9

Time and Work

INTRODUCTION

The concept of time and work is another important topic for the aptitude exams. Questions on this chapter have been appearing regularly over the past decade in all aptitude exams. Questions on Time and Work have regularly appeared in the CAT especially in its online format.

Theory

In the context of the CAT, you have to understand the following basic concepts of this chapter:

If A does a work in a days, then in one day A does $\rightarrow \frac{1}{a}$ of the work.

If B does a work in b days, then in one day B does $\rightarrow \frac{1}{b}$ of the work.

Then, in one day, if A and B work together, then their combined work is $\frac{1}{a} + \frac{1}{b}$.

or $$\frac{a+b}{ab}$$

In the above case, we take the total work to be done as "1 unit of work". Hence, the work will be completed when 1 unit of work is completed.

For example, if A can do a work in 10 days and B can do the same work in 12 days, then the work will be completed in how many days.

One day's work = 1/10 + 1/12 = (12 + 10)/120
[Taking LCM of the denominators]
= 22/120

Then the number of days required to complete the work is 120/22.

Note that this is a reciprocal of the fraction of work done in one day. This is a benefit associated with solving time and work through fractions. It can be stated as—the number of time periods required to complete the full work will be the reciprocal of the fraction of the work done in one time period.

ALTERNATIVE APPROACH

Instead of taking the value of the total work as 1 unit of work, we can also look at the total work as 100 per cent work. In such a case, the following rule applies:

If A does a work in a days, then in one day A does $\rightarrow \frac{100}{a}$% of the work.

If B does a work in b days, then in one day B does $\rightarrow \frac{100}{b}$% of the work.

Then, in one day, if A and B work together, then their combined work is

$$\frac{100}{a} + \frac{100}{b}$$

This is often a very useful approach to look at the concept of time and work because thinking in terms of percentages gives a direct and clear picture of the actual quantum of work done.

What I mean to say is that even though we can think in either a percentage or a fractional value to solve the problem, there will be a thought process difference between the two.

Thinking about work done as a percentage value gives us a linear picture of the quantum of the work that has been done and the quantum of the work that is to be done. On the other hand, if we think of the work done as a fractional

value, the thought process will have to be slightly longer to get a full understanding of the work done.

For instance, we can think of work done as 7/9 or 77.77%. The percentage value makes it clear as to how much quantum is left. The percentage value can be visualised on the number line, while the fractional value requires a mental inversion to fully understand the quantum.

An additional advantage of the percentage method of solving time and work problems would be the elimination of the need to perform cumbersome fraction additions involving LCMs of denominators.

However, you should realise that this would work only if you are able to handle basic percentage calculations involving standard decimal values. If you have really internalised the techniques of percentage calculations given in the chapter of percentages, then you can reap the benefits for this chapter.

The benefit of using this concept will become abundantly clear by solving through percentages the same example that was solved above using fractions.

Example: If *A* can do a work in 10 days and *B* can do the same work in 12 days, then the work will be completed in how many days.

One day's work = 10% + 8.33% = 18.33% (Note, no LCMs required here)

Hence, to do 100% work, it will require: 100/18.33.

This can be solved by adding 18.33 mentally to get between 5–6 days. Then on you can go through options and mark the closest answer.

The process of solving through percentages will yield rich dividends if and only if you have adequate practice on adding standard percentage values. Thus, 18.33 × 5 = 91.66 should not give you any headaches and should be done while reading for the first time.

Thus a thought process chart for this question should look like this.

If *A* can do a work in 10 days (→ means 10% work) and *B* can do the same work in 12 days (→ 8.33% work → 18.33% work in a day in 5 days 91.66% work → leaves 8.33% work to be done → which can be done in 8.33/18.33 of a day = 5/11 of a day (since both the numerator and the denominator are divisible by 1.66), then the work will be completed in 5 $\frac{5}{11}$ days.

The entire process can be done mentally.

The Concept of Negative Work

Suppose, that *A* and *B* are working to build a wall while *C* is working to break the wall. In such a case, the wall is being built by *A* and *B* while it is being broken by *C*. Here, if we consider the work as the building of the wall, we can say that *C* is doing negative work.

Example: *A* can build a wall in 10 days and *B* can build it in 5 days, while *C* can completely destroy the wall in 20 days. If they start working at the same time, in how many days will the work be completed.

Solution: The net combined work per day here is:

A's work + *B*'s work – *C*'s work = 10% + 20% – 5% = 25% work in one day.

Hence, the work will get completed (100% work) in 4 days.

The concept of negative work commonly appears as a problem based on pipes and cisterns, where there are inlet pipes and outlet pipes/leaks which are working against each other.

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

Application of Product Constancy Table to Time and Work

The equation that applies to Time and Work problems is

Work Rate × Time = Work done

This equation means that if the work done is constant, then →

Work rate is inversely proportional to time. Hence, the Product Constancy Table will be directly applicable to time and work questions.

[Notice the parallelism between this formula and the formula of time speed and distance, where again there is product constancy between speed and time if the distance is constant.]

Time is usually in days or hours although any standard unit of time can be used. The unit of time that has to be used in a question is usually decided by the denominator of the unit of work rate.

Here, there are two ways of defining the Work rate.

(a) In the context of situations where individual working efficiencies or individual time requirements are given in the problem, the work rate is defined by the unit: Work done per unit time.

In this case, the total work to be done is normally considered to be 1 (if we solve through fractions) or 100% (if we solve through percentages).

Thus, in the solved problem above, when we calculated that *A* and *B* together do 18.33% work in a day, this was essentially a statement of the rate of work of *A* and *B* together.

Then the solution proceeded as:

18.33% work per day × No. of days required = 100% work

Giving us: the no. of days required = 100/18.33 = $5\frac{5}{11}$

(b) In certain types of problems (typically those involving projects that are to be completed), where a certain category of worker has the same rate of working, the Work rate will be defined as the number of workers of a particular category working on the project.

For instance, questions where all men work at a certain rate, the work rate when 2 men are working together will be double the work rate when 1 man is working alone. Similarly, the work rate when 10 men are working together will be 10 times the work rate when 1 man is working alone.

In such cases, the work to be done is taken as the number of man-days required to finish the work.

Note, for future reference, that the *work to be done can also be measured in terms of the volume of work defined in the context of day-to-day life.*

For example, the volume of a wall to be built, the number of people to be interviewed, the number of *chapattis* to be made and so on.

WORK EQUIVALENCE METHOD (To Solve Time and Work Problems)

The work equivalence method is nothing but an application of the formula:

Work rate × Time = Work done (or work to be done)

Thus, if the work to be done is doubled, the product of *work rate* × *time* also has to be doubled. Similarly, if the work to be done increases by 20%, the product of *work rate* × *time* also has to be increased by 20% and so on.

This method is best explained by an example:

A contractor estimates that he will finish the road construction project in 100 days by employing 50 men.

However, at the end of the 50th day, when as per his estimation half the work should have been completed, he finds that only 40% of his work is done.

(a) How many more days will be required to complete the work?

(b) How many more men should he employ in order to complete the work in time?

Solution:

(a) The contactor has completed 40% of the work in 50 days.

If the number of men working on the project remains constant, the rate of work also remains constant. Hence, to complete 100% work, he will have to complete the remaining 60% of the work.

For this he would require **75** more days. (This calculation is done using the unitary method.)

(b) In order to complete the work on time, it is obvious that he will have to increase the number of men working on the project.

This can be solved as:

50 men working for 50 days → 50 × 50 = 2500 man-days.

2500 man-days has resulted in 40% work completion. Hence, the total work to be done in terms of the number of man-days is got by using unitary method:

Work left = 60% = 2500 × 1.5 = 3750 man-days

This has to be completed in 50 days. Hence, the number of men required per day is 3750/50 = 75 men.

Since, 50 men are already working on the project, the contractor needs to hire 25 more men.

[Note, this can be done using the percentage change graphic for product change. Since, the number of days is constant at 50, the 50% increase in work from 40% to 60% is solely to be met by increasing the number of men. Hence, the number of men to be increased is 50% of the original number of men = 25 men.]

The Specific Case of Building a Wall (Work as Volume of Work)

As already mentioned, in certain cases, the unit of work can also be considered to be in terms of the volume of work. For example, building of a wall of a certain length, breadth and height.

In such cases, the following formula applies:

$$\frac{L_1 B_1 H_1}{L_2 B_2 H_2} = \frac{m_1 t_1 d_1}{m_2 t_2 d_2}$$

where L, B and H are respectively the length, breadth and height of the wall to be built, while m, t and d are respectively the number of men, the amount of time per day and the number of days. Further, the suffix 1 is for the first work situation, while the suffix 2 is for the second work situation.

Consider the following problem:

Example: 20 men working 8 hours a day can completely build a wall of length 200 metres, breadth 10 metres and height 20 metres in 10 days. How many days will 25 men working 12 hours a day require to build a wall of length 400 metres, breadth 10 metres and height of 15 metres.

This question can be solved directly by using the formula above

$$\frac{L_1 B_1 H_1}{L_2 B_2 H_2} = \frac{m_1 t_1 d_1}{m_2 t_2 d_2}$$

Here,	L_1 is 200 metres	L_2 is 400 metres
	B_1 is 10 metres	B_2 is 10 metres
	H_1 is 20 metres	H_2 is 15 metres
while	m_1 is 20 men	m_2 is 25 men
	d_1 is 10 days	d_2 is unknown
and	t_1 is 8 hours a day	t_2 is 12 hours a day

Then we get (200 × 10 × 20)/(400 × 10 × 15) = (20 × 8 × 10)/(25 × 12 × d_2)

$\therefore \qquad d_2 = 5.333/0.6666 = 8$ days

Alternatively, you can also directly write the equation as follows:

$d_2 = 10 \times (400/200) \times (10/10) \times (20/15) \times (20/25) \times (8/12)$

This can be done by thinking of the problem as follows:

The number of days have to be found out in the second case. Hence, on the LHS of the equation write down the unknown and on the RHS of the equation write down the corresponding knowns.

$$d_2 = 10 \times ....$$

Then, the length of the wall has to be factored in. There are only two options for doing so, viz.

Multiplying by 200/400 (< 1, which will reduce the number of days) or multiplying by 400/200 (>1, which will increase the number of days).

The decision of which one of these is to be done is made on the basis of the fact that when the length of the wall is increasing, the number of days required will also increase.

Hence, we take the value of the fraction greater than 1 to get

$$d_2 = 10 \times (400/200)$$

We continue in the same way to get

No change in the breadth of the wall → hence, multiply by 10/10 (no change in d_2)

Height of the wall is decreasing → hence, multiply by 15/20 (< 1 to reduce d_2)

Number of men working is increasing → hence, multiply by 20/25 (< 1 to reduce d_2)

Number of hours per day is increasing → hence, multiply by 8/12 (< 1 to reduce the number of days)

The Concept of Efficiency

The concept of efficiency is closely related to the concept of work rate.

When we make a statement saying *A* is twice as efficient as *B*, we mean to say that *A* does twice the work as *B* in the same time. In other words, we can also understand this as *A* will require half the time required by *B* to do the same work.

In the context of efficiency, another statement that you might come across is *A* is two times more efficient than *B*. This is the same as *A* is thrice as efficient as *B* or *A* does the same work as *B* in 1/3rd of the time.

Equating Men, Women and Children This is directly derived from the concept of efficiencies.

Example: 8 men can do a work in 12 days while 20 women can do it in 10 days. In how many days can 12 men and 15 women complete the same work.

Solution: Total work to be done = 8 × 12 = 96 man-days.

or total work to be done = 20 × 10 = 200 woman-days.

Since, the work is the same, we can equate 96 man-days = 200 woman-days.

Hence, 1 man-day = 2.08333 woman-days.

Now, if 12 men and 15 women are working on the work we get

12 men are equal to 12 × 2.08333 = 25 women

Hence, the work done per day is equivalent to 25 + 15 women working per day.

That is, 40 women working per day.

Hence, 40 × no. of days = 200 woman days

Number of days = 5 days.

Space for Notes

WORKED-OUT PROBLEMS

Problem 9.1 *A* can do a piece of work in 10 days and *B* in 12 days. Find how much time they will take to complete the work under the following conditions:

(a) Working together
(b) Working alternately starting with *A*.
(c) Working alternately starting with *B*.
(d) If *B* leaves 2 days before the actual completion of the work.
(e) If *B* leaves 2 days before the scheduled completion of the work.
(f) If another person *C* who does negative work (i.e., works against *A* and *B* and can completely destroy the work in 20 days) joins them and they work together all the time.

Solution

(a) 1 day's work for *A* is 1/10 and 1 day's work for *B* is 1/12.

Then, working together, the work in one day is equal to: $\frac{1}{10}+\frac{1}{12}=\frac{11}{60}$ of the work. Thus working together they need 60/11 days to complete the work → 5.45 days.

Alternately, you can use percentage values to solve the above question:

A's work =10%, *B*'s work = 8.33%. Hence, *A* + *B* = 18.33% of the work in one day.

Hence, to complete 100% work, we get the number of days required = 100/18.33 → 5.55 days.

This can be calculated as

@ 18.33% per day in 5 days, they will cover 18.33 × 5 = 91.66%. (The decimal value 0.33 is not difficult to handle if you have internalised the fraction to percentage conversion table of the chapter of percentages).

Work left on the sixth day is: 8.33%, which will require: 8.33/18.33 of the sixth day.

Since, both these numbers are divisible by 1.66 we get 5/11 of the sixth day will be used → 0.45 of the sixth day is used.

Hence, 5.45 days are required to finish the work.

Note: Although the explanation to the question through percentages seems longer, the student should realise that if the values in the fraction-to-percentage table is internalised by the student, the process of solution through percentage will take much lesser time because we are able to eliminate the need for the calculation of LCMs, which are often cumbersome. (if the numbers in the problem are those that are covered in the fraction to percentage conversion table). In fact, the percentage method allows for solving while reading.

(b) Working alternately: When two people are working alternately the question has to be solved by taking 2 days as a unit of time instead of 1 day.

So in (a) above, the work done in 1 day will be covered in 2 days here.

Thus, in 2 days the work done will be 18.33%. In 10 days it will be 91.66%. On the 11th day *A* works by himself.

But *A*'s work in 1 day is 10%. Therefore, he will require 4/5 of the 11th day to finish the work.

(c) Working alternately starting with *B*: Here, there will be no difference in work completed by the 10th day. On the 11th day, *B* works alone and does 8.33% of the work (which was required to complete the work). Hence, the whole of the 11th day will get used.

(d) If *B* leaves 2 days before the actual completion of the work: In this case, the actual completion of the work is after 2 days of *B*'s leaving. This means, that *A* has worked alone for the last 2 days to complete the work. But *A* does, 10% work in a day. Hence, *A* and *B* must have done 80% of the work together (@18.33% per day). Then, the answer can be found by

80/18.33 + 20/10 days.

Note: For calculation of 80/18.33, we can use the fact that the decimal value is a convenient one. If they worked together they would complete 73.33% of the work in 4 days and the work that they would have done on the 5th day would be 6.66%.

At the rate of 18.33% work per day while working together, they would work together for 6.66/18.33 of the 5th day. Since both the numerator and denominator are divisible by 1.66 the above ratio is converted into 4/11 = 0.3636.

Hence, they work together for 4.3636 days after which *B* leaves and then *A* completes the work in 2 more days. Hence, the time required to finish the work would be = 6.3636 days.

(e) If *B* leaves 2 days before the scheduled completion of the work: Completion of the work would have been scheduled assuming that *A* and *B* both worked together for completing the work (say, this is *x* days). Then, the problem has to be viewed as $x - 2$ days was the time for which *A* and *B* worked together. The residual amount of work left (which will be got by 2 days work of *A* and *B* together) would be done by *A* alone at his own pace of work.

Thus we can get the solution by:

Number of days required to complete the work = $[(100/18.33) - 2] + \frac{36.66}{10}$

(f) If C joins the group and does negative work, we can see that one day's work of the three together would be

A's work + B's work – C's work = 10% + 8.33% – 5% = 13.33%

Hence, the work will be completed in (100/13.33) days.

[***Note:*** This can be calculated by $13.33 \times 7 = 13 \times 7 + 0.33 \times 7 = 93.33$.

Then, work left = 6.66, which will require half a day more at the rate of 13.33% per day.

Advantage of Solving Problems on Time and Work through Percentages Students should understand here, that most of the times the values given for the number of days in which the work is completed by a worker will be convenient values like: 60 days, 40 days, 30 days, 25 days, 24 days, 20 days, 16 days, 15 days, 12 days, 11 days, 10 days, 9 days, 8 days, 7 days, 6 days, 5 days, 4 days, 3 days and 2 days. All these values for the number of days will yield convenient decimal values. If your fraction to percentage table is internalised, you can use the process of solving while reading by taking the percentage of work done per day process rather than getting delayed by the need to find LCM's while solving through the process of the fraction of work done per day.]

Problem 9.2 A contractor undertakes to build a wall in 50 days. He employs 50 people for the same. However, after 25 days he finds that the work is only 40% complete. How many more men need to be employed to:

(a) complete the work in time?

Solution In order to complete the work in time, the contractor has to finish the remaining 60% of the work in 25 days.

Now, in the first 25 days the work done = 50 × 25 =1250 man-days → 40% of the work.

Hence, work left = 60% of the work = 1875 man-days.

Since, 25 days are left to complete the task, the number of people required is 1875/25 = 75 men.

Since, 50 men are already working, 25 more men are needed to complete the work.

Thought process should go like: 1250 → 40% of work. Hence, 1875 man-days required to complete the work.

Since there are only 25 days left, we need 1875/25 = 75 men to complete the work.

(b) Complete the work 10 days before time?

For this purpose, we have to do 1875 man-days of work in 15 days. Hence, men = 1875/15 = 125 men.

Hence, he would need to hire 75 more men.

Problem 9.3 For the previous problem, if the contractor continues with the same workforce:

(a) how many days behind schedule will the work be finished?

Solution He has completed 40% work in 25 days. Hence, to complete the remaining 60% of the work, he would require 50% more days (i.e. 37.5 days) (Since, 60% is 1.5 times of 40%)

Hence, the work would be done 12.5 days behind schedule.

(b) how much increase in efficiency is required from the work force to complete the work in time?

Solution If the number of men working is kept constant, the only way to finish the work in time is by increasing the efficiency so that more work is done every man-day. This should be mathematically looked at as follows:

Suppose, that 1 man-day takes care of 1 unit of work.

Then, in the first 25 days, work done = 25 (days) × 50 (men) × 1 (work unit per man-day) = 1250 units of work.

Now, this 1250 units of work is just 40% of the work.

Hence, work left = 1875 units of work.

Then, 25 (days) × 50 (men) × z (work units per man-day) = 1875 → z = 1.5

Thus, the work done per man-day has to rise from 1 to 1.5, that is, by 50%. Hence, the efficiency of work has to rise by **50%.**

Problem 9.4 A is twice as efficient as B. If they complete a work in 30 days find the times required by each to complete the work individually.

Solution When we say that A is twice as efficient as B, it means that A takes half the time that B takes to complete the same work.

Thus, if we denote A's 1 day's work as A and B's one day's work as B, we have

$$A = 2B$$

Then, using the information in the problem, we have: 30 A + 30 B = 100% work

That is, 90 B = 100% work → B = 1.11 % (is the work done by B in 1 day) → B requires **90 days** to complete the work alone.

Since, $A = 2B$ → we have A = 2.22 % → A requires 45 days to do the work alone.

You should be able to solve this mentally with the following thought process while reading for the first time:

$\frac{100}{30}$ = 3.33%. $\frac{3.33}{3}$ = 1.11%. Hence, work done is 1.11% per day and 2.22% per day → 90 and 45 days.

Problem 9.5 A is two times more efficient than B. If they complete a work in 30 days, then find the times required by each to complete the work individually.

Solution Interpret the first sentence as $A = 3B$ and solve according to the process of the previous problem to get the answers. (You should get A takes 40 days and B takes 120 days.)

LEVEL OF DIFFICULTY (I)

1. Raju can do 25% of a piece of work in 5 days. How many days will he take to complete the work ten times?
   (a) 150 days (b) 250 days
   (c) 200 days (d) 180 days
2. 6 men can do a piece of work in 12 days. How many men are needed to do the work in 18 days.
   (a) 3 men (b) 6 men
   (c) 4 men (d) 2 men
3. *A* can do a piece of work in 20 days and *B* can do it in 15 days. How long will they take if both work together?
   (a) $8\left(\frac{6}{7}\right)$ days (b) $8\left(\frac{4}{7}\right)$ days
   (c) $9\left(\frac{3}{7}\right)$ days (d) $9\left(\frac{4}{7}\right)$ days
4. In question 3 if *C*, who can finish the same work in 25 days, joins them, then how long will they take to complete the work?
   (a) $6\left(\frac{18}{47}\right)$ days (b) 12 days
   (c) $2\left(\frac{8}{11}\right)$ days (d) $47\left(\frac{6}{18}\right)$ days
5. 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
6. Baba alone can do a piece of work in 10 days. Anshu alone can do it in 15 days. If the total wages for the work is ₹ 50. How much should Baba be paid if they work together for the entire duration of the work?
   (a) ₹ 30 (b) ₹ 20
   (c) ₹ 50 (d) ₹ 40
7. 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 woman 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
8. If 8 boys and 12 women can do a piece of work in 25 days, in how many days can the work be done by 6 boys and 11 women working together?
   (a) 15 days (b) 10 days
   (c) 12 days (d) Cannot be determined
9. *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
10. *A* can do a piece of work in 20 days. He works 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
11. *A* and *B* undertake to do a piece of work for ₹ 100. *A* can do it in 5 days and *B* can do it in 10 days. With the help of *C*, they finish it in 2 days. How much should *C* be paid for his contribution?
    (a) ₹ 40 (b) ₹ 20
    (c) ₹ 60 (d) ₹ 30
12. 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
13. Arun and Vinay together can do a piece of work in 7 days. If Arun does twice as much work as Vinay in a given time, how long will Arun alone take to do the work.
    (a) 6.33 days (b) 10.5 days
    (c) 11 days (d) 72 days
14. Subhash can copy 50 pages 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
15. *X* number of men can finish a piece of work in 30 days. If there were 6 men more, the work could be finished in 10 days less. What is the original number of men?
    (a) 10 (b) 11
    (c) 12 (d) 15
16. 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

17. Raju can do a piece of work in 10 days, Vicky in 12 days and Tinku in 15 days. They all start the work together, but Raju leaves after 2 days and Vicky leaves 3 days before the work is completed. In how many days is the work completed?

(a) 5 days (b) 6 days
(c) 7 days (d) 8 days

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

(a) $\frac{88}{17}$ days (b) $\frac{144}{17}$ days
(c) $\frac{72}{17}$ days (d) 8 days

19. Manoj takes twice as much time as Anjay 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) 4 days

20. An engineer undertakes a project to build a road 15 km long in 300 days and employs 45 men for the purpose. After 100 days, he finds only 2.5 km of the road has been completed. Find the (approx.) number of extra men he must employ to finish the work in time.

(a) 43 (b) 45
(c) 55 (d) 68

21. Apurva can do a piece of work in 12 days. Apurva and Amit complete the work together and were paid ₹ 54 and ₹ 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

22. Raju is twice as good 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

23. In a company XYZ Ltd. a certain number of engineers can develop a design in 40 days. If there were 5 more engineers, it could be finished in 10 days less. How many engineers were there in the beginning?

(a) 18 (b) 20
(c) 25 (d) 15

24. 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

25. *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

26. 30 men working 5 h a day can do a work in 16 days. In how many days will 20 men working 6 h a day do the same work?

(a) $22\frac{1}{2}$ days (b) 20 days
(c) 21 days (d) None of these

27. Ajay and Vijay undertake to do a piece of work for ₹ 200. Ajay alone can do it in 24 days while Vijay alone can do it in 30 days. With the help of Pradeep, they finish the work in 12 days. How much should Pradeep get for his work?

(a) ₹ 20 (b) ₹ 100
(c) ₹ 180 (d) ₹ 50

28. 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

29. Ajay, Vijay and Sanjay are employed to do a piece of work for ₹ 529. Ajay and Vijay together are supposed to do 19/23 of the work and Vijay and Sanjay together 8/23 of the work. How much should Ajay be paid?

(a) ₹ 245 (b) ₹ 295
(c) ₹ 300 (d) ₹ 345

30. Anmol is thrice as good a workman as Vinay and therefore is able to finish the job in 60 days less than Vinay. In how many days will they finish the job working together?

(a) $22\left(\frac{1}{2}\right)$ days (b) $11\left(\frac{3}{2}\right)$ days
(c) 15 days (d) 20 days

31. In a fort there was sufficient food for 200 soldiers for 31 days. 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

32. Anju, Manju and Sanju together can reap a field in 6 days. If Anju can do it alone in 10 days and Manju

in 24 days. In how many days will Sanju alone be able to reap the field?

(a) 40 days (b) 36 days
(c) 35 days (d) 32 days

33. Ajay and Vijay can do a piece of work in 28 days. With the help of Manoj, they can finish it in 21 days. How long will Manoj take to finish the work all alone?

(a) 84 days (b) 80 days
(c) 75 days (d) 70 days

34. Ashok and Mohan can do a piece of work in 12 days. Mohan and Binod together do it in 15 days. If Ashok is twice as good a workman as Binod. In how much time will Mohan alone can do the work?

(a) 15 days (b) 20 days
(c) 25 days (d) 35 days

35. Ajay and Vijay together can do a piece of work in 6 days. Ajay alone does it in 10 days. What time does Vijay require to do it alone?

(a) 20 days (b) 15 days
(c) 25 days (d) 30 days

36. 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

37. 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 *A* and *B* will fill the cistern separately what time?

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

38. *A* can do a work in 18 days, *B* in 9 days and *C* in 6 days. *A* and *B* start working together and after 2 days *C* joins them. In how many days will the job be completed?

(a) 4.33 days (b) 4 days
(c) 4.66 days (d) 5 days

39. 24 men working 8 h a day can finish a work in 10 days. Working at a rate of 10 h a day, the number of men required to finish the work in 6 days is

(a) 30 (b) 32
(c) 34 (d) 36

40. A certain job was assigned to a group of men to do it in 20 days. But 12 men did not turn up for the job and the remaining men did the job in 32 days. The original number of men in group was

(a) 32 (b) 34
(c) 36 (d) 40

41. 12 men complete a work in 18 days. 6 days after they had started working, 4 men join them. How many more days will all of them take to complete the remaining work?

(a) 10 days (b) 12 days
(c) 15 days (d) 9 days

42. *A* takes 5 days more than *B* to do a certain job and 9 days more than *C*; *A* and *B* together can do the job in the same time as *C*. How many days *A* would take to do it?

(a) 16 days (b) 10 days
(c) 15 days (d) 20 days

43. A cistern is normally filled in 6 h but takes 4 h longer to fill because of a leak in its bottom. If the cistern is full, the leak will empty it in how much time?

(a) 15 h (b) 16 h
(c) 20 h (d) None of these

44. If three taps are open together, a tank is filled in 10 h. One of the taps can fill in 5 h and another in 10 h. At what rate does the 3rd pipe work?

(a) Waste pipe emptying the tank is 10 h
(b) Waste pipe emptying the tank is 20 h
(c) Waste pipe emptying the tank is 5 h
(d) Fills the tank in 10 h

45. There are two pipes in a tank. Pipe *A* is for filling the tank and 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

46. Abbot can do some work in 10 days, Bill can do it in 20 days and Clinton can do it in 40 days. They start working in turns with Abbot starting to work on the first day followed by Bill on the second day and by Clinton on the third day and again by Abbot on the fourth day and so on till the work is completed fully. Find the time taken to complete the work fully?

(a) 16 days (b) 15 days
(c) 17 days (d) 16.5 days

47. *A*, *B* and *C* can do some work in 36 days. *A* and *B* together do twice as much work as *C* alone and *A* and *C* together can do thrice as much work as *B* alone. Find the time taken by *C* to do the whole work.

(a) 72 days (b) 96 days
(c) 108 days (d) 120 days

48. 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

49. Two taps are running continuously to fill a tank. The 1st tap could have filled it in 5 hours by itself and the second one by itself could have filled it in 20 hours. But the operator failed to realise that there was a leak in the tank from the beginning which caused a delay of one hour in the filling of the tank. Find the time in which the leak would empty a filled tank.
(a) 15 hours (b) 20 hours
(c) 25 hours (d) 40 hours

50. *A* can do some work in 24 days, *B* can do it in 32 days and *C* can do it in 60 days. They start working together. *A* left after 6 days and *B* left after working for 8 days. How many more days are required to complete the whole work?
(a) 30 (b) 25
(c) 22 (d) 20

51. A alone can complete a job in 4 days. He is twice as fast as B while B is twice as fast as C. If all of them work together, in how many days would the job get completed?

52. 36 men take 18 days to complete a piece of work. They worked for a period of 8 days. After that, they were joined by 4 more men. How many more days will be taken by them to complete the remaining work?

53. Tap M alone can fill a tank completely in 8 hrs. Another tap N alone can empty the same tank in 12 hrs. If both the taps are opened simultaneously in what time (in hours) would the tank get full?

54. A 50 × 35 m fishing pond was dug by 250 workers in 18 days. The number of days in which a 70 m × 40 m pond having the same depth can be dug by 300 workers is?

55. The wages of 8 men and 4 women amount to ₹ 3500 per week and the wages of 5 men and 3 women to ₹ 2275 per week . Find the daily wages of a man (in rupees, assuming that the wages for a week are paid on the basis of 7 day weeks):

56. 5 women can paint a building in 30 working hours. After 16 hours of work, 2 women decided to leave. How many hours will it take for the work to be finished?

57. A certain number of men complete a piece of work in 60 days. If there were 8 men more the work could be finished in 10 days less. How many men were originally there?

58. In a garrison, there was food for 1000 soldiers for one month. After 10 days, 1000 more soldiers joined the garrison. How many days would the soldiers be able to carry on with the remaining food?

59. The tank-full petrol in Ajay's motor-cycle lasts for 10 days. If he starts using 25% more every day, how many days will the tank-full petrol last?

60. A cistern has two pipes. One can fill it with water in 8 hours and other can empty it in 5 hours. In how many hours will the cistern be emptied if both the pipes are opened together when ¾ of the cistern is already full of water?

Space for Notes

LEVEL OF DIFFICULTY (II)

1. Two forest officials in their respective divisions were involved in the harvesting of *tendu* leaves. One division had an average output of 21 tons from a hectare and the other division, which had 12 hectares of land less, dedicated to *tendu* leaves, got 25 tons of *tendu* from a hectare. As a result, the second division harvested 300 tons of *tendu* leaves more than the first. How many tons of *tendu* leaves did the first division harvest?
   (a) 3150 (b) 3450
   (c) 3500 (d) 3600
2. According to a plan, a drilling team had to drill to a depth of 270 metres below the ground level. For the first three days the team drilled as per the plan. However, subsequently finding that their resources were getting underutilised according to the plan, it started to drill 8 metres more than the plan every day. Therefore, a day before the planned date they had drilled to a depth of 280 metres. How many metres of drilling was the plan for each day.
   (a) 38 metres (b) 30 metres
   (c) 27 metres (d) 28 metres
3. A pipe can fill a tank in x hours and another can empty it in y hours. If the tank is 1/3rd full then the number of hours in which they will together fill it in is
   (a) $\frac{(3xy)}{2(y-x)}$ (b) $\frac{(3xy)}{(y-x)}$
   (c) $\frac{xy}{3(y-x)}$ (d) $\frac{2xy}{3(y-x)}$
4. Dev and Tukku can do a piece of work in 45 and 40 days respectively. They began the work together, but Dev leaves after some days and Tukku finished the remaining work in 23 days. After how many days did Dev leave
   (a) 7 days (b) 8 days
   (c) 9 days (d) 11 days
5. A finishes 6/7th of the work in $2z$ hours, B works twice as fast and finishes the remaining work. For how long did B work?
   (a) $\left(\frac{2}{3}\right)z$ (b) $\left(\frac{6}{7}\right)z$
   (c) $\left(\frac{6}{49}\right)z$ (d) $\left(\frac{3}{18}\right)z$

Directions for Questions 6 to 10: Read the following and answer the questions that follow.

A set of 10 pipes (set X) can fill 70% of a tank in 7 minutes. Another set of 5 pipes (set Y) fills 3/8 of the tank in 3 minutes. A third set of 8 pipes (set Z) can empty 5/10 of the tank in 10 minutes.

6. How many minutes will it take to fill the tank if all the 23 pipes are opened at the same time?
   (a) 5 minutes (b) $5\frac{5}{7}$ minutes
   (c) 6 minutes (d) $6\frac{5}{7}$ minutes
7. If only half the pipes of set X are closed and only half the pipes of set Y are open and all other pipes are open, how long will it take to fill 49% of the tank?
   (a) 16 minutes (b) 13 minutes
   (c) 7 minutes (d) None of these
8. If 4 pipes are closed in set Z, and all others remain open, how long will it take to fill the tank?
   (a) 5 minutes (b) 6 minutes
   (c) 7 minutes (d) 7.5 minutes
9. If the tank is half full and set X and set Y are closed, how many minutes will it take for set Z to empty the tank if alternate taps of set Z are closed.
   (a) 12 minutes (b) 20 minutes
   (c) 40 minutes (d) 16 minutes
10. If one pipe is added for set X and set Y and set Z's capacity is increased by 20% on its original value and all the taps are opened at 2.58 p.m., then at what time does the tank get filled? (If it is initially empty.)
    (a) 3.05 p.m. (b) 3.04 p.m.
    (c) 3.10 p.m. (d) 3.03 p.m.
11. Ajit can do as much work in 2 days as Baljit can do in 3 days and Baljit can do as much in 4 days as Diljit in 5 days. A piece of work takes 20 days if all work together. How long would Baljit take to do all the work by himself?
    (a) 82 days (b) 44 days
    (c) 66 days (d) 50 days
12. Two pipes can fill a cistern in 14 and 16 hours respectively. The pipes are opened simultaneously and it is found that due to leakage in the bottom of the cistern, it takes 32 minutes extra for the cistern to be filled

up. When the cistern is full, in what time will the leak empty it?

(a) 114 h (b) 112 h
(c) 100 h (d) 80 h

13. A tank holds 100 gallons of water. Its inlet is 7 inches in diametre and fills the tank at 5 gallons/min. The outlet of the tank is twice the diametre of the inlet. How many minutes will it take to empty the tank if the inlet is shut off, when the tank is full and the outlet is opened? (*Hint:* Rate of filling or emptying is directly proportional to the diametre)

(a) 7.14 min (b) 10.0 min
(c) 0.7 min (d) 5.0 min

14. A tank of capacity 25 litres has an inlet and an outlet tap. If both are opened simultaneously, the tank is filled in 5 minutes. But if the outlet flow rate is doubled and taps opened the tank never gets filled up. Which of the following can be outlet flow rate in litres/min?

(a) 2 (b) 6
(c) 4 (d) 3

15. *X* takes 4 days to complete one-third of a job, *Y* takes 3 days to complete one-sixth of the same work and *Z* takes 5 days to complete half the job. If all of them work together for 3 days and *X* and *Z* quit, how long will it take for *Y* to complete the remaining work done.

(a) 6 days (b) 8.1 days
(c) 5.1 days (d) 7 days

16. A completes 2/3 of a certain job in 6 days. *B* can complete 1/3 of the same job in 8 days and *C* can complete 3/4 of the work in 12 days. All of them work together for 4 days and then *A* and *C* quit. How long will it take for *B* to complete the remaining work alone?

(a) 3.8 days (b) 3.33 days
(c) 2.22 days (d) 4.3 days

17. Three diggers dug a ditch of 324 m deep in six days working simultaneously. During one shift, the third digger digs as many metres more than the second as the second digs more than the first. The third digger's work in 10 days is equal to the first digger's work in 14 days. How many metres does the first digger dig per shift?

(a) 15 m (b) 18 m
(c) 21 m (d) 27 m

18. *A*, *B* and *C* working together completed a job in 10 days. However, *C* only worked for the first three days when 37/100 of the job was done. Also, the work done by *A* in 5 days is equal to the work done by *B* in 4 days. How many days would be required by the fastest worker to complete the entire work?

(a) 20 days (b) 25 days
(c) 30 days (d) 40 days

19. *A* and *B* completed a work together in 5 days. Had *A* worked at twice the speed and *B* at half the speed, it would have taken them four days to complete the job. How much time would it take for *A* alone to do the work?

(a) 10 days (b) 20 days
(c) 25 days (d) 15 days

20. Two typists of varying skills can do a job in 6 minutes if they work together. If the first typist typed alone for 4 minutes and then the second typist typed alone for 6 minutes, they would be left with 1/5 of the whole work. How many minutes would it take the slower typist to complete the typing job working alone?

(a) 10 minutes (b) 15 minutes
(c) 12 minutes (d) 20 minutes

21. Three cooks have to make 80 idlis. They are known to make 20 pieces every minute working together. The first cook began working alone and made 20 pieces having worked for sometime more than three minutes. The remaining part of the work was done by the second and the third cook working together. It took a total of 8 minutes to complete the 80 idlis. How many minutes would it take the first cook alone to cook 160 idlis for a marriage party the next day?

(a) 16 minutes (b) 24 minutes
(c) 32 minutes (d) 40 minutes

22. It takes six days for three women and two men working together to complete a work. Three men would do the same work five days sooner than nine women. How many times does the output of a man exceed that of a woman?

(a) 3 times (b) 4 times
(c) 5 times (d) 6 times

23. Each of *A*, *B* and *C* need a certain unique time to do a certain work. *C* needs 1 hour less than *A* to complete the work. Working together, they require 30 minutes to complete 50% of the job. The work also gets completed if *A* and *B* start working together and *A* leaves after 1 hour and *B* works for a further 3 hours. How much work does *C* do per hour?

(a) 16.66% (b) 33.33%
(c) 50% (d) 66.66%

24. Two women Renu and Ushi are working on an embroidery design. If Ushi worked alone, she would need eight hours more to complete the design than if they both worked together. Now if Renu worked alone, it would need 4.5 hours more to complete the design than they both working together. What time would it take Renu alone to complete the design?

(a) 10.5 hours (b) 12.5 hours
(c) 14.5 hours (d) 18.5 hours

25. Mini and Vinay are quiz masters preparing for a quiz. In x minutes, Mini makes y questions more than Vinay. If it were possible to reduce the time needed by each to make a question by two minutes, then in x minutes Mini would make $2y$ questions more than Vinay. How many questions does Mini make in x minutes?
(a) $1/4[2(x+y) - \sqrt{(2x^2+4y^2)}\,]$
(b) $1/4[2(x-y) - \sqrt{(2x^2+4y^2)}\,]$
(c) Either a or b
(d) $1/4\,[2(x-y) - \sqrt{(2x^2-4y^2)}\,]$

26. A tank of 3600 cu m capacity is being filled with water. The delivery of the pump discharging the tank is 20% more than the delivery of the pump filling the same tank. As a result, twelve minutes more time is needed to fill the tank than to discharge it. Determine the delivery of the pump discharging the tank.
(a) 40 m^3/min (b) 50 m^3/min
(c) 60 m^3/min (d) 80 m^3/min

27. Two pipes A and B can fill up a half full tank in 1.2 hours. The tank was initially empty. Pipe B was kept open for half the time required by pipe A to fill the tank by itself. Then, pipe A was kept open for as much time as was required by pipe B to fill up 1/3 of the tank by itself. It was then found that the tank was 5/6 full. The least time in which any of the pipes can fill the tank fully is
(a) 4.8 hours (b) 4 hours
(c) 3.6 hours (d) 6 hours

28. A tank of 425 litres capacity has been filled with water through two pipes, the first pipe having been opened five hours longer than the second. If the first pipe were open as long as the second, and the second pipe was open as long as the first pipe was open, then the first pipe would deliver half the amount of water delivered by the second pipe; if the two pipes were open simultaneously, the tank would be filled up in 17 hours. How long was the second pipe open?
(a) 10 hours (b) 12 hours
(c) 15 hours (d) 18 hours

29. Two men and a woman are entrusted with a task. The second man needs three hours more to cope with the job than the first man and the woman would need working together. The first man, working alone, would need as much time as the second man and the woman working together. The first man, working alone, would spend eight hours less than the double period of time the second man would spend working alone. How much time would the two men and the woman need to complete the task if they all worked together?
(a) 2 hours (b) 3 hours
(c) 4 hours (d) 5 hours

30. The Bubna dam has four inlets. Through the first three inlets, the dam can be filled in 12 minutes; through the second, the third and the fourth inlet, it can be filled in 15 minutes; and through the first and the fourth inlet, in 20 minutes. How much time will it take all the four inets to fill up the dam?
(a) 8 min (b) 10 min
(c) 12 min (d) None of these

Directions for question number 31 & 32:

Dipen Loomba builds an overhead tank in his house, which has three taps attached to it. While the first tap can fill the tank in 12 hours, the second one takes one and a half times the first one to fill it completely. A third tap is attached to the tank, which empties it in 36 hours. Now, one day, in order to fill the tank, Dipen opens the first tap and after an hour opens the second tap as well. However, at the end of the fourth hour, he realises that the third tap has been kept open right from the beginning and promptly closes it.

31. What is the ratio of volume occupied by water to volume of remaining part of the tank after 6 hours?
32. What will be the total time required to fill the tank (in minutes)?

Directions for question number 33 & 34:

33. In the ancient city of Portheus, the emperor has installed an overhead tank that is filled by two pumps — X and Y. X can fill the tank in 12 hours while Y can fill the tank in 15 hours. There is a pipe Z which can empty the tank in 10 hours. Both the pumps are opened simultaneously. The supervisor of the tank, before going out on a work, asks his assistant to open Z when the tank is exactly 40% filled so that tank is exactly filled up by the time he is back. If he starts X and Y at exactly 11:00 AM and he comes back at A:B. Then find the value of A+ B.
34. Due to a miscalculation by the assistant, he opens Z when the tank is one fourth filled. If the supervisor comes back as per the plan what percent of the tank is still empty?
35. Three students A,B and C were working on a project. A is 40% more efficient than B, who is 40% more efficient than C. A takes 10 days less than B to complete the project. A starts the project and works for 10 days and then B takes over. B works on the project for the next 14 days and then stops the work, handing it over to C to complete it. In how many days, would C complete the remaining project?

Directions for questions 36 and 37:

Three water pipes, A, B and C are all used to full a container. These pipes can fill the container individually in 6 minutes,

12 minutes and 18 minutes, respectively. All the three pipes were opened simultaneously. However, it was observed that pipes A and B were supplying water at 2/3rd of their normal rates for the first minute after which they supplied water at the normal rate. Pipe C supplied water at half of its normal rate for first 3 minutes, after which it supplied water at its normal rate. Now answer the following questions:

36. What fraction of the tank is empty after 2 hours?
37. In how much time (in minutes and to the closest second), would the container be filled?
38. A contract is to be completed in 72 days and 104 men are set to work, each working 8 hours a day. After 30 days, only 1/5th of the work is finished. How many additional men need to be employed so that the work may be completed on time. (If each man is now working 9 hours per day)?
39. X, Y, Z can complete a work in 4, 6 and 8 hours, respectively. At the most only one person can work in each hour and nobody can work for two consecutive hours. Find the minimum number of hours that they will take to finish the work?
40. The rate at which tap M fills a tank is 60% more than that of tap N. If both the taps are opened simultaneously, they take 50 hours to fill the rank. The time taken by N alone to fill the tank is (in hours).

Space for Notes

LEVEL OF DIFFICULTY (III)

Directions for Questions 1 to 10: Study the following tables and answers the questions that follow.

Darbar Toy Company has to go through the following stages for the launch of a new toy:

		Expert man-days required	*Non-expert man-days required*
1.	Design and development	30	60
2.	Prototype creation	15	20
3.	Market survey	30	40
4.	Manufacturing setup	15	30
5.	Marketing and launch	15	20

The profile of the company's manpower is

Worker name	*Expert at*	*Non-Expert at*	*Refusal to work on*
A	Design and development	All others	Market survey
B	Prototype creation	All others	Market survey
C	Market survey and marketing and launch	All others development	Design and
D	Manufacturing	All others	Market survey
E	Market survey	All others	Manufacturing

1. Given this situation, the minimum number of days in which the company can launch a new toy going through all the stages is
   (a) 40 days (b) 40.5 days
   (c) 45 days (d) 44 days
2. If *A* and *C* refuse to have anything to do with the manufacturing set up. The number of days by which the project will get delayed will be
   (a) 5 days (b) 4 days
   (c) 3 days (d) 6 days
3. If each of the five works is equally valued at ₹10,000, the maximum amount will be received by
   (a) *A* (b) *C* (c) *D* (d) *E*
4. For question 3, the second highest amount will be received by
   (a) *A* (b) *C* (c) *D* (d) *E*
5. If *C* works at 90.909% of his efficiency during marketing and launch, who will be highest paid amongst the five of them?
   (a) *A* (b) *C* (c) *D* (d) *E*
6. If the company decides that the first 4 works can be started simultaneously and the experts will be allocated to their respective work areas only and a work will be done by a non-expert only if the work in his area of expertise is completed, then the expert who will first be assisted in his work will be (assume that marketing and launch can only be done after the first four are fully completed)
   (a) *A* (b) *B* (c) *C* (d) *D*
7. For the question above, the minimum number of days in which the whole project will get completed (assume everything is utilised efficiently all the time, and nobody is utilised in a work that he refuses to work upon)
   (a) 22.5 days (b) 15 days
   (c) 24.75 days (d) 25.25 days
8. For the situation in question 6, the highest earning will be for
   (a) *A* (b) Both *B* and *D*
   (c) *C* (d) Cannot be determined
9. If each work has an equal payment of ₹10,000, the lowest earning for the above situation will be for
   (a) *A* (b) *E* (c) *C* (d) *B*
10. The value of the earning for the highest earning person, (if the data for questions 6–9 are accurate) will be
    (a) 19,312.5 (b) 13,250
    (c) 12,875 (d) *B*

Directions for Questions 11 to 20: Read the following and answer the questions that follow.

A fort contains a granary, that has 1000 tons of grain. The fort is under a siege from an enemy army that has blocked off all the supply routes.

The army in the fort has three kinds of soldiers:

Sepoys → 2,00,000.

Mantris → 1,00,000

Footies → 1,00,000

100 Sepoys can hold 5% of the enemy for one month.

100 Mantris can hold 10% of the enemy for 15 days.

50 Footies can hold 5% of the enemy for one month.

A sepoy eats 1 kg of food per month, a Mantri eats 0.5 kg of food per month and a footie eats 3 kg of food. (Assume 1 ton = 1000 kg).

The king has to make some decisions based on the longest possible resistance that can be offered to the enemy.

If a king selects a soldier, he will have to feed him for the entire period of the resistance. The king is not obliged to feed a soldier not selected for the resistance.

(Assume that the entire food allocated to a particular soldier for the estimated length of the resistance is

redistributed into the king's palace in case a soldier dies and is not available for the other soldiers.)

11. If the king wants to maximise the time for which his resistance holds up, he should
    (a) Select all mantris (b) Select all footies
    (c) Select all sepoys (d) None of these
12. Based on existing resources, the maximum number of months for which the fort's resistance can last is
    (a) 5 months (b) 20 months
    (c) 7.5 months (d) Cannot be determined
13. If the king makes a decision error, the maximum reduction in the time of resistance could be
    (a) 15 months (b) 12.5 months
    (c) 16.66 months (d) Cannot be determined
14. If the king estimates that the attackers can last for only 50 months, what should the king do to ensure victory?
    (a) Select all mantris
    (b) Select the mantris and the sepoys
    (c) Select the footies
    (d) The king cannot achieve this
15. If a reduction in the ration allocation by 10% reduces the capacity of any soldier to hold off the enemy by 10%, the number of whole months by which the king can increase the life of the resistance by reducing the ration allocation by 10% is
    (a) 4 months (b) 2 months
    (c) No change (d) This will reduce the time
16. The minimum amount of grain that should be available in the granary to ensure that the fort is not lost (assuming the estimate of the king of 50 months being the duration for which the enemy can last is correct) is
    (a) 2000 tons (b) 2500 tons
    (c) 5000 tons (d) Cannot be determined
17. If the king made the worst possible selection of his soldiers to offer the resistance, the percentage increase in the minimum amount of grain that should be available in the granary to ensure that the fort is not lost is
    (a) 100% (b) 500%
    (c) 600% (d) Cannot be determined
18. The difference in the minimum grain required for the second worst choice and the worst choice to ensure that the resistance lasts for 50 months is
    (a) 5000 tons (b) 7500 tons
    (c) 10000 tons (d) Cannot be determined
19. If the king strategically attacks the feeder line on the first day of the resistance so that the grain is no longer a constraint, the maximum time for which the resistance can last is
    (a) 100 months (b) 150 months
    (c) 250 months (d) Cannot be determined
20. If the feeder line is opened after 6 months and prior to that the king had made decisions based on food availability being a constraint then the number of months (maximum) for which the resistance could last is
    (a) 100 months (b) 150 months
    (c) 5 months (d) Cannot be determined

Directions for Questions 21 to 25: Study the following and answer the questions that follow.

A gas cylinder can discharge gas at the rate of 1 cc/minute from burner *A* and at the rate of 2 cc/minute from burner *B* (maximum rates of discharge). The capacity of the gas cylinder is 1000 cc of gas.

The amount of heat generated is equal to 1 kcal per cc of gas.

However, there is wastage of the heat as per follows:

Gas discharge@	*Loss of heat*
0–0.5 cc/minute	10%
0.5–1 cc/minute	20%
1–1.5 cc/minute	25%
1.5 + cc/minute	30%

@(Include higher extremes)

21. If both burners are opened simultaneously such that the first is opened to 90% of its capacity and the second is opened to 80% of its capacity, the amount of time in which the gas cylinder will be empty (if it was half full at the start) will be:
    (a) 250 minutes (b) 400 minutes
    (c) 200 minutes (d) None of these
22. The maximum amount of heat with the fastest speed of cooking that can be utilised for cooking will be when:
    (a) The first burner is opened upto 50% of it's aperture
    (b) The second burner is opened upto 25% of it's aperture
    (c) Either (a) or (b)
    (d) None of these
23. The amount of heat utilised for cooking if a full gas cylinder is burnt by opening the aperture of burner *A* 100% and that of burner *B* 50% is
    (a) 900 kcal (b) 800 kcal
    (c) 750 kcal (d) Cannot be determined
24. For Question 23, if burner *A* had been opened only 25% and burner *B* had been opened 50%, the amount of heat available for cooking would be
    (a) 820 kcal (b) 800 kcal
    (c) 750 kcal (d) Cannot be determined
25. For Question 24, the amount of time required to finish a full gas cylinder will be
    (a) 900 minutes (b) 833.33 minutes
    (c) 800 minutes (d) None of these

ANSWER KEY

Level of Difficulty (I)

1. (c)	2. (c)	3. (b)	4. (a)
5. (a)	6. (a)	7. (a)	8. (d)
9. (a)	10. (a)	11. (a)	12. (c)
13. (b)	14. (b)	15. (c)	16. (d)
17. (c)	18. (b)	19. (a)	20. (d)
21. (c)	22. (d)	23. (d)	24. (c)
25. (a)	26. (b)	27. (a)	28. (c)
29. (d)	30. (a)	31. (d)	32. (a)
33. (a)	34. (b)	35. (b)	36. (c)
37. (c)	38. (b)	39. (b)	40. (a)
41. (d)	42. (c)	43. (a)	44. (c)
45. (b)	46. (d)	47. (c)	48. (d)
49. (b)	50. (c)	51. 2.29	52. 9
53. 24	54. 24	55. 50	56. 39.33
57. 40	58. 10	59. 8	60. 10

Level of Difficulty (II)

1. (a)	2. (b)	3. (d)	4. (c)
5. (d)	6. (b)	7. (d)	8. (a)
9. (b)	10. (d)	11. (c)	12. (b)
13. (b)	14. (b)	15. (c)	16. (b)
17. (a)	18. (a)	19. (a)	20. (b)
21. (c)	22. (d)	23. (c)	24. (a)
25. (a)	26. (c)	27. (b)	28. (c)
29. (a)	30. (b)	31. 2:1	32. 504
33. 41	34. 10	35. 9.8	36. 19/36
37. 3 minutes 49 seconds		38. 161	39. 5.33
40. 130			

Level of Difficulty (III)

1. (b)	2. (b)	3. (b)	4. (d)
5. (b)	6. (a)	7. (c)	8. (d)
9. (c)	10. (c)	11. (a)	12. (b)
13. (c)	14. (d)	15. (c)	16. (b)
17. (b)	18. (a)	19. (c)	20. (c)
21. (c)	22. (c)	23. (b)	24. (a)
25. (c)			

Hints

Level of Difficulty (III)

1–10. Interpretation of the first row of the first table in the question:

Design and Development requires 30 expert man-days or 60 non-expert man-days.

Hence, work done in 1 expert man-day = 3.33% and work done in 1 non-expert man-day = 1.66%. Further, from the second table, it can be interpreted that: *A* is an expert at design and development. Hence, his work rate is 3.33% per day and *B*, *D* and *E* are ready to work as non-experts on design and development, hence their work rate is 1.66% per day each.

Thus, in 1 day the total work will be

$A + B + D + E = 3.33 + 1.66 + 1.66 + 1.66 = 8.33\%$ work.

Thus, 12 days will be required to finish the design and development phase.

1. $\frac{100}{8.33} + \frac{100}{26.66} + \frac{100}{6.66} + \frac{100}{16.66} + \frac{100}{26.66} = 40.5$

2. Increase of number of days $\rightarrow \frac{100}{10} - \frac{100}{16.66} = 4$ days.

[This happens since the work rate will drop from 16.66% to 10% due to *A* and *C*'s refusal to work.]

3–4. Find out the work done by each of the 5 workers.

11–20. The resistance offered is equal for 100 numbers of all types of soldiers.

11–13. If all sepoys are chosen, the food requirement will be 200 tons/month. The resistance will last for 5 months.

If footies are chosen, the food will last for $\frac{1000}{100 \times 3}$ = 3.33 months.

If mantris are chosen, the food will last for $\frac{1000}{100 \times 0.5}$ = 20 months.

Hence, all mantris must be chosen.

19–20. For these questions, since food is no longer a constraint, the constraint then becomes the number of lives. Then, the assumption will be that the resistance lasts for one month with a loss of either 2000 sepoys, 2000 mantris or 1000 footies.

19. Length of resistance = $\frac{200000}{2000} + \frac{100000}{2000} + \frac{100000}{1000}$ = 250 months.

20. In 6 months, the resistance will have lost 12000 mantris. He would also have lost all other soldiers since he has not fed them.

21. $\frac{500}{0.9 + 1.6} = 200.$

23. At 1 cc/minute, the loss of heat is 20%. Hence, when 1000 cc of the gas is used, out of the 1000 kcal of heat generated 200 kcal will be lost.

Solutions and Shortcuts

Level of Difficulty (I)

1. He will complete the work in 20 days. Hence, he will complete ten times the work in 200 days.
2. 6 men for 12 days means 72 mandays. This would be equal to 4 men for 18 days.
3. *A*'s one day work will be 5%, while *B* will do 6.66 % of the work in one day. Hence, their total work will be 11.66% in a day.

   In 8 days they will complete $\rightarrow 11.66 \times 8 = 93.33\%$

This will leave 6.66% of the work. This will correspond to 4/7 of the ninth day since in 6.66/11.66 both the numerator and the denominator are divisible by 1.66.

4. A's work = 5% per day

   B's work = 6.66% per day

   C's work = 4% per day.

   Total no. of days = 100/15.66 = 300/47 = 6(18/47)

5. $N + A = 10\%$

   $N = 8.33\%$

   Hence $A = 1.66\% \rightarrow 60$ days.

6. The ratio of the wages will be the inverse of the ratio of the number of days required by each to do the work. Hence, the correct answer will be 3:2 → ₹ 30

7. 24 man days + 18 women days = 20 man days + 28 woman days

   → 4 man days = 10 woman days.

   → 1 man day = 2.5 woman days

   Total work = 24 man days + 18 woman days = 60 woman days + 18 woman days = 78 woman days.

   Hence, 1 man + 1 woman = 3.5 women can do it in 78/3.5 = 156/7 = 22(2/7) days.

8. The data is insufficient, since we only know that the work gets completed in 200 boy days and 300 women days.

9. $A = 10\%$, $B = 5\%$ and Combined work is 20%. Hence, C's work is 5% and will require 20 days.

10. In 5 days, A would do 25% of the work. Since, B finishes the remaining 75% work in 10 days, we can conclude that B's work in a day = 7.5%

    Thus, $(A + B) = 12.5\%$ per day.

    Together they would take 100/12.5 = 8 days.

11. $A = 20\%$, $B = 10\%$ and $A + B + C = 50\%$. Hence, C = 20%. Thus, in two days, C contributes 40% of the total work and should be paid 40% of the total amount.

12. Total man days required = 600 man -days. If 5 workers leave the job after 'n' days, the total work would be done in 35 days. We have to find the value of 'n' to satisfy:

    $$20 \times n + (35 - n) \times 15 = 600.$$

    Solving for n, we get

    $$20n - 15n + 35 \times 15 = 600$$
    $$5n = 75$$
    $$n = 15.$$

13. Let the time taken by Arun be 't' days. Then, time taken by Vinay = $2t$ days.

    $1/t + 1/2t = 1/7 \rightarrow t = 10.5$

14. Subhash can copy 200 pages in 40 hours (reaction to the first sentence). Hence, Prakash can copy 100 pages in 40 hours. Thus, he can copy 30 pages in 30% of the time, i.e., 12 hours.

15. $30X = 20\ (X + 6) \rightarrow 10X = 120 \rightarrow X = 12$.

16. Sashi = 4%, Rishi = 5%. In five days, they do a total of 45% work. Rishi will finish the remaining 55% work in 11 more days.

17. Raju = 10%, Vicky = 8.33% and Tinku = 6.66%. Hence, total work for a day if all three work = 25%.

    In 2 days they will complete, 50% work. On the third day onwards Raju doesn't work. The rate of work will become 15%. Also, since Vicky leaves 3 days before the actual completion of the work, Tinku works alone for the last 3 days (and must have done the last $6.66 \times 3 = 20\%$ work alone). This would mean that Vicky leaves after 80% work is done. Thus, Vicky and Tinku must be doing 30% work together over two days.

    Hence, total time required = 2 days (all three) + 2 days (Vicky and Tinku) + 3 days (Tinku alone)

18. Sambhu requires 16 days to do the work while Kalu requires 18 days to do the work.

    $$(1/16 + 1/18) \times n = 1$$
    $$\rightarrow n = 288/34 = 144/17$$

19. Let Anjay take $3t$ days, Vijay take $2t$ days and Manoj take $6t$ days in order to complete the work. Then we get:

    $1/3t + 1/2t + 1/6t = 1 \rightarrow t = 1$. Thus, Manoj would take $6t = 6$ days to complete the work.

20. After 100 days and 4500 man days, only 1/6th of the work has been completed. You can use the product change algorithm of PCG to solve this question.

    $100 \times 45 = 16.66\%$ of the work. After this you have 200 days (i.e., 100% increase in the time available) while the product $200 \times$ number of men should correspond to five times times the original product.

    $$100 \xrightarrow[+100]{\text{TIME}\ 100\%\ \text{increase}} 200 \xrightarrow[+300\ \text{required}]{?} 500$$

    This will be got by increasing the no. of men by 150% (300/200).

21. Since the ratio of money given to Apurva and Amit is 2:3, their work done would also be in the same ratio. Thus, their time ratio would be 3:2 (inverse of 2:3). So, if Apurva takes 12 days, Amit would take 8 days and the total number of days required (t) would be given by the equation:

    $(1/12 + 1/8)t = 1 \rightarrow t = 24/5 = 4.8$ days

22. Raju being twice as good a workman as Vijay, you can solve the following equation to get the required answer:

    $1/R + 1/2R = 1/14$.

    Solving will give you that Vijay takes 42 days.

23. $40n = 30\ (n + 5) \rightarrow n = 15$
24. 12×5 man days + 16×5 Boy days
    $= 13 \times 4$ man days + 24×4 Boy days
    $\rightarrow 8$ man days = 16 Boy days
    1 man day = 2 Boy days.
    Required ratio of man's work to boy's work = 2 : 1.
25. A's rate of working is 10 per cent per day while B's rate of working is 5 per cent per day. In 5 days they will complete 75 per cent work. Thus the last 25 per cent would be done by B alone. Working at the rate of 5 per cent per day, B would do the work in 5 days.
26. Work equivalence method:
    $30 \times 5 \times 16 = 20 \times 6 \times n$
    Gives the value of n as 20 days
27. Ajay's daily work = 4.1666%, Vijay's daily work = 3.33% and the daily work of all the three together is 8.33%. Hence, Pradeep's daily work will be 0.8333%. Hence, he will end up doing 10% of the total work in 12 days. This will mean that he will be paid ₹ 20.
28. Total work = 15×210 = 3150 mandays.
    After 100 days, work done = 15×100 = 1500 mandays.
    Work left = 3150 – 1500 = 1650 mandays.
    This work has to be done with 30 men working each day.
    The number of days (more) required = 1650/30 = 55 days.
29. $A + V + S = 1$ (1)
    $A + V = 19/23$
    $V + S = 8/23$
    $\rightarrow A + 2V + S = 27/23$ (2)
    (2)–(1) gives us: $V = 4/23$.
30. Interpret the starting statement as: Anmol takes 30 days and Vinay takes 90 days. Hence, the answer will be got by:
    $(1/30 + 1/90) * n = 1$
    Alternatively, you can also solve using percentages as: 3.33 + 1.11 = 4.44% is the daily work. Hence, the no. of days required is 100/4.44 = 22.5 days.
31. After 27 days, food left = 4×200 = 800 soldier days worth of food. Since, now there are only 80 soldiers, this food would last for 800/80 = 10 days. Number of extra days for which the food lasts = 10 – 4 = 6 days.
32. Total work of Anju, Manju and Sanju = 16.66%
    Anju's work = 10%
    Manju's work = 4.166%
    Sanju's work = 2.5%
    So Sanju can reap the field in 40 days.
33. Ajay + Vijay = 1/28 and Ajay + Vijay + Manoj = 1/21.
    Hence, Manoj = 1/21 – 1/28 = 1/84.
    Hence, Manoj will take 84 days to do the work.
34. $A + M = 8.33$, $M + B = 6.66$ and $A = 2B \rightarrow A$'s 1 days work = 3.33%, M's = 5% and B's = 1.66%. Thus, Mohan would require 100/5 = 20 days to complete the work if he works alone.
35. $A + V = 16.66\%$ and $A = 10\% \rightarrow V = 6.66\%$. Consequently Vijay would require 100/6.66 = 15 days to do it alone.
36. The rate of filling will be 20% and the net rate of filling (including the leak) is 16.66%. Hence, the leak accounts for 3.33% per hour, i.e., it will take 30 hours to empty the tank.
37. $A + B = 16.66\%$. From here solve this one using the options. Option (c) fits the situation as it gives us A's work = 10%, B's work = 6.66% as also that B takes 5 minutes more than A (as stipulated in the problem).
38. $A + B = 5.55 + 11.11 = 16.66$. In two days, 33.33% of the work will be done. C adds 16.66% of work to that of A and B. Hence, the rate of working will go to 33.33%. At this rate it would take 2 more days to complete the work.
    Hence, in total it will take 4 days to complete the entire work.
39. $24 \times 8 \times 10 = N \times 10 \times 6 \rightarrow N = 32$
40. $n \times 20 = (n - 12) \times 32 \rightarrow n = 32$.
41. $12 \times 18 = 12 \times 6 + 16 \times t \rightarrow t = 9$
42. $(A + B)$'s work = C's work.
    Also if A takes 'a' days
    B would take '$a - 5$' days
    and C would take '$a - 9$' days.
    Solving through options, option 'c' fits.
    A (15 days) $\rightarrow A$'s work = 6.66%
    B (10 days) $\rightarrow B$'s work = 10%
    C (6 days) $\rightarrow C$'s work = 16.66%
43. The cistern fills in 6 hours normally, means that the rate of filling is 16.66% per hour. With the leak in the bottom, the rate of filling becomes 10% per hour (as it takes 10 hours to fill with the leak).
    This means that the leak drains out water at the rate of 6.66% per hour. This in turn means that the leak would take 100/6.66 = 15 hours to drain out the entire cistern.
44. Since the net work of the three taps is 10% and the first and second do 20% + 10% = 30%. Hence, the third pipe must be a waste pipe emptying at the rate of 20% per hour. Hence, the waste pipe will take a total of 5 hours to empty the tank.
45. A's work = 10%
    B's negative work = 6.66%
    $(A + B)$'s work = 3.33%

To fill a half empty tank, they would take 50/3.33 = 15 hours.

46. The work rate would be 10% on the first day, 5% on the second day and 2.5% on the third day. For every block of 3 days there would be 17.5% work done. In 15 days, the work completed would be 17.5 × 5 = 87.5%. On the sixteenth day, work done = 10% → 2.5% work would be left after 16 days. On the 17th day the rate of work would be 5% and hence it would take half of the 17th day to complete the work. Thus, it would take 16.5 days to finish the work in this fashion.

47. $(A + B) = 2C$.
Also, $(A + C) = 3B$
$36(A + B + C) = 1$
Solving for C, we get:
$36\ (2C + C) = 1 \rightarrow 108C = 1$
$C = 1/108$
Hence, C takes 108 days.

48. $A + B + C = 19\%$. In the first two hours they will do 38 % of the work. Further, for the next two hours work will be done at the rate of 15% per hour. Hence, after 4 hours 68% of the work will be completed, when tap B is also closed. The last 32% of the work will be done by A alone. Hence, A does 40% (first 4 days) + 32% = 72% of the work.

49. Without the leak:
Rate of work = 20% + 5% = 25%. Thus, it would have taken 4 hours to complete the work.
Due to the leak the filling gets delayed by 1 hour. Thus, the tank gets filled in 5 hours. This means that the effective rate of filling would be 20% per hour. This means that the rate at which the leak empties the tank is 5% per hour and hence it would have taken 20 hours to empty a filled tank.

50. In 6 days A would do 25% of the work and in 8 days B would do 25% of the work himself. So, C has to complete 50% of the work by himself.
In all C would require 30 days to do 50% of the work. So, he would require 22 more days.

51. A is twice fast as B therefore B can complete the job in 8 days. Similarly C can complete the job in 16 days. Therefore, together they can complete the job in $\frac{1}{\frac{1}{4}+\frac{1}{8}+\frac{1}{16}}=\frac{16}{7}=2.29$ days.
Alternately, you could have solved this using percentages. A's work for 1 day = 25%, B's work for 1 day = 12.5%, while C's work for 1 day would be = 6.25%. Thus, the total work of A,B and C for 1 day would be = (25 + 12.5 + 6.25)% = 43.75%. Hence, they would complete the work in 100/43.75 = 400/175 = 16/7 days = 2.29 days.

52. If they take 'x' more days to complete the work then:
$36 \times 18 - (36 \times 8) = (36 + 4)x$
By solving we get $x = 9$ days

53. Required time = $\frac{1}{\frac{1}{8}-\frac{1}{12}}=\frac{96}{4}=24$ hours. (Note: This too can be solved using percentages as: Work of Tap M = 12.5%, Work of Tap N = –8.33%. Net work if both the taps are opened together = (12.5-8.33)% = 4.16%. To do 100% of the work, the time required would be 100/4.16 = 24 days.

54. $\frac{50\times35}{70\times40}=\frac{250\times18}{300\times x}$
$x=\frac{250\times18}{300}\times\frac{70\times40}{50\times35}=24$ days.

55. $8m + 4w = 3500$ (1)
$5m + 3w = 2275$ (2)
By solving equations 1 and 2 we get :
m = ₹ 350/week or ₹ 50/day.

56. Let the work will be finishing in x hours.
$5 \times 30 - 5 \times 16 = 3 \times (x - 16)$
By solving we get $x=\frac{118}{3}=39.33$ hours.

57. If there were 'x' men originally then according to the question :
$x \times 60 = (x + 8)(60 - 10)$
$60x = 50x + 400$
$x = 40$

58. Let soldiers would be able to carry on the remaining food for x more days.
$1000 \times 30 - 1000 \times 10 = (1000 + 1000)x$
$x=\frac{1000\times20}{2000}=10$ days.

59. Mathematical approach: If initially he uses x litres every day and now he is using $1.25x$ litre petrol every day then tank full petrol will last in
$\frac{x\times10}{1.25x}=8$

Short cut approach using Percentage change graphic: You can solve this by using the logic that if we increase the consumption by 25%, the number of days would drop by 20% (since the product of daily consumption and the number of days would be constant). Thus, the tank-full petrol would last for 20% less than 10 days = 8 days.

60. Required time to empty the tank (in hours) = $\frac{3/4}{\frac{1}{5}-\frac{1}{8}}=\frac{3/4}{3/40}=10$ hours.

Short cut approach using percentage: You can again solve this by interpreting that 3/4th of the tank to be emptied means 75% of the tank needs to be emptied – a net work of –75. Also, the work of the inlet pipe is 12.5% per hour, while the work of the outlet pipe is –20% per hour. Net work when both the inlet and the outlet pipes are opened would be –7.5% per hour. This would mean that to empty 75% of the tank, it would take 75/7.5 = 10 hours.

Level of Difficulty (II)

1. 25 (n – 12) = 21 n + 300. Solving this equation, n = 150. Hence, the first division harvest 3150 tons.
2. Let n be the number of metres planned per day. Start from the options to find the number of planned days. In the options the 2 feasible values are 30 metres and 27 metres (as these divide 270). Suppose we check for 30 metres per day, the work would have got completed in 9 days as per the original plan. In the new scenario:

   $3n + 5(n + 8) = 280 \rightarrow n = 30$ too. Hence, this option is correct.

   Note that if we tried with 27 metres per day the final equation would not match as we would get:

   $3n + 6(n + 8) = 280 \rightarrow$ which does not give us the value of n as 27 and hence this option is rejected.
3. To solve this question first assume the values of x and y (such that $x < y$). If you take x as 10 hours and y as 15 hours, you will get a net work of 3.33% per hour. At this rate it will take 20 hours to fill the tank from one third full. Using this condition try to put these values of x and y into the options to check the values.

   For instance option (a) gives the value as $3 \times 10 \times 15/10 = 45$ which is not equal to 20.
4. $n(1/45 + 1/40) + 23/40 = 1 \rightarrow n = 9$.
5. Since A finishes 6/7th of the work in 2z hours .

   B would finish 12/7 of the work in 2z hours.

   Thus, to do 1/7th of the work (which represents the remaining work), B would require $2z/12 = z/6$ hours. Option (d) is correct.

6–10.

Set X can fill 10% in a minute. Hence, every Pipe of set X can do 1% work per minute. Set Y has a filling capacity of 12.5% per minute (or 2.5% per minute for each tap in set Y). Set Z has a capacity of emptying the tank at the rate of 5% per minute and each tap of set Z can empty at the rate of 0.625% per minute.

6. If all the 23 pipes are opened the per minute rate will be:

   10 + 12.5 – 5 = 17.5% → Option (b) is correct.
7. Set X will do 5 % per minute and Set Y will do 6.25% per minute, while set Z will do 5% per minute (negative work). Hence, Net work will be 6.25% per minute. To fill 49% it will take slightly less than eight minutes and the value will be a fraction. None of the first three options matches this requirement. Hence, the answer will be (d).
8. If 4 of the taps of set Z are closed, the net work done by Set Z would be –2.5% while the work done by Sets X and Y would remain 10% and 12.5% respectively. Thus, the total work per minute would be 20% and hence the tank would take 5 minutes to fill up.
9. Again if we close 4 taps of set Z, the rate of emptying by set Z would be 2.5% per minute. A half filled tank would contain 50% of the capacity and hence would take 50/2.5 = 20 minutes to empty.
10. The rate per minute with the given changes (in percentage terms) would be:

    Set X =11%, Set Y = 15% and Set Z = –6%.

    Hence, the net rate = 11 + 15 – 6 = 20% per minute and it would take 5 minutes for the tank to fill. If all pipes are opened at 7:58, the tank would get filled at 3:03.
11. Let Ajit's rate of work be 100/2 = 50 work units per day. Baljit would do 100/3 = 33.33 work units per day and Diljit does 133.33/5 = 26.66 units of work per day. Their 1 days work = 50 + 33.33 + 26.66 = 110 units of work per day. In 20 days, the total work done would be 2200 units of work and hence for Baljit to do it alone it would take: 2200/33.33 = 66 days to complete the same work.
12. The 32 minutes extra represents the extra time taken by the pipes due to the leak.

    Normal time for the pipes $\rightarrow n \times (1/14 + 1/16) = 1$ $\rightarrow n = 112/15 = 7$ hrs 28 minutes.

    Thus, with 32 minutes extra, the pipes would take 8 hours to fill the tank.

    Thus, $8(1/14 + 1/16) - 8 \times (1/L) = 1 \rightarrow 8/L$
    $= 8(15/112) - 1$
    $1/L = 15/112 - 1/8$
    $= 1/112.$

    Thus, L = 112 hours.
13. The outlet pipe will empty the tank at a rate which is double the rate of filling (Hence, 10 gallons per minute). If the inlet is shut off, the tank will get emptied of 100 gallons of water in ten minutes.
14. The net inflow when both pipes are opened is 5 litres a minute.

    The outlet flow should be such that if its rate is doubled the net inflow rate should be negative or 0.

    Only an option greater than or equal to '5' would satisfy this condition.

    Option (b) is the only possible value.
15. X→12 days → 8.33% of the work per day.

    Y → 18 days → 5.55% of the work per day

$Z \rightarrow 10$ days $\rightarrow 10\%$ of the work per day.

In three days, the work done will be 25 + 16.66 + 30 = 71.66%. The remaining work will get done by Y in 28.33/5.55 = 5.1 days.

[*Note:* You need to be fluent with your fraction to percentage conversions in order to do well at these kinds of calculations.]

16. A takes 9 days to complete the work

B takes 24 days to complete the work

C takes 16 days to complete the work

In 4e days, work done by all three would be:

$4 \times (1/9 + 1/24 + 1/16)$

$$= 4 \times \frac{(16+6+9)}{144} = 124/144$$

$$= 31/36 \text{ of the work.}$$

Work left for B would be 5/36 of the work.

B would require: $(5/36) \times 24 = 3.33$ days.

17. The per day digging of all three combined is 54 metres. Hence, their average should be 18. This means that the first should be $18 - x$, the second, 18 & the third $18 + x$.

The required conditions are met if we take the values as 15, 18 and 21 metres for the first, second and third diggers, respectively. Hence, (a) is the correct answer.

18. The equations are:

$$3(A + B + C) = 37/100 = 37\% \text{ of the work.}$$

$$7(A + B) = 63/10 \rightarrow A + B = 9/100 = 9\%$$

(Where A, B and C are 1 day's work of the three respectively).

Further, $5A = 4B$ gives us

$A = 4\%$ and $B = 5\%$ work per day.

In 3 days $(A + B + C)$ do 37% of the work.

Out of this A and B would do 27% (= 3 × 9%) of the work. So, C would do 3.33% of the work per day.

$$\frac{37-27}{3}$$

Thus, B is the fastest and he would require 20 days to complete the work.

19. $A + B = 20\%$ of the work. Use trial and error with the options to get the answer.

Checking for option (a), $A = 10\%$ and $B = 10\%$. If A doubles his work and B halves his work rate, the total work in a day would become $A = 20$, $B = 5$. This would mean that the total work would get completed in 4 days which is the required condition that needs to be matched if the option is to be correct. Hence, this option is correct.

20. Since the first typist types for 4 minutes and the second typist types for exactly 6 minutes, the work left (which is given as 1/5 of the total work) would be the work the first typist can do in 2 minutes. Thus, the time taken by the first typist to do the work would be 10 minutes and his rate of work would be 10% per minute. Also, since both the typists can do the work together in 6 minutes, their combined rate of work would be 100/6 = 16.66% per minute.

Thus, the second typist's rate of work would be 16.66 – 10 = 6.66% per minute.

He would take 100/6.66 = 15 minutes to complete the task alone.

21. From the condition of the problem and a little bit of trial and error we can see that the first cook worked for 4 minutes and the 2nd and 3rd cooks also worked for 4 minutes. As $4(A) + 4(B + C) = 4(A + B + C)$ and we know that $A + B + C = 20$ idlis per minute.

Thus, the first cook make 20 idlis in 4 minutes. To make 160 idlis he would take 32 minutes.

22. Solve this using options. If we check for option (c), i.e., the work of a man exceeds the work of a woman by 5 times, we would get the following thought process:

Total work = 6 days × (3 women + 2 men) = 18 woman days + 12 man days = 18 woman days + 60 woman days = 78 woman days.

Thus, 9 women would take 78/9 days = 8.66 days and hence 3 men should do the same work in 3.66 days. This translates to 3 × 3.66 = 10 man days or 50 woman days which is incorrect as the number of woman days should have been 78.

Thus, we can reject this option.

If we check for option (d), i.e., the work of a man exceeds the work of a woman by 6 times, we would get the following thought process:

Total work = 6 days × (3 women + 2 men) = 18 woman days + 12 man days = 18 woman days + 72 woman days = 90 woman days.

Thus, 9 women would take 90/9 days = 10 days and hence 3 men should do the same work in 5 days. This translates to 3 × 5 = 15 man days or 90 woman days which is correct as the number of woman days should be 90.

Thus, we select this option.

23. $0.5(A + B + C) = 50\%$ of the work.

Means $\rightarrow A$, B and C can do the full work in 1 hour.

Thus, $(A + B + C) = 100\%$

From this point it is better to solve through options. Option (c) gives the correct answer based on the following thought process.

If $c = 50\%$ work per hour, it means C takes 2 hours to complete the work.

Consequently, A would take 3 hours and hence do 33.33% work per hour.

Since, $A + B + C = 100\%$, this gives us B's hourly work rate = 16.66%.

For this option to be correct these nos. should match the second instance and the information given there.

According to the second condition:

$A + 4B$ should be equal to 100%. Putting $A = 33.33\%$ and $B = 16.66\%$ we see that the condition is satisfied. Hence, this option is correct.

24. Option (a) is correct because: 1/10.5 + 1/14 = 1/6 which matches all the conditions of the problem.
25. Solve by trial and error by putting values for x and y in the options.
26. Use options for this question as follows:

    If discharging delivery is 40, filling delivery will be 16.66% less (this will give a decimal value right at the start and is unlikely to be the answer. Hence, put this option aside for the time being.)

    Option (c) gives good values. If discharging delivery is 60, filling delivery will be 50. Also, time taken for discharge of 3600 cu m will be 60 minutes and the time taken for delivery will be 72 minutes (12 minutes more — which is the basic condition of the problem).
27. The interpretation of the first statement is that (a) and (b) do 41.66 percent of the work per hour. From this point if we go through the options, option (b) fits the situation as 4 hours per one person means 25 percent work per hour per person. Consequently this means 16.66 percent per work per hour per other person.
28. From the last statement we know that since both the pipes would require 17 hours to fill the tank together, they would discharge 425/17 = 25 litres per hour together.

    From this point try to fit the values from the options in order to see which one satisfies all the conditions.

    In the case of option (a): Second pipe open for 10 hours, first pipe open for 15 hours.

    When the interchange occurs: Second pipe open for 15 hours, first pipe open for 10 hours → gives us that the respective rates of the two pipes would be 3:4 (as the first pipe delivers half the amount of the second pipe— if it delivers 3 litres per minute the second pipe would need to deliver 4 litres per minute).

    Thus, if the delivery of the first pipe is 3n litres per minute, the delivery of the second pipe would be 4n litres per minute. Then, in 10 hours of the second pipe and 15 hours of the first pipe, the total water would be 85n, which should be equal to the total water of the two pipes in 17 hours each. But in 17 hours each, the two pipes would discharge $17 \times 7n = 119n$. Thus, we reject this option.

    In the case of option (c): Second pipe open for 15 hours, first pipe open for 20 hours.

    When the interchange occurs: Second pipe open for 20 hours, first pipe open for 15 hours → gives us that the respective rates of the two pipes would be 2:3 (as the first pipe delivers half the amount of the second pipe- if it delivers 2 litre per minute the second pipe would need to deliver 3 litres per minute).

    Thus, if the delivery of the first pipe is 2n litres per minute, the delivery of the second pipe would be 3n litres per minute. Then, in 15 hours of the second pipe and 20 hours of the first pipe, the total water would be 85n, which should be equal to the total water of the two pipes in 17 hours each. In 17 hours each, the two pipes would discharge $17 \times 5n = 85n$. Thus, we realize that this is the correct option.
29. In order to solve this question, if we look at the first statement, we could think of the following scenarios:

    If the time taken by the first man and the woman is 1 hour (100% work per hour) , the time taken by the second man would be 4 hours (25% work per hour). In such a case, the total time taken by all three to complete the task would be 100/125 = 0.8 hours. But this value is not there in the options. Hence, we reject this set of values.

    If the time taken by the first man and the woman is 2 hours (50% work per hour) , the time taken by the second man would be 5 hours (20% work per hour). In such a case, the total time taken by all three to complete the task would be 100/70 = 10/7 hours. But this value is not there in the options. Hence, we reject this set of values.

    If the time taken by the first man and the woman is 3 hours (33.33% work per hour) , the time taken by the second man would be 6 hours (16.66% work per hour). In such a case, the total time taken by all three to complete the task would be 100/50 = 2 hours. Since this value is there in the options we should try to see whether this set of values meets the other conditions in the question.

    In this case, it is given that the first man working alone takes as much time as the second man and the woman. Since, the work of all three is 50%, this means that the work of the first man is 25%. Consequently the work of the woman is 8.33%.

    Looking at the third condition given in the problem – the time taken by the first man to do the work alone (@ 25% per hour he would take 4 hours) should be 8 hours less than double the time taken by the second man. This condition can be seen to be fulfilled here because the second man would take 6 hours to complete his work (@ 16.66% per hour) and hence, double his time would be 12 hours— which satisfies the difference of 8 hours.

    Thus, the total time taken is 2 hours.

30. Let the inlets be A, B, C and D.

$$A + B + C = 8.33\%$$
$$B + C + D = 6.66\%$$
$$A + D = 5\%$$

Thus, $2A + 2B + 2C + 2D = 20\%$

and $A + B + C + D = 10\%$

→ 10 minutes would be required to fill the tank completely.

31. Short cut Solution: The best way to think in this situation is to assume the tank to have a capacity of 36 litres (LCM of 12,18 and 36). In such a case, the first tap would be filling the tank at the rate of 3 litres per hour, the second one would be filling at the rate of 2 litres per hour while the third one would be emptying the tank at the rate of 1 litre per hour. In 6 hours, the total quantity of water in the tank would be $6 \times 3 + 5 \times 2 - 4 \times 1 = 24$. Hence, the ratio of volume occupied by water to the volume that is not occupied by water is 24 : 12 = 2 : 1.

32. Based on the previous solution, we have seen that after 6 hours 24 litres of the tank are filled. To fill the remaining 12 litres, when both the inlet taps are open, we would need $12 \div 5 = 2.4$ hours = 2 hours 24 minutes. Thus, it would take a total of 6 hours + 2 hours 24 minutes to fill the tank, i.e., 8 hours 24 minutes = 504 minutes.

33. Let the total capacity of the tank be 180 litres:

Efficiency of X = 15 l/hr.

Efficiency of Y = 12 l/hr.

Efficiency of Z = –18 l/hr.

Time taken to fill the tank to 40% of it's capacity (i.e., 72 litres) = 72/27 = 2 hours 40 minutes.

After 2 hours 40 minutes, Z starts working.

The rate at which the tank would be filled after this would be: 15 + 12 – 18 = 9 litres per hour.

The total quantity to be filled in order to fill up the tank = 180 – 72 = 108 litres.

This will take 108/9=12 hours to complete. Hence, the supervisor comes back after: 12 hours + 2 hours 40 minutes = 14 hours 40 minutes.

Hence, he is supposed to come back at: 1:40 AM (the next day).

The value of A + B = 41.

34. Z opens when the tank is filled with 45 litres of water. This means that Z opened after 45/27 = 1 hour 40 minutes. In the next 13 hours, $13 \times 9 = 117$ litres of water will get added to the tank. Thus, 10% of the tank would be empty when the supervisor comes back.

35. According to the situation provided in the question, A can do the work in 25 days, B in 35 days. The thought process that gives us these numbers is: Since it is given than A is 40% more efficient than B, it means that A would take 5/7th of the time that B takes. Since it is given to us that A takes, 10 days less than B, the number of days can be worked out as 25 and 35 for A and B respectively. If you notice, when it is given that A is 40% more efficient than B, then B's number of days can be worked out by increasing A's number of days by 40% directly. This can be thought of as: If A is 40% more efficient than B, then B would take 40% more time to complete the work.

Consequently, C's time required would be 40% more than 35 days = 49 days.

Given the time frames for which they have worked we can get:

Work done by A and B = 80% of the total work.

C would complete the remaining 20% of the work in 49/5 = 9.8 days.

36. Let the total capacity of the container be 108 litres. The pipes A,B and C would respectively fill the container at the rates of 18 litre per minute, 9 litres per hour and 6 litres per hour. Thus, in the first two minutes, the container would get 12 + 6 + 3 + 18 + 9 + 3 = 51 litres of water. The fraction of the tank that would be empty would be 57/108 = 19/36.

37. To fill the remaining 57 litres of the container, in the third minute: Rate of filling =18 + 9 + 3 = 30 litres. This means that at the start of the fourth minute, the container would have 27 litres unfilled. The rate of filling in the fourth minute would be 18 + 9 + 6 = 33 litres. Thus, 27/33 or 9/11 of the 4th minute would be used. Thus, the container gets filled in 3(9/11) minutes = 3 minutes 49 seconds.

38. Using the work equivalence method we know that 1/5th of the work = $104 \times 30 \times 8$ man hours.

Thus, the remaining work = $4 \times 104 \times 30 \times 8$. Since, this work has to be done in the remaining 42 days by working at 9 hours per day, the number of men required would be given by: $(4 \times 104 \times 30 \times 8) \div (42 \times 9) = 264.12 = 265$ men. This means that we would need to hire 161 additional men.

39. Let the total work be 24, therefore efficiencies of X, Y, Z are 6, 4 and 3, respectively. To complete the work in minimum time the most efficient should start the work.

After 5 hours total work done =

Remaining work =

Z will complete the remaining work in 1/3 hours.

Total time required to complete the work =

hours.

40. If the rate at which Tap N fills the tank is 10 units per hour, the rate of Tap M would be 16 units per hour.

Hence, the capacity of the tank would be $26 \times 50 = 1300$.

Time taken by Tap N alone would be 1300/10 = 130 hours.