1.7 CHAPTER

Time & Work

In real life situations we come across practical problems of accomplishing the given project in prescribed time limit. Since efficiency of different person is different, the management has to take proper note of it before distributing the task to subordinates or executives. We discuss all such problems under the heading 'Time and work'.

In Time & Work, the problems are based on real life situations to allot the work between the subordinates based on their capacities.

The basic understanding of the problems comes by quantizing a work. We will start understanding the quantization with the following example.

Let us assume a person finishes 2 units of the work in one day. So for finishing 60 units he will take 30 days. So to find out the net time we should know the capacity of the person & the net amount of work to be finished.

All time & work problems depends upon one particular relation i.e.

$$\text{Capacity} = \frac{\text{Work}}{\text{Time}}$$

So to find out any variables we need to know the other two variables. If they are not given they can be assumed based on the situation. Let us start with a simple example.

Example 1.

5 Persons finish one work in 7 days. In how many days 7 persons will finish the same amount of work.

Solution.

Here we don't know how much amount of work, is to be finished & what is the capacity of the individuals. So we will assume the capacity.

Let us assume 1 person finishes 1 unit in 1 day

$\Rightarrow$ 5 persons will finish 5 units in 1 day

$\Rightarrow$ 5 persons will finish 35 units in 7 day

$\Rightarrow$ The net work is 35 units

Now taking 7 persons,

they will finish 7 units/day

So time taken to finish 35 units = 35/7 = 5 days.

Example 2.

A can finish a work in 10 days & B can finish the same work in 12 days. In how many days, they will finish the task working together.

Solution.

Given:

A takes 10 days

B takes 12 days

Since we can not assume the same capacity here. So we will assume the work. Let us assume the work is 60 units.

So capacity of A $= \frac{60}{10} = 6$ units/day

Capacity of B $= \frac{60}{12} = 5$ units/day

Combined capacity of A & B = 11 units/day

So time taken by A & B $= \frac{60}{11} = 5\frac{5}{11}$ days

Example 3.

A finishes a task in 30 days. But with the help of B, he finishes the same task in 12 days. How much time B alone will take to finish the task.

Solution.

Let the work be 60 units

A $\xrightarrow{\text{Capacity} = 2\text{unit}}$ 30 days

A+ B $\xrightarrow{\text{Capacity} = 5\text{unit}}$ 12 days

B $\xrightarrow{\text{Capacity} = 3\text{unit}}$?

So the time taken B $= \frac{60}{3} = 20$ days

Alternate Work

Sometimes the availability of the person is limited in that case they work in a particular sequence it can be understood with the following example.

Example 1.

A can finish a task in 12 days while B can finish a task in 15 days. In how many days both of them will finish the work if they work on alternate days started by 'A'.

Solution.

Let work = 60 units

$A \xrightarrow{\text{Capacity = 5unit/day}} 12 \text{ days}$

$B \xrightarrow{\text{Capacity = 4unit/day}} 15 \text{ days}$

Now since they work on alternates day, the work distribution will be in following manner for individual day

$\underbrace{5+4}+\underbrace{5+4}+\underbrace{5+4}+ \ldots\ldots = 60$

So we can understand that in 2 days they finish 9 unit and the work is being completed as a multiple of 9 unit.

So 9 × 6 units will be finished in 12 days.

So the 60 units of work can be allocated as

Work allocation	9×6 units ↓ (A+B)	+	5 units ↓ A	+ 1 unit = 60 units ↓ B
Time allocation	2×6 days		1 day	1/4 day = 13¼ day

Suppose three people can finish work individually in A, B, C days respectively. If all three of them start working on some alternate pattern then if A > B > C ∈ N. $\frac{1}{A}+\frac{1}{B}+\frac{1}{C}=\frac{1}{N}$. A, B C & N all are natural number then work will get completed in integral number of days who is starting the work will not effect the total time taken.

But if $\frac{1}{A}+\frac{1}{B}+\frac{1}{C}\neq\frac{1}{N}$ then in order to get the job done in minimum no. of days, we should use most efficient person on day one, 2nd best person on day 2 and least efficient person on day 3 and so on.

Concept of Negative Work

Negative work indicates the destructing conditions. Take for example if a bridge has to be made the flow of water of river will cause distruction of the work. So the river water does the negative work. These problems have to be dealt same as in previous cases.

Example 1.

A can build a house in 10 days, B can build the same house in 12 days while C can completely destruct the house in 20 days. in how many days the work will be finished if all three are working together.

Solution.

Let the work = 60 units

$A \xrightarrow[\text{Constructs}]{\text{Cap.=+6 units/day}} 10 \text{ days}$

$B \xrightarrow[\text{Constructs}]{\text{Cap.=+5 units/day}} 12 \text{ days}$

$C \xrightarrow[\text{destructs}]{\text{Cap.=−3 units/day}} 20 \text{ days}$

$A + B + C \xrightarrow{6+5-3=8 \text{ units/day}} 8 \text{ units/day}$

As all of them are working together.

So time taken $= \frac{60}{8} = 7\frac{1}{2}$ days.

Concept of Wages

If the work is finished by more than one persons then the wages for them will be distributed among them based on the amount of work done by them.

So

Ratio of wages = Ratio of work finished

Now if all the persons are working for same no. of days then the ratio of work = ratio of capacities, i.e. ratio of wages = ratio of capacities.

Example 1.

5 man or 3 women finishes a work in 10 days if 6 women finishes the work along with 7 man then find out the wages received by them if the total work costs Rs. 3000.

Solution.

Lee the work 150 units

5 man ⟶ 10 days

$\Rightarrow$ 1 man $\xrightarrow{\text{Cap.=3unit/day}}$ 50 days

3 women ⟶ 10 days

$\Rightarrow$ 1 women $\xrightarrow{\text{Cap.=5unit/day}}$ 30 days

Since all of them are working for same no. of days so the wages will be divided in the ratio of their capacity

i.e. 3000 should be divided in

6 × 5 : 7 × 3 = 30 : 21 or 10 : 7

so amount received by 6 women $= \frac{30\times3000}{51}$

amount received by 7 men $= \frac{21\times3000}{51}$

Pipes & Cisterns

The Pipes and Cisterns problems are once again similar as of the general time and work problem only thing that has to be understood is the concept of positive and negative work.

The inlet pipe always does the positive work while the outlet pipe always does the negagive work. Let us see some problems.

Example 1.

Pipe A can fill a tank in 10 hours while pipe B can empty a completely filled tank in 15 hours. How much time it will take to fill a 2/3rd filled tank completely by both of the pipes.

Solution.

Take volume = 30 litres

$$A \xrightarrow[\text{Fill}]{\text{Cap.} = 3\text{litre/hr}} 10 \text{ hours}$$

$$B \xrightarrow[\text{Empty}]{\text{Cap.} = -2\text{litre/hr}} 15 \text{ hours}$$

Capacity of (A + B) = 3 – 2 = 1 litre/hr

Amount of water to be filled

$$= \left(\frac{2}{3}\right) \times 30 = 20 \text{ litre}$$

So the time taken = $\frac{20}{1} = 20$ hrs.

Efficiency Comparison

When two person's efficiencies are compared then in that case, the basic work and time calculations become much easier. In this sort of case, we will be able to assume the capacities directly. For example:

Example 1.

A is 3 times efficient than B and can finish the work 10 days earlier as compared to B. How much time both will take to finish the same amount of work?

Solution.

If A is 3 times efficient than B

Then, B will take thrice the no. of days what A takes

$$\text{as } \eta \propto \frac{1}{\text{Time}}$$

So if A takes x days then B takes $3x$ days given that

$$x + 10 = 3x \Rightarrow x = 5 \text{ so}$$

$$A \xrightarrow{\text{Cap.3unit/day}} 5 \text{ days}$$

$$B \xrightarrow{\text{Cap.1unit/day}} 15 \text{ days}$$

Work 15 unit

(A + B)'s capacity = 4 unit/day

$$\text{Time taken} = \frac{15}{4} = 3\frac{3}{4} \text{ days}$$

Example 2.

A tank can be filled completely in 6 hours but because of the leak at its bottom, it takes 2 more hours to get filled. In how much time the leak can empty a full tank?

Solution.

$$\text{Pipe} \xrightarrow{\text{Cap. 4 litre/hr}} 6 \text{ hrs}$$

$$\text{Pipe + Leak} \xrightarrow{\text{Cap. 3 litre/hr}} 8 \text{ hrs}$$

Tank 24 litre

Leak capacity = 1 litre/hour

$$\text{Time} = \frac{24}{1} = 24 \text{ hrs}$$

Example 3.

A monkey climbs on a greeced pole. In 1 minute it goes up by 3 meter while in the next 1 minute it comes down by 2 meter if the height of the pole is 50 meter. In how many minutes the monkey will be at the top?

Solution.

When monkey will reach @ the height of 47 m. In the next minute, it will reach at the top. So we will find out how much time the monkey takes to reach @ the height of 47 m.

in first minute monkey moves = +3 m

is second minute monkey moves = –2 m

so in 2 minutes monkey effectively moves = 1 m

So it will take 47 × 2 min to reach 47 m

So total time taken = 47 × 2 + 1 min = 95 mins.

Example 4.

In a hostel there was food for 100 persons for 30 days. After 10 days 100 more persons joined the hostel for how many days the food will last?

Solution.

After 10 days the situation will be as follows:

100 person can take the food for 20 days. If 100 more persons joined, total person in the hostel = 200

If 100 persons take 20 days

Then 200 persons will take $\frac{20 \times 100}{200} = 10$ days.

Example 5.

Ram can finish 1/2 of a task in 9 days while Shyam can finish 1/4th of the same task in 3 days. How many days they will take to finish the work together?

Solution.

Ram finishes 1/2 work in 9 days

He will finish full work in 18 days

Shyam finishes 1/4th work in 3 days
He will finish full work in 12 days
Let work 36 units

So Ram $\xrightarrow{2 \text{ unit/day}}$ 18 days

Shyam $\xrightarrow{3 \text{ unit/day}}$ 12 days

Capacity of Ram & Shyam = 5 unit/day

Time taken = $\frac{36}{5} = 7\frac{1}{5}$ days

Example 6.

Ramu is thrice as finish efficient as Rahul. If working together they finishes the work in 20 days. How many days Rahul will take to finish the work?

Solution.

Let us assume the capacity of Ramu is 3 unit/day
then capacity of Rahul = 1 unit/day
Total capacity of Ramu & Rahul = 4 unit/day
If they finishes the work in 20 days then net work
$= 20 \times 4 = 80$ unit

So time taken by Rahul = $\frac{80}{1}$ = 80 days.

Example 7.

Suresh can finish a task in 24 days. Along with Monika, Suresh completed the task & they were paid Rs. 108 & Rs. 162 respectively. How many days they would have taken to finish the work together?

Solution.

If they are working together for same number of days then
Ratio of wages = ratio of capacities
i.e. Monika : Suresh = 108 : 162 = 2 : 3
Let us assume
Monika's capacity = 2 unit/day
Suresh's capacity = 3 unit/day
Then net work = $24 \times 3 = 72$ units
So time taken when working together

$= \frac{72}{2+3} = 14\frac{2}{5}$ days.

Example 8.

5 men & 3 boys can finish a work in 12 days and 1 man and 3 boys can finish a work in 60 days. How much time 4 boys along with 3 men will take to finish the work?

Solution.

Let the capacity of man by 'm' and capacity of boy be 'b'

$5m + 3b \xrightarrow{5 \text{ unit/day}} 12$ days

$1m + 3b \xrightarrow{1 \text{ unit/day}} 60$ days

Work 60 unit
$\Rightarrow 5m + 3b = 5$
$1m + 3b = 1$
So $m = 1, b = 0$
Total capacity of 4 boys and 3 men
$= 4 \times 0 + 3 \times 1$
= 3 units/day

Time taken = $\frac{60}{3}$ = 20 days.

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Concept of Man-Day

If 100 workers can finish the task in 50 days, then 1 worker can finish the task in $100 \times 50 = 5000$ day.

This is represented in form of man-day

So, man day is nothing but the time required to finish the task by 1 person.

Three Cases:

Case-I.

Let 100 workers can finish the task in 50 days, then how many days are required to finish the task by 25 workers?

Solution:

Here man Day = $100 \times 50 = 5000$
how according to question only 25 workers are available so

$25 \times$ day = 5000

Day = $\frac{5000}{25}$ = 200 days are required to finished the task by 25 workers.

Case-II.

Let 100 worker can finish the task in 50 days. 100 worker started completing the task by working for 10 days. Now to finish the task as soon as possible 100 more workers are employed. Now calculate the total number of days required to complete the task.

Solution:

Here Man × Day = constant

$100 \times 50 = 5000$

Initially 100 workers are working for 10 days So they can finish

$100 \times 10 = 1000$ (Man.Day)

Now 4000 man - Day is still remaining which has to be finished by 200 workers

So, $200 \times \text{Day} = 4000$

$$\text{Day} = \frac{4000}{200} = 20 \text{ days}$$

So total it requires 10 + 20 = 30 days to complete the task.

Case-III.

Let 100 workers can finish the task in 50 days. 100 workers started the task and working for 20 days. Now because of unforeseen situations 80 workers have to left the work. Find total number of days required to complete the task.

Solution:

Here Man . Day = constant

$100 . 50 = 5000$

initially 100 workers are working for 20 day so, they can finish

$100 \times 20 = 2000$ (Man . Day)

Now, 3000 (Man . Day) is still remaining which has to be finished by 20 workers

$\text{Man} \times \text{Day} = 3000$

$20 \times \text{Day} = 3000$

$$\text{Day} = \frac{3000}{20} = 150 \text{ days}$$

So total it requires 20 + 150 = 170 days to complete the task.

Man × Day ×Hour

$M_1 \times D_1 \times H_1 =$ work, also

$M_2 \times D_2 \times H_2 =$ work

Work may be anything like construction of a wall of different size.

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Also if $W_1 = l_1 b_1 h_1$ where length is l_1 breadth b_1 and height h_1 and if $W_2 = l_2 b_2 h_2$ where l_2, b_2 and h_2 are length, and height respectively of second wall then

$$\frac{M_1 D_1 H_1}{l_1 b_1 h_1} = \frac{M_2 D_2 H_2}{l_2 b_2 h_2}$$

$$= \frac{l_1 b_1 h_1}{l_2 b_2 h_2} = \frac{M_1 D_1 H_1}{M_2 D_2 H_2}$$

Concept of Efficiency

Efficiency of persons performing same task may not be same. It may be different for different persons. If efficiency is high a person can complete the work much faster than stipulated time period. Similarly if efficiency is low, it requires more time to finish the same task than that of stipulated time.

We will observe following examples to have a glimpse of problems based on concept of efficiency.

Ex.1 A is three times as efficient as B and finish the task 32 days ahead of B. Find the number of days required to finish the task if both are working simultaneously.

Sol.: Let A requires x days then

B requires $3x$ days

$3x - x = 2x \Rightarrow 32$

$x = 16$ days

$x = 16 \quad 3x = 48$ days

Together they can finish

$$\frac{1}{16} + \frac{1}{48} = \frac{4}{48} \text{ part} = \frac{1}{12} \text{ part}$$

Thus 12 days are required by them to finish the task.

Ex.2 A is four times as efficient as of B and can finish a task 45 days ahead of B. Find total number of days required to finish the task if both are working simultaneously.

Sol.: Let A requires x days then

B requires $4x$ days.

According to given condition

$4x - x = 45 \Rightarrow 3x = 45 \Rightarrow x = 15$.

Together they can finish

$$\frac{1}{15} + \frac{1}{60} = \frac{5}{60} = \frac{1}{12} \text{ part in a day}$$

So, it requires 12 days to finish the task together.

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SOLVED EXAMPLES

1. Nishu and Archana can do a piece of work in 10 days and Nishu alone can do it in 12 days. In How many days can Archana do it alone?
(a) 60 days (b) 30 days
(c) 50 days (d) 45 days
Ans.(a)

One day work of both $= \frac{1}{10}$

and Nishu's day work $= \frac{1}{12}$

So, Archana's one day work

$= \frac{1}{10} - \frac{1}{12} = \frac{2}{120} = \frac{1}{60}$

So, 60 days required to finish the work by Archana.

2. 4 men and 3 women finish a job in 6 days. And 5 men and 7 women can do the same job in 4 days. How long will 1 man and 1 women take to do the work?

(a) $22\left(\frac{2}{7}\right)$ days (b) $25\left(\frac{1}{2}\right)$ days

(c) $5\left(\frac{1}{7}\right)$ days (d) $12\left(\frac{7}{22}\right)$ days.

And. (a)
Let man completes m part in a day and woman completes w part in a day then

$4\,m + 3\,w = \frac{1}{6}$ also ...(i)

$5\,m + 7\,w = \frac{1}{4}$ ...(ii)

After simplifying we get

$20\,m + 15\,w = \frac{5}{6}$

$20\,m + 28\,w = 1$

So $13\,w = \frac{1}{6}$

$w = \frac{1}{78}$ ...(iii)

From (i) and (iii) we get

$m = \frac{5}{156}$

$m + w = \frac{5}{156} + \frac{1}{78} = \frac{7}{156}$

So it require $\frac{156}{7}$ days $= 22\frac{2}{7}$

3. A can do a piece of work in 10 days and B can do the same work in 20 days. With the help of C, they finish the work in 5 days. How long will it take for C alone to finish the work?
(a) 20 days (b) 10 days
(c) 35 days (d) 15 days
Ans. (a)

$\frac{1}{5} - \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$

This is C's one day work so 20 days are required for C alone to finish task

4. A can do a piece of work in 20 days. He work at it for 5 days and then B finishes it in 10 more days. In how many days will A and B together finish the work?
(a) 8 days (b) 10 days
(c) 12 days (d) 6 days
Ans. (a)

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

in 5 day 'A' can complete $\frac{1}{20} \times 5 = \frac{1}{4}$ part

remaining work $= \frac{3}{4}$ part

$\therefore$ B finishes $\frac{3}{4}$ part in 10 days

$\therefore$ B finishes 1 part in $\frac{10}{3/4} = \frac{40}{3}$ days

together they can finish it in

$\frac{1}{\frac{1}{20} + \frac{3}{40}} = \frac{1}{\frac{1}{8}} = 8$ days

5. Twenty workers can finish a piece of work in 30 days. After how many days should 5 workers leave the job so that the work is completed in 35 days?
(a) 5 days (b) 10 days
(c) 15 days (d) 20 days
Ans. (c)

Man × Day = Man . Day

$20 \times 30 = 600$

Let 5 workers leave after x days then

$20x + 15\,(35 - x) = 600$

$5x + 525 = 600$

$5x = 75,\ x = 15$

6. Subhash can copy 50 page in 10 hours; subhash and Prakash together can copy 300 pages in 40 hours. In how much time can Prakash copy 30 pages?
(a) 13 h (b) 12 h
(c) 11 h (d) 9 h

Ans. (b)

$\therefore$ Subhash in 10 hours can copy 50 pages

$\therefore$ in 1 hour $\frac{50}{10} = 5$ pages

Both can copy 300 pages in 40 hours

So, in 1 hour $\frac{300}{40} = 7.5$

Clearly prakash can copy 2.5 pages in 1 hour So 30 pages in $\frac{1}{2.5} \times 30 = 12$ hours

7. Sashi can do a piece of work in 25 days and Rishi can do it in 20 days. They work for 5 days and then Sashi goes away. In how many more days will Rishi finish the work?

(a) 10 days (b) 12 days

(c) 14 days (d) None of these

Ans. (d)

Shashi's one day work = $\frac{1}{25}$

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

Together they can finish $\frac{1}{25} + \frac{1}{20}$

$= \frac{9}{100}$ part in a day

$\therefore$ Work in 5 days $\frac{9}{100} \times 5 = \frac{45}{100}$ part

$\frac{55}{100}$ part is remaining. Rishi can finsh it in $\frac{\left(\frac{55}{100}\right)}{\left(\frac{1}{20}\right)}$

= 11 days .

8. Priya can do 1/2 of the work in 8 days while Preeti can do 1/3 of the work in 6 days. How long will it take for both of them to finish the work?

(a) $\frac{88}{17}$day (b) $\frac{144}{17}$days

(c) $\frac{72}{17}$days (d) 8 days

Ans. (b)

Priya's days work = $\frac{(1/2)}{8} = \frac{1}{16}$

Preeti's days work

$\Rightarrow \frac{(1/3)}{6} = \frac{1}{18}$ days

Together they can finish in

$\frac{1}{\frac{1}{16} + \frac{1}{18}} = \frac{144}{17}$ days

9. Manoj takes twice as much time as Ajay and thrice as much as Vijay to finish a piece of work. Together they finish the work in 1 day. What is the time taken by Manoj to finish the work?

(a) 6 days (b) 3 days

(c) 2 days (d) None of these

Ans. (a)

M : A : V

2 : 1 : 2/3 or 6 : 3 : 2

Let Manoj takes $6x$ days Ajay takes $3x$ days and vijay $2x$ days then $\frac{1}{6x} + \frac{1}{3x} + \frac{1}{2x} = 1$

$\frac{1}{x}\left[\frac{1}{6} + \frac{1}{3} + \frac{1}{2}\right] = 1$

$\frac{1}{x} = 1$, So $x = 1$

Manoj will take 6 days

10. Apurva can do a piece of work in 12 days. Apurva and Amit complete the work together and were paid Rs. 54 and Rs. 81 respectively. How many days must they have taken to complete the work together?

(a) 4 days (b) 4.5 days

(c) 4.8 days (d) 5 days

Ans. (c)

Payment ratio = 54 : 81

days work = $\frac{1}{12} : \frac{1}{x}$

$54 : 81 :: \frac{1}{12} : \frac{1}{x}$

$81 \times \frac{1}{12} = 54 \times \frac{1}{x}$

$x = \frac{54 \times 12}{81}$, $x = 8$ days

together they will take = $\frac{12 \times 8}{12 + 8} = 4.8$ days .

11. Raju is twice as Vijay. Together, they finish the work in 14 days. In how many days can Vijay alone do the same work?

(a) 16 days (b) 21 days

(c) 32 days (d) 42 days

Ans. (d)

Let Raju can do the work in x days then vijay in $2x$ days

Together they can complete in

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

$x = 21$ days, $2x = 42$ days

12. 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, compare the daily work done by a man with that done by a boy?

(a) 1 : 2 (b) 1 : 3

(c) 2 : 1 (d) 3 : 1

Ans. (c)

$$12\,M + 16\,B = \frac{1}{5} \quad ...(i)$$

$$13\,M + 24\,B = \frac{1}{4} \quad ...(ii)$$

Also, $36\,M + 48\,B = \frac{3}{5}$

$$26\,M + 48\,B = \frac{2}{4}$$

$$10\,M = \frac{1}{10},\ M = \frac{1}{100}$$

from eq (1) $B = \frac{1}{200}$, M : B = 2 : 1

13. A can do a work in 10 days and B can do the same work in 20 days. They work together for 5 days and then A goes away. In how many more days will B finish the work?

(a) 5 days (b) 6.5 days

(c) 10 days (d) $8\frac{1}{3}$ days

Ans. (a)

In 5 days the can complete

$$\left[\frac{1}{10} + \frac{1}{20}\right] \times 5 = \frac{3}{4} \text{ part}$$

Remaining is $\frac{1}{4}$ part

B will finish it in $\frac{1}{1/20} = 5$ days

14. 15 men could finish a piece of work in 210 days. But at the end of 100 days, 15 additional men are employed. In how many more days will the work be complete?

(a) 80 days (b) 60 days

(c) 55 days (d) 50 days

Ans. (c)

Man × Day = Man . Day

15 × 210 = 3150, so after 100 days

15 × 100 = 1500 will be completed

remaining work = 1650 Man . Day

Man . Day = 1650

30. Day = 1650

Day = 55

15. In a fort there was sufficient food for 200 soldiers for 31 day. After 27 days 120 soldiers left the fort. For how many extra days will the rest of the food last for the remaining soldiers?

(a) 12 days (b) 10 days

(c) 8 days (d) 6 days

Ans. (b)

Man × Day = Man.Day

200 × 31 = 6200

After 27 days

200 × 27 = 5400 Man. Day is finished

remaining = 800

Man . Day = 800

80 . Day = 800

Day = 10

16. A cistern is normally filled in 5 hours. However, it takes 6 hours when there is leak in its bottom. If the cistern is full, in what time shall the leak empty it?

(a) 6 h (b) 5 h

(c) 30 h (d) 15 h

Ans. (c)

In one hour $\frac{1}{5}$ part is filled now leak can empty in x hour then

$$\frac{1}{5} - \frac{1}{x} = \frac{1}{6}$$

$$\Rightarrow \frac{1}{5} - \frac{1}{6} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{30} = \frac{1}{x},\ x = 30 \text{ hours}$$

17. Pipe A and B running together can fill a cistern in 6 minutes. If B takes 5 minutes more than A to fill the cistern, then the time in which A and B will fill the cistern separately will be respectively?

(a) 15 min, 20 min (b) 15 min, 10 min

(c) 10 min, 15 min (d) 25 min, 20 min

Ans. (c)

Let pipe A can fill in x and pipe B in $x+5$ minutes

$$\frac{1}{x}+\frac{1}{x+5}=\frac{1}{6}$$

or $$\frac{x(x+5)}{2x+5}=6$$

$$x = 10,\ x+5 = 15$$

18. There are two pipes in a tank. Pipe A is for filling the tank & Pipe B is for emptying the tank. If A can fill the tank in 10 hours and B can empty the tank in 15 hours then find how many hours will it take to completely fill a half empty tank?

(a) 30 hours (b) 15 hours

(c) 20 hours (d) 33.33 hours

Ans. (b)

$$\frac{1}{10}-\frac{1}{15}=\frac{5}{150}=\frac{1}{30}$$

So it takes 30 hours to fill the tank and 15 hours to fill half the tank

19. There are three Taps A, B and C in a tank. They can fill the tank in 10 hrs, 20 hrs and 25 hrs respectively. At first, all of them are opened simultaneously. Then after 2 hours tap C is closed and A and B are kept running. After the 4th hour, tap B is also closed. The remaining work is done by Tap A alone. Find the percentage of the work done by Tap A by itself.

(a) 32 % (b) 52 %

(c) 75 % (d) None of these

Ans. (d)

	A	B	C		
Ist hours	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	
IInd hours	$\frac{1}{10}$	$\frac{1}{20}$	$\frac{1}{25}$	$\frac{19}{100}$ part	
IIIrdhours	$\frac{1}{10}$	$\frac{1}{20}$	×	$\frac{3}{20}$	$\frac{15}{100}$part
IVthhours	$\frac{1}{10}$	$+\frac{1}{20}$	×	$\frac{3}{20}$	$\frac{15}{100}$ part

So remaining part after 4 hour is

$$\frac{\frac{32}{100}}{1/10} = 3.2 \text{ hours}$$

% of work done by A

$$\frac{(10+10+10+10+32)}{100}\times 100 = 72\%$$

□□□□

Time & Work

I Practice Exercise: I

1. 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 will the work get completed?

(a) $6\frac{2}{3}$ days (b) $8\frac{1}{3}$ days

(c) $7\frac{2}{3}$ days (d) None of these

2. A is thrice as good as B and is therefore able to finish a piece of work in 60 days less than B. Find the time in which they can do it, working together.

(a) $22\frac{3}{4}$ days (b) $22\frac{1}{2}$ days

(c) 24 days (d) None of these

3. Ramesh takes twice as much time as Mahesh and thrice as much time as Suresh to complete a job. If working together, they can complete the job in 4 days, then the time taken by each of them separately to complete the work is

(a) 36, 24 and 16 days

(b) 20, 16 and 12 days

(c) 24, 42 and 18 days

(d) None of these

4. 5 men can complete a work in 2 days, 4 women can complete the same work in 3 days and 5 children can do it in 3 days. 1 man, 1 women and 1 child, working together, can complete the work in

(a) 6 days (b) 4 days

(c) 8 days (d) None of these

5. Ajay and Sunil can do a piece of work in 10 days, sunil and Sanjay in 15 days and Sanjay and Ajay in 20 days. They together work at it for 6 days and then Ajay leaves and Sunil and Sanjay go on together for 4 days more. If Sunil then leaves, how long will Sanjay take to complete the work?

(a) 12 days (b) 10 days

(c) 16 days (d) None of these

6. Bansal, Gupta and Singhal together can complete a work in 4 days. If Bansal and Gupta together can

complete the work in $4\frac{4}{5}$ days, Gupta and Singhal together can do it in 8 days, then Gupta alone can complete the work in

(a) 16 days (b) 12 days
(c) 20 days (d) None of these

7. Working 7 hours daily 24 men can complete a piece of work in 27 days. In how many days would 14 men complete the same piece of work working 9 hours daily?

(a) 36 days (b) 30 days
(c) 32 days (d) None of these

8. 4 men or 6 women can finish a piece of work in 20 days. In how many days can 6 men and 11 women finish the same work?

(a) 9 days (b) 6 days
(c) 7 days (d) None of these

9. A does half as much work as B in three- fourths of the time. If together they take 18 days to complete a work, how much time shall B take to do it?

(a) 30 days (b) 35 days
(c) 40 days (d) 66 days

10. Two men undertake to do a piece of work for Rs. 600. One alone could do it in 6 days and the other in 8 days. With the assistance of a boy they finish it in 3 days. Boy's share should be

(a) Rs. 300 (b) Rs. 225
(c) Rs. 75 (d) Rs. 100

11. 5 men and 2 boys working together can do four times as much work per hour as a man and a boy together. The work done by a man and a boy should be in the ratio

(a) 1 : 2 (b) 2 : 1
(c) 1 : 3 (d) 4 : 1

12. A and B working separately can do a piece of work in 9 and 12 days, respectively. If they work for a day altenately with A starting the work. In how many days the work will be completed?

(a) $10\frac{1}{2}$ days (b) $10\frac{1}{4}$ days

(c) $10\frac{2}{3}$ days (d) $10\frac{1}{2}$ days

13. A and B can do a piece of work in 45 and 40 days, respectively. They began the work together, but A leaves after some days and B finished the remaining work in 23 days. After how many days, did A leaves?

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

14. A can do a piece of work in 30 days, B in 50 days and C in 40 days. If A is assisted by B on one day and by C on the next day alternately work will be completed in

(a) $17\frac{32}{35}$ days (b) $19\frac{2}{3}$ days

(c) $16\frac{31}{37}$ days (d) $18\frac{1}{3}$ days

□□□□

Solutions

1. Ans. (a)

Here, $x = 15$ and $y = 12$

∴ Working together, 10 men and 15 women will complete the work in

$$= \frac{xy}{x+y} \text{ days}$$

$$= \frac{15 \times 12}{15+12}, \text{ i.e. } \frac{20}{3} \text{ or, } 6\frac{2}{3} \text{ days.}$$

2. Ans. (b)

Let B takes x days to do the work. Then, A takes $(x - 60)$ days to complete the work.

Since ratio of work done by A and B is 3 : 1, ratio of time taken by A and B is 1 : 3.

We have, $\frac{x-60}{x} = \frac{1}{3}$

$\Rightarrow 3(x - 60) = x$ or, $x = 90$.

∴ Time taken by B to finish the work = 90 days

and time taken by A to finish the work $= \frac{90}{3} = 30$ days.

∴ A and B, working together, will complete the work in $\frac{xy}{x+y}$ days

$$= \frac{90 \times 30}{90+30} \text{ days, i.e. } \frac{45}{2}$$

or, $22\frac{1}{2}$ days.

3. Ans. (d)

Let Ramesh takes x days to finish the work.

Then, Mahesh takes $\frac{x}{2}$ and Suresh takes $\frac{x}{3}$ days to finish the same work.

$\therefore$ Ramesh, Mahesh and Suresh, working together, will complete the work in

$$\frac{xyz}{xy+yz+zx} \text{ day}$$

$$= \frac{x \times \frac{x}{2} \times \frac{x}{3}}{x \times \frac{x}{2} + \frac{x}{2} \times \frac{x}{3} + x \times \frac{x}{3}} \text{ days}$$

i.e. $\frac{x^3/6}{x^2}$ or, $\frac{x}{6}$ days

Given : $\frac{x}{6} = 4$. $\therefore$ $x = 24$

$\therefore$ Ramesh takes 24 days. Mahesh takes $\frac{24}{2}$ or 12 days and Suresh takes $\frac{24}{3} = 8$ days to finish the work.

4. Ans. (b)

1 Man can complete the work in $5 \times 2 = 10$ days, 1 woman can complete the work in $4 \times 3 = 12$ days. And 1 child can complete the work in $5 \times 3 = 15$ days.

$\therefore$ 1 man, 1 woman and 1 child, working together, can complete the work in

$$\frac{xyz}{xy+yz+zx} \text{ days}$$

$$= \frac{10 \times 12 \times 15}{10 \times 12 + 12 \times 15 + 15 \times 10} = 4 \text{ days}$$

5. Ans. (b)

Ajay, sunil and Sanjay, working together, can complete the work in

$$= \left(\frac{2xyz}{xy+yz+zx} \right) \text{ days}$$

$$= \left(\frac{2 \times 10 \times 15 \times 20}{10 \times 15 + 15 \times 20 + 20 \times 10} \right)$$

$\frac{6000}{650}$, i.e. $\frac{120}{13}$ days

$\therefore$ Work done by all of them together in 6 days

$$= \frac{6 \times 13}{120} \text{ i.e. } \frac{13}{20}$$

Also, work done by Sunil and Sanjay in 4 days

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

$\therefore$ Remaining work

$$= 1 - \left(\frac{13}{20} + \frac{4}{15} \right) = \frac{1}{12}$$

Which is to be done by Sanjay.

Now, Ajay Sunil and Sanjay, can complete the work in $\frac{120}{13}$ days and Ajay and Sunil can complete the work in 10 days.

$\therefore$ Sanjay alone can complete the work in

$$\frac{\frac{120}{13} \times 10}{10 - \frac{120}{13}} = 120 \text{ days.}$$

$\therefore$ $\frac{1}{12}$ of the work is done by Sanjay in $\frac{120}{12} = 10$ days.

6. Ans. (b)

Bansal, Guptal and Singhal together can finish the work in 4 days.

Bansal and Gupta together can do it in $\frac{24}{5}$ days.

Gupta and Singhal together can do it in 8 days.

Therefore, Bansal alone can complete the work in

$$= \frac{xy}{y-x} \text{ days } = \left(\frac{8 \times 4}{8-4} \right) \text{ days}$$

[Here, $x = 4$ and $y = 8$ days

Also, Singhal alone can complete the work in

$$= \left(\frac{xy}{x-y} \right) \text{days} = \left(\frac{\frac{24}{5} \times 4}{\frac{24}{5} \times 4} \right) \text{days}$$

Here, $x = 4$ and $y = \frac{24}{5} = 24$ days.

$\therefore$ Bansal and Singhal can complete the work in

$$= \left(\frac{xy}{x+y} \right) \text{ days. } = \left(\frac{24 \times 8}{24+8} \right) \text{days}$$

[Here $x = 24$ and $y = 8$] $= 6$ days.

Gupta alone can complete the work $\frac{6 \times 4}{6-4} = 12$.

7. Ans. (a)

We have $M_1 = 24\ D_1 = 27,\ W_1 = 1,\ t_1 = 7,$

$M_2 = 14,\ D_2 = ?,\ W_2 = 1,\ t_2 = 9,$

$M_1D_1t_1W_2 = M_2D_2t_2W_1$

$\Rightarrow 24 \times 27 \times 7 \times 1 = 14 \times D_2 \times 9 \times 1$

$\Rightarrow\ D_2 = 36$ days.

8. Ans. (b)

Here, $a = 4,\ b = 6,\ n = 20,\ c = -6,$ and $d = 11.$

$\therefore$ Required number of days

$$= \left(\frac{nab}{bc + ad}\right) \text{days}$$

$$= \left(\frac{20 \times 4 \times 6}{6 \times 6 + 4 \times 11}\right) \text{days} = 6 \text{ days.}$$

9. Ans. (d)

If B does x part of work in 1 hour

Then B does $\frac{3}{4}x$ part in $\frac{3}{4}$ hour

Now, A does $\frac{3x}{8}$ work in 1 hour

It is given that $x + \frac{3}{8}x = \frac{1}{18}$

So $x = \frac{4}{99}$

B complete work in $\frac{99}{4}$ days and A in 66 days.

10. Ans. (c)

1st man's 3 days' work $= \frac{3}{6} = \frac{1}{2}$

2nd man's 3 days' work $= \frac{3}{8}$

Boy's 3 days' work $= 1 - \left(\frac{1}{2} + \frac{3}{8}\right) = \frac{1}{8}$

$\therefore$ They should get money in the ratio

$\frac{1}{2} : \frac{3}{8} : \frac{1}{8}$ i.e. 4 : 3 : 1

$\therefore$ Boy's share $= \text{Rs.}\frac{1}{8} \times 600 = \text{Rs. } 75.$

11. Ans. (b)

Obviously,

$(5\ M + 2B) = 4(1M + 1B)$

$\therefore\ M = 2B$

$\therefore$ Work done by a man and boy are in the ratio 2 : 1

12. Ans. (b)

(A + B)'s 2 days' work $\frac{1}{9} + \frac{1}{7} = \frac{7}{36}$ Evidently, the work done by A and B during 5 pairs of days

$= 5 \times \frac{7}{36} = \frac{35}{36}$

Remaining work $= 1 - \frac{35}{36} = \frac{1}{36}$

Now, $\frac{1}{9}$ work is done by A in 1 day

$\therefore$ $\frac{1}{36}$ work, will be done by A in

$9 \times \frac{1}{36} = \frac{1}{4}$ day

So, total time taken $= 10\frac{1}{4}$ days.

13. Ans. (c)

B's 23 days' work $= \frac{23}{40}$

Remaining work $= 1 - \frac{23}{40} = \frac{17}{40}$

Now, (A+B)'s 1 day's work

$= \frac{1}{45} + \frac{1}{40} = \frac{17}{360}$

$\frac{17}{360}$ work is done by A and B in 1 day

$\therefore$ $\frac{17}{40}$ work is done by A and B in

$\frac{360 \times 17}{17 \times 40} = 9$ days

So, A left after 9 days.

14. Ans. (a)

(A + B)'s 1 day's work $= \frac{1}{30} + \frac{1}{50} = \frac{8}{150}$

$\therefore$ (A+C)'s 1day's work

$= \frac{1}{30} + \frac{1}{40} = \frac{7}{120}$

$\therefore$ Work done in first 2 days

$= \frac{8}{150} + \frac{7}{120} = \frac{67}{600}$

Work done in $8 \times 2 = 16$ days

$= \frac{67 \times 8}{600} = \frac{67}{75}$

Work left $= 1 - \frac{67}{75} = \frac{8}{75}$

On 17 th day(A + B) will work and they will finish $\frac{8}{150}$

$\therefore$ Work left $= \frac{8}{75} - \frac{8}{150} = \frac{8}{150} = \frac{4}{75}$

On 18th day (A + C) will work and they will finish it in $\frac{120}{7} \times \frac{4}{75} = \frac{32}{35}$ days

$\therefore$ Whole work will be done in $17\frac{32}{35}$ days

□□□□

Pipes & Cisterns

Practice Exercise: I

1. One tap can fill a cistern in 2 hours and another can empty the cistern in 3 hours. How long will they take to fill the cistern if both the taps are opened?
   (a) 6 hours (b) 7 hours
   (c) 6.30 hours (d) None of these

2. A tap can fill a tank in 25 minutes and another can empty it in 50 minutes. Find whether the tank will be filled up or emptied and in how many minutes?
   (a) Tank is filled up in 50 minutes
   (b) Tank is emptied in 25 minutes
   (c) Tank is filled up in 25 minutes
   (d) None of these

3. Two taps A and B can fill a tank in 10 hours and 15 hours, respectively. If both the taps are opened together the tank will be full in:
   (a) 8 hours (b) 6 hours
   (c) 5 hours (d) None of these

4. Two pipes can fill a tank in 10 hours and 12 hours, respectively. While a third pipe can empty the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time the tank will be filled?
   (a) 7 hours 30 minutes
   (b) 6 hours 40 minutes
   (c) 8 hours 30 minutes
   (d) None of these

5. A cistern is normally filled in 8 hours but takes 2 hours longer to fill because of a leak in its bottom. If the cistern is full, the leak will empty it in
   (a) 35 hours (b) 45 hours
   (c) 40 hours (d) None of these

6. If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours does the faster pipe take to fill the reservoir?
   (a) 35 hours (b) 30 hours
   (c) 40 hours (d) None of these

7. One fill pipe A is 3 times faster than second fill pipe B and takes 32 minutes less than the fill pipe B. When will the cistern be full if both pipes are opened together?
   (a) 28 minutes (b) 12 minutes
   (c) 30 minutes (d) data inadequate

8. Two pipes A and B can fill a cistern in 4 minutes and 6 minutes, respectively. If these pipes are turned on alternately for 1 minute each how long will it take for the cistern to fill?
   (a) 4 min 40 sec (b) 3 min 20 sec
   (c) 4 min 50 sec (d) 3 min 30 sec

9. A cistern is provided by two taps A and B. A can fill it in 20 minutes and B in 25 taps minutes. Both the taps are kept open for 5 minutes and then the second is turned off. The cistern will be completely filled in another
   (a) 11 minutes (b) 10 minutes
   (c) 15 minutes (d) 12 minutes

10. 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 pipes are opened, the empty cistern is full 20 minutes. How long will the waste pipe take to empty a full cistern?
    (a) 8 minutes (b) 10 minutes
    (c) 12 minutes (d) 16 minutes

□□□□

Solutions

1. Ans. (a)

Here, $x = 2$ and $y = 3$

$\therefore$ Part of the cistern filled in 1 hour

$$= \frac{1}{x} - \frac{1}{y} = \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$$

$\therefore$ Total time taken to fill the cistern = 6 hrs.

2. Ans. (a)

Here, $x = 25$ and $y = 50$

$\therefore$ Part of the tank filled or emptied in 1 minutes

$$= \frac{1}{x} - \frac{1}{y} = \frac{1}{25} - \frac{1}{50} = \frac{1}{50}$$

Which is positive, therefore the tank will be filled.

$\therefore$ Total time taken to fill the tank

= 50 minutes

3. Ans. (b)

Here, $x = 10$ and $y = 15$.

$\therefore$ The tank will be full in

$$= \left(\frac{xy}{x+y}\right) \text{hours}$$

$$= \left(\frac{10 \times 15}{10+15}\right) \text{hours or 6 hours.}$$

4. Ans. (a)

Here, $x = 10$, $y = 12$ and $z = -20$

$\therefore$ The tank will be full in

$$= \left(\frac{x \times y \times z}{xy - yz - zx}\right) \text{hours}$$

$$= \left(\frac{10 \times 12 \times -20}{10 \times 12 - 12 \times 20 - 20 \times 10}\right) \text{hours}$$

$$= \left(\frac{15}{2}\right) \text{hours or, 7 hours 30 minutes}$$

5. Ans. (c)

Here, $x = 8$ and $y = 8 + 2 = 10$.

$\therefore$ The leak will empty the cistern in

$$= \left(\frac{xy}{y-x}\right) \text{hours}$$

$$= \left(\frac{8 \times 10}{10-8}\right) \text{hours or, 40 hours}$$

6. Ans. (b)

Let one pipe takes x hours to fill the reservoirs.

Then, another pipe takes $(x - 10)$ hours.

$$\therefore \quad \frac{1}{x} + \frac{1}{x-10} = \frac{1}{12}$$

$$\Rightarrow \quad x(x-10) = 12(x + x - 10)$$

$$\Rightarrow \quad x^2 - 34x + 120 = 0$$

or $\quad (x-30)(x-4) = 0$

$\therefore \quad x = 30$ or $x = 4$

$\therefore$ The faster pipe takes 30 hours to fill the reservoir.

7. Ans. (b)

As pipe 'A' is 3 times faster than pipe 'B'. So if 'A' takes 'x' min, 'B' will take '$3x$' min. to fill tank. According to question $3x - x = 2x = 32$, $x = 16$,

$$3x = \frac{4}{8}.$$

Both pipe together can fill tank in

$$\frac{1}{\frac{1}{16} + \frac{1}{48}} = 12 \text{ min.}$$

8. Ans. (a)

As the pipes are operating alternately, thus their 2 minutes job is $\frac{1}{4} + \frac{1}{6} = \frac{5}{12}$

In the next 2 minutes the pipes can fill another $\frac{5}{12}$ part of cistern. Therefore, in 4 minutes the two pipes which are operating alternately will fill $\frac{5}{12} + \frac{5}{12} = \frac{10}{12} = \frac{5}{6}$ part.

The part of the cistern left unfilled $= 1 - \frac{5}{6} = \frac{1}{6}$

Pipe A can fill $\frac{1}{4}$ of the cistern in 1 minutes.

Pipe A can fill $\frac{1}{6}$ of the cistern in

$4 \times \frac{1}{6} = \frac{2}{3}$ minutes

Total time taken to fill the cistern

$4 + \frac{2}{3} = 4\frac{2}{3}$ min.

Or, 4 minutes 40 seconds.

9. Ans. (a)

Part filled in 1 minute $\frac{1}{20} + \frac{1}{25} = \frac{9}{100}$

Part filled in 5 minutes $= \frac{9}{100} \times 5 = \frac{9}{20}$

Unfilled part = $1-\frac{9}{20}=\frac{11}{20}$

This is to be filled by A alone and hence will be filled in $20\times\frac{11}{20}$ = 11 minutes.

10. Ans. (b)

Work done by waste pipe in 1 minutes

$$=\left(\frac{1}{12}+\frac{1}{15}\right)-\frac{1}{20}=\left(\frac{3}{20}-\frac{1}{20}\right)=\frac{1}{10}$$

∴ Waste pipe can empty the cistern in 10 minutes.

□□□□

Pipes & Cisterns

II Practice Exercise: II

1. Two pipes can fill a tank in 10 hours and 12 hours respectively while a third pipe empties the full tank in 20 hours. If all the three pipes operate simultaneously, in how much time the tank will be filled?
   (a) 7 hrs (b) 8 hrs
   (c) 7 hrs 30 min. (d) 8 hrs 30 min.

2. An electric pump can fill a tank in 3 hours. Because of a leak in the tank, it took 3½ hours to fill the tank. The leak can drain out all the water of the tank in:
   (a) 10:30 hrs (b) 12 hrs
   (c) 21 hrs (d) 24 hrs

3. If two pipes function simultaneously, the reservoir will be filled in 12 hours. One pipe fills the reservoir 10 hours faster than the other. How many hours it takes the second pipes to fill the reservoir?
   (a) 25 hrs (b) 28 hrs
   (c) 30 hrs (d) 35 hrs

4. 12 buckets of water fill a tank when the capacity of each bucket is 13.5 liters. How many buckets will be needed to fill the same tank, if the capacity of each bucket is 9 liters?
   (a) 8 (b) 16
   (c) 15 (d) 18

5. Bucket P has thrice the capacity as bucket Q. It takes 60 turns for bucket P to fill the empty drum. How many turns it will take for both the buckets P and Q, having each turn together to fill the empty drum?
   (a) 30 (b) 40
   (c) 45 (d) 90

6. Two pipes A and B can fill a cistern in 12 minutes and 15 minutes respectively but a third pipe C can empty the full tank in 6 minutes, A and B are kept open for 5 minutes in the begining and then C is also opened. In what time is the cistern emptied?
   (a) 30 min. (b) 33 min.
   (c) $37\frac{1}{2}$ min. (d) 45 min.

7. Three pipes A, B and C can fill a tank in 6 hours. After working at it together for 2 hours, C is closed and A and B can fill the remaining part in 7 hours. The number of hours taken by C alone to fill the cistern, is:
   (a) 10 (b) 12
   (c) 14 (d) 16

8. A leak in the bottom of tank can empty the full tank in 8 hours. An inlet pipe fills water at the rate of 6 liters per minute. When the tank is full, the inlet is opened and due to the leak, the tank is empty in 12 hours. How many liters does the cistern hold?
   (a) 7580 (b) 7960
   (c) 8290 (d) 8640

9. A cistern has two taps which fill it in 12 min. and 15 min, 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) 8 min (b) 10 min
   (c) 12 min (d) 16 min

10. Two pipes A and B can fill a cistern in 12 minutes and 16 minutes respectively. If both the pipes are opened together, then after how much time B should be closed so that the tank is full in 9 minutes?
    (a) $3\frac{1}{2}$ min. (b) 4 min.
    (c) $4\frac{1}{2}$ min. (d) $4\frac{3}{4}$ min.

□□□□

Solutions

1. Ans. (c)
Net part filled in 1 hour
$$= \left(\frac{1}{10}+\frac{1}{12}-\frac{1}{20}\right)=\frac{8}{60}=\frac{2}{15}$$
$\therefore$ The tank will be full in $\frac{15}{2}$ hrs.
= 7 hrs. 30 min.

2. Ans. (c)
Work done by the leak in 1 hour
$$=\left(\frac{1}{3}-\frac{2}{7}\right)=\frac{1}{21}$$
$\therefore$ Leak will empty the tank in 21 hours.

3. Ans. (c)
Let the reservoir be filled by first pipe in x hours.
The second pipe will fill it in $(x+10)$ hours.
$$\therefore \quad \frac{1}{x}+\frac{1}{x+10}=\frac{1}{12} \Leftrightarrow \frac{x+10+x}{x(x+10)}=\frac{1}{12}$$
$$\Rightarrow \quad x^2-14x-120=0$$
$$\Rightarrow \quad (x-20)(x+6)=0 \quad \Rightarrow x=20$$
$\therefore$ Second pipe takes 30 hrs to fill the reservoir.

4. Ans. (d)
Capacity of the tank = (12 × 13.5) litres
= 162 litres.
Capacity of each bucket = 9 litres
Number of buckets needed $= \left(\frac{162}{9}\right) = 18$

5. Ans. (c)
Let capacity of P be x litres.
Then, capacity of Q = $\frac{x}{3}$ litres.
Capacity of the drum = $60x$ litres.
Required number of turns
$$= \frac{60}{\left(x+\frac{x}{3}\right)}=\left(60\times\frac{3}{4x}\right)=45.$$

6. Ans. (d)
Part filled in 5 min
$$= 5\left(\frac{1}{12}+\frac{1}{15}\right)=\left(5\times\frac{9}{60}\right)=\frac{3}{4}$$
Part emptied in 1 min., when all the pipes are opened
$$=\frac{1}{6}-\left(\frac{1}{12}+\frac{1}{15}\right)=\left(\frac{1}{6}-\frac{3}{20}\right)=\frac{1}{60}$$
Now, $\frac{1}{60}$ part is emptied in 1 min
$\therefore$ $\frac{3}{4}$ part will be emptied on $\left(60\times\frac{3}{4}\right)$
= 45 min.

7. Ans. (c)
Part filled in 2 hours = $\frac{2}{6}=\frac{1}{3}$
Remaining part = $\left(1-\frac{1}{3}\right)=\frac{2}{3}$
$\therefore$ (A + B)'s 7 hour's work = 2/3
$\therefore$ (A+B)'s 1 hour's work = 2/21
$\therefore$ C's 1 hour's work
= [(A+B+C)'s 1 hour's work] – (A+B)'s 1 hour's work = $\left(\frac{1}{6}-\frac{2}{21}\right)=\frac{1}{14}$
$\therefore$ C alone can fill the tank in 14 hours.

8. Ans. (d)
Work done by the inlet in 1 hour
$$=\left(\frac{1}{8}-\frac{1}{12}\right)=\frac{1}{24}$$
Work done by the inlet in 1 min.
$$=\left(\frac{1}{24}\times\frac{1}{60}\right)=\frac{1}{1440}$$
$\therefore$ Volume of $\frac{1}{1440}$ part = 6 litres
$\therefore$ Volume of whole = (1440 × 6) litres
= 8640 litres

9. Ans. (b)
Work done by waste pipe in 1 min.
$$=\frac{1}{20}-\left(\frac{1}{12}+\frac{1}{15}\right)=-\frac{1}{10}$$
[-Ve sign means emptying]
$\therefore$ Waste pipe will empty the full cistern in 10 min.

10. Ans. (b)
Let B be closed after x minutes.
Then, Part filled by (A +B) in x min. + Part filled by A in $(9-x)$ min. = 1
$$\therefore \quad x\left(\frac{1}{12}+\frac{1}{16}\right)+(9-x).\frac{1}{12}=1$$
or $$\frac{7x}{48}+\frac{9-x}{12}=1$$
or $7x + 36 - 4x = 48$ or $x = 4$.
So, B must be closed after 4 minutes.

■■■■