4 Time and Work

Introduction

This is one of the most important and simplest of chapters for the students. In this chapter, one concept will play a very important role, which is known as the concept of efficiency. Since this chapter is easy, even an average student can perform well when compared to other chapters.

Every year from this chapter, two or three problems are asked in CAT. In this chapter, we will study various concepts related to a single concept, i.e., efficiency $\propto \frac{1}{\text{time}}$

As we know, if a person is more efficient than another person, he will take less time to do a work as compared to another person. Hence, we can say that work depends on the efficiency of the person or machine and the time taken by the person or machine to complete the work.

Concept 1: Concept of Efficiency

Efficiency

Work done per unit time or 1-day work of a person or machine is known as the efficiency of that person.

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

If work is constant for all the people performing the work, or if the same work is allotted to everyone, then efficiency becomes inversely proportional to time.

$$\text{Efficiency} \propto \frac{1}{\text{time}}$$

For example, suppose a person can do a work in 10 days, and another person can do the same work in 20 days, find the ratio of the efficiency of each person.

Since the 1st person can do the work in 10 days, then his 1-day work is $\frac{1}{10}$ unit.

Hence, $\frac{1}{10}$ unit/day is the efficiency of the first person.

Similarly, the efficiency of the second person is $\frac{1}{20}$ unit/day.

So, the ratio is 2 : 1

- We can solve the above example using the inverse proportional concept by the ratio method.

	A:B
Time	10:20
Efficiency	20:10

$$2:1 \left(\text{since efficiency} \propto \frac{1}{\text{time}}\right)$$

- Efficiency is denoted by the symbol η.
  We can also obtain two other relations from the single formula of work and time.
  - Total work = Efficiency × Time
  - Efficiency (η) = $\frac{\text{Work}}{\text{Time}}$
  - Time (T) = $\frac{\text{Work}}{\text{Efficiency}}$

  All the above relations are very important for solving the problems.
- Time and work related problems can be solved by using different methods:
  - Unitary method
  - Percentage efficiency method
  - LCM method

Unitary method

The unitary method generally becomes obsolete concerning high-level aptitude exams like CAT, since it involves difficult calculations of fractions.

Example 1:

Arun can do a piece of work in 5 days, Varun can do it in 13 days, whereas Tarun can do the same work in 10 days. Find in how many days they will finish the same work working together.

Solution:

One-day work of Arun = $\frac{1}{5}$ unit

One-day work of Varun = $\frac{1}{13}$ unit

and 1-day work of Tarun = $\frac{1}{10}$ unit

Since 1-day work is nothing but the efficiency of that person.

∴ Total efficiency of (Arun + Varun + Tarun)

$= \frac{1}{5}+\frac{1}{13}+\frac{1}{10}$

$= \frac{3}{10}+\frac{1}{13} = \frac{39+10}{130}$

$= \frac{49}{130}$ unit/day

Therefore, the total time is taken by all the three to complete the whole work

$= \frac{1 \rightarrow \text{Work}}{\frac{49}{130} \rightarrow \text{Efficiency}}$

Note: In the unitary method, total work is always considered as 1.

∴ Total time = $\frac{130}{49}$ days = $2\frac{32}{49}$ days

Hence, the total time taken by all the three to complete the whole work is $2\frac{32}{49}$ days.

Therefore, we can see that in the unitary method, it takes too much time to solve a single problem.

Alternate solution

		130 →	Total work (LCM)
Arun →	5 days	26 →	Efficiency of Arun
Varun →	13 days	10 →	Efficiency of Varun
Tarun →	10 days	13 →	Efficiency of Tarun
Arun + Varun + Tarun		49 unit/day	

$t_{A+V+T} = \frac{130}{49}$ days

$= 2\frac{32}{49}$ days = 2.65 days (approx.)

Percentage efficiency method

In this method, the efficiency of each person is expressed in terms of percentage. The total work is considered 100%. This method is easy, but students may face difficulties in the beginning. As they become good at the topic percentage, the problems of work and time also becomes easy to solve.

For example, if a man completes a certain task in 12 days, his efficiency is $\frac{100}{12}$ = 8.33% per day.

$$\text{Time taken} = \frac{100\%}{\text{total efficiency of the system}}$$

Example 2:

A can do a work in 12 days, B can do the same job in 15 days, whereas C can do the same work in 20 days, then find in how many days they will finish the work, working together.

Solution:

A's efficiency = $\frac{100}{12}$ = 8.33%

B's efficiency = $\frac{100}{15}$ = 6.66%

C's efficiency = $\frac{100}{20}$ = 5%

∴ Total efficiency of (A + B + C) = 8.33% + 6.66% + 5% = 19.99%.

Hence, the time taken to finish the work when they work together is:

$= \frac{100}{19.99}$ = 5.002 days = 5 days (approx.)

Note: Example 1 can also be solved by this method as follows:

Efficiency of Arun = $\frac{100}{5}$ = 20%

Efficiency of Varun = $\frac{100}{13}$ = 7.69%

Efficiency of Tarun = $\frac{100}{10}$ = 10%

∴ Combined efficiency of A + B + C

= 20% + 7.69% + 10%

= 37.69%

∴ Total time taken by all the three working together to complete the same work is:

$= \frac{100}{37.69}$ = 2.6532 days

Concept 2: Alternate Days

In this concept, two or three, or more than three people have to complete the work, but they are not working all at once. In this concept, the people may work alternatively as the first person will work on the first day, the second person will work on the second day, and the third person will work on the third day.

OR

The question can also be framed like this A, B, and C are three people, and they work alternatively, but A begins the work, and A is assisted by B on the first day, and A is assisted by C on the next day.

- So, in these types of problems, first, we have to find the pattern of working of every person. If we know the pattern, problems can be solved easily.

Example 3:

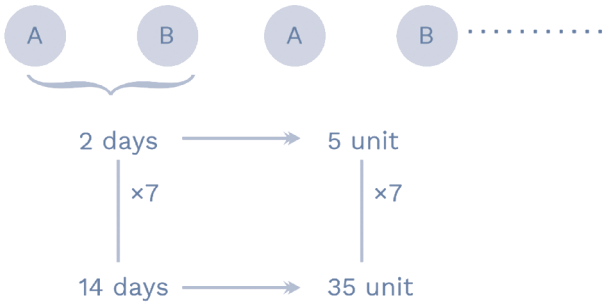
A and B can complete a piece of work in 12 and 18 days, respectively. A begins to do the work, and they work alternatively one at a time for 1 day each. The whole work be completed in:

(A) $14\frac{1}{3}$ days (B) $14\frac{2}{3}$ days

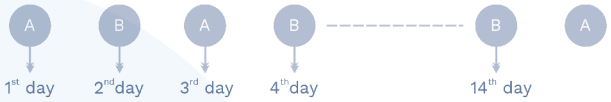
(C) $7\frac{1}{2}$ days (D) $9\frac{1}{2}$ days

Solution: (A)

Since A begins the work, they work alternatively. Hence, the working pattern will be as follows:



In 14 days, 35 unit of work is completed. The remaining 1 unit of work is left. Since the work is done, every alternate day begins with A. Therefore, on every odd day, A is working, and on every even day, B is working.



Hence, the remaining 1 unit work will be done by A only. Since A can do 3 units of work per day, for doing 1 unit of work, he will take $\frac{1}{3}$ part of a day.

∴ Total time taken to complete the whole work is:

$$= 14 + \frac{1}{3} = 14\frac{1}{3} \text{ days}$$

Hence, option (A) is the correct answer.

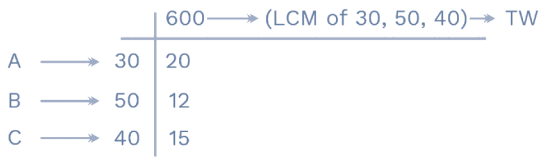
Example 4:

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 day 1 and by C on the next day alternatively, then in how many days will the work be completed?

(A) $17\frac{32}{35}$ days (B) $19\frac{2}{3}$ days

(C) $16\frac{31}{37}$ days (D) $18\frac{1}{3}$ days

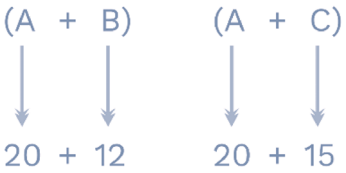
Solution: (A)



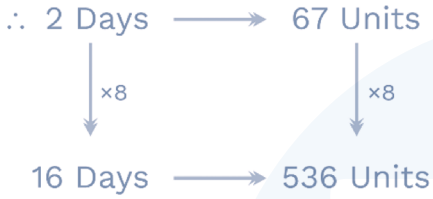
where TW = Total work

Since it is given in the question that A is assisted by B on 1 day and by C on the next day, then working pattern will be like this:

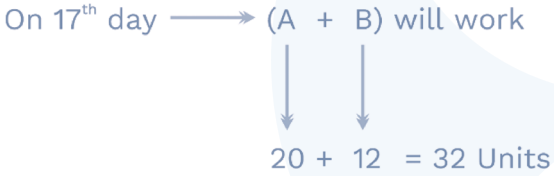
∴ We have to find 2 days' work first.



∴ Total work completed in 2 days = 67 units



In 16 days, 536 unit of work is completed, and on the 17th day, A + B have to work.



∴ Remaining work after 17th day
= 600 – (536 + 32) = 32 units.

On the 18th day, A + C will work, and they will take the whole 1 day to complete 35 units of work. But we have only 32 units of work left. So, the time needed is less than a day for completing 32 units of work.

∴ Time needed by A + C for completing 32 units of work is:

$$= \frac{32}{35} \text{ days}$$

∴ Total time required to complete whole work is:

$$= 17 + \frac{32}{35} = 17\frac{32}{35} \text{ days}$$

Concept of Negative Work

In this concept of negative work, one person works, but another person destroys it. For example, A can build a 10 m wall in 1 day, whereas on another day, B destroys 3 m of the same wall. So, this is the case of negative work.

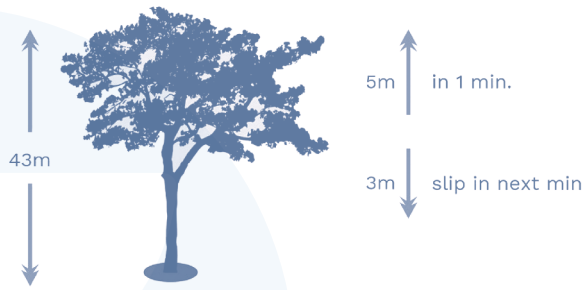
Example 5:

A monkey starts climbing up a 43 m tall tree. In the first minute, he climbs 5 m, whereas, in the next minute, he slips by 3 m. In how many minutes he will be on the top of the tree?

(A) 42 minutes (B) 41 minutes

(C) 39 minutes (D) 86 minutes

Solution: (C)

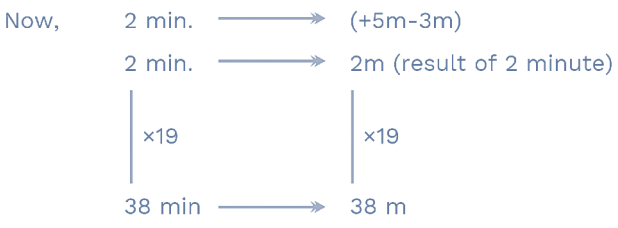


Note: In the concept of negative work, if you will leave the work for first hour, first minute, or first day, the problem can be easily solved. Otherwise, many students will give the wrong answer.

Therefore, the working pattern will be like this

First, subtract the first minute work from total work. (we will consider it later).

Remaining work = 43 m – 5 m = 38 m



In the 38th minute, the monkey slips down by 3 m, but in the 39th minute, he will again climb 5 m and reach the top of the tree.

38 min	38 m
+1 min	5 m
39 min	43 m

Hence, option (C) is the correct answer.

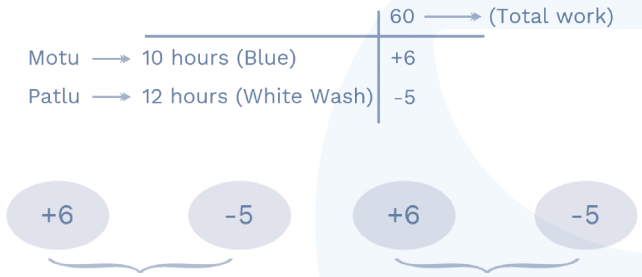
Example 6:

Motu can paint a wall blue in 10 hours, whereas Patlu can whitewash the wall completely in 12 hours. If Motu and Patlu work alternatively for an hour each, starting when the wall has just cement on it until it is completely painted blue, then in how many hours will the entire wall be painted blue?

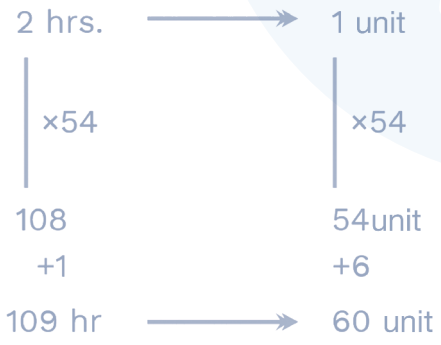
(A) 109 hours (B) 108 hours

(C) 120 hours (D) 110 hours

Solution: (A)



In 2 hours → 1 unit wall is painted.



Hence, option (A) is the correct answer.

Concept 3: Efficiency Based

Efficiency: We know that 1 day's work or 1 hour's work of a person is known as the efficiency of that person.

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

If work is going to be constant, then

$$\text{Efficiency} \propto \frac{1}{\text{time}}$$

Efficiency is denoted by η.

Example 7:

A can do a work in 10 days, B can do the same work in 12 days, whereas C can do the same work in 15 days, respectively. Find the ratio of their efficiencies.

Solution:

A's 1-day work = $\frac{1}{10}$th part = 10%

B's 1-day work = $\frac{1}{12}$th part = $8\frac{1}{3}$%

While C's 1 day work = $\frac{1}{15}$th part = 6.66%

As we know, 1 day work of any person is known as their efficiency.

$\therefore$ A:B:C

Efficiency → $\left[\frac{1}{10}:\frac{1}{12}:\frac{1}{15}\right]$

Since LCM of (10, 12, 15) = 60.

Therefore, multiply with 60 in each ratio.

$$\left[\frac{1}{10}\times 60:\frac{1}{12}\times 60:\frac{1}{15}\times 60\right]$$

[6:5:4]

Alternate solution

As we know,

$$\text{Efficiency} \propto \frac{1}{\text{time}}$$

Therefore, A:B:C

Time → 10:12:15

$\therefore$ Efficiency → $\frac{1}{10}:\frac{1}{12}:\frac{1}{15}$

$$\left[\frac{1}{10}\times 60:\frac{1}{12}\times 60:\frac{1}{15}\times 60\right]$$

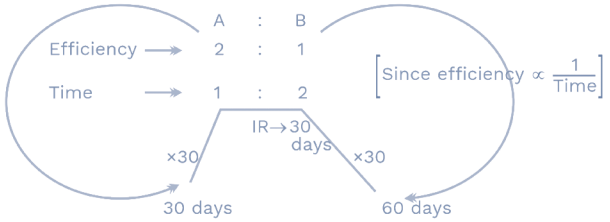
[6:5:4]

Example 8:

A is twice efficient as B. A does the same work in 30 days less time than the time taken by B. Then in how many days the same work can be done by both together?

Solution:

Let the efficiency of B be 1 unit/day, then the efficiency of A is 2 units/day.



We also know that total work = efficiency × time

TW = 30 days × 2 = 60 units

Or

TW = 60 days × 1 = 60 units

∴ Time taken by both to complete whole work = $\frac{60}{2+1}$ $\begin{matrix}\rightarrow\text{Work}\\ \rightarrow\text{Efficiency}\end{matrix}$

t = 20 days

Alternate solution

Let time taken by A = x days

Then time taken by B = x + 30 days

We know that: $\eta \propto \frac{1}{\text{time}}$

A:B

∴ Time → x:x + 30

Efficiency → $\frac{1}{x}:\frac{1}{x+30}$

It is also given in the question that A's efficiency is double that of B.

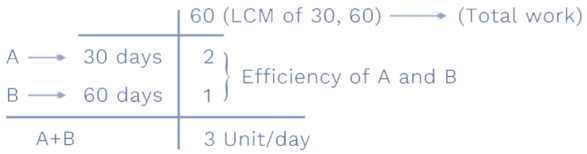
$$\frac{1}{x} = \frac{1}{x+30} \times 2$$

$$x + 30 = 2x$$

$$x = 30$$

∴ Time taken by A = 30 days

Time taken by B = 60 days



$$\text{Time} = \frac{60}{3} = 20 \text{ days}$$

Concept 4: MDH

If M_1 men can do W_1 work in D_1 days working H_1 hours per day and M_2 men can do W_2 work in D_2 days working H_2 hours per day, then

$$\therefore \frac{M_1 \times D_1 \times H_1 \times E_1}{W_1} = \frac{M_2 \times D_2 \times H_2 \times E_2}{W_2}$$

where

M → number of men

D → number of days

H → number of hours

E → efficiency of 1 man

W_1 → part of work done by M_1 men

W_2 → part of work done by M_2 men

Note:

MDH formula compares the work of the same nature done at two different times using different manpower.

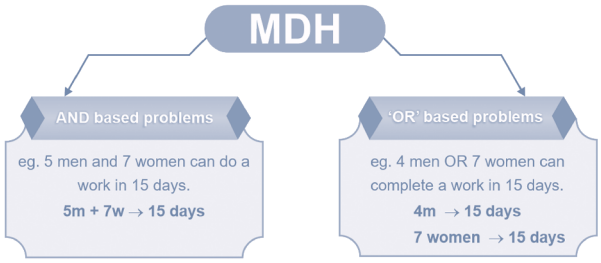
If some of the parameters are same or not considered, the formula can be shortened as follows:

$$\frac{M_1D_1H_1}{W_1} = \frac{M_2D_2H_2}{W_2}$$

$M_1 \times D_1 = M_2 \times D_2$

Man × days = Total work

In MDH-based concept, two types of problems are generally asked



Example 9:

22 men and 19 women can complete a work in 12 days, whereas 13 men and 15 women

can complete the same work in 18 days. Then in how many days can 9 men and 4 women compete the same work?

(A) 45 days (B) 28 days

(C) 15 days (D) 36 days

Solution: (D)

We know that $M_1D_1 = M_2D_2$

Let efficiency of 1 man be M and efficiency of 1 women be W.

$\therefore$ (22 men + 19 women) × 12 = total work

(13 men + 15 women) × 18 = total work

Therefore,

(22 + 19w) × 12 = (13m + 15w) × 18

44m + 38w = 39m + 45w

5m = 7w

m = 7k and m = 5k where k is the common ratio

Therefore, total work

= (22m + 19w) × 12

= 2988k units

$\therefore$ (9m + 4w) × x = 2,988

(9 × 7k + 4 × 5k) × x = 2,988k

$x = \frac{2988}{83}$ = 36 days

Hence, option (D) is the correct answer.

Example 10:

8 men and 6 women can complete a work in 9 days, whereas 6 men and 8 women can complete the same work in 12 days. In how many days can 16 men and 21 women complete the same work?

(A) 4.5 days (B) 8.5 days

(C) 9.2 days (D) 13.5 days

Solution: (A)

Let efficiency of a man be M and a woman be W.

$\therefore$ (8m + 6w) × 9 = (6m + 8w) × 12

24m + 18w = 24m + 32w

14w = 0

w = 0

If some women are sitting idle, they are not doing any work

$\therefore$ Total work = (8m + 6w) × 9

Put w = 0

= 8m × 9 = 72m

Let the total work is completed by 16 men and 21 women in D days

Therefore,

(16m + 21w) × D = 72m

$\therefore$ 16m × D = 72m (as w = 0)

$D = \frac{72}{16} = \frac{18}{4}$ = 4.5 days

Hence, option (A) is the correct answer.

Concept 5: Work and Wages

Important points while solving work and wages-related problems:

1. Wages $\propto$ work done (it means more work = more money)

2. Wages $\propto \frac{1}{\text{time taken to complete the work}}$

That means more time taken to do a work = less money.

Example 11:

Arpita can do a piece of work in 6 days, whereas Kumud can do the same work in 8 days. The wage for the full work is 2,800. If they both work together to complete the work, then find the money earned by Arpita and Kumud.

Solution:

Arpita's 1-day work = $\frac{1}{6}$

Kumud's 1-day work = $\frac{1}{8}$

∴ Arpita:Kumud

Efficiency $\frac{1}{6}:\frac{1}{8}$

8:6

4:3

So, wages will be distributed in the ratio of efficiency i.e., 4 : 3

According to the question:

Total wages are ₹ 2,800 given in the question.

Therefore, Arpita's wages $= \frac{4}{4+3} \times 2{,}800$

$= \frac{4}{7} \times 2{,}800$

= ₹ 1,600

Similarly, Kumud's wages $= \frac{3}{4+3} \times 2{,}800$

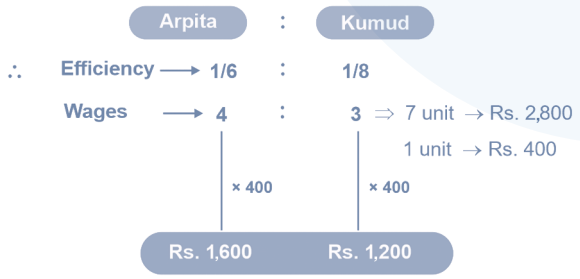
$= \frac{3}{7} \times 2{,}800$

= ₹ 1,200

Alternate solution

Since efficiency is directly proportional to wages.

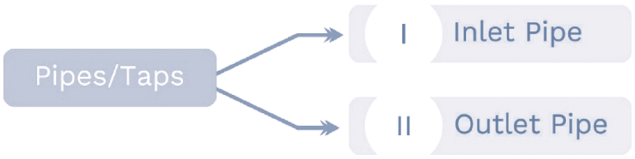
Therefore,



Concept 6: Pipes and Cisterns

- Pipe and cistern concepts are generally similar to work and time. Only few changes are seen here; in time and work, we are considering total work, but in pipe and cistern at the place of total work, we will use the total capacity of the tank.
  The total work → capacity of the tank

- In pipes and cisterns, there will be two types of pipes that will work:



1. **Inlet pipe:** An Inlet is a pipe connected to fill a tank with water. So, this will be considered as a positive type of work done.
2. **Outlet pipe:** An outlet is a pipe connected to empty the tank of water. This will be a negative type of work done.

Note: Outlet pipe or tap sometimes refers to a leak in the questions.

∴ Efficiency of a pipe

$= \frac{\text{total capacity of a tank}}{\text{time taken to fill a tank}}$

η Pipe $= \frac{\text{Capacity of tank}}{\text{Time taken}}$

Example 12:

An inlet pipe A can fill a tank in 12 minutes, whereas another inlet pipe B can fill the tank in 15 minutes, whereas another pipe C can empty the filled cistern in 20 minutes. Find when the cistern will be filled if all the pipes are opened together.

		60 → (LCM of 12, 15, 20)
A →	12 min	+5 Liter/Min.
B →	15 min	+4 Liter/Min.
C →	20 min	-3 Liter/Min.
$A+B+C^{\ominus}$		6 Liter/Min.

Here, 60 litres (LCM of 12, 15, and 20) become the capacity of the tank.

All the filler pipes have positive efficiency because they fill the tank, whereas pipe C is the outlet pipe which is an empty pipe. Therefore, its efficiency is negative.

When all the pipes open together, pipe A will fill 5 litres/min, pipe B will fill 4 litres/min, whereas pipe C will empty 3 litres/min.

∴ The volume of water entering the tank per minute = 5 + 4 − 3 = 6 litre/min.

∴ The time taken to fill the tank

$$(T) = \frac{60 \rightarrow \text{Tank capacity}}{6 \rightarrow \text{combined efficiency of all pipes}}$$

$$T = \frac{60}{6} = 10 \text{ minutes}$$

Example 13:

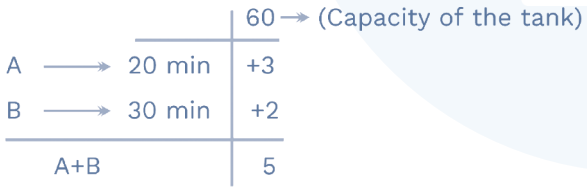
Two pipes, A and B, can fill a tank in 20 and 30 minutes, respectively. If initially only pipe B was kept open for the $\frac{2}{5}$th part of the total time and both the pipes A and B were kept open for the remaining time, the tank would be filled. In how many minutes, the talk was filled?

(A) $14\frac{2}{7}$ minutes (B) $15\frac{15}{19}$ minutes

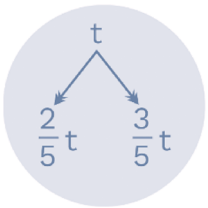
(C) 18 minutes (D) $19\frac{1}{2}$ minutes

Solution: (B)

Let the total time to fill the tank be 't' minutes.



Therefore, according to the question,



$$\underbrace{\frac{2}{5}t}_{B} \times 2 + \underbrace{\frac{3}{5}t}_{A+B} \times 5 = 60$$

$$\frac{4t + 15t}{5} = 60$$

$$19t = 300$$

$$t = 15\frac{15}{19} \text{ minutes}$$

Hence, option (B) is the correct answer.

Example 14:

An inlet tap can fill a tank in 7.5 hours. Because of a leak in the tank, it takes 50 minutes more to fill the tank. The leak can drain all the water from the tank in:

(A) 82 hours (B) 25 hours

(C) 80 hours (D) 75 hours

Solution: (D)

First of all, we have to find the total time taken to fill the tank by A + B (−).

Total time taken by (A + B) to fill the tank working together

= 7 hr 30 min + 50 min

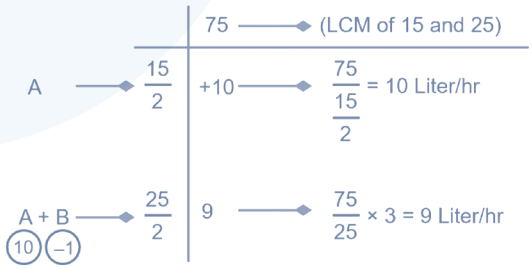
= 7 hr + 80 min

= 7 hr + 1 hr + 20 min

= 8 hr 20 min

$$= \left(8 + \frac{20}{60}\right) \text{ hour}$$

$$= \left(8 + \frac{1}{3}\right) \text{ hr} = \frac{25}{3} \text{ hr}$$



∴ The efficiency of B is:

A + B = 9

10 + B = 9

B = −1 litre/hour

∴ Time taken by the leak to empty the full tank:

$$t_B = \frac{75}{1} = 75 \text{ hours}$$

Hence, option (D) is the correct answer.

Practice Questions

Level of Difficulty – 1

1. 'A' does $\frac{2}{5}$th of a work in 9 days. B then joined him, and they together completed the remaining work in 6 days. B alone can finish the whole work in:

(A) 18 days
(B) 95 days
(C) 19 days
(D) 17 days

2. 'A' and 'B' can do a work in 45 days and 40 days, respectively. They began the work together but A left after some days and B finished the remaining work in 23 days. A left after:

(A) 13 days
(B) 9 days
(C) 10 days
(D) 12 days

3. A can do 50% of the job in 16 days, B can do $\frac{1}{4}$th of the job in 24 days. In how many days can they do $\frac{3}{4}$th of the job working together?

(A) 18 days
(B) 22 days
(C) 25 days
(D) 28 days

4. Arun and Varun working together, can complete a piece of work in 8 days. Had Arun worked twice as fast and Varun at an efficiency of one-third of his original efficiency, then they would have finished the job in 6 days. In how many days can Varun complete the whole work working alone?

(A) 35 days
(B) 30 days
(C) 20 days
(D) 12 days

5. Pipe P can fill an empty tank in 30 minutes, whereas pipe Q can fill it in 45 minutes. Pipe P and Q are opened and closed alternatively, i.e., the first pipe P is opened then Q again P and then Q, and so on 1 minute each time without any time lapse. In how many minutes will the tank be filled when it was empty initially?

(A) 40 minutes
(B) 30 minutes
(C) 15 minutes
(D) 36 minutes

Level of Difficulty – 2

6. Ruby can do a work in 40 days, whereas Nandini can do the same work in 50 days. They started working together. A few days later Bhavna also joined them and thus all of them completed the whole work in 20 days. All of them were paid total ₹1,400. What is the share of Bhavna?

(A) ₹140
(B) ₹200
(C) ₹250
(D) ₹290

7. P can do a piece of work in 10 days. Q and R who can do the work $\frac{3}{4}$th as fast as P joined the group. Also S and T who can do the work $\frac{1}{5}$as fast as P also joined the group. If all five people start working on a particular data science project together. Find in how many days this data science project will end?

(A) $2\frac{13}{29}$ days
(B) $3\frac{13}{29}$ days
(C) $5\frac{1}{13}$ days
(D) 45 days

8. In an automobile company, an engineer started work on a machine learning project on day 1, on day 2, two more engineers joined the m/c learning project, on day 3, three more engineers joined the project, and so on till the machine learning project

was completed in 10 days. In how many days can the project be completed by 20 data scientists, if each data scientist is twice as efficient as an engineer of an automobile company?

(A) $\frac{11}{2}$ days

(B) $\frac{22}{3}$ days

(C) $\frac{7}{2}$ days

(D) 9 days

9. The rate of discharge of water from a pipe is 40 m/sec. The pipe is attached to the bottom of a cuboidal water tank of dimensions 20 m × 18 m × 10 m. If the tank is emptied in 30 minutes. Find the area of the cross-section of the pipe.

(A) 600 cm^2

(B) 800 cm^2

(C) 700 cm^2

(D) 500 cm^2

10. Three taps can fill an empty tank in 40 minutes. If two of the three taps can alone fill the empty tank in 120 minutes and 180 minutes, respectively, then in how much time does the third tap alone fill the empty tank?

(A) 90 minutes

(B) 75 minutes

(C) 80 minutes

(D) 70 minutes

Level of Difficulty – 3

11. C is twice efficient as A, B takes thrice as many days as C. A takes 12 days to finish the work alone. If they work in pairs (i.e., AB, BC, and CA), starting with AB on the first day then BC on the second day, AC on the third day, and so on. Then how many days are required to finish the work?

(A) $6\frac{1}{5}$ days

(B) 4.5 days

(C) $5\frac{1}{9}$ days

(D) 8 days

12. A cistern is attached to a few pipes. Some of them are large pipes and some of them are small pipes. Each of these pipes can be used to fill or empty the tank. The filling speed of each pipe is 10 times the speed of its emptying capacity. Further, all the large pipes have the same filling rate among themselves and all the small pipes have the same filling rate among themselves. One large pipe and seven small pipes can empty the cistern in 6 minutes, whereas one large pipe and three small pipes can fill it in just 1 minute. How many minutes will one large pipe and one small pipe together take to empty a completely filled cistern?

(A) 12 minutes

(B) 16 minutes

(C) 15 minutes

(D) 18 minutes

13. A tank has four pipes attached to it. The amount of water flowing per minute through each pipe is directly proportional to the area of its cross-section. The pipes attached to the tank are of the square cross-section with sides of 2 cm, 4 cm, 8 cm, and 16 cm, respectively. If the smallest pipe alone takes 60 minutes to fill the tank, how much time (in seconds) will it take for all four pipes to fill the tank?

(A) 42.35 seconds

(B) 41.45 seconds

(C) 40.4 seconds

(D) 43.5 seconds

14. Simba can do a piece of work in 15 days. At the same time, Jaggu can do the same piece of work in 18 days. They started the work together. After some days Bala joined them and all of them completed the whole work in 8 days. All of them were paid a total of ₹3,600. What is the share of Bala?

(A) ₹70

(B) ₹75

(C) ₹80

(D) ₹85

15. Anil, Aman, Amit, and Anshul have taken the task to make several wooden chairs. Anil alone can make a chair in 12 hours. Aman is 20% more efficient than Anil, whereas Amit is 25% more efficient than Aman. Anshul is one-third as efficient as Anil. One day, they together had to make a chair. Initially, for 15 minutes all four worked on the chair. Then, Anil and Aman left and the remaining two of them worked on the chair for another 4 hours. Then, Anshul finished the remaining work alone. For how much time did Anshul work alone?

(A) 678.5 minutes
(B) 658.5 minutes
(C) 666.3 minutes
(D) 645.5 minutes

Solutions

1. (A)

Since A does $\frac{2}{5}$ work in 9 days

$\therefore$ Total work done by A in $= 9 \times \frac{5}{2}$ days

According to the question,

A + B together complete the remaining work $\left(\frac{3}{5}\text{th}\right)$ in 6 days.

$\frac{3}{5}\text{th} \rightarrow 6$ days

$1 \rightarrow \frac{6}{\frac{3}{5}} = 6 \times \frac{5}{3} = 10$ days

Therefore, the total work done by A and B working together in 10 days.

Efficiency of A $= \frac{1}{\frac{45}{2}} = \frac{2}{45}$ unit/ day

Efficiency of (A + B) $= \frac{1}{10} = \frac{1}{10}$ unit/ day

$\therefore$ Efficiency of B alone $= \frac{1}{10} - \frac{2}{45}$

$= \frac{9-4}{90} = \frac{5}{90}$

$= \frac{1}{18}$ units/day

$\therefore$ Total work done by B in 18 days.

Hence, option (A) is the correct answer.

Alternate solution

	90 → Total work (LCM of 45 and 10)	
A	→ $\frac{45}{2}$	4 unit/day
A + B	→ 10	9 unit/day

$\therefore$ Efficiency of B = 9 − 4 = 5 unit/day

Total time is taken by B to complete work $= \frac{90}{5} = 18$ days.

2. (B)

According to the question,

They began the work together but after some days, A left the work, and B finished the remaining work in 23 days.

$\therefore$ Work done by B in 23 days = 9 × 23 = 207 units

$\therefore$ Remaining work = 360 − 207 = 153 units

Therefore, (A + B) has done the 153 units work in $= \frac{153}{17} = 9$ days.

Hence, after 9 days, A left the work.

Alternate solution

Let (A + B) work together for x days then A left.

$\therefore$ (A + B) × x + B × 23 = 360

(8 + 9) × x + 9 × 23 = 360

$17x + 207 = 360$

$17x = 360 - 207$

$x = \frac{153}{17}$

$x = 9$ days

3. (A)

Since A does 50% of the job in 16 days.

$\therefore$ A does 100% of the job in 32 days.

Similarly, B does 25% of the job in 24 days.

$\therefore$ B does 100% of the job in 96 days.

Therefore,

	96 →	Total work
A	→ 32 days	3 unit/day
B	→ 96 days	1 unit/day

Here, we can see that if A + B work together, then they will do 4 units of work per day.

$\therefore$ Time is taken by them to complete $\frac{3}{4}$th work while working together

$= \frac{96}{4} \times \frac{3}{4} = 18$ days.

Hence, option (A) is the correct answer.

4. (C)

Let the efficiency of Arun is A unit/day and the efficiency of Varun is V unit/day.

Moreover, we know that man × days = Total work

According to the question,

$(A + V) \times 8$ = Total work .....(i)

Again, if Arun starts working with twice his efficiency and Varun with the 1/3rd of the original efficiency then

$\left(2A + \frac{V}{3}\right) \times 6$ = Total work .....(ii)

Since total work is the same in both cases.

$\therefore (A + V) \times 8 = \left(2A + \frac{V}{3}\right) \times 6$

$4A + 4V = 6A + V$

$3V = 2A$

$2A = 3V$

$\therefore$ Total work = $(A + V) \times 8$

$= (3 + 2) \times 8 = 40$ units

Therefore, the total time is taken by Varun to complete the whole work.

$(t) = \frac{40}{2} = 20$ days

Hence, option (C) is the correct answer.

5. (D)

In 1 minute, pipe A can fill = $\frac{1}{30}$ part of the tank.

Again, in a 1-minute, pipe B can fill = $\frac{1}{45}$ part of the tank.

Therefore, in 2 minutes pipes A and B can fill = $\left(\frac{1}{30} + \frac{1}{45}\right)$ part of the tank.

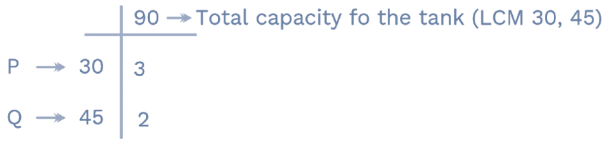
$= \frac{75}{30 \times 45} = \frac{1}{18}$th part of the tank

$\therefore \frac{1}{18}$th part $\rightarrow$ 2 min

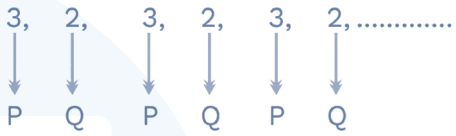
1 part $\rightarrow \frac{2}{\frac{1}{18}} = 36$ minutes

Hence, option (D) is the correct answer.

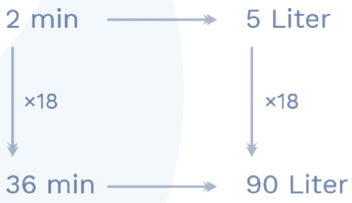
Alternate solution



Since they work alternatively.



In,



6. (A)

Efficiency of Ruby = $\frac{1}{40} \times 100 = 2.5\%$

Efficiency of Nandini = $\frac{100}{50} = 2\%$

Thus in 20 days, working together they will complete = $(2.5 + 2) \times 20 = 90\%$.

Hence, the remaining work will surely be done by Bhavna, which is 10%.

Thus, Bhavna will get 10% of 1,400 = ₹140.

Hence, option (A) is the correct answer.

Alternate solution

∴ (Ruby + Nandini) will complete the work in 20 days, therefore, total work = 9 × 20 = 180 units.

Remaining work will be done by Bhavna = 200 units – 180 units.

= 20 units

Part of work done by Bhavna = $\frac{20}{200} = \frac{1}{10}$

∴ Bhavna will get = $\frac{1}{10}$ × 1,400 = ₹140.

Hence, option (A) is the correct answer.

7. (B)

Let efficiencies of P, Q, R, S, and T be E_P, E_Q, E_R, E_S, and E_T.

According to the question,

LCM = 20

Let efficiency of P (E_P) is 20 unit/day.

Therefore,

$E_Q = \frac{3}{4} \times 20 = 15$ unit/day

$E_R = \frac{3}{4} \times 20 = 15$ unit/day

Similarly,

$E_S = \frac{1}{5} \times 20 = 4$ unit/day

$E_T = \frac{1}{5} \times 20 = 4$ unit/day

∴ Combine efficiency of (P, Q, R, S, T)

$= E_P + E_Q + E_R + E_S + E_T$

= 20 + 15 + 15 + 4 + 4

= 58 unit/day

Since the efficiency of P is 20 units per day and he completes the work in 10 days.

∴ Total work = E_P × Time taken

= 20 × 10 = 200 units

Therefore, we have to find the time taken to complete the data science project while all of them are working together.

$t = \frac{200}{58} = \frac{100}{29}$ days

$= 3\frac{13}{29}$ days

Hence, option (B) is the correct answer.

8. (A)

Let the efficiency of an engineer be 1 unit/day.

E_1 = 1 unit

W_1 = 1 unit (work done on first day)

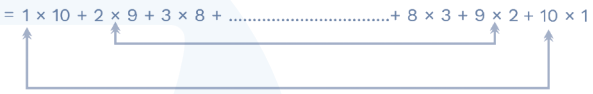
W_2 = 1 + 2

W_3 = 1 + 2 + 3

W_{10} = 1 + 2 + 3 ... 10

∴ Total work done in 10 days

$W_T = W_1 + W_2 + W_3 + \cdots + W_{10}$



$W_T = 2(1 \times 10 + 2 \times 9 + 3 \times 8 + 4 \times 7 + 5 \times 6)$

$W_T = 2 \times 110 = 220$ units.

According to the question,

Efficiency of a data scientist = 2 × efficiency of an engineer

$E_d = 2 \times 1$

= 2 unit/day

Therefore, the total efficiency of all the 20 data scientists

= 2 × 20 = 40 unit/day.

∴ 20 data scientists take time to complete the project

$= \frac{220}{40} = \frac{11}{2} = 5.5$ days.

Hence, option (A) is the correct answer.

9. (D)

The flow rate of water from the pipe = cross-sectional × speed of discharge.

Let the area of the cross-section of the pipe be A.

The volume flow rate of the pipe $= \frac{\text{Total discharged volume}}{\text{Time taken}}$

$\Rightarrow \frac{(20 \times 18 \times 10)}{30 \text{ min}} = \frac{3,600}{1,800} = 2$

Now, the volume of flow rate = A × 40

$2 = A \times 40$

$A = \frac{2}{40} = \frac{1}{20} m^2$

$A = \frac{1}{20} \times 100 \times 100$

Area = 500 cm^2

Hence, option (D) is the correct answer.

10. (A)

Let the third pipe fill the empty tank in t minutes.

$\Rightarrow \frac{1}{120} + \frac{1}{180} + \frac{1}{t} = \frac{1}{40}$

$\therefore \frac{180 + 120}{120 \times 180} + \frac{1}{t} = \frac{1}{40}$

$\frac{1}{72} + \frac{1}{t} = \frac{1}{40}$

$\frac{1}{t} = \frac{1}{40} - \frac{1}{72}$

$\frac{1}{t} = \frac{1}{90}$

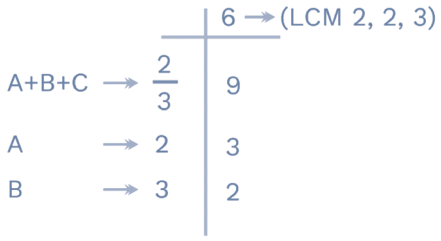
$\therefore t = 90$ minutes.

Alternate solution

Let three pipes be A, B, C

40 min $= \frac{40}{60}$ hr $= \frac{2}{3}$ hr

120 min = 2 hr, 180 min = 3 hr



Since A + B + C = 9 litre/hour

3 + 2 + C = 9

C = 9 − 5 = 4 litre/hour

∴ Efficiency of third pipe is 4 litre/hour.

Hence, total time taken by tap C.

$t_c = \frac{6}{4} = \frac{3}{2}$ hr

$= \frac{3}{2} \times 60 = 90$ minutes.

11. (C)

Since it is given in the question that C is twice efficient as A.

Therefore, let the efficiency of A be 1 unit/day and the efficiency of C be 2 unit/day.

Moreover, it is given in the question that the time taken by B is three times the time taken by A.

B:C

∴ Time → 3:1

Efficiency → 1:3 $\left[\text{efficiency} \propto \frac{1}{\text{time}}\right]$

Now combining all ratios

$A : C = [1 : 2] \times 3$

$\frac{B : C = [1 : 3] \times 2}{A : B : C = 3 : 2 : 6}$

Total work = efficiency of A × time taken by A to complete the work

TW = 3 × 12 = 36 units

Since the working pattern is already mentioned in the question.

∴ Total time taken to complete the work

$= 5 \text{ days} + \frac{1}{9}$ → Remaining work / → Efficiency of (CA)

$= 5\frac{1}{9}$ days

Hence, option (C) is the correct answer.

12. (C)

Let the time taken by any large pipe to fill and to empty the tank be 'a' and '10a' minutes, respectively.

Let the time taken by any small pipe to fill and to empty the tank be 'b' and '10b' minutes, respectively.

Let the Total capacity of the tank be the LCM of a, b, 10a, and 10b, i.e., 10ab.

This means that a large pipe can fill and empty 10b and b litres, respectively, in a minute.

A small pipe can fill and empty 10a and a litre, respectively, in a minute.

One large pipe and seven small pipes can empty the tank in 6 minutes:

$6(b + 7a) = 10ab$ ...(i)

Moreover, one large pipe and three small pipes can fill the tank in 1 minute:

$1(10b + 30a) = 10ab$ ...(ii)

Solving both the equations, we get $b = 3a$ ...(iii)

Solving equations (i) and (iii), we get $b = 6$ and $a = 2$

Now, the time taken by one large pipe and one small pipe to empty the tank will be $(10ab)/(a + b)$.

Substituting the values, we get 15 minutes.

Hence, option (C) is the correct answer.

13. (A)

Rate of flow of water $\propto$ area of the cross-section of a pipe

But, the rate of flow of water $\propto \frac{1}{(\text{Time taken})}$

Therefore, the area of the cross-section of pipe $\propto \frac{1}{(\text{time taken})}$

Area of cross-section of pipes is 4 cm^2, 16 cm^2, 64 cm^2, 256 cm^2.

Now, time taken by 4 cm^2 = 60 minutes.

So, time taken by 16 cm^2 = 60/4 = 12.5 minutes.

Time taken by 64 cm^2 = 60/16 = 3.75 minutes.

Time taken by 256 cm^2 = 60/64 = 0.9375 minutes.

i.e., Fraction of tank filled in 1 minute $= \frac{1}{60} + \frac{4}{60} + \frac{16}{60} + \frac{64}{60} = \frac{85}{60}$

So, time taken = (60/85) × 60 = 42.35 seconds.

Hence, option (A) is the correct answer.

14. (C)

Let the total work = LCM (15 and 18) = 90

Work done by Simba in 1 day $= \frac{90}{15} = 6$ units.

Work done by Jaggu in 1 day $= \frac{90}{18} = 5$ units.

Simba and Jaggu work for 8 days together

∴ Work done by them in 8 days = 8 × 11 = 88 units.

Now, remaining work = 90 − 88 = 2 units.

Work done by Bala = 2 units

As we know, the share is distributed among them based on their work done.

Simba's work = 48 units, Jaggu's work = 40 units and Bala's work = 2 units.

Total work = 90 units = ₹3,600

1 unit = ₹40

Bala's share = 2 × 40 = ₹80

Hence, option (C) is the correct answer.

15. (B)

Anil can make a chair in 12 hours.

Aman can make a chair in (12/1.2) = 10 hours.

Amit can make a chair in (10/1.25) = 8 hours.

Anshul can make a chair in = 12 × 3 = 36 hours.

Now, the amount of work done by all of them in 1 hour = $\frac{1}{12}+\frac{1}{10}+\frac{1}{8}+\frac{1}{36}=\frac{121}{360}$.

So, work done in 15 minutes $=\frac{1}{4}\times\frac{121}{360}=\frac{121}{1,440}$

Now,

Work done by Amit and Anshul in 1 hour $=\frac{1}{8}+\frac{1}{36}=\frac{11}{72}=\frac{220}{1,440}$

So, work done by Amit and Anshul in 4 hours $=\frac{220}{1,440}\times 4=\frac{880}{1,440}$.

Work left $=1-\frac{880}{1,440}-\frac{121}{1,440}=\frac{439}{1,440}$

This is to be done by Anshul alone. Anshul can do 1 work in 36 hours.

Therefore, $\frac{439}{1,440}$ work can be done in $\frac{439}{1,440}\times 36$

= 10.975 hours, i.e., 658.5 minutes.

Hence, option (B) is the correct answer.

Practice Exercise – 2

Level of Difficulty – 1

1. Manik, Ruby, and Ashwin are friends. Together they can finish a task in 24 days. If Manik is thrice as efficient as Ruby and Ruby is half as efficient as Ashwin, then find in how many days Manik can finish that work alone.

(A) 12 hours
(B) 48 hours
(C) 72 hours
(D) 144 hours

2. Mukesh alone can do a job in 30 days, whereas Sujeet alone can do it in 60 days. Mukesh started the job, and after 2 days, Sujeet joined him. Again, after a few more days, Smita joined them and they together finished the job. If Smita did 10% of the job, then in how many days was the job done?

(A) $16\frac{2}{3}$ days
(B) $18\frac{2}{3}$ days
(C) 17 days
(D) 19 days

3. A cistern has three inlet taps and two outlet taps. The inlet taps can fill the cistern individually in 8, 12, and 16 hours. The outlet taps can individually empty the cistern in 4 hours and 20 hours, respectively. If all the taps are opened together, how much time does the empty cistern will take to fill?

(A) 8 hours
(B) 5 hours
(C) 3 hours
(D) Cistern will never be filled

4. Sita and Geeta are working together to complete a job in 8 days. If Sita worked twice efficiently as she actually did and Geeta worked one-third as efficiently as she did, then the work would have been completed in 6 days. Find the time taken by Sita to complete the job alone.

(A) $13\frac{1}{3}$ days
(B) $15\frac{1}{2}$ days
(C) $7\frac{1}{2}$ days
(D) 9 days

5. Ravi can do work in 24 days, whereas Chandan can do the same work in 32 days. Ravi, Chandan, and Sushma undertook this work for ₹96,000 and all together can complete the same work in 12 days. If Sushma is paid in proportion to her work, then the amount in ₹ received by her is:

(A) ₹36,000
(B) ₹12,000
(C) ₹18,000
(D) ₹32,000

6. Rajan alone can finish a piece of work in 156 days. A new person with the same efficiency as him joins him every third day, fifth day, seventh day, and so on until the work is finished. In how many days work will be finished?

(A) 12 days
(B) 13 days
(C) 14 days
(D) 15 days

7. Twenty four men can complete work in 20 days. 40 women can complete the same work in 12 days. 16 men and 8 women started working and after 18 days, 20 more women joined them. How many days will they now take to complete the remaining work?

(A) $1\frac{1}{11}$ Days

(B) $2\frac{1}{11}$ Days

(C) $3\frac{1}{11}$ Days

(D) $4\frac{1}{11}$ Days

8. Five identical small pumps and two identical large pumps are filling a tank. The filling rate per minute of each small pump is 60% of the filling rate of each large pump. Find the ratio of the time taken by all seven pumps to the time taken by two large pumps to fill the same tank.

(A) 2 : 7
(B) 3 : 7
(C) 1 : 4
(D) 2 : 5

9. A, B, and C can complete a work in 6, 10, or 12 days, respectively. If they started working together, but B left 3 days before the completion of the work and C left 5 days before the completion of the work, then find how many days work it had taken less if B and C not left the work?

(A) $4\frac{5}{21}$ days

(B) $3\frac{1}{21}$ days

(C) $2\frac{1}{21}$ days

(D) $3\frac{1}{3}$ days

10. Four men and six women get ₹40,000 by doing a piece of work in 5 days. Three men and seven women get ₹43,500 by doing the same work in 6 days. In how many days, seven men and six women can complete the same work getting ₹94,000?

(A) 8 days
(B) 6 days
(C) 5 days
(D) 10 days

Level of Difficulty – 2

11. P alone can do a piece of work in 10 days. Q and R each of whom can do the work three-fourth as fast as P joined the group. Moreover, S and T, each of whom can do the work one-fifth as fast as P joined the group. If all the five people start working on a particular project together. Find in how many days this project will end.

(A) $2\frac{13}{29}$ days

(B) $3\frac{13}{29}$ days

(C) $5\frac{1}{13}$ days

(D) 45 days

12. Sonu and Monu can finish a piece of work in 12 and 15 days, respectively. They started the work at the same time. After 2 days, Sonu left work and Rahul joined Monu. For 1 day Monu worked with 1.5 times his efficiency with Rahul and left after that. The rest of the work is finished by Rahul in 2 more days. In how many days Rahul alone can finish that piece of work?

(A) 12 days
(B) 6 days
(C) 10 days
(D) 5 days

13. 72 men working 9 hours a day plan to complete a piece of work in 12 days. However, 8 days later, they found that they had completed only 45% of the

total work. They now want to complete the remaining work in 10 more days. How many hours per day should they work to achieve the target?

(A) 8 hours
(B) 9 hours
(C) 10 hours
(D) None of these

14. A can do 2/5th of the work in 18 days and B can do 3/8th of the work in 18 days. A and B along with C started working on the work and they worked together for 12 days. After 12 days, A left, and then B and C together completed the remaining work in 10 days. In how many days, C alone will complete the entire work?

(A) 60 days
(B) 72 days
(C) 80 days
(D) 90 days

15. Two pipes P and Q are connected to an empty water tank. Pipe P can fill the tank, whereas pipe Q empty it. If pipe P is opened at 3 pm and pipe Q is opened at 4 pm, the tank becomes filled at 8 pm. Instead, if pipe P is opened at 3 pm and pipe Q is opened at 5 pm. Then the tank becomes full at 6 pm. If pipe Q is not opened at all, then the time taken to fill the tank is:

(A) 130 minutes
(B) 140 minutes
(C) 42 minutes
(D) 56 minutes

16. A buffalo can graze as much in 6 days as a goat can in 10 days. A cow can graze as much in 8 days as a buffalo can in 5 days. The goat and the cow together take 89 days to graze a certain field. How much time does it take for all three to graze the same field?

17. X can complete the construction of the building in which 1 lakh bricks are to be used in 15 days and Y can complete the same job in 20 days. Initially, X worked for 5 days and then Y joined him. X left 4 days after Y joined. Find the number of bricks that are put by Y alone in this entire construction.

(A) 20,000
(B) 25,000
(C) 40,000
(D) 45,000

18. P, Q, and R can complete a work in 8, 12, or 16 days, respectively. They started working together, but Q left 6 days before completing the work, and R left 3 days before completing the work. Find how many days would it have taken less if Q and R had not left the work in between.

(A) $5\frac{1}{3}$ days
(B) $4\frac{3}{7}$ days
(C) $2\frac{7}{13}$ days
(D) $8\frac{1}{3}$ days

19. Mr. Joe has three dogs, namely Max, Charlie, and Buddy. Max is double efficient as Charlie, Buddy alone takes 15 minutes more to fill a hole in the earth than the time taken by Max alone to fill the same hole. Charlie started filling the hole and after 4 minutes Max also joined and together they filled the hole after working for 2 more minutes. Find the time taken by Charlie and Buddy together to fill a hole of volume equal to half the volume of the previous hole with double their efficiency:

(A) 3 minutes
(B) 2 minutes
(C) $\frac{10}{3}$ minutes
(D) $\frac{5}{3}$ minutes

20. Satyam, Shivam, and Sundram start working on a contract to build a house. Satyam and Shivam can build this house working together in 12 months. Shivam and Sundram work together to build the same house in 16 months, whereas Sundram and Satyam can build the same house in 24 months. If the person who is neither the fastest nor the slowest work alone, then the time in months, he will take to build the same house is:

(A) 24 months
(B) 32 months
(C) 28 months
(D) 15 months

Level of Difficulty – 3

21. Five men and seven women can complete a piece of work in 20 days. Four men and three women can complete the same work in 30 days. In how many days will one man and four women can complete twice the original work?

(A) 60 days
(B) 90 days
(C) 120 days
(D) 180 days

22. Rohan builds an overhead tank in his house, which has three taps attached to it. While the first tap alone can fill the tank in 18 hours, the time taken by the second tap alone to fill the tank is two and a half time that of the first one. A third tap is attached to the tank, emptying it in 36 hours. Now, day 1, to fill the tank, Rohan opens the first tap and after 3 hours opens the second tap as well. However, at the end of the 8th hour, he realises that the third tap has been kept open right from the beginning and promptly closes it. What would be the total time required to fill the tank?

(A) $16\frac{4}{7}$ hours
(B) $15\frac{3}{7}$ hours
(C) $13\frac{4}{7}$ hours
(D) $14\frac{5}{7}$ hours

23. A can do a piece of work in 3 days. B takes thrice as much time as A to complete the same piece of work. C takes thrice as much time as B to complete the same piece of work. D takes thrice as much time as C to complete the same piece of work and E takes thrice as much time as D to complete the same piece of work. If A's 1-day work exceeds the total 1-day work of B, C, D, and E together by 123 units, then find how many units of B's 1-day work are more than D's 1-day work.

24. Work done by Jeevan decreases every day as compared to his previous day's work. Every day, he works 20% less efficiently than the previous day. If the work gets over in 7 days, what fraction of the work was done in the first 5 days together?

(A) $\frac{2,101}{5,120}$
(B) $\frac{57,525}{61,741}$
(C) $\frac{8,102}{9,315}$
(D) $\frac{7,351}{9,377}$

25. A worker can build a wall in 16 days when working alone without taking any energy drink or other substance. He takes an energy drink which can double his work output on any day. He does not take the drink for 3 days consecutively as it can damage his liver. What is the minimum number of days he needs to finish the wall?

(A) 10
(B) 12
(C) 15
(D) 20

26. Isha can finish a piece of work in 12 days and Nisha can finish the same piece of work in 16 days. They both worked together for 4 days, thereafter, Nisha left and Isha worked alone for 1 day. The next day, Rajni joined. Isha and Rajni worked together for 2 days and completed the remaining work. In these 2 days, Isha worked with half of her efficiency. In how many days, Rajni alone could finish the same piece of work?

(A) 4 days
(B) 7 days
(C) 8 days
(D) 12 days

27. 32 boys and 48 girls complete certain construction work in 6 days. All boys work with the same efficiency and all the girls work with the same efficiency; though the efficiency of a boy and a girl may or may not be equal. If 6 boys and 4 girls complete the same work in N^2 days (where N is an integer). Find the total possible values of N.

(A) 0
(B) 4
(C) 6
(D) 8

28. A tank is filled with water. There are four pipes attached to the tank from which pipe A and pipe B are outlet pipes that can empty the tank in 10 hours and 30 hours, respectively, working alone. Pipe C and D are inlet pipes and can fill the empty tank in 20 hours and 15 hours, respectively, working alone. Pipe A is opened on Monday at 3 pm, at 5 pm pipe B is opened, at 6 pm pipe C is opened, and pipe D is also opened at 7 pm. At what time the filled tank will be empty?

(A) 7 pm, Tuesday
(B) 7 pm, Wednesday
(C) 6 am, Wednesday
(D) Tank will never be empty

29. A worker alone can complete a piece of work in 63 days. On the Nth day ($N \geq 2$) the number of workers becomes the number of workers on ($N - 1$)th day thrice. Moreover, the efficiency of each worker on the Nth day is two-thirds of his efficiency on ($N - 1$)th day. In how many days will they be able to complete the original work? (Assume that all the workers are of the same efficiency.)

30. Thirty workers all working with the same efficiency started a job and worked on it for 30 days. From day 31 onwards, a new worker with the same efficiency as previous workers joined them every day till the job was finished. It took exactly 38 days (since the beginning of the work) to finish the entire job. Now, the same job has to be done, starting with the minimum possible number of workers when it is known that a worker will quit the job every day after the first day. How many days will it take to finish the job in such a manner?

(A) 40 days
(B) 44 days
(C) 48 days
(D) 52 days

Solutions

1. (B)

Let the efficiency of Ashwin be x

$\Rightarrow$ Ashwin's 1 day's work = x units

Ruby is half efficient as Ashwin

$\Rightarrow$ Ruby's 1 day's work = $\frac{x}{2}$ units

Similarly, Manik's 1 day's work = $\frac{3x}{2}$ units

Total units of work that they complete in 24 days

$= 24\left(x+\frac{x}{2}+\frac{3x}{2}\right) = 24\ (3x) = 72x$ units

$\Rightarrow$ Manik can complete $72x$ of work in $\frac{72x}{\frac{3}{2}x}$ = 48 days.

Hence, option (B) is the correct answer.

2. (B)

Let 60 units be the total work.

Mukesh's 1-day work = 2 units

Sujeet's 1-day work = 1 unit

For the first 2 days work to be done by Mukesh = 4 units.

Work done by Smita = 6 units

The work done by Mukesh and Sujeet during this time = 60 − (4 + 6) = 50 units.

$\therefore$ The number of days = $\frac{50}{3}$ days = $16\frac{2}{3}$ days.

$\therefore$ The total number of days = $16\frac{2}{3}$ days + 2 days = $18\frac{2}{3}$ days.

Hence, option (B) is the correct answer.

3. (D)

First of all, find the LCM of (8, 12, 16, 4, 20) = 240.

$\therefore$ Let the capacity of the cistern be 240 litres.

$\therefore$ The efficiency of all the inlet pipes/taps

$= \left[\frac{1}{8}:\frac{1}{12}:\frac{1}{16}\right]\times 240.$

= (30:20:15)

Therefore, the inlet pipe fills 30, 20, and 15 litres/hour.

Similarly, the efficiency of all the outlet taps

$= \left[\frac{1}{4}:\frac{1}{20}\right]\times 240$

= [60:12]

Therefore, the outlet taps will empty at 60 litre/hour and 12 litre/hour, respectively.

If all the taps will be opened together then the rate of flow

= (30 + 20 + 15) − (60 + 12)

= 65 litre/hour − 72 litres/hour

= −7 litre/hour

This means no water will remain in the cistern, as the empty rate is more than the per-hour filling rate.

Hence, the cistern will never be filled.

Hence, option (D) is the correct answer.

4. (A)

Let's assume Sita's and Geeta's 1-day work be S and G, respectively.

$\therefore$ (S + G) × 8 = $\left(2S+\frac{1}{3}G\right)\times 6$

4S + 4G = 6S + G

2S = 3G

$\frac{S}{G}=\frac{3}{2}$

$\therefore$ Total work = (S + G) × 8 = 5 × 8 = 40 units

Work done by Sita alone is = $\frac{\text{Total work}}{\text{Efficiency of Sita}} = \frac{40}{3} = 13\frac{1}{3}$ days.

Hence, option (A) is the correct answer.

5. (B)

	96 ⟶ Total work (LCM of 24, 32 and 12)
Ravi ⟶ 24	4 unit/day
Chandan ⟶ 32	3 unit/day
Ravi + Chandan + Sushma ⟶ 12	8 unit/day

Now, we have to find the efficiency of Sushma.

$\therefore$ Ravi + Chandan + Sushma = 8 unit/day

4 + 3 + Sushma = 8

Sushma = 8 − 7 = 1 unit/day

Thus, the efficiency of Sushma is 1 unit/day.

Moreover, the amount they have received in proportion of their work.

$\therefore$ Ravi : Chandan : Sushma

Efficiency/es → 4 : 3 : 1 ⇒ $8R$

Since, $8R$ → ₹ 96,000

$\therefore$ $1R \rightarrow \frac{96,000}{8}$ = ₹ 12,000

Therefore, the amount (in ₹) received by Sushma = ₹ 12,000.

Hence, option (B) is the correct answer.

6. (A)

Rajan can finish work in 156 days. Now on the 3rd day one person joined, on the 5th day, one more joined, and so on.

Let's assume each person 1-day work = 1 unit and it's given that all of them have same efficiency. So, total work = 1 × 156 = 156 units

According to the question:

1 + 1 + 2 + 2 + 3 + 3 + ⋯ = total work = 156 units.

⇒ 2 (1 + 2 + 3 + ⋯) = 156 days

⇒ $2\left[\frac{n(n+1)}{2}\right] = 156$

⇒ $n(n + 1) = 156$

⇒ 12 × 13 = 156

⇒ $n = 12$

It will take 12 days to complete the work in this way.

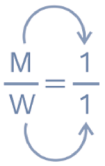
Hence, option (A) is the correct answer.

7. (A)

Let's assume that one man's 1-day work = M units and 1 woman's 1-day work = W units.

So, according to the question: $24M$ × 20 days

= $40W$ × 12 days = total work



Now, we are getting ratio of M:W = 1:1, so we can assume M = W = 1.

Therefore, total work = $24M$ × 20 days = 24 × 1 × 20 = 480 unit.

Now, we have to find the work done by 16 men and 8 women in 18 days

= $(16M + 8W)$ × 18

= (16 × 1 + 8 × 1) × 18

= 24 × 18 = 432 units

Remaining work = (480 − 432) unit = 48 units.

Now, according to the question:

Let the number of days taken by 16 men and 28 women (10 more women joined) to complete the remaining work be N.

$(16M + 28W) \times N = 48$

(16 × 1 + 28 × 1) × N= 48

44 × N = 48

⇒ $N = \frac{48}{44} = \frac{12}{11}$ days = $1\frac{1}{11}$ days

Hence, option (A) is the correct answer.

8. (D)

Let's assume that the filling rate of large pump = 5 units/min.

So, the filling rate of each small pump = 60% of 5 = 3 units/min.

Filling rate of seven pumps (two large and five small) together = 5 × 3 + 2 × 5 = 25 units/min.

Filling rate of two large pumps = 2 × 5 = 10 units/min.

Let's assume the capacity of tank = K units.

Time taken by all seven pumps to fill the tank = $\frac{K}{25}$ min.

Time taken by 2 large pumps to fill the tank = $\frac{K}{10}$ min.

Required ratio = $\frac{K}{25} : \frac{K}{10}$ = 10:25 = 2:5.

Hence, option (D) is the correct answer.

9. (C)

Suppose, the total work is going to complete in x days.

		60+18+25 = 103 units
A ⟶	6	10
B ⟶	10	6×3 = 18 unit/day
C ⟶	12	5×5 = 25 unit/day

∴ Total work done by all person (A, B, C) = 60 days

$10x + 6(x - 3) + 5(x - 5) = 60$

$10x + 6x - 18 + 5x - 25 = 60$

$21x = 60 + 43$

$21x = 103$

$x = \frac{103}{21}$ days

If 'B' and 'C' have not left the work then the time taken by them to complete the work (t)

$= \frac{\text{Total work}}{\text{Sum of efficiency of } (A, B, C)}$

$= \frac{60}{(10+6+5)} = \frac{60}{21}$

$t = \frac{20}{7}$ days

∴ The difference in time

$= \left(\frac{103}{21} - \frac{20}{7}\right)$ days $= \left(\frac{103}{21} - \frac{60}{21}\right)$ days

$= \frac{43}{21}$ days $= 2\frac{1}{21}$ days

Hence, option (C) is the correct answer.

10. (D)

4M + 6W ⇒ 8,000

3M + 7W ⇒ 7,250

$M - W \Rightarrow 750$

By solving these equations

M = 1,250, W = 500

$(7M + 6W)\ D = 94{,}000 \Rightarrow (8{,}750 + 3{,}000)\ D = 94{,}000$

$\Rightarrow D$ = 94,000/11,750 = 8 days

Hence, option (D) is the correct answer.

11. (B)

Let efficiencies of P, Q, R, S, and T be E_P, E_Q, E_R, E_S, and E_T

According to the question,

$\frac{3}{4}$, $\frac{1}{5}$

LCM=20

Let the efficiency of P (E_P) be 20 units/day.

Therefore, $E_Q = \frac{3}{4} \times 20 = 15$ unit/day

$E_R = \frac{3}{4} \times 20 = 15$ unit/day

Similarly, $E_S = \frac{1}{5} \times 20 = 4$ unit/day

$E_T = \frac{1}{5} \times 20 = 4$ unit/day

∴ Combine efficiency of (P, Q, R, S, T)

$= E_P + E_Q + E_R + E_S + E_T$

= 20 + 15 + 15 + 4 + 4 = 58 unit/day

Since the efficiency of 'P' is 20 units per day, he completes the work in 10 days.

∴ Total work = E_P × time taken= 20 × 10 = 200 units

Therefore, we have to find the time taken to complete the project while all of them working together.

$t = \frac{200}{58} = \frac{100}{29}$ days $= 3\frac{13}{29}$ days

Hence, option (B) is the correct answer.

12. (D)

LCM (12, 15) = 60

Total work = 60 units

Sonu's 1-day work = 5 units

Monu's 1-day work = 4 units

In 2 days, they finished = 9 × 2 = 18 units

Work left = 60 − 18 = 42 units

Let Rahul's 1-day work = x units

Monu's 1-day work with 1.5 times efficiency = 4 × 1.5 = 6.

In 1 day, Rahul and Monu finished = (6 + x) units.

Remaining work = 42 − 6 − x = (36 − x) units.

These (36 − x) units are finished by Rahul in 2 more days

$\Rightarrow 2x = (36 - x)$

$\Rightarrow x = 12$ units

Therefore, the number of days in which Rahul can alone finish that piece of work:

$= \frac{60}{12} = 5$ days.

Hence, option (D) is the correct answer.

13. (D)

Assume 1 man 1-hour work = 1 unit and also assume the total work = 100K units.

Work done in 8 days = 72 × 1 × 9 × 8 = 45K ...(i)

Let's assume each of them worked P hours to complete the remaining work in 10 more days.

72 × 1 × P × 10 = 55K ...(ii)

On dividing (ii) by (i), we will get P = 8.8 hours.

Hence, option (D) is the correct answer

14. (C)

A can do the complete work in $18 \times \left(\frac{5}{2}\right)$ = 45 days.

B can do the complete work in $18 \times \left(\frac{8}{3}\right)$ = 48 days.

So, let's assume the total work = LCM of (45 and 48) = 720 units.

A's 1-day work = $\frac{720}{45}$ = 16 units

B's 1-day work = $\frac{720}{48}$ = 15 units

Let's assume C's 1-day work = K units

(A + B + C)'s 1-day work = 31 + K units

(A + B + C)'s 12-days work = 12 (31 + K) = (372 + 12K) units.

After 12 days, A left and (B and C) together work for 10 more days.

(B + C)'s 10 days work = 10 (15 + K) = (150 + 10K) units.

Total work = (372 + 12K) + (150 + 10K) = 720 units.

Solving which, we will get K = 9

Hence, C alone can do the complete work in = $\frac{720}{9}$ = 80 days.

Hence, option (C) is the correct answer.

15. (B)

Let the efficiency of the inlet pipe P be a litre/hour and the efficiency of the outlet pipe Q be a litre/hour.

Now, according to condition 1:

It is given in the question that the tank is filled at 8 pm as per condition 1.

∴ Volume of the tank = (5a − 4b) litre ...(i)

Again according to the second condition:

The tank is filled at 6 pm as per condition 2.

∴ Volume of the tank = 3a − 1 × b

= (3a − b) litres ...(ii)

If we equate the equations (i) and (ii) we will get:

$5a - 4b = 3a - b$

$2a = 3b$

$b = \frac{2}{3}a$

If we put the value of b = $\frac{2}{3}a$ in equation (i) we will get:

Volume of the tank = (5a − 4b) litres

$= 5a - 4 \times \frac{2}{3}a = \frac{7}{3}a$

According to the third condition if pipe Q is not opened then the time has been taken by the pipe P or filler pipe

$$\frac{\frac{7a}{3}}{a} = \frac{7}{3}\text{hr} = \frac{7}{3} \times 60 \text{ minutes} = 140 \text{ minutes.}$$

Hence, option (B) is the correct answer.

16. 49 days

The ratio of grazing efficiency of buffalo and goat = 10:6 or 40:24.

The ratio of grazing efficiency of buffalo and cow = 8:5 or 40:25.

The ratio of grazing efficiency of buffalo, cow, and goat = 40:25:24.

So, let's assume that a buffalo, a cow, and a goat graze 40, 25, and 24 units per day.

Field graze by a goat and a cow together in 89 days = (24 + 25) × 89 = 49 × 89 units = total work.

Now, the time is taken by all three together to graze the same field.

$$= \frac{49 \times 89}{(40 + 25 + 24)} = 49 \text{ days.}$$

17. (C)

Let's assume the total work = putting 1 lakh bricks = 60 units

X does per day = 4 units

Y does per day = 3 units

X alone did work = 5 × 4 = 20

Then, *X* + *Y* did for = 7 × 4 = 28

Remaining work = 12, which will be done by *Y* alone.

In the entire job

Work done by *X* = 20 + 4 × 4 = 36 units

Done by *Y* = 24

Bricks put alone by *Y* = $\frac{24}{60}$ × (100,000) = 40,000.

Hence, option (C) is the correct answer.

18. (C)

Suppose, the total work is going to be completed in *x* days.

Therefore,

		48(LCM of 8, 12, 16) ⟶ Total work
P ⟶	8 days	$6x$ ⟶ work done by 'P'
Q ⟶	12 days	$4(x-6)$ ⟶ work done by 'Q'
R ⟶	16 days	$3(x-3)$ ⟶ work done by 'R'

$$6x + 4(x - 6) + 3(x - 3) = 48$$

$$6x + 4x - 24 + 3x - 9 = 48$$

$$13x = 48 + 33$$

$$x = \frac{81}{13} \text{ days}$$

If Q and R have not left the work, then their time to complete the work is:

$$t = \frac{48}{6 + 4 + 3} \begin{matrix} \rightarrow \text{Total work} \\ \rightarrow \text{Efficiency} \end{matrix}$$

$$t = \frac{48}{13} \text{ days}$$

$$\therefore \text{ The difference in time} = \left(\frac{81}{13} - \frac{48}{13}\right) \text{days}$$

$$= \frac{33}{13} \text{ days} = 2\frac{7}{13} \text{ days}$$

Hence, option (C) is the correct answer.

19. (D)

Since Max is double powerful as Charlie. So, the time taken by Max is half the time taken by Charlie to fill the hole.

Let the time taken by Max and Charlie be *x* and 2*x*.

Time taken by Buddy = *x* + 15

According to question:

$$\Rightarrow \frac{4}{\left(\frac{1}{2x}\right)} + \frac{2}{\left[\left(\frac{1}{2x}\right) + \left(\frac{1}{x}\right)\right]} = 1$$

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

$$\Rightarrow \frac{10}{2x} = 1$$

$$\Rightarrow x = 5$$

Hence, the time taken by Max, Charlie, and Buddy is 5 minutes, 10 minutes, and 20 minutes, respectively.

Let Charlie and Buddy together take t minutes to fill the hole with double their efficiencies.

$$\Rightarrow \left(\frac{2t}{10}\right)+\left(\frac{2t}{20}\right)=\frac{1}{2}$$

$$\Rightarrow t=\frac{5}{3}\text{ min}$$

Hence, option (D) is the correct answer.

20. (B)

		48 (LCM of 12, 16, 24) total work
Satyam + Shivam	12	4 unit/day
Shivam + Sundram	16	3 unit/day
Sundram + Satyam	24	2 unit/day

Let the efficiency of Satyam, Shivam, Sundram be a, b, and c unit/day.

$\therefore$ $a + b = 4$ ...(i)

$b + c = 3$ ...(ii)

$c + a = 2$ ...(iii)

If we solve equations (i) and (ii) we will get,

$a - c = 1$ ...(iv)

Again, if we solve equations (iii) and (iv) we will get,

$c + a = 2$

$a - c = 1$

$\therefore$ $2a = 3$

$a = 1.5$ unit/day

Thus, $c + a = 2$

$c = 2 - 1.5 = 0.5$

$c = 0.5$ unit/day

Since, $a + b = 4$

$\therefore$ $b = 4 - a = 4 - 1.5$

$b = 2.5$ unit/day

The person who is neither the fastest nor the slowest is Satyam, whose efficiency is 1.5 units/day

$\therefore$ Time taken $= \frac{48 \rightarrow \text{Total work}}{15 \rightarrow \text{Efficiency}}$

$t = 32$ months

Therefore, the time has taken Satyam to build the same house by working alone is 32 months.

Hence, option (B) is the correct answer.

21. (C)

Let's assume one man and one woman 1-day work be M and W units, respectively.

$(5M + 7W) \times 20$ = total work = $(4M + 3W) \times 30$ ...(i)

Solving which we will get $\frac{M}{W}=\frac{5}{2}$

So, let's assume $M = 5$ units and $W = 2$ units

Putting the value of M and W in (i), we will get total work = 780 units

Work required to do = twice the original work = 780 × 2 = 1,560 units

1 man and 4 women 1-day work = $M + 4W$ = 5 + 4 × 2 = 13 units

Time taken by them to complete the required work = $\frac{1,560}{13}$ = 120 days

Hence, option (C) is the correct answer.

22. (A)

Time taken by second tap to fill the tank = 18 × 2.5 = 45 hours.

Let's assume the capacity of the tank = LCM of (18, 45, and 36) = 180 litres.

So, the first tap would fill $\frac{180}{18}$ = 10 litres per hour.

The second tap would fill $\frac{180}{45}$ = 4 litres per hour.

And, the third tap would empty $\frac{180}{36}$ = 5 litres per hour.

Tap one in first 3 hours would fill = 10 × 3 = 30 litres.

Tap one + Tap two in next 5 hours would fill = 14 × 5 = 70 litres.

Tap three in first 8 hours would empty = 5 × 8 = 40 litres.

So, net tank filled in first 8 hours = 30 + 70 − 40 = 60 litres.

Now, the remaining 120 litres would be filled by both pipes one and two, so the time taken would be $= \frac{120}{14} = \frac{60}{7} = 8\frac{4}{7}$ hours.

Hence, the total time taken to fill the tank completely is:

$= 8 + 8\frac{4}{7}$ hours $= 16\frac{4}{7}$ hours

Hence, option (A) is the correct answer.

23. 72

A, B, C, D, and E alone will take 3, 9, 27, 81, and 243 days, respectively, to complete the given piece of work.

Let's assume the total work = 243K units

So, 1-day work of A, B, C, D, and E will be 81K, 27K, 9K, 3K, and 1K units, respectively.

According to the question:

$81K - (27K + 9K + 3K + K) = 123$ units

Solving which we will get $K = 3$

Required answer = B's 1-day work − D's 1-day work = 24K = 72 units.

24. (B)

Let Jeevan do 'x' units of work on the first day.

Then, on second day he does $= \frac{4x}{5}$

on third day, he does $\frac{4x}{5} \times 80\% = \frac{16x}{25}$ units

on the fourth day, he does

$= \frac{16x}{25} \times 80\% = \frac{16x}{25} \times \frac{4}{5} = \frac{64}{125}x = \left(\frac{4}{5}\right)^3 x$ units

Similarly, on the seventh day, he does

$= \left(\frac{4}{5}\right)^6 x$ units

We have to find the amount of work done in the first 5 days.

Work done in the first 5 days

$= x + \frac{4}{5}x + \frac{16}{25}x + \frac{64}{125}x + \frac{256}{625}x$

$= \frac{625x + 500x + 400x + 320x + 256x}{625}$

$= \frac{2,101}{625}x$

Similarly, work done on the sixth and seventh day

$= \left(\frac{4}{5}\right)^5 x + \left(\frac{4}{5}\right)^6 x = \left(\frac{4}{5}\right)^5 \times \left[1 + \frac{4}{5}\right]x$

$= \left(\frac{4}{5}\right)^5 \times \left[\frac{9}{5}\right]x = \frac{1,024}{3,125} \times \frac{9}{5}x = \frac{9,216}{15,625}x$

∴ Total work of all 7 days.

$= \frac{2,101}{625}x + \frac{9,216}{15,625}x = \frac{2,101 \times 25}{15,625}x + \frac{9,216}{15,625}x$

$= \frac{61,741}{15,625}x$

Thus, the fraction of work done in the first 5 days

$= \frac{\frac{2,101x}{625}}{\frac{61,741x}{15,625}} = \frac{2,101 \times 25}{61,741} = \frac{52,525}{61,741}$

Hence, option (B) is the correct answer.

25. (A)

Given constraints, he takes the drink on day 1, 2, and not on day 3, then he takes it on day 4, 5, and not on day 6.

1-day work, without the drink: $\frac{1}{16}$ of total work.

Day 1 work (with drink): $\frac{2 \times 1}{16}$ of total work.

Day 2 work (with drink): $\frac{2 \times 1}{16}$ of total work.

Day 3 work (without drink): $\frac{1}{16}$ of total work.

Day 4 work (with drink): $\frac{2 \times 1}{16}$ of total work.

Day 5 work (with drink): $\frac{2 \times 1}{16}$ of total work.

Day 6 work (without drink): $\frac{1}{16}$ of total work.

Day 7 work (with drink): $\frac{2 \times 1}{16}$ of total work.

Day 8 work (with drink): $\frac{2\times1}{16}$ of total work.

Day 9 work (without drink): $\frac{1}{16}$ of total work.

Thus, the total amount of work done till now is: $\frac{15}{16}$ of total work i.e., $\frac{1}{16}$ of work is remaining, which he can finish on the 10th day (with or without the drink).

Minimum days: 10

Hence, option (A) is the correct answer.

26. (C)

Isha alone can finish a piece of work in 12 days.

Isha's 1-day work = $\frac{1}{12}$

Nisha alone can finish a piece of work in 16 days.

Nisha's 1-day work = $\frac{1}{16}$

According to the question:

Isha and Nisha worked together for 4 days, so their 4 days of work

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

Isha worked alone for 1 day; her 1-day work $= \frac{1}{12}$.

Let us assume Rajni takes x days to finish that work alone.

Rajni's 1-day work $= \frac{1}{x}$

Isha and Rajni worked together for 2 days (with Isha working with half of her efficiency), so their 2 days of work

$= 2\left(\frac{1}{24}+\frac{1}{x}\right)$

$$\Rightarrow 4\left(\frac{1}{12}+\frac{1}{16}\right)+\frac{1}{12}+2\left(\frac{1}{24}+\frac{1}{x}\right)=1$$

$$\Rightarrow \frac{1}{3}+\frac{1}{4}+\frac{1}{12}+\frac{1}{12}+\frac{2}{x}=1$$

$$\Rightarrow \frac{4+3+1+1}{12}+\frac{2}{x}=1$$

$$\Rightarrow \frac{2}{x}=1-\frac{9}{12}$$

On solving, $x = 8$

Rajni alone can finish that work in 8 days.

Hence, option (C) is the correct answer.

27. (D)

Let A be a boy complete the work alone, and B be a girl who can complete the work alone.

32 boys and 48 girls complete the work in 6 days.

$$\frac{32}{a}+\frac{48}{b}=\frac{1}{6} \quad \text{...(i)}$$

Moreover, six boys and four girls complete the same work in N^2 days.

$$\therefore \quad \frac{6}{a}+\frac{4}{b}=\frac{1}{N^2} \quad \text{...(ii)}$$

Multiplying equation (ii) by 12 and subtracting from equation (i), we get:

$$\frac{72}{a}+\frac{48}{b}-\frac{32}{a}-\frac{48}{b}=\frac{12}{N^2}-\frac{1}{6}$$

$$\Rightarrow \frac{72}{a}-\frac{32}{a}=\frac{12}{N^2}-\frac{1}{6}$$

$$\Rightarrow \frac{40}{a}=\frac{12}{N^2}-\frac{1}{6}$$

$$\Rightarrow \frac{1}{a}=\frac{1}{40}\left(\frac{12}{N^2}-\frac{1}{6}\right)$$

Put the value $\frac{1}{a}$ in equation (i), and we get:

$$32\times\frac{1}{40}\left(\frac{12}{N^2}-\frac{1}{6}\right)+\frac{48}{b}=\frac{1}{6}$$

$$\Rightarrow \frac{48}{b}=\frac{1}{6}-\frac{48}{5N^2}+\frac{4}{30}$$

$$\Rightarrow \frac{1}{b}=\frac{1}{5}\left(\frac{1}{24}-\frac{1}{N^2}\right)$$

$$\therefore \frac{1}{a}=\frac{1}{40}\left(\frac{12}{N^2}-\frac{1}{6}\right) \text{ and } \frac{1}{b}=\frac{1}{5}\left(\frac{1}{24}-\frac{1}{N^2}\right)$$

When $a = 0$,

$$\frac{12}{N^2}-\frac{1}{6}=0$$

$$\Rightarrow \frac{12}{N^2}=\frac{1}{6}$$

$$\Rightarrow N^2 = 72$$

When $b = 0$,

$$\frac{1}{24} - \frac{1}{N^2} = 0$$

$$\Rightarrow \frac{1}{24} = \frac{1}{N^2}$$

$\Rightarrow N^2 = 24$

$\therefore$ The range of N^2 is $24 < N^2 < 72$

The possible value of $N^2 = 25, 36, 49$, and 64

$\therefore$ $N = 5, -5, 6, -6, 7, -7, 8$, or -8

Hence, the total possible values of N are 8.

Hence, option (D) is the correct answer.

28. (C)

Let the total work,

LCM (10, 30, 20, 15) = 60 units.

Hence, the efficiency of pipes

Pipe A = −6 units/hour (Empty)

Pipe B = −2 units/hour (Empty)

Pipe C = +3 units/hour (Fill)

Pipe D = +4 units/hour (Fill)

From, 3 pm to 5 pm, pipe A = −6 × 2 = −12 units

5 pm–6 pm (Pipe A + Pipe B) = −8 × 1 = −8 units

6 pm–7 pm (Pipe A + Pipe B + Pipe C) = −5 × 1 = −5 units

Remaining work need to be done = 60 − (12 + 8 + 5) = 60 − 25 = 35 units.

From 7 pm onwards, all the four pipes will work simultaneously and net they will empty = 1 unit in 1 hour, so it will take 35 hours to empty the 35 units.

35 hours from 3 pm Monday, the tank will get empty at 6 am on Wednesday.

Hence, option (C) is the correct answer.

29. 6

Let's assume (one man) 1-day work = 1 unit.

Total work = (one man) × 63 days' work = 63 units.

	Workers	Work/Day	Work Done
Day 1	1	1 unit/day	$1 \times 1 = 1$
Day 2	3	$\frac{2}{3}$ unit/day	$3 \times \frac{2}{3} = 2$
Day 3	9	$\frac{2}{3} \times \frac{2}{3}$ unit/day	$9 \times \frac{4}{9} = 4$
Day 4	27	$\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ unit/day	$27 \times \frac{8}{27} = 8$
Day 5	81	$\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ unit/day	$81 \times \frac{16}{81} = 16$
Day 6	243	$\frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3} \times \frac{2}{3}$ unit/day	$243 \times \frac{32}{243} = 32$

Total work done in 6 days = 1 + 2 + 4 + 8 + 16 + 32 = 63 units = total work.

Hence, the work will be completed in 6 days.

30. (C)

Let's assume the one man's 1 day's work = 1 unit

According to the question:

30 workers will do 30 units of work each day

In 30 days, they will complete 30 × 30 = 900 units of work.

On the 31st day, we have 31 workers, and they will do 31 units of work.

On the day 32, we have 32 workers, and they will do 32 units of work.

Similarly, on the 38th day, we will have 38 workers, and they will do 38 units of work.

So total work done in 38 days

= 400 + 31 + 32 + 33 + 34 + 35 + 36 + 37 + 38 = 1,176 units

According to the question:

Let's assume N workers started working on the first day, followed by (N – 1) workers on the second day and so on till the last day where one worker will be left.

Their work done = N + (N – 1) + (N – 2) … + 3 + 2 + 1 = 1,176 units.

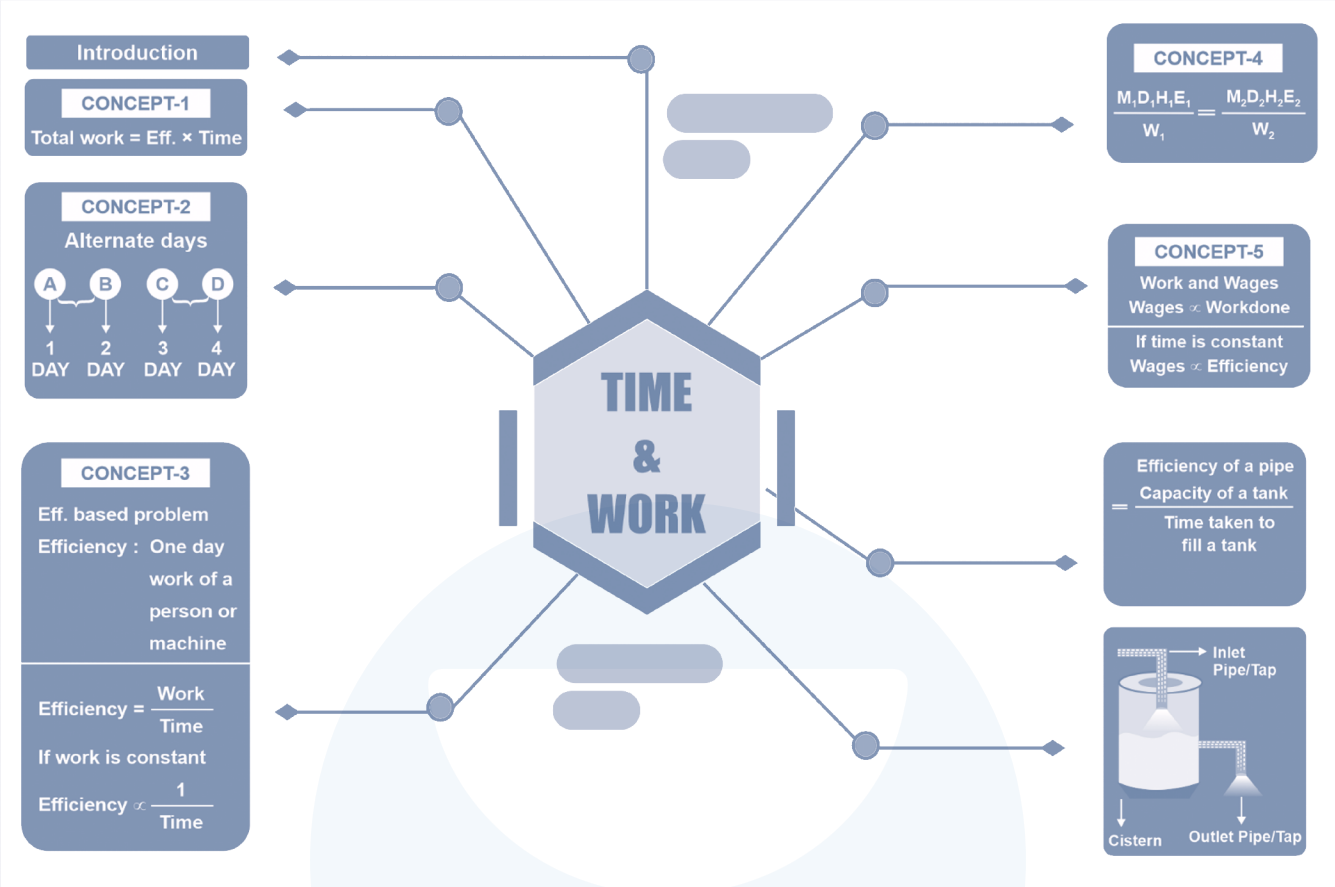
$\frac{[N(N+1)]}{2} = 1{,}176$

$\Rightarrow N = 48$

Thus, it will take 48 days to complete the work.

Hence, option (C) is the correct answer.

Mind Map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Cistern
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