150x = 150\times 12 + 25x\times 12$

or $-150x = 1800$ $\therefore$ $x = -12$

–ve sign shows that the third pipe is a waste pipe which vacates the tank in 12 hrs.

EXAMPLE 39. 4 pipes can fill a reservoir in 15, 20, 30 and 60 hours respectively. The first was opened at 6 am, second at 7 am third at 8 am and fourth at 9 am. When will the reservoir be full?

Sol. (1) Let the time be t hours after 6 am.

$\therefore$ $\frac{1}{15}\times t + \frac{(t-1)}{20} + \frac{(t-2)}{30} + \frac{(t-3)}{60} = 1$

$\therefore$ $4t + 3(t-1) + 2(t-2) + (t-3) = 60$

$\therefore$ $t = 7$ hours $\therefore$ It is filled at 1 pm

EXAMPLE 40. A and B can fill a cistern in 7.5 minutes and 5 minutes respectively and C can carry off 14 litres per minute. If the cistern is already full and all the three pipes are opened, then it is emptied in 1 hour. How many litres can it hold ?

Sol. If the capacity is L litres, water filled in 1 hour = Water removed in 1 hour.

$$L + \frac{L}{7\frac{1}{2}} \times 60 + \frac{L}{5} \times 60 = 14 \times 60$$

$$\therefore \quad L + \frac{2L}{15} \times 60 + 12L = 14 \times 60 \Rightarrow L + 8L + 12L = 14 \times 60$$

$\Rightarrow$ $21L = 14 \times 60$ or $L = 40$ litres.

So the capacity of the cistern is 40 litres.

EXAMPLE 41. A cistern can be filled by two taps A and B in 25 minutes and 30 minutes respectively can be emptied by a third in 15 minutes. If all the taps are turned on at the same moment, what part of the cistern will remain unfilled at the end of 100 minutes ?

Sol. We have $\frac{1}{25} + \frac{1}{30} - \frac{1}{15} = \frac{1}{150}$ part filled in 1 minute

Hence, $1 - 100\left(\frac{1}{150}\right)$ = 1/3rd of the tank is unfilled after 100 minutes.

EXAMPLE 42. A barrel full of beer has 2 taps one midway, which draw a litre in 6 minutes and the other at the bottom, which draws a litre in 4 minutes. The lower tap is lower normally used after the level of beer in the barrel is lower than midway. The capacity of the barrel is 36 litres. A new assistant opens the lower tap when the barrel is full and draws out some beer. As a result the lower tap has been used 24 minutes before the usual time. For how long was the beer drawn out by the new assistant ?

Sol. The top tab is operational till 18 litres is drawn out.

$\therefore$ Time after which the lower tap is usually open $= 18 \times 6 = 108$ minutes

$\therefore$ Time after which it is open now $= 108 - 24 = 84$ minutes

$\therefore$ Litres drawn $= 84/6 = 14$ litres

$\therefore$ $18 - 14 = 4$ litres were drawn by the new assistant.

$\therefore$ Time $= 4 \times 4 = 16$ minutes

EXAMPLE 43. A cistern can be filled by two pipes filling separately in 12 and 16 min. respectively. Both pipes are opened together for a certain time but being clogged, only 7/8 of the full quantity of water flows through the former and only 5/6 through the latter pipe. The obstructions, however, being suddenly removed, the cistern is filled in 3 min. from that moment. How long was it before the full flow began?

(a) 2.5 min **(b) 4.5 min**

(c) 3.5 min **(d) 5.5 min**

Sol. (b) Both the pipes A and B can fill $\frac{1}{12} + \frac{1}{16} = \frac{7}{48}$ of the cistern in one minute, when their is no obstruction.

With obstruction, both the pipes can fill

$\frac{1}{12} \times \frac{7}{8} + \frac{1}{16} \times \frac{5}{6} = \frac{7}{96} + \frac{5}{96} = \frac{1}{8}$ of the cistern in one minute.

Let the obstructions were suddenly removed after x minutes.

$\therefore$ With obstruction, $\frac{x}{8}$ of the cistern could be filled in x minutes and so the remaining $1 - \frac{x}{8} = \frac{8-x}{8}$ of the cistern was filled without obstruction in 3 minutes, i.e.

In one minute, $\frac{8-x}{24}$ of the cistern was filled.

$$\Rightarrow \frac{8-x}{24} = \frac{7}{48} \Rightarrow 16 - 2x = 7 \Rightarrow x = 4.5$$

EXERCISE

1. 12 men take 18 days to complete a job whereas 12 women in 18 days can complete $\frac{3}{4}$ of the same job. How many days will 10 men and 8 women together take to complete the same job?
   (a) 6 (b) $13\frac{1}{2}$
   (c) 12 (d) Data inadequate
   (e) None of these
2. Seven men and four boys can complete a work in 6 days. A man completes double the work than a boy. In how many days will 5 men and 4 boys complete the work?
   (a) 5 (b) 4
   (c) 6 (d) Cannot be determined
   (e) None of these
3. The work done by a woman in 8 hours is equal to the work done by a man in 6 hours and by a boy in 12 hours. If working 6 hours per day, 9 men can complete a work in 6 days then in how many days can 12 men, 12 women and 12 boys together finish the same work by working 8 hours per day?
   (a) $1\frac{1}{3}$ days (b) $3\frac{2}{3}$ days
   (c) 3 days (d) $1\frac{1}{2}$ days
   (e) None of these
4. Tap '*A*' can fill a water tank in 25 minutes, tap '*B*' can fill the same tank in 40 minutes and tap '*C*' can empty that tank in 30 minutes. If all the three taps are opened together, in how many minutes will the tank be completely filled up or emptied?
   (a) $3\frac{2}{13}$ (b) $15\frac{5}{13}$
   (c) $8\frac{2}{13}$ (d) $31\frac{11}{19}$
   (e) None of these
5. Machine A can print one lakh books in 8 hours. Machine B can do the same job in 10 hours. Machine C can do the same job in 12 hours. All the three machines start job at 9.00 am. A breaks down at 11.00 am and the other two machines finish the job. **Approximately** at what time will the job be finished?
   (a) 12.00 noon (b) 1.30 pm
   (c) 1.00 pm (d) 11.30 am
   (e) None of these
6. Suresh can complete a job in 15 hours. Ashutosh alone can complete the same job in 10 hours. Suresh works for 9 hours and then the remaining job is completed by Ashutosh. How many hours will it take Ashutosh to complete the remaining job alone?
   (a) 4 (b) 5
   (c) 6 (d) 12
   (e) None of these
7. 10 men and 15 women finish a work in 6 days. One man alone finishes that work in 100 days. In how many days will a woman finish the work?
   (a) 125 days (b) 150 days
   (c) 90 days (d) 225 days
   (e) None of these
8. 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) 35 hours (b) 25 hours
   (c) 20 hours (d) Cannot be determined
   (e) None of these
9. 24 men working 8 hours a day can finish a work in 10 days. Working at the rate of 10 hours a day, the number of men required to finish the same work in 6 days is :
   (a) 30 (b) 32
   (c) 34 (d) 36
   (e) None of these
10. A water tank is $\frac{2}{5}$ th full. Pipe A can fill the tank in 10 minutes and the 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?
    (a) 6 minutes to empty (b) 6 minutes to fill
    (c) 9 minutes to empty (d) 9 minutes to fill
    (e) None of these
11. A water tank has three taps A, B and C. Tap A, when opened, can fill the water tank alone in 4 hours. Tap B, when opened, can fill the water tank alone in 6 hours and tap C, when opened, can empty the water tank alone in 3 hours. If taps A, B and C are opened simultaneously, how long will it take to fill the tank completely?
    (a) 10 hours (b) 8 hours
    (c) 18 hours (d) 12 hours
    (e) None of these
12. 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?
    (a) 48 (b) 24
    (c) 36 (d) 16
    (e) None ofthe above
13. The total monthly income of four men and two women is ₹ 46,000. If every woman earns ₹ 500 more than a man then what is the monthly income of a woman?
    (a) ₹ 7,500 (b) ₹ 8,000
    (c) ₹ 9,000 (d) ₹ 6,500
    (e) None of these

14. 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?

(a) 6 (b) $7\frac{2}{3}$

(c) $6\frac{2}{3}$ (d) $6\frac{1}{3}$

(e) None of these

15. 'A' completes a work in 12 days. *'B'* completes the same work in 15 days. *'A'* started working alone and after 3 days B joined him. How many days will they now take together to complete the remaining work?

(a) 5 (b) 8
(c) 6 (d) 4
(e) None of these

16. Rajani has to read a book of 445 pages. She has already read the first 157 pages of the book and if she reads 24 pages of the book everyday then how long will she take now to complete the book?

(a) 25 days (b) 20 days
(c) 46 days (d) 21 days
(e) None of these

17. 10 horses and 15 cows eat grass of 5 acres in a certain time. How many acres will feed 15 horses and 10 cows for the same time, supposing a horse eats as much as 2 cows ?

(a) 40/7 acres (b) 39/8 acres
(c) 40/11 acres (d) 25/9 acres
(e) None of these

18. X and Y can do job in 25 days and 30 days respectively. They work together for 5 days and then X leaves. Y will finish the rest of the work in how many days?

(a) 18 days (b) 19days
(c) 20days (d) 21 days
(e) None of these

19. A and B can do a job is 16 days and 12 days respectively. 4 days before finishing the job, A joins B. B has started the work alone. Find how many days B has worked alone?

(a) 6 days (b) 4 days
(c) 5 days (d) 7 days
(e) None of these

20. A contractor undertakes to built a walls in 50 days. He employs 50 peoples for the same. However after 25 days he finds that only 40% of the work is complete. How many more man need to be employed to complete the work in time?

(a) 25 (b) 30
(c) 35 (d) 20
(e) None of these

21. A is 30% more efficient than B. How much time will they, working together, take to complete a job which A along could have done in 23 days?

(a) 11 days (b) 13 days

(c) $20\frac{3}{17}$ days (d) 12 days

(e) None of these

22. A and B can finish a work in 10 days while B and C can do it in 18 days. A started the work, worked for 5 days, then B worked for 10 days and the remaining work was finished by C in 15 days. In how many days could C alone have finished the whole work ?

(a) 30 days (b) 15 days
(c) 45 days (d) 24 days
(e) None of these

23. 12 men complete a work in 18 days. Six days after they had started working, 4 men joined them. How many days will all of them take to complete the remaining work ?

(a) 10 days (b) 12 days
(c) 15 days (d) 9 days
(e) None of these

24. A tyre has two punctures. The first puncture along 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

(e) None of these

25. A man, a woman or a boy can do a job in 20 days, 30 days or 60 days respectively. How many boys must assist 2 men and 8 women to do the work in 2 days?

(a) 15 boys (b) 8 boys
(c) 10 boys (d) 11 boys
(e) None of these

26. A can do 50% more work as B can do in the same time. B alone can do a piece of work in 20 hours. A, with help of B, can finish the same work in how many hours ?

(a) 12 (b) 8

(c) $13\frac{1}{3}$ (d) $5\frac{1}{2}$

(e) None of these

27. If 15 women or 10 men can complete a project in 55 days, in how many days will 5 women and 4 men working together complete the same project ?

(a) 75 (b) 8
(c) 9 (d) 85
(e) None of these

28. 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
(e) None of these

29. Water flows at 3 metres per sec through a pipe of radius 4 cm. How many hours will it take to fill a tank 40 metres long, 30 metres broad and 8 metres deep, if the pipe remains full?
(a) 176.6 hours (b) 120 hour
(c) 135.5 hours (d) None of these
(e) None of these

30. A can do a piece of work in 10 days, while B alone can do it in 15 days. They work together for 5 days and the rest of the work is done by C in 2 days. If they get ₹ 450 for the whole work, how should they divide the money ?
(a) ₹ 225, ₹ 150, ₹ 75 (b) ₹ 250, ₹ 100, ₹ 100
(c) ₹ 200, ₹ 150, ₹ 100 (d) ₹ 175, ₹ 175, ₹ 100
(e) None of these

31. A alone would take 8 days more to complete the job than if both A and B would together. If B worked alone, he took $4\frac{1}{2}$ days more to complete the job than A and B worked together. What time would they take if both A and B worked together?
(a) 7 days (b) 5 days
(c) 4 days (d) 6 days
(e) None of these

32. A alone can complete work in 15 days and B alone in 20 days. Starting with A, the work on alternate days. The total work will be completed in
(a) 17 days (b) 16 days
(c) 14 days (d) 13 days
(e) None of these

33. A contractor undertook to do a piece of work in 9 days. He employed certain number of laboures but 6 of them were absent from the very first day and the rest could finish the work in only 15 days. Find the number of men originally employed .
(a) 15 (b) 6
(c) 13 (d) 9
(e) None of these

34. After working for 8 days, Anil finds that only $\frac{1}{3}$ of the work has been done. He employs Rakesh who is 60 % efficient as Anil. How many more days will Anil take to complete the job?
(a) 15 days (b) 12 days
(c) 10 days (d) 8 days
(e) None of these

35. A sum of ₹ 25 was paid for a work which A can do in 32 days, B in 20 days, B and C in 12 days and D in 24 days. How much did C receive if all the four work together ?
(a) ₹ $\frac{14}{3}$ (b) ₹ $\frac{16}{3}$
(c) ₹ $\frac{15}{3}$ (d) ₹ $\frac{17}{3}$
(e) None of these

36. A and B can do a job in 15 days and 10 days, respectively. They began the work together but A leaves after some days and B finished the remaining job in 5 days. After how many days did A leave?
(a) 2 days (b) 3 days
(c) 1 day (d) 4 days
(e) None of these

37. Mr. Suresh is on tour and he has ₹ 360 for his expenses. If he exceeds his tour by 4 days he must cut down daily expenses by ₹ 3. The number of days of Mr. Suresh's tour programme is :
(a) 20 days (b) 24 days
(c) 40 days (d) 42 days
(e) None of these

38. A can knit a pair of socks in 3 days. B can knit the same thing in 6 days. If they are knitting together, in how many days will they knit two pairs of socks?
(a) 4 days (b) 2 days
(c) $4\frac{1}{2}$ days (d) 3 days
(e) None of these

39. A can do a job in 3 days less time than B. A works at it alone for 4 days and then B takes over and completes it. If altogether 14 days were required to finish the job, how many days would each of them take alone to finish it?
(a) 17 days, 20 days (b) 12 days, 15 days
(c) 13 days, 16 days (d) 14 days, 11 days
(e) None of these

40. 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 completed in 3 days. Find the time for A to complete the job alone.
(a) $6\frac{1}{4}$ days (b) $5\frac{3}{4}$ days
(c) 5 days (d) 3 days
(e) None of these

41. X can do a piece of work in 15 days. If he is joined by Y who is 50% more efficient, in what time will X and Y together finish the work?
(a) 10 days (b) 6 days
(c) 18 days (d) Data insufficient
(e) None of these

42. A can build up a wall in 8 days while B can break it in 3 days. A has worked for 4 days and then B joined to work with A for another 2 days only. In how many days will A alone build up the remaining part of wall?
(a) $13\frac{1}{3}$ days (b) $7\frac{1}{3}$ days
(c) $6\frac{1}{3}$ days (d) 7 days
(e) None of these

43. 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
(e) None of these

44. Two taps can fill a tank in 12 and 18 minutes respectively. Both are kept open for 2 minutes and the first is turned off. In how many minutes more will the tank be filled ?
(a) 15 min. (b) 20 min.
(c) 11 min. (d) 13 min.
(e) None of these

45. A cistern normally takes 6 hours to be filled by a tap but because of a leak, 2 hours more. In how many hours will the leak empty a full cistern ?
(a) 20 hours (b) 24 hours
(c) 26 hours (d) 18 hours
(e) None of these

46. One fill pipe A is 3 times faster than second fill pipe B and takes 10 minutes less time to fill a cistern than B takes. Find when the cistern will be full if fill pipe B is only opened.
(a) 20 min (b) 18 min
(c) 15 min (d) 10 min
(e) None of these

47. Two pipes can fill a cistern in 14 and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom, 32 minutes extra are taken for the cistern to be filled up. If the cistern is full, in what time would the leak empty it ?
(a) 110 hours (b) 112 hours
(c) 115 hours (d) 100 hours
(e) None of these

48. Two pipes A and B can fill a cistern in 10 and 15 minutes respectively. Both fill pipes are opened together, but at the end of 3 minutes, 'B' is turned off. How much time will the cistern take to fill ?
(a) 6 min (b) 8 min
(c) 10 min (d) 12 min
(e) None of these

49. 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 ?
(a) 10 min (b) 12 min
(c) 15 min (d) 9 min
(e) None of these

50. Two taps A and B can fill a cistern in 12 minutes and 18 minutes respectively. They are turned on at the same time. If the tap A is turned off after 4 minutes, how long will tap B take to fill the rest of the cistern ?
(a) 8 min. (b) 9 min.
(c) 10 min. (d) 7 min.
(e) None of these

51. A pipe can fill a tank in 15 minutes and another one in 10 minutes. A third pipe can empty the tank in 5 minutes. The first two pipes are kept open for 4 minutes in the beginning and then the third pipe is also opened. In what time will the tank be empited ?
(a) 35 min (b) 15 min
(c) 20 min (d) Cannot be emptied
(e) None of these

52. Two fill pipes A and B can fill a cistern in 12 and 16 minutes respectively. Both fill pipes are opened together, but 4 minutes before the cistern is full, one pipe A is closed. How much time will the cistern take to fill ?
(a) $9\frac{1}{7}$ min. (b) $3\frac{1}{3}$ min.
(c) 5 min. (d) 3 min.
(e) None of these

53. Two fill taps A and B can separately fill a cistern in 45 and 40 minutes respectively. They started to fill a cistern together but tap A is turned off after few minutes and tap B fills the rest part of cistern in 23 minutes. After how many minutes, was tap A turned-off ?
(a) 9 min (b) 10 min
(c) 12 min (d) 7 min
(e) None of these

54. Three fill pipes A, B and C can fill separately a cistern in 3, 4 and 6 minutes respectively. A was opened first. After 1 minute, B was opened and after 2 minutes from the start of A, C was also opened. Find the time when the cistern will be full ?
(a) $2\frac{1}{9}$ min (b) $4\frac{1}{2}$ min
(c) $3\frac{3}{4}$ min (d) 3 min
(e) None of these

55. A tap can fill a tank in 16 minutes and another can empty it in 8 minutes. If the tank is already 1/2 full and both the taps are opened together, will the tank be filled or emptied? How long will it take before the tank is either filled or emptied completely as the case may be ?
(a) Emptied; 16 min (b) Filled; 8 min
(c) Emptied; 8 min (d) Filled; 12 min
(e) None of these

ANSWER KEY

1	(b)	7	(d)	13	(b)	19	(c)	25	(b)	31	(d)	37	(a)	43	(b)	49	(a)	55	(c)
2	(e)	8	(a)	14	(c)	20	(a)	26	(b)	32	(a)	38	(a)	44	(d)	50	(a)		
3	(d)	9	(b)	15	(a)	21	(b)	27	(a)	33	(a)	39	(b)	45	(b)	51	(c)		
4	(d)	10	(a)	16	(e)	22	(c)	28	(d)	34	(c)	40	(a)	46	(c)	52	(a)		
5	(c)	11	(d)	17	(a)	23	(d)	29	(a)	35	(b)	41	(b)	47	(b)	53	(a)		
6	(a)	12	(b)	18	(b)	24	(c)	30	(a)	36	(b)	42	(b)	48	(b)	54	(a)		

Hints & Explanations

1. (b) $12M \times 18 = 12W \times 18 \times \frac{4}{3}$

$\therefore \quad 1W = \frac{3}{4}M$

$10M + 8W = 10M + 8 \times \frac{3}{4}M = 16M$

$\therefore$ 16 men can complete the same work

in $\frac{12 \times 18}{16} = \frac{27}{2} = 13\frac{1}{2}$ days

2. (e) $M = 2B$

$\therefore \quad 7M + 4B = 14B + 4B = 18B$

$5M + 4B = 10B + 4B = 14B$

$\because$ 18 boys complete the work in 6 days.

$\therefore$ 14 boys complete the work in

$\frac{6 \times 18}{14} = 7\frac{5}{7}$ days.

Note: *7 men and 4 boys complete the work in 6 days. We have to find out the no. of days in which 5 men and 4 boys complete the work. Here, we see that 4 boys are common in both the cases, therefore, 5 men will take more time to complete the work, i.e., more than 6 days, which is not given in any options. Therefore, without calculating we can say that our answer is (e).*

3. (d) $8W = 6M = 12B$

$12M + 12W + 12B \Rightarrow 12M + 9M + 6M = 27M$

$\therefore$ 9 men can complete the work by working 1 hour per day in 6 × 6 days

$\therefore$ 27 men working 8 hours per day $= \frac{6 \times 6 \times 9}{27 \times 8} = 1\frac{1}{2}$ days.

4. (d) Tank filled in 1 minute $= \frac{1}{25} + \frac{1}{40} - \frac{1}{30}$ part

$= \frac{24 + 15 - 20}{600} = \frac{19}{600}$ part

$\therefore$ tank will be filled complete in minutes

$= \frac{600}{19} = 31\frac{11}{19}$

5. (c) Part of print done by A, B and C in 2

hours $= 2\left(\frac{1}{8} + \frac{1}{10} + \frac{1}{12}\right) = \frac{37}{60}$

Remaining $= 1 - \frac{37}{60} = \frac{23}{60}$

If B and C print together, then they can print

in $\frac{10 \times 12}{10 + 12}$ hrs.

Therefore, remaining part can be printed by B and C in $\frac{10 \times 12}{22} \times \frac{23}{60} \approx 2$ hrs

Hence, the job will be finished at

9 am + 2 + 2 = 1.00 p.m.

6. (a) The part of job that Suresh completes in 9 hours

$= \frac{9}{15} = \frac{3}{5}$

Remaining job $= 1 - \frac{3}{5} = \frac{2}{5}$

Remaining job can be done by Ashutosh in

$\frac{2}{5} \times 10 = 4$ hours

7. (d) 15 women's work of a day $= \frac{1}{6} - \frac{1}{10} \Rightarrow \frac{1}{15}$ part

$\therefore$ for 1 whole part a woman will take

$= 15 \times 15 = 225$ days.

8. (a) Here ratio of efficiencies of pipes A, B and C are as follows:

C	B	A
2	1	
	2	1
4 :	2 :	1

Suppose the efficiencies of pipes C, B and A are 4K, 2K and K.

Since, the tank is filled in 5 hours by the three pipes having combined efficiency equal to 7K, the time required to fill the tank by A alone $= \frac{7K \times 5}{K} = 35$ hours

9. (b) $m_1 \times d_1 \times t_1 \times w_2 = m_2 \times d_2 \times t_2 \times w_1$

$24 \times 10 \times 8 \times 1 = m_2 \times 6 \times 10 \times 1$

$\Rightarrow m_2 = \frac{24 \times 10 \times 8}{6 \times 10} = 32$ men

10. (a)

$\because$ Pipe *A* in 1 minute fills 1/10 part and Pipe *B* in 1 min. empties $\frac{1}{6}$ part

$\therefore$ Pipe A + B in 1 min $= \frac{1}{10} - \frac{1}{6} = \frac{-1}{15}$

$\because$ $\frac{1}{15}$ part gets emptied in 1 min

$\therefore$ $\frac{2}{5}$ part is emptied in $15 \times \frac{2}{5}$ min = 6 min

11. (d) Required time to fill the tank

$$= \frac{1}{\left(\frac{1}{4}+\frac{1}{6}\right)-\frac{1}{3}} = \frac{1}{\frac{5}{12}-\frac{1}{3}} = \frac{1}{\frac{1}{12}} = 12 \text{ h}$$

12. (b) 24 men complete the work in 16 days

$\therefore$ 16 men complete $\left(\frac{16}{24}\times\frac{12}{16}=\right)\frac{1}{2}$ part of work in 12 days

32 women complete the work in 24 days

$\therefore$ 16 women complete $\frac{16}{32}\times\frac{14}{24}=\frac{7}{24}$ part of work in $(12+2=)$ 14 days

So, the remaining part of the work which is done by sixteen men + sixteen women and the reqd additional no. of men in 2 days

$$= 1-\left(\frac{1}{2}+\frac{7}{24}\right) = \frac{1}{2}-\frac{7}{24} = \frac{5}{24} \text{ (part)}$$

Now, in 2 days $\frac{5}{24}$ part of the work is done by

$$24\times\frac{16}{2}\times\frac{5}{24} = 40 \text{ men}$$

Hence, the reqd. additional no. of men
$= 40 - 16 = 24$ men.

13. (b) $4M + 2W = 46000$;
Again, $W = M + 500$
or, $M = W - 500$
$\therefore$ $4(W-500)+2W = 46000$
or, $6W = 46000 + 2000 = 48000$
$\therefore$ $W = ₹\,8000$

14. (c) 10 men + 15 women in 1 day do $\frac{1}{15}+\frac{1}{12}=\frac{9}{60}$ work

$\therefore$ Time taken $= \frac{60}{9}$ days $= 6\frac{2}{3}$ days

15. (a) Work done by 'A' in 3 days

$$= \frac{1}{12}\times 3 = \frac{1}{4}$$

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

Work done by A and B together $= \frac{12\times 15}{27}=\frac{20}{3}$

$\therefore$ Remaining work done by A and B together in

$$= \frac{3}{4}\times\frac{20}{3} = 5 \text{ days}$$

16. (e) Remaining pages to read $= 445 - 157 = 288$

$\therefore$ Reqd. number of days $= \frac{288}{24} = 12$

17. (a) 1 horse = 2 cows, 10 horses = 20 cows.
$\Rightarrow$ 10 horses + 15 cows = 20 + 15 = 35 cows.
15 horses + 10 cows = 40 cows. Now 35 cows eat 5 acres.

$\Rightarrow$ 40 cows eat $5\times\frac{40}{35} = 5\frac{5}{7}$ acres.

Here we have converted everything in terms of cows, you can work in terms of horses also.

18. (b) X's one day's work $= \frac{1}{25}$th part of whole work.

Y's one day's work $= \frac{1}{30}$th part of whole work.

Their one day's work $= \frac{1}{25}+\frac{1}{30}=\frac{1}{150}$th part of whole work.

Now, work is done in 5 days $= \frac{11}{150}\times 5 = \frac{11}{30}$th of whole work

$\therefore$ Remaining work $= 1-\frac{11}{30}=\frac{19}{30}$th of whole work

Now, $\frac{1}{30}$th work is done by Y in one day.

$\therefore$ $\frac{19}{30}$th work is done by Y in $\frac{1}{1/30}\times\frac{19}{30} = 19$ days

19. (c) A's one day's work $= \frac{1}{16}$th work

B's one day's work $= \frac{1}{12}$th work

Let B has worked alone = x days. Then,
A's amount of work + B's amount of work = 1

$$\Rightarrow 4\left(\frac{1}{16}\right)+(x+4)\left(\frac{1}{12}\right)=1$$

$$\Rightarrow \frac{1}{4}+\frac{x+4}{12}=1 \Rightarrow x = \frac{3}{4}\times 12 - 4$$

$\Rightarrow x = 5$ days

20. (a) 50 men complete 0.4 work in 25 days.

Applying the work rule, $m_1\times d_1\times w_2 = m_2\times d_2\times w_1$ we have,

$$50\times 25\times 0.6 = m_2\times 25\times 0.4$$

or $m_2 = \frac{50\times 25\times 0.6}{25\times 0.4} = 75$ men

Number of additional men required = (75 – 50) = 25

21. (b) 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.

22. (c) Let C completes the work in x days.

Work done by $(A+B)$ in 1 day $= \frac{1}{10}$

Work done by $(B+C)$ in 1 day $= \frac{1}{18}$

A's 5 days' work + B's 10 days' work + C's 15 days' work = 1

or $(A+B)$'s 5 days' work + $(B+C)$'s 5 days' work + C's 10 days' work = 1

or $\frac{5}{10}+\frac{5}{18}+\frac{10}{x}=1$ or $x=45$ days

23. (d) In 1 day, work done by 12 men $= \frac{1}{18}$

In 6 days, work done by 12 men $= \frac{6}{18}=\frac{1}{3}$

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

Now, $m_1 \times d_1 \times w_2 = m_2 \times d_2 \times w_1$

or $12\times 18\times\frac{2}{3}=16\times d_2\times 1$

or $d_2=\frac{4\times 18\times 2}{16}=9$ days

24. (c) 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.

25. (b) Man's two day's work $= 2\times\frac{1}{20}$ th work $= \frac{1}{10}$ th work

Woman's two days's work

$= 2\times\frac{1}{30}$ th work $= \frac{1}{15}$ th work

Boy's two day's work $= 2\times\frac{1}{60}$ th work $= \frac{1}{30}$ th work

Now, let 2 men, 8 women and x boys can complete work in 2 days. Then ,

2 men's work + 8 women's work + x boy's work = 1

$2\left(\frac{1}{10}\right)+8\left(\frac{1}{15}\right)+x\left(\frac{1}{30}\right)=1$

$\Rightarrow x=\left(1-\frac{1}{5}-\frac{8}{15}\right)\times 30 \Rightarrow x=8$ boys

26. (b) B alone can do a work in 20 hours.

$\therefore$ A alone can do $\frac{3}{2}$ of the work in 20 hours.

i.e., A alone can do the same work in $\frac{40}{3}$ hours

$\therefore$ $(A+B)$'s one hour's work $= \frac{3}{40}+\frac{1}{20}=\frac{5}{40}=\frac{1}{8}$

$\Rightarrow$ A and B together can finish the whole work in 8 hours.

27. (a) $15\,W = 10\,M$

Now, $5W+4M=5W+\frac{4\times 15}{10}W=5W+6W=11W$

If 15 women can complete the project in 55 days, 11 women can complete the same project in

$\frac{55\times 15}{11}=75$ days

28. (d) Capacity of the tank = (12×13.5) litres = 162 litres.
Capacity of each bucket = 9 litres.

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

29. (a) Radius of the pipe (r) = 4 cm. = 0.04 meter
Volume of water flowing out per sec
$= \pi r^2 \times$ rate of flow

$= \frac{22}{7}\times 0.04^2\times 3$ cu meters $= 0.0151$ cubic m

Time taken to fill the tank $= 40\times 30\times\frac{8}{0.0151}$ sec

$= \frac{40\times 30\times 8}{0.01}\times\frac{1}{3600}$ hours $= 176.6$ hours

30. (a) Work done by A and B in 5 days $= \left(\frac{1}{10}+\frac{1}{15}\right)\times 5=\frac{5}{6}$

Work remaining $= 1-\frac{5}{6}=\frac{1}{6}$

$\therefore$ C alone can do the work in $6\times 2=12$ days

Ratio of their share work $= \frac{5}{10}:\frac{5}{15}:\frac{2}{12}=3:2:1$

Share of wages = ₹ 225, ₹ 150, ₹ 75.

31. (d) Let if both A and B work together, they take x days.

$\therefore$ $(A+B)$'s 1 days's work $= \frac{1}{x}$ th work.

A's 1 day's work $= \frac{1}{x+8}$ th work.

B's 1 day's work $= \frac{1}{x+9/2}$ th work.

Now, $\frac{1}{x+8}+\frac{2}{2x+9}=\frac{1}{x}$

$\Rightarrow x(2x+9+2x+16)=(x+8)(2x+9)$
$\Rightarrow 4x^2+25x=2x^2+25x+72$
$\Rightarrow x^2=36 \Rightarrow x=6$ days

32. (a) (A + B)'s 2 day's work $=\frac{1}{15}+\frac{1}{20}=\frac{7}{60}$

Work done in 8 pairs of days $=\left(\frac{7}{60}\times 8\right)=\frac{14}{15}$

Remaining work $=\left(1-\frac{14}{15}\right)=\frac{1}{15}$

$\therefore$ Work done by A on 17th day $=\frac{1}{15}$

$\therefore$ Total time taken = 17 days

33. (a) Let the number of men originally employed be x.
$9x=15(x-6)$
or $x=15$

34. (c) In 8 days, Anil does $=\frac{1}{3}$rd work.

$\therefore$ in 1 day, he does $=\frac{1}{24}$th work.

$\therefore$ Rakesh's one day's work

= 60% of $\frac{1}{24}=\frac{1}{40}$th work.

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

(Anil and Rakesh)'s one day's work

$=\frac{1}{24}+\frac{1}{40}=\frac{1}{15}$th work

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

$\therefore \frac{2}{3}$rd work is done by them in $15\times\frac{2}{3}=10$ days

35. (b) A's one day's work = $\frac{1}{32}$

B's one day's work = $\frac{1}{20}$

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

$\therefore$ C's one day's work = $\frac{1}{12}-\frac{1}{20}=\frac{1}{30}$

D's one day's work = $\frac{1}{24}$

$\therefore$ (A + B + C + D)'s one day's work

$=\frac{1}{32}+\frac{1}{20}+\frac{1}{30}+\frac{1}{24}=\frac{75+120+80+100}{2400}$

$=\frac{375}{2400}=\frac{15}{96}=\frac{5}{32}$

$\therefore$ Out of $\frac{5}{32}$ of work done,

$\frac{1}{30}$ of the work is done by C.

$\Rightarrow$ Out of ₹ 25 paid for the work, C will receive

₹ $\frac{1/30}{5/32}\times 25$, i.e. $\frac{1}{30}\times\frac{32}{5}\times 25$, i.e. ₹$\frac{16}{3}$

36. (b) A's one day's work = $\frac{1}{15}$th work.

B's one day's work $=\frac{1}{10}$th work.

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

Let A left after x days.

$\therefore$ (A +B)'s x days' work $=\frac{x}{6}$th work.

Remaining work $=1-\frac{x}{6}=\frac{6-x}{6}$th work.

Now, in 5 days, work done by B $=\frac{6-x}{6}$th work.

$\therefore$ in 1 day work done by B $=\frac{6-x}{30}$th work

and $\frac{6-x}{30}=\frac{1}{10}$

$\therefore x=3$ days

37. (a) Let Suresh undertakes a tour of x days.

Then, expenses for each day = $\frac{360}{x}$

Now, $\frac{360}{x+4}=\frac{360}{x}-3$

or $360\left(\frac{1}{x}-\frac{1}{x+4}\right)=3$

or $x^2+4x-480=0$ or $x=-24$ or $x=20$
Since, $x\neq -24$ we have $x=20$

38. (a) A's one day's work $=\frac{1}{3}$rd work.

B's one day's work $=\frac{1}{6}$th work.

(A + B)'s one day's work $=\frac{1}{3}+\frac{1}{6}=\frac{1}{2}$nd work

$\therefore$ A and B together can complete the work (knit a pair of socks) in 2 days.
$\therefore$ They together knit two pair of socks in 4 days.

39. (b) Let B can finish the work in x days.
Then A can finish the work in $(x-3)$ days.

B's one day's work $=\frac{1}{x}$th work

A's one day's work $=\frac{1}{x-3}$th work

A's 4 days' work $=\frac{4}{x-3}$th work

Remaining work $=1-\frac{4}{x-3}=\frac{x-7}{x-3}$th work

The remaining work done by B in $14-4=10$ days.

Now, in 10 days, work done by B $=\frac{x-7}{x-3}$ th work

$\therefore$ in 1 day, work done by B $=\frac{1}{10}\left(\frac{x-7}{x-3}\right)$th work

and $\frac{1}{10}\left(\frac{x-7}{x-3}\right)=\frac{1}{x}$

$\Rightarrow x=15$days

$\therefore$ B $\rightarrow$ 15 days and A $\rightarrow$ 12 days

40. (a) $(A+B)$'s one day's work $=\frac{1}{5}$th work

Let A can do job in x days. Then,

A's one day's work $=\frac{1}{x}$th work

and B's one day's work $=\frac{1}{5}-\frac{1}{x}=\frac{x-5}{5x}$th work

Now, $(2A)$'s work $+\left(\frac{1}{3}\right)$B's work $=\frac{1}{3}$rd work

$\Rightarrow \frac{2}{x}+\frac{1}{3}\left(\frac{x-5}{5x}\right)=\frac{1}{3} \Rightarrow x=\frac{25}{4}=6\frac{1}{4}$ days

41. (b) X's one day's work $=\frac{1}{15}$th work.

Y's one day's work $=\frac{1}{15}+50\%$ of $\frac{1}{15}=\frac{1}{10}$th work

$\therefore$ $(X+Y)$'s one day's work $=\frac{1}{15}+\frac{1}{10}=\frac{1}{6}$th work

Hence, they together finish the work in 6 days.

42. (b) A's one day's work $=\frac{1}{8}$th work

B's one day's work $=\frac{1}{3}$rd work

$\therefore$ A's 4 day's work $=4\times\frac{1}{8}=\frac{1}{2}$nd work

$\therefore$ In next two days, total wall $=\frac{1}{2}+2\left(\frac{1}{8}\right)-2\left(\frac{1}{3}\right)$

$=\frac{1}{12}$th wall

Remaining wall $=1-\frac{1}{12}=\frac{11}{12}$th

Now, $\frac{1}{8}$th wall is built up by A in one day.

$\therefore$ $\frac{11}{12}$th wall is built up by A in $8\times\frac{11}{12}=7\frac{1}{3}$ days.

43. (b) Sakshi's one day's work $=\frac{1}{20}$th work

Tanya's one day's work

$=\frac{1}{20}+25\%$ of $\frac{1}{20}=\frac{1}{16}$th work

Hence, Tanya takes 16 days to complete the work.

44. (d) Part filled by first tap in one min $=\frac{1}{12}$th

Part filled by second tap in one min $=\frac{1}{18}$th

Now, $2\left[\frac{1}{12}+\frac{1}{18}\right]+$ unfilled part $=1$

$\Rightarrow$ unfilled part $=\frac{13}{18}$th

$\because$ $\frac{1}{18}$th part of tank is filled by second tap in 1min.

$\therefore$ $\frac{13}{18}$th part of tank is filled by second tap in 1 min.

$=18\times\frac{13}{18}$ min $=13$ min.

45. (b) $\because$ cistern fill in 6 hours.

$\therefore$ in 1 hour, filled part $=\frac{1}{6}$th

Now, due to leakage, filled part in 1 hour $=\frac{1}{8}$th

Part of the cistern emptied, due to leakage in 1 hour

$=\frac{1}{6}-\frac{1}{8}=\frac{1}{24}$th

$\therefore$ The leakage will empty the full cistern in 24 hrs.

46. (c) Let B can fill the cistern in x min. Then,

then A can fill the cistern in $\frac{x}{3}$min

Given $x-\frac{x}{3}=10 \Rightarrow x=15$ min

47. (b) Cistern filled by both pipes in one hour

$$= \frac{1}{14} + \frac{1}{16} = \frac{15}{112}\text{th}$$

$\therefore$ Both pipes filled the cistern in $\frac{112}{15}$hrs.

Now, due to leakage both pipes filled the cistern in

$$\frac{112}{15} + \frac{32}{60} = 8\text{hrs.}$$

$\therefore$ due to leakage, filled part in one hour $= \frac{1}{8}$

$\therefore$ part of cistern emptied, due to leakage in one hour

$$= \frac{15}{112} - \frac{1}{8} = \frac{1}{112}\text{th}$$

$\therefore$ in 112hr, the leakage would empty the cistern.

48. (b) In one min, (A + B) fill the cistern $= \frac{1}{10} + \frac{1}{15} = \frac{1}{6}$th

In 3 min, (A + B) fill the cistern $= \frac{3}{6} = \frac{1}{2}$th

Remaining part $= 1 - \frac{1}{2} = \frac{1}{2}$

$\because$ $\frac{1}{10}$th part filled by A in one min.

$\therefore$ $\frac{1}{2}$nd part filled by A in $10 \times \frac{1}{2} = 5\text{min}$.

$\therefore$ Total time = 3 + 5 = 8 min.

49. (a) Work done by the waste pipe in 1 minutes

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

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

50. (a) In one min, (A + B) fill the cistern $= \frac{1}{12} + \frac{1}{18} = \frac{5}{36}$th

In 4 min, (A + B) fill the cistern $= \frac{5}{36} \times 4 = \frac{5}{9}$th

Rest part $= 1 - \frac{5}{9} = \frac{4}{9}$th

$\because$ $\frac{1}{18}$th part is filled by B in one min.

$\therefore$ $\frac{4}{9}$th part is filled by B in $18 \times \frac{4}{9} = 8\text{min}$.

51. (c) Proportion of the volume of the tank filled by both the pipes in 4 min $= 4\left(\frac{1}{15} + \frac{1}{10}\right) = \frac{2}{3}$rd of the tank.

Volume of the tank filled by all the pipes working together $= \frac{1}{15} + \frac{1}{10} - \frac{1}{5} = \frac{-1}{30}$

i.e. $\frac{1}{30}$ tank is emptied in 1 min.

$\therefore$ $\frac{2}{3}$rd of the tank can be emptied in $\frac{2 \times 30}{3} = 20\text{min}$

52. (a) Let cistern will be full in x min. Then,
part filled by B in x min + part filled by A in (x – 4) min = 1

$$\Rightarrow \frac{x}{16} + \frac{x-4}{12} = 1$$

$$\Rightarrow x = \frac{64}{7} = 9\frac{1}{7}\text{hours.}$$

53. (a) Let A was turned off after x min. Then,
cistern filled by A in x min + cistern filled by B in (x + 23) min = 1

$$\Rightarrow \frac{x}{45} + \frac{x+23}{40} = 1$$

$$\Rightarrow 17x + 207 = 360 \Rightarrow x = 9\text{min}.$$

54. (a) Let cistern will be full in x min. Then,
part filled by A in x min + part filled by B in (x – 1) min + part filled by C in (x – 2) min = 1

$$\Rightarrow \frac{x}{3} + \frac{x-1}{4} + \frac{x-2}{6} = 1$$

$$\Rightarrow 9x = 19 \Rightarrow x = \frac{19}{9} = 2\frac{1}{9}\text{min}$$

55. (c) If both the pumps are opened together, then the tank will be emptied because the working efficiency of pump empting is more than that of the pump filling it. Thus in 1 min net proportion of the volume of tank filled

$$= \left(\frac{1}{8} - \frac{1}{16}\right) = \frac{1}{16}$$

or the tank will be emptied in 16 min

$\Rightarrow$ $\frac{1}{2}$ tank will be emptied in 8 min.