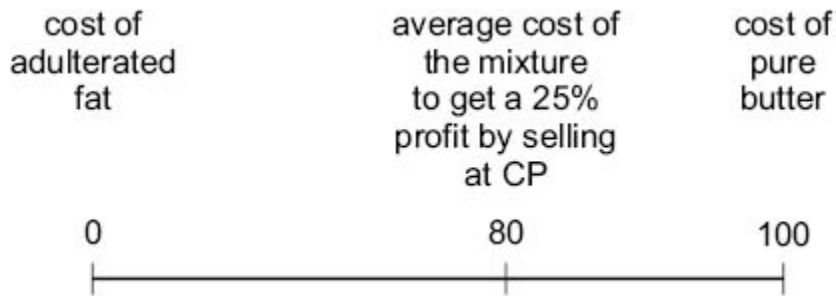


Since we are putting in 5 liters of water, the amount of milk must be 20 liters. The amount of mixture then would become 25 liters.

10. Amount of water left = $50 \times \frac{9}{10} \times \frac{9}{10} = 40.5$ liters. Hence, wine = 9.5 liters. Ratio of wine and water = 19:81. Option (c) is correct.
11. The amount of spirit left = $20 \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} \times \frac{4}{5} = \frac{4096}{625} = 6 \frac{346}{625}$.
12. Let the quantity of refined oil initially be Q . Then we have $Q \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4} = 10 \Rightarrow Q = \frac{2560}{81}$ liters.
13. The ratio would be 1:2 as seen from the figure:

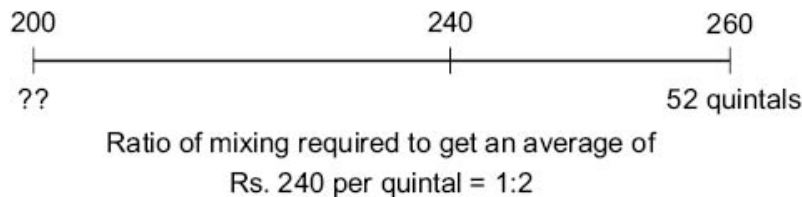


14. It can be seen from the ratio 36:13 that the proportion of liquid soap to water is $\frac{36}{49}$ after two mixings. This means that $\frac{6}{7}$ th of the liquid soap must have been allowed to remain in the container and hence $\frac{1}{7}$ th of the container's original liquid soap would have been drawn out by the thief. Since he takes out 4 gallons every time, there must have been 28 gallons in the container. (as 4 should be $\frac{1}{7}$ th of 28).
15. In order to sell at a 25% profit by selling at 13.75 the cost price should be $13.75/1.25 = 11$. Also since water is freely available, we can say that the ratio of water and soda must be 1:11.
16. The average value of a coin is 41 paise and there are only 20 paise and 50 paise coins in the sum. Hence, the ratio of the number of 20 paise coins to 50 paise coins would be $9:21 = 3:7$. Since there are a total of 90 coins, the number of 20 paise coins would be $3 \times \frac{90}{10} = 27$ coins.
- 17.



The ratio of mixing required would be 1:4 which means that the percentage of adulterated fat would be 20%.

18. Solve using options. Initially there are 7 liters of water in 70 liters of the mixture. By mixing 2 liters of water we will have 9 liters of water in 72 liters of the mixture – which is exactly 12.5%.
19. Again solve this question using options. Initially there are 2 liters of water in 20 liters of the mixture. To take the water to 25% of the mixture we would need to add 4 liters of water as that would give us 6 liters of water in 24 liters of the mixture.
20. By selling at 300 if we need to get a profit of 25% it means that the cost price would be $300/1.25 = 240$.



Thus, in 52 quintals of the second we need to mix 26 quintals of the first.

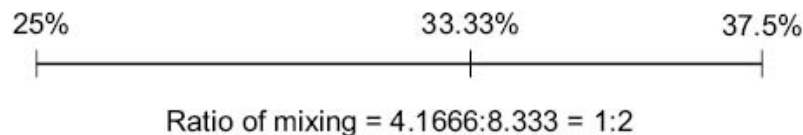
21. The requisite 11.11% profit can be got by mixing 0.111 liters of water in 1 liter of milk. In such a case the total milk quantity would be 1.111 liters and the price would be for 1 liter only. The profit would be $0.111/1 = 11.11\%$.
22. The percentage of honey in the new mixture would be:
 $(2 \times 25 + 3 \times 75)/5 = 275/5 = 55\%$. The ratio of honey to water in the new mixture would be $55:45 = 11:9$.
23. In order to mix two tin alloys containing 86.66% tin and 93.33% tin to get 90% tin, the ratio of mixing should be 1:1. Thus, each variety should be 25 kgs each.

24. Assume the capacity of the two containers is 198 liters each. When we mix 198 liters of the first and 198 liters of the second the amount of oil would be:

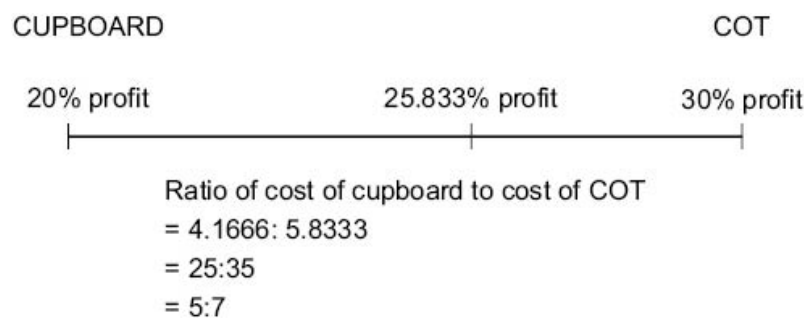
$$198 \times \frac{4}{11} + 198 \times \frac{7}{18} = 72 + 77 = 149 \text{ liters.}$$

Consequently the amount of water would be $396 - 149 = 247$ liters.
Option (a) is correct.

25. The first vessel contains 25% spirit while the second vessel contains 37.5 % spirit. To get a 1:2 ratio we need 33.33% spirit in the mixture. The ratio of mixing can be seen using the following alligation figure:

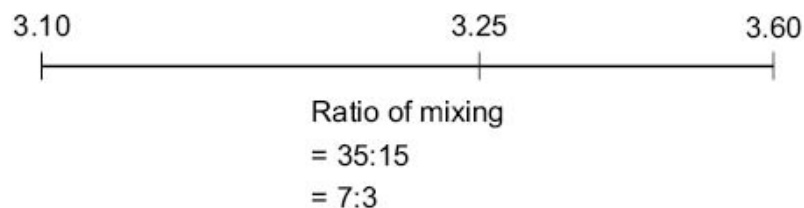


26. Solve using options as that would be the best way to tackle this question. Option (b) fits the situation perfectly as if we take the price of the pen as ` 25, the cost of the pencil would be ` 10. The profit in selling the pen would be `5 while the loss in selling the pencil would be ` 1. The total profit would be ` 4 as stipulated by the problem.
27. The following alligation visualization would help us solve the problem:



$$\text{Cost of cupboard} = 5 \times 18000/12 = 7500.$$

28. The following visualization would help:



34. We cannot determine the answer to this question as we do not know the price per kg of the other type of ghee. Hence, we cannot find the ratio of mixing which would be required in order to move further in this question.
35. To gain 20% by selling at cost price, milk should comprise 83.33% of the total mixture. The ratio of mixing that achieves this is 1:5.
36. 20% spirit is mixed with 50% spirit to get 25% spirit. The ratio of mixing would be 5:1. This means he stole $\frac{5}{6}$ th of the bottle or 83.33% of the bottle.
37. $O + F + T = 95$
 $O + 0.5F + 0.25T = 50.5$
 $T = 1.333 O$.
 Solving we get: 24 coins of 25 paise each.
38. Annual interest income = $1904 / 3.5 = 544$. Interest of ` 544 on a lending of ` 6800 implies an 8% average rate of interest. This 8% is generated by mixing two loans @ 7.5% and 10% respectively. The ratio in which the two loans should be allocated would be 4:1. The amount lent at 10% would be $1 \times 6800 / 5 = 1360$.
39. Solve using options. If he travels 48 km on foot he would take 6 hours on foot. Also, in this case he would travel 32 km on bicycle @ 16kmph – which would take him 2 hours. Thus a total of 8 hours. Option (c) satisfies the conditions of the question.
40. Solving through options is the best way to tackle this question. Option (a) fits the conditions of the problem as if there are 11 liters in the first vessel, there would be 8 liters of spirit. Also it means that we would be taking 24 liters from the second vessel out of which there would be 20 liters of spirit. Thus, total spirit would be 28 out of 35 liters giving us 7 liters of water.



BLOCK REVIEW TEST

Review Test

1. Rakshit bought 19 erasers for ₹ 10. He paid 20 paise more for each white eraser than for each brown eraser. What could be the price of a white eraser and how many white erasers could he have bought?
(a) 60 paise, 8 (b) 60 paise, 12
(c) 50 paise, 8 (d) 50 paise, 10
2. After paying all your bills, you find that you have ₹ 7.20 in your pocket. You have equal number of 50 paise and 10 paise coins; but no other coins nor any other currency notes. How many coins do you have?
(a) 8 (b) 24
(c) 27 (d) 30
3. Suresh Kumar went to the market with ₹ 100. If he buys three pens and six pencils he uses up all his money. On the other hand if he buys three pencils and six pens he would fall short by 20%. If he wants to buy equal number of pens & pencils, how many pencils can he buy?
(a) 4 (b) 5
(c) 6 (d) 7
4. For the above question, what is the amount of money he would save if he were to buy 3 pens and 3 pencils?
(a) ₹ 50 (b) ₹ 25
(c) ₹ 75 (d) ₹ 40
5. Abdul goes to the market to buy bananas. If he can bargain and reduce the price per dozen by ₹ 2, he can buy 3 dozen bananas

instead of 2 dozen with the money he has. How much money does he have?

- (a) ₹ 6 (b) ₹ 12
(c) ₹ 18 (d) ₹ 24

6. Two oranges, three bananas and four apples cost ₹15. Three oranges, two bananas and one apple cost ₹10. I bought 3 oranges, 3 bananas and 3 apples. How much did I pay?

- (a) ₹10 (b) ₹8
(c) ₹15 (d) cannot be determined

7. John bought five mangoes and ten oranges together for forty rupees. Subsequently, he returned one mango and got two oranges in exchange. The price of an orange would be

- (a) ₹ 1 (b) ₹ 2
(c) ₹ 3 (d) ₹ 4

8. Two towns A and B are 100 km apart. A school is to be built for 100 students of Town B and 30 students of Town A. The Expenditure on transport is ₹1.20 per km per person. If the total expenditure on transport by all 130 students is to be as small as possible, then the school should be built at

- (a) 33 km from Town A
(b) 33 km from Town B
(c) Town A
(d) Town B

9. A person who has a certain amount with him goes to the market. He can buy 50 oranges or 40 mangoes. He retains 10% of the amount for taxi fare and buys 20 mangoes and of the balance he purchases oranges. Number of oranges he can purchase is

- (a) 36 (b) 40
(c) 15 (d) 20

10. 72 hens costs `96.7_. Then what does each hen cost, where numbers at “_” are not visible or are written in illegible hand?
- (a) `3.43 (b) `5.31
(c) `5.51 (d) `6.22

Directions for Questions 10 to 12: There are 60 students in a class. These students are divided into three groups A, B and C of 15, 20 and 25 students each. The groups A and C are combined to form group D

11. What is the average weight of the students in group D?
- (a) more than the average weight of A.
(b) more than the average weight of C.
(c) less than the average weight of C.
(d) Cannot be determined.
12. If one student from Group A is shifted to group B, which of the following will be true?
- (a) The average weight of both groups increases
(b) The average weight of both groups decreases
(c) The average weight of the class remains the same.
(d) Cannot be determined.
13. If all the students of the class have the same weight then which of the following is false?
- (a) The average weight of all the four groups is the same.
(b) The total weight of A and C is twice the total weight of B.
(c) The average weight of D is greater than the average weight of A.
(d) The average weight of all the groups remains the same even if a number of students are shifted from one group to another.
14. The average marks of a student in ten papers are 80. If the highest and the lowest score are not considered the average is 81. If his highest score is 92 find the lowest.

- (a) 55 (b) 60
(c) 62 (d) Cannot be determined

15. A shipping clerk has five boxes of different but unknown weights each weighing less than 100 kg. The clerk weighs the boxes in pairs. The weights obtained are 110, 112, 113, 114, 115, 116, 117, 118, 120 and 121 kg. What is the weight of the heaviest box?

- (a) 60 kg (b) 62 kg
(c) 64 kg (d) Cannot be determined

16. The total expenses of a boarding house are partly fixed and partly varying linearly with the number of boarders. The average expense per boarder is ₹ 700 when there are 25 boarders and ₹ 600 when there are 50 boarders. What is the average expense per boarder when there are 100 boarders?

- (a) 550 (b) 580
(c) 540 (d) 570

17. A yearly payment to a servant is ₹ 90 plus one turban. The servant leaves the job after 9 months and receives ₹ 65 and a turban, then find the price of the turban.

- (a) ₹ 10 (b) ₹ 15
(c) ₹ 7.50 (d) Cannot be determined

18. A leather factory produces two kinds of bags, standard and deluxe. The profit margin is ₹ 20 on a standard bag and ₹ 30 on a deluxe bag. Every bag must be processed on machine A and on Machine B. The processing times per bag on the two machines are as follows:

Time required (Hours/bag)

	Machine A	Machine B
Standard Bag	4	6
Deluxe Bag	5	10

The total time available on machine A is 700 hours and on machine B is 1250 hours. Among the following production plans, which one

meets the machine availability constraints and maximizes the profit?

- (a) Standard 75 bags, Deluxe 80 bags
- (b) Standard 100 bags, Deluxe 60 bags
- (c) Standard 50 bags, Deluxe 100 bags
- (d) Standard 60 bags, Deluxe 90 bags

19. Three math classes: X, Y, and Z, take an algebra test.

The average score of class X is 83.

The average score of class Y is 76.

The average score of class Z is 85.

What is the average score of classes X, Y, Z ?

- (a) 81.5
- (b) 80.5
- (c) 83
- (d) Cannot be determined

20. Prabhat ordered 4 Arrow shirts and some additional Park Avenue shirts. The price of one Arrow shirt was twice that of one Park Avenue shirt. When the order was executed it was found that the number of the two brands had been interchanged. This increased the bill by 40%. The ratio of the number of Arrow shirts to the number of Park Avenue shirts in the original order was:

- (a) 1:3
- (b) 1:4
- (c) 1:2
- (d) 1:5

21. Three groups of companies: Tata, Birla and Reliance announced the average of the annual profit for all years since their establishment.

The average profit of Tata is ` 75,000 lakh

The average profit of Birla is ` 64000 lakh

The average profit of Reliance is ` 73000 lakh

The average profit of all results of Tata and Birla together is ` 70000 lakh.

The average profit of all results of Birla and Reliance together is ` 69000 lakh.

Approximately what is the average profit for all the three group of companies?

(a) ` 70800 lakh

(b) ` 71086 lakh

(c) ` 70666 lakh

(d) Cannot be determined

ANSWER KEY

Review Test

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

OceanofPDF.com

BLOCK III

ARITHMETIC AND WORD-BASED PROBLEMS

Chapter 5
Percentages

Chapter 6
Profit & Loss

Chapter 7
Interest

Chapter 8
Ratio,
Proportion
and
Variation

Chapter 9
Time and Work

Chapter 10
Time, Speed
and Distance

OceanofPDF.com



...BACK TO SCHOOL

As you are already aware, this block consists of the following chapters:

Percentages,

Profit & Loss,

Interest,

Ratio, Proportion and Variation,

Time and Work,

Time, Speed and Distance

To put it very simply, the reason for these seemingly diverse chapters to be under one block of chapters is: **Linear Equations**

Yes, the solving of linear equations is the common thread that binds all the chapters in this block.

But before we start going through what a linear equation is, let us first understand the concept of a variable and its need in the context of solving mathematical expressions.

Let us start off with a small exercise first:

Think of a number.

Add 2 to it.

Double the number to get a new number.

Add half of this new number to itself.

Divide the no. by 3.

Take away the original number from it.

The number you now have is..... 2!!

How do I know this result?

The answer is pretty simple. Take a look. I am assuming that you had taken the initial number as 5 to show you what has happened in this entire process.

<i>Instruction</i>	<i>You</i>	<i>Me</i>
Think of a number.	5	X
Add 2 to it.	$5 + 2 = 7$	$X + 2$
Double the number to get a new number.	$7 \times 2 = 14$	$2X + 4$
Add half of this new number to itself.	$14 + 7 = 21$	$3X + 6$
Divide the result by 3.	$21/3 = 7$	$X + 2$
Take away the original number from it.	$7 - 5 = 2$	$X + 2 - X = 2$
The number you now have is..... 2 and is independent of the value again.	The number you now have is..... 2!	The number you now have is..... 2!

The above is a perfect illustration of what a variable is and how it operates.

In this entire process, it does not matter to me as to what number you have assumed. All I set up is a kind of a parallel world wherein the number in your mind is represented by the variable X in my mind.

By ensuring that the final value does not have an X in it, I have ensured that the answer is independent of the value you would have assumed. Thus, even if someone had assumed 7 as the original value, his values would go as: 7, 9, 18, 27, 9, 2.

What you need to understand is that in Mathematics, whenever we have to solve for the value of an unknown we represent that unknown by using some letter (like x , y , a etc.) These letters are then called as the variable representations of the unknown quantity.

Thus, for instance, if you come across a situation where a question says: The temperature of a city increases by 1°C on Tuesday from its value on Monday, you assume that if Monday's temperature was t , then Tuesday's temperature will be $t + 1$.

The opposite of a variable is a constant. Thus if it is said in the same problem that the temperature on Wednesday is 34°C , then 34 becomes

a constant value in the context of the problem.

Thus although you do not have the actual value in your mind, you can still move ahead in the question by assuming a variable to represent the value of the unknowns. All problems in Mathematics ultimately take you to a point which will give the value of the unknown—which then becomes the answer to the question.

Hence, in case you are stuck in a problem in this block of chapters, it could be due to any one of the following three reasons:

Reason 1: You are stuck because you have either not used all the information given in the problem or have used them in the incorrect order.

In such a case go back to the problem and try to identify each statement and see whether you have utilized it or not. If you have already used all the information, you might be interested in knowing whether you have used the information given in the problem in the correct order. If you have tried both these options, you might want to explore the next reason for getting stuck.

Reason 2: You are stuck because even though you might have used all the information given in the problem, you have not utilized some of the information completely.

In such a case, you need to review each of the parts of the information given in the question and look at whether any additional details can be derived out of the same information. Very often, in Quants, you have situations wherein one sentence might have more than one connotation. If you have used that sentence only in one perspective, then using it in the other perspective will solve the question.

Reason 3: You are stuck because the problem does not have a solution. In such a case, check the question once and if it is correct go back to Reasons 1 and 2. Your solution has to lie there.

My experience in training students tells me that the 1st case is the most common reason for not being able to solve questions correctly. (more than 90% of the times) Hence, if you consider yourself to be weak at Maths, concentrate on the following process in this block of chapters.



THE LOGIC OF THE STANDARD STATEMENT

What I have been trying to tell the students is that most of the times, you will get stuck in a problem only when you are not able to interpret a statement in the problem. Hence, my advise to students (especially those who are weak in these chapters)—concentrate on developing your ability to decode the mathematical meaning of a sentence in a problem.

To do this, even in problems that you are able to solve (easily or with difficulty) go back into the language of the question and work out the mathematical reaction that you should have with each statement.

It might not be a bad idea to make a list of standard statements along with their mathematical reactions for each chapter in this block of chapters. You will realise that in almost no time, you will come to a situation where you will only rarely encounter new language.

Coming back to the issue of **linear equations**:

Linear equations are expressions about variables that might help us get the value of the variable if we can solve the equation.

Depending upon the number of variables in a problem, a linear equation might have one variable, two variables or even three or more variables. The only thing you should know is that in order to get the value of a variable, the number of equations needed is always equal to the number of variables. In other words, if you have more variables in a system of equations than the number of equations, you cannot solve for the individual values of the variables.

The basic mathematical principle goes like this:

For a system of equations to be solvable, the number of equations should be equal to the number of variables in the equations.

Thus for instance, if you have two variables, you need two equations to get the values of the two variables, while if you have three variables you will need three equations.

This situation is best exemplified by the situation where you might have the following equation. $x + y = 7$. If it is known that both x and y

are natural numbers, it yields a set of possibilities for the values of x & y as follows: (1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1). One of these possibilities has to be the answer.

In fact, it might be a good idea to think of all linear equation situations in this fashion. Hence, before you go ahead to read about the next equation, you should set up this set of possibilities based on the first equation.

Consider the following situation where a question yields a set of possibilities:

Four enemies A , B , C and D gather together for a picnic in a park with their wives. A 's wife consumes 5 times as many glasses of juice as A . B 's wife consumes 4 times as many glasses of juice as B . C 's wife consumes 3 times as many glasses of juice as C and D 's wife consumes 2 times as many glasses of juice as D . In total, the wives of the four enemies consume a total of 44 glasses of juice. If A consumes at least 5 glasses of juice while each of the other men have at least one glass, find the least number of drinks that could have been consumed by the 4 enemies together.

- | | |
|--------|--------|
| (1) 9 | (2) 12 |
| (3) 11 | (4) 10 |

In the question above, we have 8 variables— A , B , C & D and a , b , c , d – the number of glasses consumed by the four men and the number of glasses consumed by the four wives.

Also, the question gives us five informations which can be summarized into 5 equations as follows.

$$a = 5A$$

$$b = 4B$$

$$c = 3C$$

$$d = 2D$$

$$\text{and } a + b + c + d = 44$$

Also, $A > 5$.

Under this condition, you do not have enough information to get all values and hence you will get a set of possibilities.

Since the minimal value of A is 5, a can take the values 25, 30, 35 and 40 when A takes the values 5, 6, 7 and 8 respectively. Based on these, and on the realization that b has to be a multiple of 4, c a multiple of 3 and d a multiple of 2, the following possibilities emerge:

At $A = 5$

a (multiple of 5)	25	25	25	25	25
b (multiple of 4)	12	8	8	4	4
c (multiple of 3)	3	9	3	3	9
d (multiple of 2)	4	2	8	12	6
$a + b + c + d$	44	44	44	44	44

a	$A=6, a=30$	$A=7, a=35$	$A=8, a=40$
b (multiple of 4)	4	4	No solution
c (multiple of 3)	6	3	
d (multiple of 2)	4	2	
$a + b + c + d$	44	44	

In this case the answer will be 10, since in the case of $a=35$, $b=4$, $c=3$ & $d=2$, the values for A, B, C and D will be respectively 7, 1, 1 and 1. This solution is the least number of drinks consumed by the 4 enemies together as in all the other possibilities the number of glasses is greater than 10.

Such utilisations of linear equations are very common in CAT and top level aptitude examinations.

The relationship between the decimal value and the percentage value of a ratio:

Every ratio has a percentage value and a decimal value and the difference between the two is just in the positioning of the decimal point.

Thus $\frac{2}{4}$ can be represented as 0.5 in terms of its decimal value and can be represented by 50% in terms of its percentage value.

OceanofPDF.com

Pre-assessment Test

1. Three runners A, B and C run a race, with runner A finishing 24 metres ahead of runner B and 36 metres ahead of runner C, while runner B finishes 16 metres ahead of runner C. Each runner travels the entire distance at a constant speed. .What was the length of the race?
(a) 72 metres (b) 96 metres
(c) 120 metres (d) 144 metres
2. A dealer buys dry fruits at `100, ` 80 and ` 60 per kilogram. He mixes them in the ratio 4:5:6 by weight, and sells at a profit of 50%. At what price per kilogram does he sell the dry fruit?
(a) `116 (b) `106
(c) `115 (d) None of these
3. There are two containers: the first contains 500 ml of alcohol, while the second contains 500 ml of water. Five cups of alcohol from the first container is taken out and is mixed well in the second container. Then, five cups of this mixture is taken out from the second container and put back into the first container. Let X and Y denote the proportion of alcohol in the first and the proportion of water in the second container. Then what is the relationship between X & Y? (Assume the size of the cups to be identical)
(a) $X > Y$ (b) $X < Y$
(c) $X = Y$ (d) Cannot be determined
4. Akhilesh took five papers in an examination, where each paper was of 200 marks. His marks in these' papers were in the proportion of 7: 8: 9 :10 : 11. In all papers together, the candidate obtained 60% of the total marks. Then, the number of papers in which he got more than 50% marks is:
(a) 1 (b) 3

(c) 4

(d) 5

5. A and B walk up an escalator (moving stairway). The escalator moves at a constant speed, A takes six steps for every four of B's steps. A gets to the top of the escalator after having taken 50 steps, while B (because his slower pace lets the escalator do a little more of the work) takes only 40 steps to reach the top. If the escalator were turned off, how many steps would they have to take to walk up?

(a) 80

(b) 100

(c) 120

(d) 160

6. Fifty per cent of the employees of a certain company are men, and 80% of the men earn more than ` 2.5 lacs per year. If 60% of the company's employees earn more than ` 2.5 lacs per year, then what fraction of the women employed by the company earn more than ` 2.5 lacs per year?

(a) $\frac{2}{5}$

(b) $\frac{1}{4}$

(c) $\frac{1}{3}$

(d) $\frac{3}{4}$

7. A piece of string is 80 centimeters long. It is cut into three pieces. The longest piece is 3 times as long as the middle-sized and the shortest piece is 46 centimeters shorter than the longest piece. Find the length of the shortest piece (in cm).

(a) 14

(b) 10

(c) 8

(d) 18

8. Three members of a family A, B, and C, work together to get all household chores done. The time it takes them to do the work together is six hours less than A would have taken working alone, one hour less than B would have taken alone, and half the time C would have taken working alone. How long did it take them to do these chores working together?

(a) 20 minutes

(b) 30 minutes

(c) 40 minutes

(d) 50 minutes

9. Fresh grapes contain 90% water by weight while dried grapes contain 20% water by weight. What is the weight of dry grapes available from 20 kg of fresh grapes?
- (a) 2kg (b) 2.4kg
(c) 2.5kg (d) None of these
10. At the end of the year 2008, a shepherd bought twelve dozen goats. Henceforth, every year he added $p\%$ of the goats at the beginning of the year and sold $q\%$ of the goats at the end of the year where $p > 0$ and $q > 0$. If the shepherd had twelve dozen goats at the end of the year 2012, (after making the sales for that year), which of the following is true?
- (a) $p = q$ (b) $p < q$
(c) $p > q$ (d) $p = q/2$

Directions for Questions 11 and 12: Answer the questions based on the following information.

An Indian company purchases components X and Y from UK and Germany, respectively. X and Y form 40% and 30% of the total production cost. Current gain is 25%. Due to change in the international exchange rate scenario, the cost of the German mark increased by 50% and that of UK pound increased by 25%. Due to tough competitive market conditions, the selling price cannot be increased beyond 10%.

11. What is the maximum current gain possible?
- (a) 10% (b) 12.5%
(c) 0% (d) 7.5%
12. If the UK pound becomes cheap by 15% over its original cost and the cost of German mark increased by 20%, what will be the gain if the selling price is not altered.
- (a) 10% (b) 20%
(c) 25% (d) 7.5%

13. A college has raised 80% of the amount it needs for a new building by receiving an average donation of ₹ 800 from the people already solicited. The people already solicited represent 50% of the people, the college will ask for donations. If the college is to raise exactly the amount needed for the new building, what should be the average donation from the remaining people to be solicited?
- (a) 300 (b) 200
(c) 400 (d) 500
14. A student gets an aggregate of 60% marks in five subjects in the ratio 10: 9: 8: 7: 6. If the passing marks are 45% of the maximum marks and each subject has the same maximum marks, in how many subjects did he pass the examination?
- (a) 2 (b) 3
(c) 4 (d) 5
15. After allowing a discount of 12.5 % a trader still makes a gain of 40%. At what per cent above the cost price does he mark on his goods?
- (a) 45% (b) 60%
(c) 25% (d) None of these
16. The owner of an art shop conducts his business in the following manner. Every once in a while he raises his prices by X%, then a while later he reduces all the new prices by X%. After one such up-down cycle, the price of a painting decreased by ₹ 441. After a second up-down cycle, the painting was sold for ₹ 1944.81. What was the original price of the painting (in ₹)?
- (a) 2756.25 (b) 2256.25
(c) 2500 (d) 2000
17. Manas, Mirza, Shorty and Jaipal bought a motorbike for \$60,000. Manas paid 50% of the amounts paid by the other three boys, Mirza paid one third of the sum of the amounts paid by the other

boys; and Shorty paid one fourth of the sum of the amounts paid by the other boys. How much did Jaipal have to pay?

- (a) \$15000
- (b) \$13000
- (c) \$17000
- (d) None of these

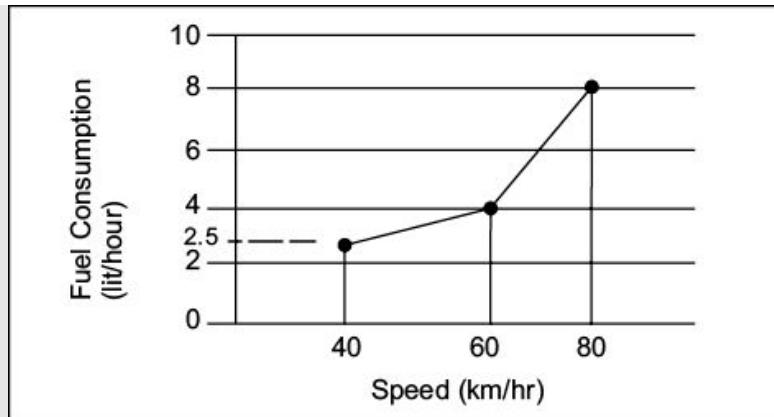
18. A train X departs from station A at 11.00 a.m. for station B, which is 180 km away. Another train Y departs from station B at 11.00 a.m. for station A. Train X travels at an average speed of 70 kms/hr and does not stop anywhere until it arrives at station B. Train Y travels at an average speed of 50 km/hr, but has to stop for 10 minutes at station C, which is 60 kms away from station B enroute to station A. Ignoring the lengths of the trains, what is the distance, to the nearest km, from station A to the point where the trains cross each other?

- (a) 110
- (b) 112
- (c) 116
- (d) None of these

19. In a survey of political preferences, 81% of those asked were in favour of at least one of the three budgetary proposals A, B and C. 50% of those asked favoured proposal A, 30% favoured proposal B and 20% favoured proposal C. If 5% of those asked favoured all the three proposals, what percentage of those asked favoured more than one of the three proposals?

- (a) 10%
- (b) 12%
- (c) 9%
- (d) 14%

Directions for Questions 20 and 21: The petrol consumption rate of a new model car 'Palto' depends on its speed and may be described by the graph below:



20. Manasa makes the 240 km trip from Mumbai to Pune at a steady speed of 60 km per hour. What is the amount of petrol consumed for the journey?
 - (a) 12.5 litres
 - (b) 16 litres
 - (c) 15 litres
 - (d) 19.75 litres
21. Manasa would like to minimise the fuel consumption for the trip by driving at the appropriate speed. How should she change the speed?
 - (a) Increase the speed
 - (b) Decrease the speed
 - (c) Maintain the speed at 60km/hour
 - (d) Cannot be determined

(a) 12.5 litres

(b) 16 litres

(c) 15 litres

(d) 19.75 litres

21. Manasa would like to minimise the fuel consumption for the trip by driving at the appropriate speed. How should she change the speed?

(a) Increase the speed

(b) Decrease the speed

(c) Maintain the speed at 60km/hour

(d) Cannot be determined

Directions for Questions 22 and 23: Answer the questions based on the following information:

There are five machines—A, B, C, D, and E situated on a straight line at distances of 10m, 20 m, 30 m, 40 m and 50m respectively from the origin of the line. A robot is stationed at the origin of the line. The robot serves the machines with raw material whenever a machine becomes idle. All the raw materials are located at the origin. The robot is in an idle state at the origin at the beginning of a day. As soon as one or more machines become idle, they send messages to the robot-station and the robot starts and serves all the machines from which it received messages. If a message is received at the station while the robot is away from it, the robot takes notice of the

message only when it returns to the station. While moving, it serves the machines in the sequence in which they are encountered, and then returns to the origin. If any messages are pending at the station when it returns, it repeats the process again. Otherwise, it remains idle at the origin till the next message(s) is (are) received.

22. Suppose on a certain day, machines A and D have sent the first two messages to the origin at the beginning of the first second, C has sent a message at the beginning of the 7th second, B at the beginning of the 8th second and E at the beginning of the 10th second. How much distance has the robot traveled since the beginning of the day, when it notices the message of E? Assume that the speed of movement of the robot is 10m/s.

(a) 140 m (b) 80 m
(c) 340 m (d) 360 m

23. Suppose there is a second station with raw material for the robot at the other extreme of the line which is 60 m from the origin, i.e., 10m from E. After finishing the services in a trip, the robot returns to the nearest station. If both stations are equidistant, it chooses the origin as the station to return to. Assuming that both stations receive the messages sent by the machines and that all the other data remains the same, what would be the answer to the above question?

(a) 120 (b) 160
(c) 140 (d) 170

24. One bacteria splits into eight bacteria of the next generation. But due to environment, only 50% of a generation survive. If the eighth generation number is 8192 million, what is the number in the first generation?

(a) 1 million (b) 2 million
(c) 4 million (d) 8 million

25. I bought 10 pens, 14 pencils and 4 erasers. Ravi bought 12 pens, 8 erasers and 28 pencils for an amount which was half more what I

had paid. What percent of the total amount paid by me was paid for the pens?

(a) 37.5%

(b) 62.5%

(c) 50%

(d) None of these

ANSWER KEY

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



SCORE INTERPRETATION ALGORITHM FOR PRE-ASSESSMENT TEST OF BLOCK III

If You Scored: <7 : (In Unlimited Time)

Step One

Go through the Block III **Back to School** Section carefully. Grasp each of the concepts explained in that part carefully. I would recommend that you go back to your Mathematics school books (ICSE/ CBSE) Class 8,9 & 10 if you feel you need it.

Step Two

Move into each of the chapters of Block III one by one.

When you do so, concentrate on clearly understanding each of the concepts explained in the chapter theory.

Step Three

Then move onto the LOD 1 exercises. These exercises will provide you with the first level of challenge. Try to solve each and every question provided under LOD 1. While doing so do not think about the time requirement. Once you finish solving LOD 1, revise the questions and their solution processes.

Step Four

Go to the first review test given at the end of the block and solve it. While doing so, first look at the score you get within the time limit mentioned. Then continue to solve the test further without a time limit and try to evaluate the improvement in your unlimited time score.

In case the growth in your score is not significant, go back to the theory of each chapter and review each of the LOD 1 questions for all the chapters.

Step Five

Move to LOD 2 and repeat the process that you followed in LOD 1 in each of the chapters. Concentrate on understanding each and every question and it's underlying concept.

Step Six

Go to the second review test given at the end of the block and solve it. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.

Step Seven

Move to LOD 3 only after you have solved and understood each of the questions in LOD 1 & LOD 2. Repeat the process that you followed in LOD 1 – going into each chapter one by one.

Step Eight

Go to the remaining review tests given at the end of the block and solve them. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.

In case the growth in your score is not significant, go back to the theory of each chapter and review each of the LOD 1,2 & 3 questions for all the chapters.

If You Scored:7–15 (In Unlimited Time)

Although you are better than the person following the instructions above, obviously there is a lot of scope for the development of your score. You will need to work both on your concepts as well as speed. Initially emphasize more on the concept development aspect of your preparations, then move your emphasis onto speed development. The following process is recommended for you:

Step One

Go through the **Block III Back to School Section** carefully. Revise each of the concepts explained in that part. Going through your 8th, 9th and

10th standard books will be an optional exercise for you. It will be recommended in case you scored in single digits, while if your score is in two digits, I leave the choice to you.

Step Two

Move into each of the chapters of Block III one by one.

When you do so, concentrate on clearly understanding each of the concepts explained in the chapter theory.

Step Three

Then move onto the LOD 1 & LOD 2 exercises. These exercises will provide you with the first level of challenge. Try to solve each and every question provided under LOD 1 & 2. While doing so do not think about the time requirement. Once you finish solving LOD 1, revise the questions and their solution processes. Repeat the same process for LOD 2.

Step Four

Go to the first review test given at the end of the block and solve it. While doing so, first look at the score you get within the time limit mentioned. Then continue to solve the test further without a time limit and try to evaluate the improvement in your unlimited time score.

Step Five

Go to the second review test given at the end of the block and solve it. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.

In case the growth in your score is not significant, go back to the theory of each chapter and review each of the LOD 1& LOD 2 questions for all the chapters.

Step Six

Move to LOD 3 only after you have solved and understood each of the questions in LOD 1 & LOD 2. Repeat the process that you followed in LOD 1 – going into each chapter one by one.

Step Seven

Go to the remaining review tests given at the end of the block and solve them. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.

In case the growth in your score is not significant, go back to the theory of both the chapters and re solve all LODs of all the chapters. While doing so concentrate more on the LOD 2 & LOD 3 questions.

If You Scored 15+ (In Unlimited Time)

Obviously you are much better than the first two category of students. Hence unlike them, your focus should be on developing your speed by picking up the shorter processes explained in this book. Besides, you might also need to pick up concepts that might be hazy in your mind. The following process of development is recommended for you:

Step One

Quickly review the concepts given in the Block III Back to School Section. Only go deeper into a concept in case you find it new. Going back to school level books is not required for you.

Step Two

Move into each of the chapters of Block III one by one.

When you do so, concentrate on clearly understanding each of the concepts explained in the chapter theory.

Then move onto the LOD 1 & LOD 2 exercises. These exercises will provide you with the first level of challenge. Try to solve each and every question provided under LOD 1 & 2. While doing so try to work on faster processes for solving the same questions. Concentrate on how you could have solved the same question faster. Also try to think of how much time you took over the calculations.

Step Three

Go to the first review test given at the end of the block and solve it. While doing so, first look at the score you get within the time limit mentioned. Then continue to solve the test further without a time limit and try to evaluate the improvement in your unlimited time score.

Step Four

Go to the second review test given at the end of the block and solve it. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.

Step Five

In case the growth in your score is not significant (esp. under time limits), review each of the LOD 1 & LOD 2 questions for all the chapters.

Step Six

Move to LOD 3 only after you have solved and understood each of the questions in LOD 1 & LOD 2. Repeat the process that you followed in LOD 1 – going into each chapter one by one.

Step Seven

Go to the remaining review tests given at the end of the block and solve them. Again, while doing so measure your score within the provided time limit first and then continue to solve the test further without a time limit and try to evaluate the improvement that you have had in your score.



Percentages

INTRODUCTION

In my opinion, the chapter on Percentages forms the most important chapter (apart from Number Systems) in the syllabus of the CAT and the XLRI examination. The importance of ‘percentages’ is accentuated by the fact that there are a lot of questions related to the use of percentage in all chapters of commercial arithmetic (especially Profit and Loss, Ratio and Proportion, Time and Work, Time, Speed and Distance).

Besides, the calculation skills that you can develop while going through the chapter on percentages will help you in handling Data Interpretation (DI) calculations. A closer look at that topic will yield that at least 80% of the total calculations in any DI paper is constituted of calculations on additions and percentage.

BASIC DEFINITION AND UTILITY OF PERCENTAGE

Percent literally, means ‘for every 100’ and is derived from the French word ‘cent’, which is French for 100.

The basic utility of Percentage arises from the fact that it is one of the most powerful tools for comparison of numerical data and information. It is also one of the simplest tools for comparison of data.

In the context of business and economic performance, it is specifically useful for comparing data such as profits, growth rates, performance, magnitudes and so on.

Mathematical definition of percentage The concept of percentage mainly applies to ratios, and the percentage value of a ratio is arrived at by multiplying by 100 the decimal value of the ratio.

For example, a student scores 20 marks out of a maximum possible 30 marks. His marks can then be denoted as 20 out of 30 = $(20/30)$ or $(20/30) \times 100\% = 66.66\%$.

The process for getting this is perfectly illustrated through the unitary method:

then,

$$\begin{array}{ccc} \text{Marks scored} & & \text{Out of} \\ 20 & \xrightarrow{\text{out of}} & 30 \\ x & \xrightarrow{\text{out of}} & 100 \end{array}$$

Then the value of $x \times 30 = 20 \times 100$

$x = (20/30) \times 100$ Æ the percentage equivalent of a ratio.

Now, let us consider a classic example of the application of percentage:

Example: Student *A* scores 20 marks in an examination out of 30 while another student *B* scores 40 marks out of 70. Who has performed better?

Solution: Just by considering the marks as 20 and 40, we do not get a clear picture of the actual performance of the two students. In order to get a clearer picture, we consider the percentage of marks.

Thus, *A* gets $(20/30) \times 100 = 66.66\%$

While *B* gets $(40/70) \times 100 = 57.14\%$

Now, it is clear that the performance of *A* is better.

Consider another example:

Example: Company *A* increases its sales by 1 crore rupees while company *B* increases its sales by 10 crore rupees. Which company has grown more?

Solution: Apparently, the answer to the question seems to be company *B*. The question cannot be answered since we don't know the previous year's sales figure (although on the face of it Company *B* seems to have grown more).

If we had further information saying that company *A* had a sales turnover of ₹ 1 crore in the previous year and company *B* had a sales turnover of ₹ 100 crore in the previous year, we can compare growth rates and say that it is company *A* that has grown by 100%. Hence, company *A* has a higher growth rate, even though in terms of absolute value increase of sales, company *B* has grown much more.

IMPORTANCE OF BASE/ DENOMINATOR FOR PERCENTAGE CALCULATIONS

Mathematically, the percentage value can only be calculated for ratios that, by definition, must have a denominator. Hence, one of the most critical aspects of the percentage is the denominator, which in other words is also called the base value of the percentage. No percentage calculation is possible without knowing the base to which the percentage is to be calculated.

Hence, whenever faced with the question 'What is the percentage ...?' always try first to find out the answer to the question 'Percentage to what base?'

CONCEPT OF PERCENTAGE CHANGE

Whenever the value of a measured quantity changes, the change can be captured through

- (a) Absolute value change or
- (b) Percentage change.

Both these measurements have their own advantages and disadvantages.

Absolute value change: It is the actual change in the measured quantity. For instance, if sales in year 1 is ₹ 2500 crore and the sales in year 2 is ₹ 2600 crore, then the absolute value of the change is ₹ 100 crore.

Percentage change: It is the percentage change got by the formula

$$\begin{aligned}\text{Percentage change} &= \frac{\text{Absolute value change}}{\text{Original quantity}} \times 100 \\ &= \frac{100}{2500} \times 100 = 4\%\end{aligned}$$

As seen earlier, this often gives us a better picture of the effect of the change.

Note: The base used for the sake of percentage change calculations is always the original quantity unless otherwise stated.

Example: The population of a city grew from 20 lakh to 22 lakh. Find the

- (a) percentage change
- (b) percentage change based on the final value of population

Solution:

- (a) percentage change = $(2/20) \times 100 = 10\%$
- (b) percentage change on the final value = $(2/22) \times 100 = 9.09\%$

Difference between the Percentage Point Change and the Percentage Change

The difference between the percentage point change and the percentage change is best illustrated through an example. Consider this:

The savings rate as a percentage of the GDP was 25% in the first year and 30% in the second year. Assume that there is no change in the GDP between the two years. Then:

Percentage point change in savings rate = $30\% - 25\% = 5$ percentage points.

$$\text{Percentage change in savings rate} = \frac{30 - 25}{25} \times 100 = 25\%.$$

PERCENTAGE RULE FOR CALCULATING PERCENTAGE VALUES THROUGH ADDITIONS

Illustrated below is a powerful method of calculating percentages. In my opinion, the ability to calculate percentage through this method depends on your ability to handle 2 digit additions. Unless you develop the skill to add 2 digit additions in your mind, you are always likely to face problems in calculating percentage through the method illustrated below. In fact, trying this method without being strong at 2-digit additions/subtractions (including 2 digits after decimal point) would prove to be a disadvantage in your attempt at calculating percentages fast.

This process, essentially being a commonsense process, is best illustrated through a few examples:

Example: What is the percentage value of the ratio: 53/81?

Solution: The process involves removing all the 100%, 50%, 10%, 1%, 0.1% and so forth of the denominator from the numerator.

Thus, 53/81 can be rewritten as: $(40.5 + 12.5)/81 = 40.5/81 + 12.5/81 = 50\% + 12.5/81$
 $= 50\% + (8.1 + 4.4)/81 = 50\% + 10\% + 4.4/81$
 $= 60\% + 4.4/81$

At this stage you know that the answer to the question lies between 60 – 70% (Since 4.4 is less than 10% of 81)

At this stage, you know that the answer to the calculation will be in the form: 6a.bcd...
....

All you need to do is find out the value of the missing digits.

In order to do this, calculate the percentage value of 4.4/81 through the normal process of multiplying the numerator by 100.

Thus the % value of $\frac{4.4}{81} = \frac{4.4 \times 100}{81} = \frac{440}{81}$

[**Note:** Use the multiplication by 100, once you have the 10% range. This step reduces the decimal calculations.]

Thus $\frac{440}{81} = 5\%$ with a remainder of 35

Our answer is now refined to 65.bcd. (1% Range)

Next, in order to find the next digit (first one after the decimal add a zero to the remainder;

Hence, the value of 'b' will be the quotient of

$b \in 350/81 = 4$ Remainder 26

Answer: 65.4cd (0.1% Range)

$c \div 260/81 = 3$ Remainder 17

Answer: 65.43 (0.01% Range)

and so forth.

The advantages of this process are two fold:

- (1) You only calculate as long as you need to in order to eliminate the options. Thus, in case there was only a single option between 60 – 70% in the above question, you could have stopped your calculations right there.
- (2) This process allows you to go through with the calculations as long as you need to.

However, remember what I had advised you right at the start: Strong Addition skills are a primary requirement for using this method properly.

To illustrate another example:

What is the percentage value of the ratio $\frac{223}{72}$?

$223/72 \div 300 - 310\%$ Remainder 7

$700/72 \div 9$. Hence $309 - 310\%$, Remainder 52

$520/72 \div 7$. Hence, 309.7 , Remainder 16

$160/72 \div 2$. Hence, 309.72 Remainder 16

Hence, 309.7222 (2 recurs since we enter an infinite loop of $160/72$ calculations).

In my view, percentage rule (as *I* call it) is one of the best ways to calculate percentages since it gives you the flexibility to calculate the percentage value up to as many digits after decimals as you are required to and at the same time allows you to stop the moment you attain the required accuracy range.

Effect of a Percent Change in the Numerator on a Ratio's Value

The numerator has a direct relationship with the ratio, that is, if the numerator increases the ratio increases. The percentage increase in the ratio is the same as the percentage increase in the numerator, if the denominator is constant.

Thus, $\frac{22}{40}$ is exactly 10% more than $\frac{20}{40}$. (in terms of percentage change)

Percentage Change Graphic and its Applications

In mathematics there are many situations where one is required to work with percentage changes. In such situations the following thought structure (Something I call Percentage Change Graphic) is a very useful tool:

What I call Percentage Change Graphic (PCG) is best illustrated through an example:
Suppose you have to increase the number 20 by 20%. Visualise this as follows:

$$20 \xrightarrow[\substack{= +4}]{20\% \uparrow} 24$$

The PCG has 6 major applications listed and explained below: PCG applied to:

1. Successive changes
2. Product change application
3. Product constancy application
4. A Æ B Æ A application
5. Denominator change to Ratio Change application
6. Use of PCG to calculate Ratio Changes

Application 1: PCG Applied to Successive Changes

This is a very common situation in most questions.

Suppose you have to solve a question in which a number 30 has two successive percentage increases (20% and 10% respectively).

The situation is handled in the following way using PCG:

$$30 \xrightarrow[\substack{+6}]{20\% \text{ increase}} 36 \xrightarrow[\substack{+3.6}]{10\% \text{ increase}} 39.6$$

Illustration

A's salary increases by 20% and then decreases by 20%. What is the net percentage change in A's salary?

Solution:

$$100 \xrightarrow[\substack{+20}]{20\% \text{ inc.}} 120 \xrightarrow[\substack{-24}]{20\% \text{ decrease}} 96$$

Hence, A's salary has gone down by 4%

Illustration

A trader gives successive discounts of 10%, 20% and 10% respectively. The percentage of the original cost price he will recover is:

Solution:

$$100 \xrightarrow[\substack{-10}]{10\% \text{ decrease}} 90 \xrightarrow[\substack{-18}]{20\% \text{ decrease}} 72 \xrightarrow[\substack{-7.2}]{10\% \text{ decrease}} 64.8$$

Hence the overall discount is 35.2% and the answer is 64.8%.

Illustration

A trader marks up the price of his goods by 20%, but to a particularly haggling customer he ends up giving a discount of 10% on the marked price. What is the

percentage profit he makes?

Solution:

$$100 \xrightarrow[\substack{+20}]{\substack{20\% \text{ increase}}} 120 \xrightarrow[\substack{-12}]{\substack{10\% \text{ decrease}}} 108$$

Hence, the percentage profit is 8%.

Application 2: PCG applied to Product Change

Suppose you have a product of two variables say 10×10 .

If the first variable changes to 11 and the second variable changes to 12, what will be the percentage change in the product? [Note there is a 10% increase in one part of the product and a 20% increase in the other part.]

The formula given for this situation goes as: $(a + b + ab/100)$

$$\text{Hence, Required \% change} = 10 + 20 + \frac{10 \times 20}{100}$$

(Where 10 and 20 are the respective percentage changes in the two parts of the product)
(This is being taught as a shortcut at most institutes across the country currently.)

However, a much easier solution for this case can be visualized as:

$$100 \xrightarrow[\substack{+20}]{\substack{20\% \uparrow}} 120 \xrightarrow[\substack{+12}]{\substack{10\% \uparrow}} 132. \text{ Hence, the final product shows a 32\% increase.}$$

Similarly suppose $10 \times 10 \times 10$ becomes $11 \times 12 \times 13$

In such a case the following PCG will be used:

$$100 \xrightarrow[\substack{+30}]{\substack{30\% \uparrow}} 130 \xrightarrow[\substack{+26}]{\substack{20\% \uparrow}} 156 \xrightarrow[\substack{+15.6}]{\substack{10\% \uparrow}} 171.6$$

Hence, the final product sees a 71.6 percent increase

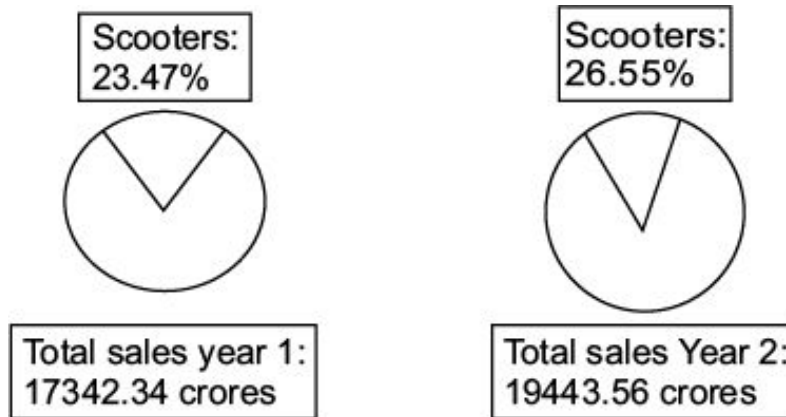
(Since, the product changes from 100 to 171.6)

Note: You will get the same result irrespective of the order in which you use the respective percentage changes.

Also note that this process is very similar to the one used for calculating successive percentage change.

Application for DI:

Suppose you have two pie charts as follows:



If you are asked to calculate the percentage change in the sales revenue of scooters for the company from year one to year two, what would you do?

The formula for percentage change would give us:

$$\frac{(0.2655 \times 19443.56) - (0.2347 \times 17342.34) \times 100}{(0.2347 \times 17342.34)}$$

i.e. $\frac{\text{New Sales Revenue} - \text{Original Sales Revenue}}{\text{Original Sales Revenue}} \times 100$

Obviously this calculation is easier said than done.

However, the Product change application of PCG allows us to execute this calculation with a lot of ease comparatively. Consider the following solution:

Product for year one is: 0.2347×17342.34

Product for year two is: 0.2655×19443.56

These can be approximated into:

234×173 and 265×194 respectively (Note that by moving into three digits we do not end up losing any accuracy. We have elaborated this point in the chapter on Ratio and Proportions.)

The overall percentage change depends on two individual percentage changes:

234 increases to 265: A % change of $31/234 = 13.2\%$ approx. This calculation has to be done using the percentage rule for calculating the percentage value of the ratio

173 increases to 194 – A percentage change of approximately 12%.

Thus PCG will give the answer as follows:

$$100 \xrightarrow[+13.2]{13.2\% \uparrow} 113.2 \xrightarrow[+13.56]{12\% \uparrow} 126.76$$

Hence, 26.76 % increase in the product's value. (Note that the value on the calculator for the full calculation sans any approximations is 26.82 %, and given the fact that we have come extremely close to the answer—the method is good enough to solve the question with a reasonable degree of accuracy.)

Application 3 of PCG: Product Constancy Application (Inverse proportionality)

Suppose you have a situation wherein the price of a commodity has gone up by 25%. In case you are required to keep the total expenditure on the commodity constant, you would obviously need to cut down on the consumption. By what percentage? Well, PCG gives you the answer as follows:

$$100 \xrightarrow[\substack{+ 25 \\ \text{Price effect}}]{25\% \uparrow} 125 \xrightarrow[\substack{- 25 \\ \text{Consumption Effect}}]{} 100$$

Hence, the percentage drop in consumption to offset the price increase is 20%.

I leave it to the student to discover the percentage drop required in the second part of the product if one part increases by 50 percent.

Note: Product constancy is just another name for Inverse proportionality.

Table 5.1 gives you some standard values for this kind of a situation.

Application 4 of PCG: AÆBÆA.

Very often we are faced with a situation where we compare two numbers say A and B . In such cases, if we are given a relationship from A to B , then the reverse relationship can be determined by using PCG in much the same way as the product constancy use shown above.

Illustration

B 's salary is 25% more than A 's salary. By what percent is A 's salary less than B 's salary?

$$100(A) \xrightarrow[\substack{+ 25}]{25\% \uparrow} 125(B) \xrightarrow[\substack{- 25}]{} 100(A)$$

A drop of 25 on 125 gives a 20% drop.

Hence A 's salary is 20% less than B 's.

Note: The values which applied for Product Constancy also apply here. Hence Table 4.1 is useful for this situation also.

Application 5 of PCG Æ Effect of change in Denominator on the Value of the Ratio

The denominator has an inverse relationship with the value of a ratio.

Hence the process used for product constancy (and explained above) can be used for calculating percentage change in the denominator.

For instance, suppose you have to evaluate the difference between two ratios:

Ratio 1 : 10/20

Ratio 2 : 10/25

As is evident the denominator is increasing from 20 to 25 by 25%.

If we calculate the value of the two ratios we will get:

Ratio 1 = 0.5, Ratio 2 = 0.4.

$$\% \text{ change between the two ratios} = \frac{0.1}{0.5} \times 100 = 20\% \text{ Drop}$$

This value can be got through PCG as:

100 \longrightarrow 125 \longrightarrow 100 Hence, 20% drop.

Note: This is exactly the same as Product constancy and works here because the numerator is constant.

Hence, $R_1 = N/D_1$ and $R_2 = N/D_2$

i.e. $R_1 \times D_1 = N$ and $R_2 \times D_2 = N$, which is the product constancy situation.

Direct process for calculation

To find out the percentage change in the ratio due to a change in the denominator follow the following process:

In order to find the percentage change from 10/20 to 10/25, calculate the percentage change in the denominator in the reverse fashion.

i.e. The required percentage change from R_1 to R_2 will be given by calculating the percentage change in the denominators from 25 to 20 (i.e. in a reverse fashion) & not from 20 to 25.

Table 5.1 Product Constancy Table, Inverse Proportionality Table, A \propto B \propto A table, Ratio Change to Denominator table

<i>Product XY is Constant</i>	<i>X increases (%)</i>	<i>Y Decreases (%)</i>
<i>A \propto B \propto A</i>	<i>A \propto B % increase</i>	<i>B \propto A % decrease</i>
<i>X is inversely proportional to Y</i>	<i>X increases (%)</i>	<i>Y decreases (%)</i>
<i>Ratio change effect of Denominator change</i>	<i>Denominator increases (%)</i>	<i>(Ratio decreases(%))</i>
<i>Denominator change effect of Ratio change</i>	<i>Ratio increases (%)</i>	<i>As Denominator decreases (%)</i>
Standard Value 1	9.09	8.33
Standard Value 2	10	9.09
Standard Value 3	11.11	10
Standard Value 4	12.5	11.11

Standard Value 5	14.28	12.5
Standard Value 6	16.66	14.28
Standard Value 7	20	16.66
Standard Value 8	25	20
Standard Value 9	33.33	25
Standard Value 10	50	33.33
Standard Value 11	60	37.5
Standard Value 12	66.66	40
Standard Value 13	75	42.85
Standard Value 14	100	50

Application 6: Use of PCG to Calculate Ratio Changes:

Under normal situations, you will be faced with ratios where both numerator and denominator change. The process to handle and calculate such changes is also quite convenient if you go through PCG.

Illustration

Calculate the percentage change between the Ratios.

Ratio 1 = $10/20$ Ratio 2 = $15/25$

The answer in this case is $0.5 \text{ } \pm \text{ } 0.6$ (20% increase). However, in most cases calculating the values of the ratio will not be easy. The following PCG process can be used to get the answer:

When $10/20$ changes to $15/25$, the change occurs primarily due to two reasons:

- (A) Change in the numerator (Numerator effect)
- (B) Change in the denominator (Denominator effect)

By segregating the two effects and calculating the effect due to each separately, we can get the answer easily as follows:

Numerator Effect The numerator effect on the value of the ratio is the same as the change in the numerator. Hence, to calculate the numerator effect, just calculate the percentage change in the numerator:

In this case the numerator is clearly changing from 10 to 15 (i.e. a 50% increase.) This signifies that the numerator effect is also 50%.

Denominator Effect As we have just seen above, the effect of a percentage change in the denominator on the value of the ratio is seen by calculating the denominator's percentage change in the reverse order.

In this case, the denominator is changing from 20 to 25. Hence the denominator effect will be seen by going reverse from 25 to 20 i.e. 20% drop.

With these two values, the overall percentage change in the Ratio is seen by:

$$100 \xrightarrow[\substack{+ 50 \\ \text{Numerator} \\ \text{Effect}}]{50\% \uparrow} 150 \xrightarrow[\substack{- 30 \\ \text{Denominator} \\ \text{Effect}}]{20\% \downarrow} 120$$

This means that the ratio has increased by 20%.

I leave it to the student to practice such calculations with more complicated values for the ratios.

Implications for Data Interpretation

Percentage is perhaps one of the most critical links between QA and Data Interpretation. In the chapter theory mentioned above, the Percentage Rule for Percentage Calculations and the PCG applied to product change and ratio change are the most critical.

As already shown, the use of PCG to calculate the percentage change in a product (as exhibited through the pie chart example above) as well as the use of PCG to calculate ratio changes are two extremely useful applications of the concepts of percentages into DI.

Applying Percentages for the special case of comparing two ratios to find the larger one.

Suppose you have two ratios to compare. Say $R_1 = N_1/D_1$ and $R_2 = N_2/D_2$

The first step is to find the ten percent ranges for each of these ratios. In case, they belong to different ranges of 10% (say R_1 lies between 50-60 while R_2 lies between 70 to 80), it becomes pretty simple to say which one will be higher.

In case, both of these values for percentage of the ratios belong to the same ten percent range, then we can use the following process

Step 1: Calculate the percentage change in the numerator

Step 2: Calculate the percentage change in the denominator.

There could be four cases in this situation, when we move from Ratio₁ to Ratio₂:

Case 1: Numerator is increasing while denominator is decreasing Æ obviously the net effect of the two changes will be an increase in the ratio. Hence, R_2 will be greater.

Case 2: Numerator is decreasing while denominator is increasing Æ obviously the net effect of the two changes will be a decrease in the ratio. Hence, R_1 will be greater.

It is only in the following cases that we need to look at the respective changes in the Numerator and denominator.

Case 3: Numerator and denominator are both increasing

Calculate the percentage value of the respective increases. If the numerator is increasing more than the denominator the ratio will go up. On the other hand, if the denominator is increasing more than the numerator, Ratio₂ will be smaller than Ratio₁. (Note: Compare in percentage values)

Case 4: Numerator and denominator are both decreasing

Calculate the percentage value of the respective decreases. If the numerator is decreasing more than the denominator the ratio will go down. On the other hand, if the denominator is decreasing more than the numerator, Ratio₂ will be greater than Ratio₁.

FRACTION TO PERCENTAGE CONVERSION TABLE

The following percentage values appear repeatedly over the entire area where questions can be framed on the topic of percentage. Further, it would be of great help to you if you are able to recognize these values separately from values that do not appear in the Table 5.2.

Some Utilisations of the Table

- The values that appear in the table are all percentage values. These can be converted into decimals by just shifting the decimal point by two places to the left. Thus, 83.33% = 0.8333 in decimal value.
- A second learning from this table is in the process of division by any of the numbers such as 2, 3, 4, 5, 6, 7, 8, 9, 11, 12, 15, 16, 24 and so on, students normally face problems in calculating the decimal values of these divisions. However, if one gets used to the decimal values that appear in the Table 5.2, calculation of decimals in divisions will become very simple. For instance, when an integer is divided by 7, the decimal values can only be .14, .28, .42, .57, .71, .85 or .00. (There are approximate values)
- This also means that the difference between two ratios like $\frac{x}{6} - \frac{x}{7}$ can be integral if and only if x is divisible by both 6 and 7.

This principle is very useful as an advanced short cut for option based solution of some questions. I leave it to the student to discover applications of this principle.

Table 5.2 Percentage Conversion Table

1	2	3	4	5	6	7	8	9	10	11	12
---	---	---	---	---	---	---	---	---	----	----	----

1	100											
2	50	100										
3	33.33	66.66	100									
4	25	50	75	100								
5	20	40	60	80	100							
6	16.66	33.33	50	66.66	83.33	100						
7	14.28	28.57	42.85	57.14	71.42	85.71	100					
8	12.5	25	37.5	50	62.5	75	87.5	100				
9	11.11	22.22	33.33	44.44	55.55	66.66	77.77	88.88	100			
10	10	20	30	40	50	60	70	80	90	100		
11	9.09	18.18	27.27	36.36	45.45	54.54	63.63	72.72	81.81	90.09	100	
12	8.33	16.66	25	33.33	41.66	50	58.33	66.66	75	83.33	91.66	100
15	6.66	13.33	20	26.66	33.33	40						
16	6.25	12.5	18.75	25								
20	5	10	15	20	25							
24	4.166	8.33	12.5	16.66	20.83	25						
25	4	8	12	16	20	24	28	32	26	40		
30	3.33	6.66	10	13.33	16.66	20						
40	2.5	5	7.5	10	12.5	15	17.5	20				
60	1.66	3.33	5	6.66	8.33	10						

Formula for any cell = Column value \times 100/Row value

Calculation of Multiplication by Numbers like 1.21, 0.83 and so on

In my opinion, the calculation of multiplication of any number by a number of the form 0.xy or of the form 1.ab should be viewed as a subtraction/addition situation and not as a multiplication situation. This can be explained as follows.

Example: Calculate 1.23×473 .

Solution: If we try to calculate this by multiplying, we will end up going through a very time taking process, which will yield the final value at the end but nothing before that (i.e. you will have no clue about the answer's range till you reach the end of the calculation).

Instead, one should view this multiplication as an addition of 23% to the original number. This means, the answer can be got by adding 23% of the number to itself.

Thus $473 \times 1.23 = 473 + 23\% \text{ of } 473 = 473 + 94.6 + 3\% \text{ of } 473 = 567.6 + 14.19 = 581.79$

(The percentage rule can be used to calculate the addition and get the answer.)

The similar process can be utilised for the calculation of multiplication by a number such as 0.87

(Answer can be got by subtracting 13% of the number from itself and this calculation can again be done by percentage rule.)

Hence, the student is advised to become thorough with the percentage rules. Percentage calculation & additions of 2 & 3 digit numbers.

OceanofPDF.com



WORKED-OUT PROBLEMS

Problem 5.1 A sells his goods 30% cheaper than B and 30% dearer than C. By what percentage is the cost of C's goods cheaper than B's goods.

Solution There are two alternative processes for solving this question:

1. Assume the price of C's goods as p : Then A's goods are at $1.3p$ and B's goods are such that A's goods are 30% cheaper than B's goods. i.e. A's goods are priced at 70% of B's goods.

Hence, $1.3p \propto 70$

B's price $\propto 100$

B's price = $130p/70 = 1.8571p$

Then, the percentage by which C's price is cheaper than B's price =

$(1.8571p - p) \times 100/(1.8571p) = 600/13 = 46.15\%$

Learning task for student Could you answer the question: Why did we assume C's price as a variable p and then work out the problem on its basis. What would happen if we assumed B's price as p or if we assumed A's price as p ?

2. Instead of assuming the price of one of the three as p , assume the price as 100.

Let $B = 100$. Then $A = 70$, which is 30% more than C. Hence $C = 23.07\%$ less than A (from Table 4.1) = approx. 53.84. Hence answer is 46.15% approximately.

(This calculation can be done mentally if you are able to work through the calculations by the use of percentage rule. The students are advised to try to assume the value of 100 for each of the variables A, B and C and see what happens to the calculations involved in the problem. Since the value of 100 is assumed for a variable to minimise the requirements of calculations to solve the problems, we should ensure that the variable assumed as 100 should have the maximum calculations associated with it.)

Note: In fact this question and the ones that follow contain some of the most basic operations in the chapter of percentages. The questions at the first level of difficulty would appear in examinations like CET Maharashtra, Bank P.O., MAT, NMAT, CLAT, NLS and most other aptitude exams. Hence, if you are able to do the operations illustrated here mentally, you would be able to solve LOD 1 questions easily and gain a significant time advantage over your competitors.

However, for the serious CAT aspirant, the logic used for LOD I questions would normally be used as a part of the entire logic. You would be able to see this in the questions of the second and the third level of difficulties in the exercises later in the chapter. Hence, developing the process for solving questions of the LOD 1 level mentally would help you gain an improved speed for the CAT level questions.

Also remember that since percentages are the basis for most of the commercial mathematics as well as for calculation and the Data Interpretation section, developing skills for calculation and problem solving illustrated here would go a long way towards helping you clear aptitude exams.

Problem 5.2 The length and the breadth of a rectangle are changed by +20% and by -10% respectively. What is the percentage change in the area of the rectangle.

Solution The area of a rectangle is given by: length \times breadth. If we represent these by:

Area = $L \times B = LB$ \therefore then we will get the changed area as

$$\text{Area}_{(\text{NEW})} = 1.2 L \times 0.9 B = 1.08 LB$$

Hence, the change in area is 8% increase.

Note: You can solve (and in fact, finish the problem) during your first reading by using percentage change graphic as follows:

100 $\xrightarrow{+20\%}$ 120 $\xrightarrow{-10\%}$ 108. Hence, the percentage change is **8%**.

Problem 5.3 Due to a 25% price hike in the price of rice, a person is able to purchase 20 kg less of rice for ₹ 400. Find the initial price.

Solution Since price is rising by 25%, consumption has to decrease by 20%. But there is an actual reduction in the consumption by 20 kg. Thus, 20% decrease in consumption is equal to a 20 kg drop in consumption.

Hence, original consumption is: 100 kg of rice.

Money spent being ₹ 400, the original price of rice is ₹ 4 per kg.

(There, you see the benefit of internalising the product constancy table! It is left to the student to analyze why and how the product constancy table applies here.)

Problem 5.4 A's salary is 20% lower than B's salary, which is 15% lower than C's salary. By how much percent is C's salary more than A's salary?

Solution The equation approach here would be

$$A = 0.8 B$$

$$B = 0.85 C$$

$$\text{Then } A = 0.8 \times 0.85 C$$

$$A = 0.68 C \text{ (Use percentage change graphic to calculate the value of 0.68)}$$

Thus, A's salary is 68 % of C's salary.

If A's salary is 68, B's salary is 100.

Using percentage change graphic

$$68 \xrightarrow[\text{+32}]{(3200/68)\%} 100$$

Students are advised to refrain from using equations to solve questions of this nature. In fact, you can adopt the following process, which can be used while you are reading the problem, to get the result faster.

Assume one of the values as 100. (Remember, selection of the right variable that has to take the value of 100 may make a major difference to your solving time and effort required. The thumb rule for selecting the variable whose value is to be taken as 100 is based on three principal considerations:

Select as 100, the variable

1. With the maximum number of percentage calculations associated with it.
2. Select as 100 the variable with the most difficult calculation associated with it.
3. Select as 100 the variable at the start of the problem solving chain.

The student will have to develop his own judgment in applying these principles in specific cases.

Here I would take C as 100, getting B as 85 and A as 68.

Hence, the answer is $(32 \times 100/68)$.

Problem 5.5 The cost of manufacture of an article is made up of four components A , B , C and D which have a ratio of $3 : 4 : 5 : 6$ respectively. If there are respective changes in the cost of $+10\%$, -20% , -30% and $+40\%$, then what would be the percentage change in the cost.

Solution Assume the cost components to be valued at 30, 40, 50 and 60 as you read the question. Then we can get changed costs by effecting the appropriate changes in each of the four components.

Thus we get the new cost as 33, 32, 35 and 84 respectively.

The original total cost was 180 the new one is 184. The percent change is $4/180 = 2.22\%$.

Problem 5.6 Harsh receives an inheritance of a certain amount from his grandfather. Of this he loses 32.5% in his effort to produce a film. From the balance, a taxi driver stole the sum of ₹ 1,00,000 that he used to keep in his pocket. Of the rest, he donated 20% to a charity. Further he purchases a flat in Ganga Apartment for ₹ 7.5 lakh. He then realises that he is left with only ₹ 2.5 lakh cash of his inheritance. What was the value of his inheritance?

Solution These sort of problems should either be solved through the reverse process or through options.

Reverse process for this problem He is left with ₹ 2.5 lakh after spending ₹ 7.5 lakh on the apartment.

Therefore, before the apartment purchase he has ₹ 10 lakh. But this is after the 20% reduction in his net value due to his donation to charity. Hence, he

must have given ₹ 2.5 lakh to charity (20% decrease corresponds to a 25% increase). As such, he had 12.5 lakh before the charity. Further, he must have had ₹ 13.5 lakh before the taxi driver stole the sum. From 13.5 lakh you can reach the answer by trial and error trying whole number values. You will get that if he had 20 lakh and lost 32.5% of it he would be left with the required 13.5 lakh.

Hence, the answer is ₹ 20 lakh.

This process can be done mentally by: $2.5 + 7.5 = 10$ lakh $\times +25\% \times 12.5$ lakh $\times +1$ lakh $\times 13.5$ lakh.

From this point move by trial and error. You should try to find the value of the inheritance, which on reduction by 32.5%, would leave 13.5 lakh. A little experience with numbers leaves you with ₹ 20 lakh as the answer. This process should be started as soon as you finish reading the first time.

Through options Suppose the options were:

- | | |
|-------------|---------------|
| (a) 25 lakh | (b) 22.5 lakh |
| (c) 20 lakh | (d) 18 lakh |

Start with any of the middle options. Then keep performing the mathematical operation in the order given in the problem. The final value that he is left with should be ₹ 2.5 lakh. The option that gives this, will be the answer. If the final value yielded is higher than ₹ 2.5 lakh in this case, start with a value lower than the option checked. In case it is the opposite, start with the option higher than the one used.

As a thumb rule, start with the most convenient option—the middle one. This would lead us to start with ₹ 20 lakh here.

However, if we had started with ₹ 25 lakh the following would have occurred.

25 lakh $-32.5\% \times 16.875$ lakh -1 lakh $\times 15.875$ lakh $-20\% \times 7.5$ lakh, should equal 2.5 lakh \times (Prior to doing this calculation, you should see that there is no way the answer will yield a nice whole number like 2.5 lakh. Hence, you can abandon the process here and move to the next option)

Trying with 20 lakh, $20 - 32.5\% \times 13.5$ lakh -1 ac. $\times 12.5$ lakh $-20\% \times 10$ lakh $- 7.5$ lakh = **2.5 lakh** \times Required answer.

OceanofPDF.com

LEVEL OF DIFFICULTY (I)

1. Which of the following is the largest number?
(a) 20% of 200 (b) 7% of 500
(c) 1300% of 3 (d) 700% of 9
2. If 25% of a number is 75, then 45% of that number is:
(a) 145 (b) 125
(c) 150 (d) 135
3. What is 20% of 50% of 75% of 70?
(a) 5.25 (b) 6.75
(c) 7.25 (d) 5.5
4. If we express $41\frac{3}{17}\%$ as a fraction, then it is equal to
(a) $\frac{17}{7}$ (b) $\frac{7}{17}$
(c) $\frac{12}{17}$ (d) $\frac{3}{17}$
5. Mr. Abhimanyu Banerjee is worried about the balance of his monthly budget. The price of petrol has increased by 40%. By what percent should he reduce the consumption of petrol so that he is able to balance his budget?
(a) 33.33 (b) 28.56
(c) 25 (d) 14.28
6. In Question 5, if Mr. Banerjee wanted to limit the increase in his expenditure to 5% on his basic expenditure on petrol then what should be the corresponding decrease in consumption so that expenditure exceeds only by 5%?
(a) 33.33 (b) 28.56

(c) 25 (d) 20

7. Ram sells his goods 25% cheaper than Shyam and 25% dearer than Bram. How much percentage is Bram's goods cheaper than Shyam's?

(a) 33.33% (b) 50%
(c) 66.66% (d) 40%

8. In an election between 2 candidates, Bhiku gets 65% of the total valid votes. If the total votes were 6000, what is the number of valid votes that the other candidate Mhatre gets if 25% of the total votes were declared invalid?

(a) 1625 (b) 1575
(c) 1675 (d) 1525

9. In a medical certificate, by mistake a candidate gave his height as 25% more than normal. In the interview panel, he clarified that his height was 5 feet 5 inches. Find the percentage correction made by the candidate from his stated height to his actual height.

(a) 20 (b) 28.56
(c) 25 (d) 16.66

10. Arjit Sharma generally wears his father's coat. Unfortunately, his cousin Shaurya poked him one day that he was wearing a coat of length more than his height by 15%. If the length of Arjit's father's coat is 120 cm then find the actual length of his coat.

(a) 105 (b) 108
(c) 104.34 (d) 102.72

11. A number is mistakenly divided by 5 instead of being multiplied by 5. Find the percentage change in the result due to this mistake.

(a) 96% (b) 95%
(c) 2400% (d) 200%

12. Harsh wanted to subtract 5 from a number. Unfortunately, he added 5 instead of subtracting. Find the percentage change in the result.

- (a) 300% (b) 66.66%
(c) 50% (d) Cannot be determined

13. If 65% of $x = 13\%$ of y , then find the value of x if $y = 2000$.

- (a) 200 (b) 300
(c) 400 (d) 500

14. In a mixture of 80 litres of milk and water, 25% of the mixture is milk. How much water should be added to the mixture so that milk becomes 20% of the mixture?

- (a) 20 litres (b) 15 litres
(c) 25 litres (d) 24 litres

15. 50% of $a\%$ of b is 75% of $b\%$ of c . Which of the following is c ?

- (a) $1.5a$ (b) $0.667a$
(c) $0.5a$ (d) $1.25a$

16. A landowner increased the length and the breadth of a rectangular plot by 10% and 20% respectively. Find the percentage change in the cost of the plot assuming land prices are uniform throughout his plot.

- (a) 33% (b) 35%
(c) 22.22% (d) None of these

17. The height of a triangle is increased by 40%. What can be the maximum percentage increase in length of the base so that the increase in area is restricted to a maximum of 60%?

- (a) 50% (b) 20%
(c) 14.28% (d) 25%

18. The length, breadth and height of a room in the shape of a cuboid are increased by 10%, 20% and 50% respectively. Find the percentage change in the volume of the cuboid.

- (a) 77% (b) 75%
(c) 88% (d) 98%

19. The salary of Amit is 30% more than that of Varun. Find by what percentage is the salary of Varun less than that of Amit?
- (a) 26.12% (b) 23.07%
(c) 21.23% (d) 27.27%
20. The price of sugar is reduced by 25% but inspite of the decrease, Aayush ends up increasing his expenditure on sugar by 20%. What is the percentage change in his monthly consumption of sugar ?
- (a) +60% (b) -10%
(c) +33.33% (d) 50%
21. The price of rice falls by 20%. How much rice can be bought now with the money that was sufficient to buy 20 kg of rice previously?
- (a) 5 kg (b) 15 kg
(c) 25 kg (d) 30 kg
22. 30% of a number when subtracted from 91, gives the number itself. Find the number.
- (a) 60 (b) 65
(c) 70 (d) 75
23. When 60% of a number A is added to another number B , B becomes 175% of its previous value. Then which of the following is true regarding the values of A and B ?
- (a) $A > B$
(b) $B > A$
(c) $B \geq A$
(d) Either (a) or (b) can be true depending upon the values of A and B
24. At an election, the candidate who got 56% of the votes cast won by 144 votes. Find the total number of voters on the voting list if 80% people cast their vote and there were no invalid votes.
- (a) 360 (b) 720

(c) 1800 (d) 1500

25. The population of a village is 1,00,000. The rate of increase is 10% per annum. Find the population at the start of the third year.

(a) 1,33,100 (b) 1,21,000
(c) 1,18,800 (d) 1,20,000

26. The population of the village of Gavas is 10,000 at this moment. It increases by 10% in the first year. However, in the second year, due to immigration, the population drops by 5%. Find the population at the end of the third year if in the third year the population increases by 20%.

(a) 12,340 (b) 12,540
(c) 1,27,540 (d) 12,340

27. A man invests ₹ 10,000 in some shares in the ratio 2 : 3 : 5 which pay dividends of 10%, 25% and 20% (on his investment) for that year respectively. Find his dividend income.

(a) 1900 (b) 2000
(c) 2050 (d) 1950

28. In an examination, Mohit obtained 20% more than Sushant but 10% less than Rajesh. If the marks obtained by Sushant is 1080, find the percentage marks obtained by Rajesh if the full marks is 2000.

(a) 86.66% (b) 72%
(c) 78.33% (d) 77.77%

29. In a class, 25% of the students were absent for an exam. 30% failed by 20 marks and 10% just passed because of grace marks of 5. Find the average score of the class if the remaining students scored an average of 60 marks and the pass marks are 33 (counting the final scores of the candidates).

(a) 37.266 (b) 37.6
(c) 37.8 (d) 36.93

30. Ram spends 20% of his monthly income on his household expenditure, 15% of the rest on books, 30% of the rest on clothes and saves the rest. On counting, he comes to know that he has finally saved ₹ 9520. Find his monthly income.
- (a) 10000 (b) 15000
(c) 20000 (d) 12000
31. Hans and Bhaskar have salaries that jointly amount to ₹ 10,000 per month. They spend the same amount monthly and then it is found that the ratio of their savings is 6 : 1. Which of the following can be Hans's salary?
- (a) ₹ 6000 (b) ₹ 5000
(c) ₹ 4000 (d) ₹ 3000
32. The population of a village is 5500. If the number of males increases by 11% and the number of females increases by 20%, then the population becomes 6330. Find the population of females in the town.
- (a) 2500 (b) 3000
(c) 2000 (d) 3500
33. Vicky's salary is 75% more than Ashu's. Vicky got a raise of 40% on his salary while Ashu got a raise of 25% on his salary. By what percent is Vicky's salary more than Ashu's?
- (a) 96% (b) 51.1%
(c) 90% (d) 52.1%
34. On a shelf, the first row contains 25% more books than the second row and the third row contains 25% less books than the second row. If the total number of books contained in all the rows is 600, then find the number of books in the first row.
- (a) 250 (b) 225
(c) 300 (d) None of these.

35. An ore contains 25% of an alloy that has 90% iron. Other than this, in the remaining 75% of the ore, there is no iron. How many kilograms of the ore are needed to obtain 60 kg of pure iron?
- (a) 250 kg (b) 275 kg
(c) 300 kg (d) 266.66 kg
36. Last year, the Indian cricket team played 40 one-day cricket matches out of which they managed to win only 40%. This year, so far it has played some matches, which has made it mandatory for it to win 80% of the remaining matches to maintain its existing winning percentage. Find the number of matches played by India so far this year.
- (a) 30 (b) 25
(c) 28 (d) Insufficient Information
37. The population of a village is 1,00,000. Increase rate per annum is 10%. Find the population at the starting of the fourth year.
- (a) 1,33,100 (b) 1,21,000
(c) 1,33,000 (d) None of these
38. In the recent, climate conference in New York, out of 700 men, 500 women, 800 children present inside the building premises, 20% of the men, 40% of the women and 10% of the children were Indians. Find the percentage of people who were not Indian.
- (a) 73% (b) 77%
(c) 79% (d) 83%
39. A cow and a calf cost ₹ 2000 and ₹ 1400 respectively. If the price of the cow and that of the calf is increased by 20% and 30% respectively then the price of 1 dozen cows and 2 dozens calves is:
- (a) 72,480 (b) 71,360
(c) 74,340 (d) None of these
40. Ram sells his goods 20% cheaper than Bobby and 20% dearer than Chandilya. How much percentage is Chandilya's goods

cheaper/dearer than Bobby's?

- (a) 33.33% (b) 50%
(c) 42.85% (d) None of these

41. During winters, an athlete can run 'x' metres on one bottle of Glucose. But in the summer, he can only run $0.5x$ metres on one bottle of Glucose. How many bottles of Glucose are required to run 400 meters during summer?

- (a) $800/x$ (b) $890/x$
(c) 96 (d) $454/x$

42. Out of the total production of iron from hematite, an ore of iron, 20% of the ore gets wasted, and out of the remaining ore, only 25% is pure iron. If the pure iron obtained in a year from a mine of hematite was 80,000 kg, then the quantity of hematite mined from that mine in the year is

- (a) 5,00,000 kg (b) 4,00,000 kg
(c) 4,50,000 kg (d) None of these

43. A man buys a truck for ₹ 2,50,000. The annual repair cost comes to 2.0% of the price of purchase. Besides, he has to pay an annual tax of ₹ 2000. At what monthly rent must he rent out the truck to get a return of 15% on his net investment of the first year?

- (a) ₹ 3350 (b) ₹ 2500
(c) ₹ 4000 (d) ₹ 3212.50

44. Recently, while shopping in Patna Market in Bihar, I came across two new shirts selling at a discount. I decided to buy one of them for my little boy Sherry. The shopkeeper offered me the first shirt for ₹ 42 and said that it usually sold for $\frac{8}{7}$ of that price. He then offered me the other shirt for ₹ 36 and said that it usually sold for $\frac{7}{6}$ th of that price. Of the two shirts which one do you think is a better bargain and what is the percentage discount on it?

- (a) first shirt, 12.5% (b) second shirt, 14.28%
(c) Both are same (d) None of these

45. $\frac{4}{5}$ th of the voters in Bellary promised to vote for Sonia and the rest promised to vote for Sushma. Of these voters, 10% of the voters who had promised to vote for Sonia, did not vote on the election day, while 20% of the voters who had promised to vote for Sushma did not vote on the election day. What is the total no. of votes polled if Sonia got 216 votes?
- (a) 200 (b) 300
(c) 264 (d) 100
46. In an examination, 80% students passed in Physics, 70% in Chemistry while 15% failed in both the subjects. If 325 students passed in both the subjects. Find the total number of students who appeared in the examination.
- (a) 500 (b) 400
(c) 300 (d) 600
47. Ravana spends 30% of his salary on house rent, 30% of the rest he spends on his children's education and 24% of the total salary he spends on clothes. After his expenditure, he is left with ₹ 2500. What is Ravana's salary?
- (a) ₹ 11,494.25 (b) ₹ 20,000
(c) ₹ 10,000 (d) ₹ 15,000
48. The entrance ticket at the Minerva theatre in Mumbai is worth ₹ 250. When the price of the ticket was lowered, the sale of tickets increased by 50% while the collections recorded a decrease of 17.5%. Find the deduction in the ticket price.
- (a) ₹ 150 (b) ₹ 112.5
(c) ₹ 105 (d) ₹ 120
49. Ravi's monthly salary is A rupees. Of this, he spends X rupees. The next month he has an increase of $C\%$ in his salary and $D\%$ in his expenditure. The new amount saved is:
- (a) $A(1 + C/100) - X(1 + D/100)$
(b) $(A/100)(C - (D)X(1 + D/100))$

(c) $X(C - (D)/100$

(d) $X(C + D)/100$

50. In the year 2000, the luxury car industry had two car manufacturers —Maruti and Honda with market shares of 25% and 75% respectively. In 2001, the overall market for the product increased by 50% and a new player BMW also entered the market and captured 15% of the market share. If we know that the market share of Maruti increased to 50% in the second year, the share of Honda in that year was:

(a) 50%

(b) 45%

(c) 40%

(d) 35%

LEVEL OF DIFFICULTY (II)

1. Bill Ambani, a very clever businessman, started off a business with very little capital. In the first year, he earned a profit of 50% and donated 50% of the total capital (initial capital + profit) to a charitable organisation. The same course was followed in the 2nd and 3rd years also. If at the end of three years, he is left with ₹ 16,875, then find the amount donated by him at the end of the 2nd year.
(a) ₹ 45,000 (b) ₹ 12,500
(c) ₹ 22,500 (d) ₹ 20,000
2. In an examination, 48% students failed in Hindi and 32% students in History, 20% students failed in both the subjects. If the number of students who passed the examination was 880, how many students appeared in the examination if the examination consisted only of these two subjects?
(a) 2000 (b) 2200
(c) 2500 (d) 1800
3. At IIM Bangalore, 60% of the students are boys and the rest are girls. Further 15% of the boys and 7.5% of the girls are getting a fee waiver. If the number of those getting a fee waiver is 90, find the total number of students getting 50% concession if it is given that 50% of those not getting a fee waiver are eligible to get half fee concession?
(a) 360 (b) 280
(c) 320 (d) 330
4. A machine depreciates in value each year at the rate of 10% of its previous value. However, every second year there is some maintenance work so that in that particular year, depreciation is only 5% of its previous value. If at the end of the fourth year, the value of

the machine stands at ₹ 1,46,205, then find the value of machine at the start of the first year.

- (a) ₹ 1,90,000 (b) ₹ 2,00,000
(c) ₹ 1,95,000 (d) ₹ 2,10,000

5. Arushi's project report consists of 25 pages each of 60 lines with 75 characters on each line. In case the number of lines is reduced to 55 but the number of characters is increased to 90 per lines, what is the percentage change in the number of pages. (Assume the number of pages to be a whole number.)

- (a) +10% (b) +5%
(c) -8% (d) -10%

6. The price of soap is collectively decided by five factors: research, raw materials, labour, advertisements and transportation. Assume that the functional relationship is

Price of soap = $(k \times \text{Research costs} \times \text{Raw material costs} \times \text{Labour costs} \times \text{Advertising cost} \times \text{Transportation cost})$.

If there are respective changes of 10%, 20%, -20%, 25% and 50% in the five factors, then find the change in the price of soap.

- (a) 97% (b) 95%
(c) 98% (d) 96%

7. After receiving two successive raises, Hursh's salary became equal to $\frac{15}{8}$ times of his initial salary. By how much percent was the salary raised the first time if the second raise was twice as high (in percent) as the first?

- (a) 15% (b) 20%
(c) 25% (d) 30%

8. The ratio of Jim's salary for October to his salary for November was 1.5 : 1.333 and the ratio of the salary for November to that for December was 2 : 2.6666. The worker got 40 rupees more for December than for October and received a bonus constituting 40 per

cent of the salary for three months. Find the bonus. (Assume that the number of workdays is the same in every month.)

- (a) 368.888 rupees (b) 152.5555 rupees
(c) 222.22 rupees (d) 265.6 rupees

9. After three successive equal percentage rise in the salary the sum of 100 rupees turned into 140 rupees and 49 paise. Find the percentage rise in the salary.

- (a) 12% (b) 22%
(c) 66% (d) 82%

10. Prema goes to a shop to buy a sofa set costing ₹ 13,080. The rate of sales tax is 9%. She tells the shopkeeper to reduce the price of the sofa set to such an extent that she has to pay ₹ 13080 inclusive of sales tax. Find the percentage reduction needed in the price of the sofa set to just satisfy her requirement.

- (a) 8.33% (b) 8.26%
(c) 9% (d) 8.5%

11. The price of a certain article was raised by 10% in India. The consumption of the same article was increased from 200 tons to 225 tons. By how much percent will the expenditure on the article rise in the Indian economy?

- (a) 24.25% (b) 22.5%
(c) 23.75% (d) 26.75%

12. In the university examination last year, Rajesh scored 65% in English and 82% in History. What is the minimum percent he should score in Sociology, which is out of 50 marks (if English and History were for 100 marks each), if he aims at getting 78% overall?

- (a) 94% (b) 92%
(c) 98% (d) 96%

13. King Dashratha, at his eleventh hour, called his three queens and distributed his gold in the following way: He gave 50% of his

wealth to his first wife, 50% of the rest to his second wife and again 50% of the rest to his third wife. If their combined share is worth 1,30,900 kilograms of gold, find the quantity of gold King Dashratha was having initially?

- (a) 1,50,000 kg (b) 1,49,600 kg
(c) 1,51,600 kg (d) 1,52,600 kg

14. The population of New Foundland increases with a uniform rate of 8% per annum, but due to immigration, there is a further increase of population by 1% (however, this 1% increase in population is to be calculated on the population after the 8% increase and not on the previous years population). Find what will be the percentage increase in population after 2 years.

- (a) 18.984 (b) 18.081
(c) 18.24 (d) 17.91

15. 10% of Mexico's population migrated to South Asia, 10% of the remaining migrated to America and 10% of the rest migrated to Australia. If the female population, which was left in Mexico, remained only 3,64,500, find the population of Mexico City before the migration and its effects if it is given that before the migration the female population was half the male population and this ratio did not change after the migration?

- (a) 10,00,000 (b) 12,00,000
(c) 15,00,000 (d) 16,00,000

16. According to a recent survey report issued by the Commerce Ministry, Government of India, 30% of the total FDI goes to Gujarat and 20% of this goes to rural areas. If the FDI in Gujarat, which goes to urban areas, is \$72 m, then find the size of FDI in rural Andhra Pradesh, which attracts 50% of the FDI that comes to Andhra Pradesh, which accounts for 20% of the total FDI?

- (a) \$30 m (b) \$9 m
(c) \$60 m (d) \$40 m

17. If in question 16, the growth in the size of FDI for the next year with respect to the previous year is 20%, then find the share of urban Maharashtra next year if 12% of the total FDI going to Maharashtra went to urban areas (provided Maharashtra attracted only 10% of the total share for both years).
- (a) \$36 m (b) \$4.32 m
(c) \$3 m (d) \$5 m
18. The cost of food accounted for 25% of the income of a particular family. If the income gets raised by 20%, then what should be the percentage point decrease in the food expenditure as a percentage of the total income to keep the food expenditure unchanged between the two years?
- (a) 3.5 (b) 8.33
(c) 4.16 (d) 5
19. If the length, breadth and height of a cube are decreased, decreased and increased by 5%, 5% and 20% respectively, then what will be the impact on the surface area of the cube (in percentage terms)?
- (a) 7.25% (b) 5%
(c) 8.33% (d) 20.75%
20. A's salary is first increased by 25% and then decreased by 20%. The result is the same as B's salary increased by 20% and then reduced by 25%. Find the ratio of B's salary to that of A's.
- (a) 4 : 3 (b) 11 : 10
(c) 10 : 9 (d) 12 : 11
21. The minimum quantity of milk in litres (in whole number) that should be mixed in a mixture of 60 litres in which the initial ratio of milk to water is 1 : 4 so that the resulting mixture has 15% milk is
- (a) 3 (b) 4
(c) 5 (d) This is not possible

22. A person saves 6% of his income. Two years later, his income shoots up by 15% but his savings remain the same. Find the hike in his expenditure.
- (a) 15.95% (b) 15%
(c) 14.8% (d) 15.5%
23. A is 50% more than B , C is $\frac{2}{3}$ of A and D is 60% more than C . Now, each of A , B , C and D is increased by 10%. Find what per cent of B is D (after the increase)?
- (a) 150% (b) 160%
(c) 175% (d) 176%
24. A and B have, between them, ₹ 1200. A spends 12% of his money while B spends 20% of his money. They are then left with a sum that constitutes 85% of the whole sum. Find what amount is left with A .
- (a) ₹ 750 (b) ₹ 800
(c) ₹ 700 (d) ₹ 660
25. Maya has ₹ M with her and her friend Chanda has ₹ C with her. Maya spends 12% of her money and Chanda also spends the same amount as Maya did. What percentage of her money did Chanda spend?
- (a) $\frac{18M}{C}$ (b) $\frac{18C}{M}$
(c) $\frac{12M}{C}$ (d) $\frac{12C}{M}$
26. In a village consisting of p persons, $x\%$ can read and write. Of the males alone $y\%$, and of the females alone $z\%$ can read and write. Find the number of males in the village in terms of p , x , y and z if $z < y$.
- (a) $\frac{p(x-z)}{(y+x-z)}$ (b) $\frac{p(x-z)}{(y+x-2z)}$

(c) $\frac{p(y-x)}{(x-z)}$

(d) $\frac{p(x-z)}{(y-z)}$

27. In order to maximise his gain, a theatre owner decides to reduce the price of tickets by 20% and as a result of this, the sales of tickets increase by 40%. If, as a result of these changes, he is able to increase his weekly collection by ` 1,68,000, find by what value did the gross collection increase per day.

(a) 14,000

(b) 18,000

(c) 24,000

(d) 20,000

28. In a town consisting of three localities A, B and C, the population of the three localities A, B and C are in the ratio 9 : 8 : 3. In locality A, 80% of the people are literate, in locality B, 30% of the people are illiterate. If 90% people in locality C are literate, find the percentage literacy in that town.

(a) 61.5%

(b) 78%

(c) 75%

(d) None of these

29. A fraction is such that if the double of the numerator and the triple of the denominator is changed by +10% and –30% respectively then we get 11% of 16/21. Find the fraction.

(a) $\frac{4}{25}$

(b) $\frac{2}{25}$

(c) $\frac{3}{25}$

(d) None of these

30. To pass an examination, 40% marks are essential. A obtains 10% marks less than the pass marks and B obtains 11.11% marks less than A. What percent less than the sum of A's and B's marks should C obtain to pass the exam?

(a) 40%

(b) $41\frac{3}{17}\%$

(c) 28%

(d) Any of these

31. The hourly wages of a female labour are increased by 12.5%, whereas the weekly working hours are reduced by 8%. Find the percentage change in the weekly wages if she was getting ₹ 1200 per week for 50 hours previously.
- (a) +3.5% (b) 4%
(c) 4.5% (d) None of these
32. Two numbers X and Y are 20% and 28% less than a third number Z . Find by what percentage is the number Y less than the number X .
- (a) 8% (b) 12%
(c) 10% (d) 9%
33. Price of a commodity is first increased by $x\%$ and then decreased by $x\%$. If the new price is $K/100$, find the original price.
- (a) $(x - 100)100/K$ (b) $(x^2 - 100^2)100/K$
(c) $(100 - x)100/K$ (d) $100K/(100^2 - x^2)$
34. The salary of a person is increased by ₹ 4800 and the rate of tax is decreased by 2% from 12% to 10%. The effect is such that he is now paying the same tax as before. If in both the cases, the standard tax deduction is fixed at 20% of the total income, find the increased salary?
- (a) ₹ 32,800 (b) ₹ 36,800
(c) ₹ 28,000 (d) None of these
35. Reena goes to a shop to buy a radio costing ₹ 2568. The rate of sales tax is 7% and the final value is rounded off to the next higher integer. She tells the shopkeeper to reduce the price of the radio so that she has to pay ₹ 2568 inclusive of sales tax. Find the reduction needed in the price of the radio.
- (a) ₹ 180 (b) ₹ 210
(c) ₹ 168 (d) None of these

Directions for Questions 36 to 38: Read the following passage and answer the questions.

In a recent youth fete organised by Mindworkzz, the entry tickets were sold out according to the following scheme:

Tickets bought in one lot	6	12	18
Percentage discount	10%	20%	25%

Original price per ticket: ` 40

This offer could have been availed only when tickets were bought in a fixed lot according to the scheme and any additional ticket was available at its original price.

36. If a person has to buy 25 tickets, then what will be the minimum price per ticket?
- (a) Equal to ` 32 (b) 32.32
(c) 31.84 (d) Cannot be determined.
37. In the above question, what will be the approximate possible maximum price per ticket (if discounts have been availed for 24 tickets)?
- (a) ` 30 (b) ` 32
(c) ` 36 (d) ` 36.16
38. On the last day of the fete, with the objective of maximising participation, the number of tickets sold in a lot was halved with the same discount offer. Mr. X is in a fix regarding the number of tickets he can buy with ` 532. The maximum number of tickets he can purchase with this money is
- (a) 14 (b) 15
(c) 16 (d) 17
39. 800 people were supposed to vote on a resolution, but 1/3rd of the people who had decided to vote for the motion were abducted. However, the opponents of the motion, through some means managed to increase their strength by 100%. The motion was then rejected by a majority, which was 50% of that by which it would have been passed if none of these changes would have occurred.

How many people finally voted for the motion and against the motion?

- (a) 200 (for), 400 (against)
- (b) 100 (for) and 200 (against)
- (c) 150 (for), 300 (against)
- (d) 200 (for) and 300 (against)

40. Of the adult population in Nagpur, 45% of men and 25% of women are married. What percentage of the total population of adults is married (assume that no man marries more than one woman and vice versa)?

- (a) 33.33%
- (b) 32.14%
- (c) 31.1%
- (d) None of these

41. The weight of an iron bucket increases by 33.33% when filled with water to 50% of its capacity. Which of these may be 50% of the weight of the bucket when it is filled with water (assume the weight of bucket and its capacity in kg to be integers)?

- (a) 7 kg
- (b) 6 kg
- (c) 5 kg
- (d) 8 kg

42. Australia scored a total of x runs in 50 overs. India tied the scores in 20% less overs. If India's average run rate had been 33.33% higher the scores would have been tied 10 overs earlier. Find how many runs were scored by Australia.

- (a) 250
- (b) 240
- (c) 200
- (d) Cannot be determined

43. Due to a 25% hike in the price of rice per kilogram, a person is able to purchase 20 kg less for ₹ 400. Find the increased price of rice per kilogram.

- (a) ₹ 5
- (b) ₹ 6
- (c) ₹ 10
- (d) ₹ 4

44. A salesman is appointed on the basic salary of ₹ 1200 per month and the condition that for every sales of ₹ 10,000 above ₹ 10,000, he will get 50% of basic salary and 10% of the sales as a reward. This incentive scheme does not operate for the first ₹ 10000 of sales. What should be the value of sales if he wants to earn ₹ 7600 in a particular month?
- (a) ₹ 60,000 (b) ₹ 50,000
(c) ₹ 40,000 (d) None of these
45. In Question 44, which of the following income cannot be achieved in a month?
- (a) ₹ 6000
(b) ₹ 9000
(c) Both a and b
(d) Any income can be achieved
46. In Question 44, despite a 5 percentage point increment on the commission from 20%, the total commission remained unaltered. Find the change in the volume of the transaction.
- (a) -10% (b) -16%
(c) -25% (d) -20%
47. In an assembly election at Surat, the total turnout was 80% out of which 16% of the total voters on the voting list were declared invalid. Find which of the following can be the percentage votes got by the winner of the election if the candidate who came second got 20% of the total voters on the voting list. (There were only three contestants, only one winner and the total number of voters on the voters' list was 20000.)
- (a) 44.8% (b) 46.6%
(c) 48% (d) None of these
48. A watch gains by 2% per hour when the temperature is in the range of 40°C–50°C and it loses at the same rate when the temperature is in the range of 20°C–30°C. However, the watch owner is fortunate

since it runs on time in all other temperature ranges. On a sunny day, the temperature started soaring up from 8 a.m. in the morning at the uniform rate of 2°C per hour and sometime during the afternoon it started coming down at the same rate. Find what time will it be by the watch at 7 p.m. if at 8 a.m. the temperature was 32°C and at 4 p.m., it was 40°C .

- (a) 6 : 55 p.m. (b) 6 : 55 : 12 p.m.
(c) 6 : 55 : 24 p.m. (d) None of these

Questions 49 and 50: Study the following table and answer the questions that follow.

<i>Beverages</i>	<i>% of Vitamin</i>	<i>% of Minerals</i>	<i>% of Micronutrients</i>	<i>Cost per 250 gram (In `)</i>
Pepsi	12	18	30	8
Coke	15	20	10	10
Sprite	20	10	40	7

49. Which of the following beverages contains the maximum amount of vitamins?
- (a) Pepsi worth ` 16
(b) Coke worth ` 15
(c) Sprite worth ` 8
(d) All the three worth ` 12.5 (125 grams of each)
50. Which of these is the cheapest?
- (a) 200 grams of Pepsi + 200 grams of Coke
(b) 300 grams of Coke + 100 grams of Pepsi
(c) 100 grams of Coke + 100 grams of Pepsi + 100 grams of Sprite
(d) 300 grams of Coke + 100 grams of Sprite

LEVEL OF DIFFICULTY (III)

1. The price of raw materials has gone up by 15%, labour cost has also increased from 25% of the cost of raw material to 30% of the cost of raw material. By how much percentage should there be a reduction in the usage of raw materials so as to keep the cost same?
(a) 17% (b) 24%
(c) 28% (d) 25%
2. Mr. A is a computer programmer. He is assigned three jobs for which time allotted is in the ratio of 5 : 4 : 2 (jobs are needed to be done individually). But due to some technical snag, 10% of the time allotted for each job gets wasted. Thereafter, owing to the lack of interest, he invests only 40%, 30%, 20% of the hours of what was actually allotted to do the three jobs individually. Find how much percentage of the total time allotted is the time invested by A.
(a) 38.33% (b) 39.4545%
(c) 32.72% (d) 36.66%
3. In the Mock CAT paper at Mindworkzz, questions were asked in five sections. Out of the total students, 5% candidates cleared the cut-off in all the sections and 5% cleared none. Of the rest, 25% cleared only one section and 20% cleared four sections. If 24.5% of the entire candidates cleared two sections and 300 candidates cleared three sections, find out how many candidates appeared at the Mock CAT at Mindworkzz?
(a) 1000 (b) 1200
(c) 1500 (d) 2000
4. There are three galleries in a coal mine. On the first day, two galleries are operative and after some time, the third gallery is made operative. With this, the output of the mine became half as large again. What is the capacity of the second gallery as a percentage of the first, if it is given that a four-month output of the first and the

third galleries was the same as the annual output of the second gallery?

- (a) 70% (b) 64%
(c) 60% (d) 65%

5. 10% of salty sea water contained in a flask was poured out into a beaker. After this, a part of the water contained in the beaker was vapourised by heating and due to this, the percentage of salt in the beaker increased M times. If it is known that after the content of the beaker was poured into the flask, the percentage of salt in the flask increased by $x\%$. Find the original quantity of sea water in the flask.

- (a) $\frac{9M + 1\%}{M - 1}$ (b) $\frac{(9M + 1)x\%}{M - 1}$
(c) $\frac{9M - 1x\%}{M + 1}$ (d) $\frac{9M + x\%}{M + 1}$

6. In an election of 3 candidates A , B and C , A gets 50% more votes than B . A also beats C by 1,80,00 votes. If it is known that B gets 5 percentage point more votes than C , find the number of voters on the voting list (given 90% of the voters on the voting list voted and no votes were illegal)

- (a) 72,000 (b) 81,000
(c) 90,000 (d) 1,00,000

7. A clock is set right at 12 noon on Monday. It loses $1/2\%$ on the correct time in the first week but gains $1/4\%$ on the true time during the second week. The time shown on Monday after two weeks will be

- (a) 12 : 25 : 12 (b) 11 : 34 : 48
(c) 12 : 50 : 24 (d) 12 : 24 : 16

8. The petrol prices shot up by 7% as a result of the hike in the price of crudes. The price of petrol before the hike was ` 28 per litre. Vawal travels 2400 kilometres every month and his car gives a mileage of 18 kilometres to a litre. Find the increase in the expenditure that

Vawal has to incur due to the increase in the price of petrol (to the nearest rupee)?

- (a) ` 270
- (b) ` 262
- (c) ` 276
- (d) ` 272

9. For Question 8, by how many kilometres should Vawal reduce his travel if he wants to maintain his expenditure at the previous level (prior to the price increase)?

- (a) 157 km
- (b) 137 km
- (c) 168 km
- (d) 180 km

10. In Question 8, if Vawal wants to limit the increase in expenditure to ` 200, what strategy should he adopt with respect to his travel?

- (a) Reduce travel to 2350 kilometres
- (b) Reduce travel to 2340 kilometres
- (c) Reduce travel to 2360 kilometres
- (d) None of these

11. A shopkeeper announces a discount scheme as follows: for every purchase of ` 3000 to ` 6000, the customer gets a 15% discount or a ticket that entitles him to get a 7% discount on a further purchase of goods costing more than ` 6000. The customer, however, would have the option of reselling his right to the shopkeeper at 4% of his initial purchase value (as per the right refers to the 7% discount ticket). In an enthusiastic response to the scheme, 10 people purchase goods worth ` 4000 each. Find the maximum. Possible revenue for the shopkeeper.

- (a) ` 38,400
- (b) ` 38,000
- (c) ` 39,400
- (d) ` 39,000

12. For question 11, find the maximum possible discount that the shopkeeper would have to offer to the customer.

- (a) ` 1600
- (b) ` 2000
- (c) ` 6000
- (d) ` 4000

Directions for Questions 13 to 16: Read the following and answer the questions that follow.

Two friends Shayam and Kailash own two versions of a car. Shayam owns the diesel version of the car, while Kailash owns the petrol version.

Kailash's car gives an average that is 20% higher than Shayam's (in terms of litres per kilometre). It is known that petrol costs 60% of its price higher than diesel.

13. The ratio of the cost per kilometre of Kailash's car to Shayam's car is
- (a) 3 : 1 (b) 1 : 3
(c) 1.92 : 1 (d) 2 : 1
14. If Shayam's car gives an average of 20 km per litre, then the difference in the cost of travel per kilometre between the two cars is
- (a) ₹ 4.3 (b) ₹ 3.5
(c) ₹ 2.5 (d) Cannot be determined
15. For Question 14, the ratio of the cost per kilometre of Shayam's travel to Kailash's travel is
- (a) 3 : 1 (b) 1 : 3
(c) 1 : 1.92 (d) 2 : 1
16. If diesel costs ₹ 12.5 per litre, then the difference in the cost of travel per kilometre between Kailash's and Shayam's is (assume an average of 20 km per litre for Shayam's car and also assume that petrol is 50% of its own price higher than diesel)
- (a) ₹ 1.75 (b) ₹ 0.875
(c) ₹ 1.25 (d) ₹ 1.125

Directions for Questions 17 to 23: Read the following and answer the questions that follow.

In the island of Hoola Boola Moola, the inhabitants have a strange process of calculating their average incomes and expenditures. According to an old legend prevalent on that island, the average monthly income had to be

calculated on the basis of 14 months in a calendar year while the average monthly expenditure was to be calculated on the basis of 9 months per year. This would lead to people having an underestimation of their savings since there would be an underestimation of the income and an overestimation of the expenditure per month.

17. Mr. Boogle Woogle comes back from the USSR and convinces his community comprising 273 families to start calculating the average income and the average expenditure on the basis of 12 months per calendar year. Now if it is known that the average estimated income in his community is (according to the old system) 87 moolahs per month, then what will be the percentage change in the savings of the community of Mr. Boogle Woogle (assume that there is no other change)?
- (a) 12.33% (b) 22.22%
(c) 31.31% (d) Cannot be determined
18. For Question 17, if it is known that the average estimated monthly expenditure is 19 moolahs per month for the island of Hoola Boola Moola, then what will be the percentage change in the estimated savings of the community?
- (a) 32.42% (b) 38.05%
(c) 25.23% (d) Cannot be determined
19. For Question 18, if it is known that the average estimated monthly expenditure was 22 moolahs per month for the community of Boogle Woogle (having 273 families), then what will be the percentage change in the estimated savings of the community?
- (a) 30.77% (b) 28.18%
(c) 25.23% (d) 25.73%
20. For Question 19, what will be the percentage change in the estimated average income of the community (calculated on the basis of the new estimated average)?
- (a) 14.28% increase (b) 14.28% decrease

(c) 16.66% increase (d) 16.66% decrease

21. If the finance minister of the island Mr. Bhola Ram declares that henceforth the average monthly income has to be estimated on the basis of 12 months per year while the average monthly expenditure is to be estimated on the basis of 11 months to the year, what will happen to the savings in the economy of Hoola Boola Moola?

(a) Increase (b) Decrease
(c) Remain constant (d) Either (b) or (c)

22. For Question 21, what will be the percentage change in savings?

(a) 3.1% (b) 1.52%
(c) 2.5% (d) Cannot be determined

23. For Question 22, what will be the percentage change in the estimated monthly expenditure?

(a) 22.22% decrease (b) 22.22% increase
(c) 18.18% decrease (d) 18.18% increase

24. Abhimanyu Banerjee has 72% vision in his left eye and 68% vision in his right eye. On corrective therapy, he starts wearing contact lenses, which augment his vision by 15% in the left eye and 11% in the right eye. Find out the percentage of normal vision that he possesses after corrective therapy. (Assume that a person's eyesight is a multiplicative construct of the eyesight's of his left and right eyes)

(a) 52.5% (b) 62.5%
(c) 72.5% (d) 68.6%

25. A shopkeeper gives 3 consecutive discounts of 10%, 15% and 15% after which he sells his goods at a percentage profit of 30.05% on the C.P. Find the value of the percentage profit that the shopkeeper would have earned if he had given discounts of 10% and 15% only.

(a) 53% (b) 62.5%
(c) 72.5% (d) 68.6%

26. If the third discount in Question 25 was ₹ 2,29,50, then find the original marked price of the item.
- (a) ₹ 1,00,000 (b) ₹ 1,25,000
(c) ₹ 2,00,000 (d) ₹ 2,50,000
27. Krishna Iyer, a motorist uses 24% of his fuel in covering the first 20% of his total journey (in city driving conditions). If he knows that he has to cover another 25% of his total journey in city driving conditions, what should be the minimum percentage increase in the fuel efficiency for non-city driving over the city driving fuel efficiency, so that he is just able to cover his entire journey without having to refuel? (Approximately)
- (a) 39.2% (b) 43.5%
(c) 45.6% (d) 41.2%

Directions for Questions 28 to 30: Read the following and answer the questions that follow the BSNL announced a cut in the STD rates on 27 December 2011. The new rates and slabs are given in the table below and are to be implemented from 14 January 2012.

Slab Details

Distance	Rates (₹/min)			
	Peak Rates		Off Peak	
	Old	New	Old	New
50–200	4.8	2.4	1.2	1.2
200–500	11.6	4.8	3.0	2.4
500–1000	17.56	9.00	4.5	4.5
1000+	17.56	9.00	6.0	4.5

28. The maximum percentage reduction in costs will be experienced for calls over which of the following distances?
- (a) 50–200 (b) 500–1000

(c) 1000+ (d) 200–500

29. The percentage difference in the cost of a set of telephone calls made on the 13th and 14th January having durations of 4 minutes over a distance of 350 km, 3 minutes for a distance of 700 km and 3 minutes for a distance of 1050 km is (if all the three calls are made in peak times)

(a) 51.2% (b) 51.76%
(c) 59.8 % (d) Cannot be determined

30. If one of the three calls in Question 29 were made in an off peak time on both days, then the percentage reduction in the total cost of the calls between 13th and 14th January will

(a) Definitely reduce
(b) Definitely increase
(c) Will depend on which particular call was made in an off peak time
(d) Cannot be determined

Directions for Questions 31 to 35: Read the following caselet and answer the questions that follow.

The circulation of the *Deccan Emerald* newspaper is 3,73,000 copies, while its closest competitors are *The Times of Hindustan* and *India's Times*, which sell 2,47,000 and 20% more than that respectively (rounded off to the higher thousand). All the newspapers cost ₹ 2 each. The hawker's commissions offered by the three papers are 20%, 25% and 30% respectively (these commissions are calculated on the sale price of the newspaper). Also, it is known that newspapers earn primarily through sales and advertising.

31. Taking the base as the net revenue of *Deccan Emerald*, the percentage difference of the net revenue (revenues – commission disbursed to hawkers) between *Deccan Emerald* and *India's Times* is

(a) 24.62% (b) 30.32%

(c) 26.28% (d) None of these

32. The ratio of the percentage difference in the total net revenue between *Deccan Emerald* and *India's Times* to the percentage difference in the total revenue between *Deccan Emerald* and *India's Times* is

(a) 1.488 (b) 0.3727
(c) 0.6720 (d) Cannot be determined

33. If the cost of printing the newspaper is ₹ 8, 7.5 and 7 respectively per day for *Deccan Emerald*, *Times of Hindustan* and *India's Times* respectively and on any day the available advertising space in the *Deccan Emerald* newspaper is 800 cc (column centimetres) and the advertising rate for *Deccan Emerald* is ₹ 3000 per cc then the percentage of the advertising space that must be utilised to ensure the full recovery of the day's cost for *Deccan Emerald* is

(a) 95.83% (b) 99.46%
(c) 97.28% (d) Cannot be determined

34. Based on the data in the previous question and the additional information that the space availability in *India's Times* is 1000 cc and that in the *Times of Hindustan* is 1100 cc, find the percentage point difference in the percentage of advertising space to be utilised in *India's Times* and that which must be utilised in *Times of Hindustan* so that both newspapers just break even.

(a) 4.5 (b) 5.2
(c) 10 (d) Cannot be determined

35. For the data in Questions 33 and 34 if it is known that the advertising rate in *Times of Hindustan* is ₹ 1800 per cc and that in the *India's Times* is ₹ 2100 per cc, then what is the percentage point difference in the percentage of advertising space to be utilised by *Times of Hindustan* and *India's Times* so that both of them are just able to break even?

(a) 4.18 (b) 5.6

(c) 4.09 (d) Cannot be determined

36. On a train journey, there are 5 kinds of tickets AC I, AC II, AC III, 3-tier, and general. The relationship between the rates of the tickets for the Eurail is:

AC II is 20% higher than AC III and AC I is 70% of AC III's value higher than the AC II ticket's value. The 3-tier ticket is 25% of the AC I's ticket cost and the general ticket is $\frac{1}{3}$ the price of the AC II ticket. The AC II ticket costs 780 euros between London and Paris. The difference in the rates of 3 tier and general ticket is

(a) 41.25 euros (b) 55.8 euros
(c) 48.75 euros (d) 52.75 euros

37. For the above question, the total cost of one ticket of each class will be

(a) 3233.75 (b) 3533.75
(c) 4233.75 (d) 3733.75

Directions for Questions 38 to 40: Read the following and answer the questions that follow.

A Eurailexpress train has 2 AC I bogeys having 24 berths each, 3 AC II bogeys having 45 berths each, 2 AC III bogeys having 64 berths each and 12 3-tier bogeys having 64 berths each. There are no general bogeys in the train. If 200 euros is the cost of an AC 3-tier berth from London to Glasgow, answer the following questions:

38. The value of the maximum revenues possible from the Eurailexpress between Glasgow to London and back is

(a) 3,15,600 (b) 2,44,800
(c) 2,98,400 (d) 2,96,760

39. For a Eurailexpress journey from London to Glasgow, 80% of the train was uniformly booked across classes. What percentage of the total revenues came out of the sales of 3-tier tickets?

(a) 44.23% (b) 52.18%

(c) 39.23%

(d) 48.9%

40. If bookings for the above question was 40% in AC I, 70% in AC II, 60% in AC III and 55% in 3-tier, then what will happen to the percentage contribution of 3-tier to the total revenues on the train journey?

(a) Decrease

(b) Increase

(c) Remain constant

(d) Cannot be determined

41. A 14.4 kg gas cylinder runs for 104 hours when the smaller burner on the gas stove is fully opened while it runs for 80 hours when the larger burner on the gas stove is fully opened. Which of these values are the closest to the percentage difference in the usage of gas per hour, between the smaller and the larger burner?

(a) 26.23%

(b) 30%

(c) 32.23%

(d) 23.07%

42. For Question 41, assume that the rate of gas dispersal is directly proportional to the degree of opening of the aperture of the gas. If we are given that the smaller burner is open to 60% of its maximum and the larger burner is open to 50% of its maximum, the percentage decrease in the percentage difference between the smaller burner and the larger burner (in terms of hours per kg) is

(a) 72.22%

(b) 73.33%

(c) 66.66%

(d) None of these

43. Hursh Sarma has a salary of ₹10,800 per month. In the first month of the year, he spends 40% of his income on food, 50% on clothing and saves 11.11% of what he has spent. In the next two months, he saves 9.09% of what he has spent (spending 38.33% of his income on food). In the fourth month, he gets an increment of 11.11% on his salary and spends every single paise on celebrating his raise. But from the fifth month onwards good sense prevails on him and he saves 12.5%, 15%, 20%, 10%, 8.33%, 12.5%, 15% and 20% on his new income per month. The ratio between the sum of the savings

for the two months having the highest savings to the sum of the savings for the two months having the lowest savings is

- (a) 2.6666 (b) 5.3333
(c) 8 (d) None of these

44. In an economy, the rate of savings has a relation to the investment in industry for that year and the following three years. The relation is such that a percentage point change in investment in industry for that year has a relation to the total production output in the next 4 years. A 2 percentage point increase in the savings rate in a year, increases the investment in the industry of the economy by 1%. Further, the rate of investment also goes up by 0.5% in the next year, by 0.25% in the second year and again by 0.25% in the third year. Also assume that the investment in an economy is only dependent on the patterns of savings in the previous 3 years in the economy. Also, the percentage change in the investment in a particular year is got by adding the effect of the previous three years savings pattern.

In fiscal 2008–09, the rate of savings in the Indian economy is 25% while that in the Pakistani economy, is 20%. This has remained constant since 2003. In 2009–10 the savings rate in the Indian economy suddenly rises by 5 percentage points to 30% while that in the Pakistani economy rises by 2 percentage points to 22%. It is further known that the value of the investment in the industry in the 2 countries was 2 million dollars and 1.8 million dollars respectively (for the previous year). The percentage difference between the investment in the Pakistani economy to the investment in the Indian economy in 2010–11 will be (if it is known that there is no change in the savings rate in 2010–11):

- (a) 13.6% (b) 15.12%
(c) 11.18% (d) 12.2%

Directions for Questions 45 to 48: In an economy the rate of savings has a relation to the investment in industry for that year and for the

following three years and the investment in industry for that year has a relation to the total production output in the next 4 years.

45. For Question 44, if there is no additional change in the savings rate until 2011–12, then the percentage difference in the value of the investment in India to the investment in Pakistan in 2011–12 (as a percentage of the investment in India) is
- (a) 11.28% (b) 14.18%
(c) 14.02% (d) None of these
46. If the change in production is directly related to the change in investment in the previous year, and if the data of the savings rate change for the previous 2 questions are to be assumed true, then for which year did the difference between the production in the Indian economy and the production in the Pakistani economy show the maximum percentage change?
- (a) 2010–11 (b) 2011–12
(c) 2012–13 (d) Cannot be determined
47. For Question 44, it is known that the percentage change in investment in a year leads to a corresponding equal percentage increase in the manufacturing production in the next year. Further, if the growth rate of manufacturing production is 27% of the GDP growth rate of the country, then what is the GDP growth rate of India in 2010–11?
- (a) 8.52% (b) 7.28%
(c) 9.26% (d) None of these
48. The Euro was ushered in on the 1st January 2002 and the old currencies of the European economies were exchanged into Euros. In France, 4 Francs were exchanged for 1 Euro while in Germany 5 Deutsche Marks were exchanged for 1 Euro and in Italy 3 Liras were exchanged for 1 Euro. The exchange rate for Moolahs, the official currency of Hoola Boola Moola, was set at 185 Moolahs per Euro. Dr. Krishna Iyer, an NRI doctor based in Europe, had a practice across each of these three countries and he sends back

money orders to his native island of Hoola Boola Moola. The existing exchange rate of Moolahs with the above-mentioned currencies was 51 moolahs per Franc, 36 Moolahs per Deutsche Mark and 70 moolahs per Lira. If Dr. Iyer has this information, then what should he do with his currency holdings in these three currencies on the 31st December 2001 so that he maximises his moolah value on the 1st of January 2002. (Assume no arbitrage possibilities between the three currencies)

- (a) Change to Francs
- (b) Change to Deutsche Marks
- (c) Change to Liras
- (d) Remain indifferent

49. For the above questions, the exchange rates for the three currencies with respect to a dollar was: 2\$ per Lira, 1.5\$ per Franc and 1.4 dollar per Deutsche Mark. If Dr. Iyer has 100 liras, 100 Deutsche Marks and 100 Francs on 31st December 2001, the maximum percentage change he can achieve in his net holding in terms of dollars due to the arbitrage created by the Euro conversion could be

- (a) 17.23%
- (b) 7.33%
- (c) 11.2%
- (d) Cannot be determined

50. For Question 48, which one of the following will allow the calculation of all possibilities of percentage change in terms of moolah value of Dr. Iyer's portfolio? (That is possible through currency conversions.)

- (a) Dr. Iyer's money holding in all three currencies
- (b) Dr. Iyer's monthly earnings in all three currencies
- (c) The inter-currency conversion rates between Liras, Deutsche Mark and Francs
- (d) Both (a) and (c)

ANSWER KEY

Level of Difficulty (I)

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

Level of Difficulty (II)

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

Level of Difficulty (III)

1. (a)	2. (c)	3. (b)	4. (c)
5. (b)	6. (d)	7. (a)	8. (b)
9. (a)	10. (d)	11. (a)	12. (c)
13. (a)	14. (d)	15. (a)	16. (b)

17. (d)	18. (d)	19. (a)	20. (c)
21. (a)	22. (d)	23. (c)	24. (b)
25. (a)	26. (c)	27. (b)	28. (d)
29. (b)	30. (a)	31. (b)	32. (a)
33. (b)	34. (c)	35. (b)	36. (c)
37. (a)	38. (c)	39. (a)	40. (a)
41. (b)	42. (a)	43. (b)	44. (a)
45. (c)	46. (d)	47. (c)	48. (b)
49. (d)	50. (d)		

Hints

Level of Difficulty (II)

1. Assume the initial value to be 100 and solve.
3. Total number of students = Full fee waver + 50% concession + No concession.
6. Assume initial value of price = 100.
Since, the price is a mutiplicative function, we have
 $100 \times 1.1 \times 1.2 \times 0.8 \times 1.25 \times 1.5$
Solve using percentage change graphic.
8. Salary ratio is 2.25 : 2.2.6666.
Hence $0.41666 = \text{` } 40$.
Then, $6.9166 = \text{` } 664$
9. Solve using options
13. Assume initial amount of gold to be 100.
Then he gives away: $50 + 25 + 12.5 = 87.5$
But $87.5 = 1309000 \text{ kg}$
Hence, $100 = 149600$
18. If initial income = 100, initial food expenditure = 25.
New income = 120
Since, food expenditure is constant at 25, the percentage of the new income = 20.833.
Percentage point change = $25 - 20.833 = 4.166$

24. Solve using options.
25. Use standard formulae of percentage.
Alternatively, this problem can also be solved by assuming values for p , x , y and z . Then compare the options to see which one fits.
29. Solve using options.
31. $100 \times 1.125 \times 0.92 = 103.5$
34. Solve using options.
35. Reduction required = $\frac{7}{107} \times 2568$
- 36-38. To maximise the discount, tickets, need to be bought in two groups of 18 and 6 respectively. The maximum possible price per ticket will occur when tickets are bought in sets of 6.
39. Solve through options.
Checking for option (a) Æ Final voting is 200 for and 400 against.
Hence, the motion is rejected by 200 votes. This means that if none of the things had occurred then the motion would have been passed by 400 votes. i.e. 600 (for) and 200 (against) $\frac{1}{3}$ of 600 were abducted and the opponents doubled their votes from 200 to 400.
Since all the values fit; the answer is (a).
40. Take 45% men = 25% women.
42. Since, runs scored = overs \times run rate. If overs reduce by 25%, run rate will go up by 33.33%. Hence, Australia could have scored any number of runs.
47. Valid votes = 64%
The second placed candidate gets 20% votes.
Then the winner can get between 20.01% to 44% votes.

Level of Difficulty (III)

1. Assume initial raw material price to be 100. This means that the initial labour cost is 25. Hence the net cost is 125. Now, since there is a 15% increment in raw material cost and the labour cost has gone up to 30% of the raw material cost, it is clear that the new total

expenditure is $115 \times 1.3 = 149.5$. Reduce the cost to 125 by reducing the usage of raw materials used.

2. Assume that 50, 40 and 20 hours are available. There is no need to use 10% waste of time in this question.
4. Half as large again means 1.5 times (or an addition of 50%).
5. Assume values for M and x and solve through options.
6. $A = 1.5 B$, $A - C = 180000$ and $B = 1.05 C$. Solve to get A , B and C . Also, $A + B + C = 90\%$ of total voters on voting list. This will give you the answer.

Ideally solve this question through options.

7. Clock loses 0.5% of 168 hours in the first week and gains 0.25% of 168 hours in the second week. Hence, net loss is 0.25% of 168 hours.
8. Vawal uses 133.33 litres of petrol every month, while the price of petrol has gone up by ` 1.96. Hence, the increase in expenditure = $133.33 \times 1.96 = \text{` } 261$ approximately.
11. Maximum revenue for the shopkeeper will occur when the minimum discount offer is used by the customer. This level is 4%.
12. This is the case of maximum discounts.

Hints for Questions 13–16

	Diesel	Petrol
	Shyam	Kailash
Average (in litre per km)	x	$1.2x$
Cost of Fuel (in `/litre)	$0.4 p$	p

13. Average in liter per kilometre multiplied by the Cost of fuel in `/litre will give the required cost per kilometre.
14. Shyam's car gives 20 km/litre means 0.05 litres per kilometre then Kailash's car gives 0.06 litre/km. However, since we do not know the price of petrol or diesel we cannot find out the difference in the cost of travel.
15. This question is the opposite of question 13.

16. Cost of petrol is ` 25 per liter. Cost per kilometre for Shyam = 12.5×0.05

Also, cost per kilometre for Kailash = 25×0.06

Hints for Questions 17–23

Estimated average savings

$$= \frac{\text{Annual Income}}{14} - \frac{\text{Annual Expenditure}}{9}$$

17. The value will depend on the values of annual expenditure which is not available.
18. Average estimated monthly expenditure is given for the island of Hoola Boola Moola and not for Mr. Boogle Woogle's community.
19. Original estimated savings = $87 - 22 = 65$ Moolahs.
New estimated savings = $1218/12 - 198/12 = 85$.
24. $0.72 \times 1.15 \times 0.68 \times 1.11$.
25. Solve through options: A 15% reduction on the correct answer will give a profit of 30.05%.
Option (a) is correct.
26. The last discount being 22,950, it means that the value prior to this 15% discount must have been 1,53,000 checking with options:
 $200,000 \xrightarrow{15\% \downarrow} 17,000 \xrightarrow{10\% \downarrow} 1,53,000$. Hence option (c) is correct.
27. For 45% of the journey in city driving conditions, 54% of the fuel is consumed.
Hence, for the remaining 55% journey, 46% fuel is left.
Required increase in fuel efficiency
$$= \frac{\frac{55}{45} - \frac{45}{54}}{\frac{45}{54}} \times 100$$
.
28. The maximum percentage reduction in peak rates is for the 200 – 500 category.

$$29. \frac{(4 \times 11.6 + 3 \times 17.56 + 3 \times 17.56) - (4 \times 4.8 + 3 \times 9 + 3 \times 9)}{4 \times 11.6 + 3 \times 17.56 + 3 \times 17.56}$$

$$33. \text{ Loss to be made up everyday} = 373000(8 - 1.60) \\ = 6.4 \times 373000.$$

$$\text{No. of cc required to be sold} = \frac{373000 \times 6.4}{3000}$$

34. Advertising rates have not been mentioned. Hence, we cannot solve the question.

36-40. The ticket cost are:

AC III £ 100 (assume), AC – II £ 120,

AC I £ 190, 3 Tier £ 47.5, General £ 40.

Also, AC – II = 780 Euros for a London – Paris journey

$$36. (47.5 - 40) \times 6.5 = 48.75$$

$$37. (100 + 120 + 190 + 47.5 + 40) \times 6.5.$$

38. Maximum revenues on a return journey means 100% bookings both ways.

$$39. \frac{\text{Revenues from 3-Tier}}{\text{Total Revenues}} \times 100$$

$$41. \frac{\frac{14.4}{80} - \frac{14.4}{104}}{\frac{14.4}{104}} = \frac{104 - 80}{80} = 30\%$$

42. Original percentage difference = 30%

At 60% aperture opening the smaller gas will last $\frac{104}{0.6} = 173.33$ hours.

Similarly, the larger gas will last $\frac{80}{0.5} = 160$ hours.

Thus, the smaller gas lasts $\frac{173.33 - 160}{173.33} \times 100 = 8.33\%$ more than the larger gas.

$$\text{Then, required answer} = \frac{30 - 8.33}{30} \times 100 = 72.22\%$$

44. The 5% point increase in savings rate will account for a 2.5% increase in investment in 2005–06 and a further 1.25% increase in investment in 2006–07.

Thus, Indian investment is 2006-07 = 2 million \times 1.025 \times 1.0125 similarly, calculate for Pakistan.

45. Use the same process as for the previous question.
 46. Cannot be determined since we do not know the initial values of the production output.
 47. Since there is a 2.5% increase in investment in 2005–06, there will be a 2.5% increase in manufacturing production in 2006–07.

$$\text{Then, GDP growth rate} = \frac{2.5}{0.27} = 9.26\%.$$

Solutions and Shortcuts

Level of Difficulty (I)

1. It can be clearly seen that 700% of 9 = 63 is the highest number.
2. $0.25 N = 75 \text{ } \text{Æ} = 300$. Thus, $0.45 \times 300 = 135$.
3. $20\% \text{ of } 50\% \text{ of } 75\% \text{ of } 70\% = 20/100 \times 50/100 \times 75/100 \times 70 = 0.2 \times 0.5 \times 0.75 \times 70 = 5.25$.

A quicker way to think here would be: 20% of 70 = 14 Æ 50% of 14 = 7 Æ 75% of 7 = 5.25

4. $41 (3/17)\% = 700/17\%$. As a fraction, the value = $700/(17 \times 100) = 7/17$.
5. The following PCG will give the answer:

$$100 \xrightarrow[\text{Price effect}]{40\% \uparrow} 140 \xrightarrow[\text{Consumption effect}]{\quad} 100$$

Hence, the percentage reduction required is 28.56% (40/140)

6. $100 \text{ } \text{Æ} 140$ (after a 40% increase) $\text{Æ} 105$. The reduction from 140 to 105 is 25% and hence, it means that he needs to reduce his

consumption by 25%.

7. Assume Ram as 100. Shyam will be 133.33 and Bram will be 80
Thus, Bram's goods are 40% cheaper than Shyam's ($53.33/133.33$)
8. Total votes = 6000. Valid votes = 75% of 6000 = 4500. Bhiku gets 65% of 4500 votes and Mhatre gets 35% of 4500. Hence, Mhatre gets: $0.35 \times 4500 = 1575$ votes.
9. If the candidate has inadvertently increased his height by 25% the correction he would need to make to go back to his original height would be to reduce the stated height by 20%.
10. Let Arjit's height be H . Then, $H \times 1.15 = 120 \Rightarrow H = 120/1.15 = 104.34$.
11. Let the number be N . Then, $5N$ should be the correct outcome. But instead the value got is $0.2N$. Change in value = $5N - 0.2N = 4.8N$. The percentage change in the value = $4.8N \times 100/5N = 96\%$.
12. The percentage difference would be given by thinking of the percentage change between two numbers: $(x - 5)$ to $(x + 5)$ ['What he wanted to get' to 'what he got by mistake'].
The value of the percentage difference in this case depends on the value of x . Hence, this cannot be answered. Option (d) is correct.
13. 65% of $x = 13\%$ of 2000 $\Rightarrow 0.65x = 260 \Rightarrow x = 400$
14. From the first statement we get that out of 80 litres of the mixture, 20 litres must be milk. Since, we are adding water to this and keeping the milk constant, it is quite evident that 20 litres of milk should correspond to 20% of the total mixture. Thus, the amount in the total mixture must be 100, which means we need to add 20 litres of water to make 100 litres of the mixture.
15. $(50/100) \times (a/100) \times (b) = (75/100) \times (b/100) \times (c) \Rightarrow 50a = 75c \Rightarrow c = 0.667a$
16. $100 \xrightarrow{10\% \uparrow} 110 \xrightarrow{20\% \uparrow} 132$

Hence, the required answer is 32%

17. The area of a triangle depends on the product base \times height.

Since, the height increases by 40% and the area has to increase by 60% overall, the following PCG will give the answer.

$$100 \xrightarrow[\text{base}]{40\% \uparrow} 140 \xrightarrow[\text{height}]{?} 160$$

The required answer will be $20/140 = 14.28\%$

18. The volume goes up by:

$$100 \xrightarrow[\text{Height}]{50\% \uparrow} 150 \xrightarrow[\text{breadth}]{20\% \uparrow} 180 \xrightarrow[\text{length}]{10\% \uparrow} 198$$

Hence, 98%

19. $100 \longrightarrow 130 \longrightarrow 100$ (AÆBÆA use of PCG)

$$\backslash \text{Answer} = 30/130 = 23.07\%$$

20. $100 \xrightarrow{25\% \downarrow} 75 \xrightarrow{?} 120$

We have assumed initial expenditure to be 100, in the above figure. Then the final expenditure is 120. The percentage change in consumption can be seen to be $45/75 \times 100 = 60\%$

21. If the price of rice has fallen by 20% the quantity would be increased by 25% (if we keep the expenditure constant.)

This means that 20 kgs would increase by 25% to 25 kgs.

22. $91 - 0.3N = N \text{ \AA } 1.3 N = 91 \text{ \AA } N = 70.$

23. $B + 60\% \text{ of } A = 175\% \text{ of } B \text{ \AA }$

$$60\% \text{ of } A = 75\% \text{ of } B.$$

$$\text{i.e. } 0.6A = 0.75B$$

$$A/B = 5/4$$

Apparently it seems that A is bigger, but if you consider A and B to be negative the opposite would be true.

Hence, option (d) is correct.

24. The winning candidate gets 56% of the votes cast and the losing candidate gets 44% of the votes cast. Thus, the gap between the two is 12% of the votes cast = 144 votes. Thus, the votes cast = 1200. Since, this is 80% of the number of voters on the voting list, the number of people on the voting list = $1200/0.8 = 1500$.

25. $100000 \xrightarrow{10\% \uparrow} 110000 \xrightarrow{10\% \uparrow} 121000$
26. $10000 \text{ } \text{Æ} \text{ } 11000 \text{ (after a 10\% increase)} \text{ } \text{Æ} \text{ } 10450 \text{ (after a 5\% decrease)} \text{ } \text{Æ} \text{ } 12540 \text{ (after a 20\% increase)}$
27. His investments are 2000, 3000 and 5000 respectively. His dividends are: 200, 750 and 1000, which means total dividend = 1950.
28. Sushant 1080, hence Mohit = $1080 \times 1.2 = 1296$. Rajesh = $1296/0.9 = 1440$. 1440 out of 2000 means a percentage of 72%.
29. 30% students got a final score of 13. 10% students got a final score of 33 (inclusive of grace marks.) 35% students got a final score of 60
- Hence, average score of the class
- $$= \frac{0.35 \times 60 + 0.1 \times 33 + 0.3 \times 13}{0.75} = 37.6$$
30. Ram would spend 20%, 12% and 20.4% respectively on household expenditure, books and clothes. His savings would account for $100 - 20 - 12 - 20.4 = 47.6\%$ of his income. Since the savings = 9520, we get $0.476 \times \text{Income} = 9520 \text{ } \text{Æ} \text{ } \text{Income} = 9520/0.476 = 20000$
31. The only logic for this question is that Hans' salary would be more than Bhaskar's salary. Thus, only option (a) is possible for Hans' salary.
32. By using options, you can easily see that option (a) satisfies.
2500 females means 3000 males.
Increase = $2500 \times 0.2 + 3000 \times 0.11 = 830$
33. If Ashu's salary = 100, then Vicky's salary = 175. Ashu's new salary = 125, Vicky's new salary = $175 \times 1.4 = 245$. Percentage difference between Vicky's salary and Ashu's salary now = $120 \times 100/125 = 96\%$.
34. Let the second row contain 100 books. Then, the first row would contain 125 books and the third row would contain 75 books. The total number of books would be $100 + 125 + 75 = 300$. But this number is given as 600 which means that the total number of books

would be double the assumed value for each row. Thus, the first row would contain $125 \times 2 = 250$ books.

35. Since the only iron contained in the ore is 90% of 25%, the net iron percentage would be 22.5%. Thus, 60 kg should be 22.5% of the ore
 $\text{Æ } 60/0.225 = 266.66$
36. The data is insufficient since the number of matches to be played by India this year is not given. (You cannot assume that they will play 40 matches.)
37. 100000 Æ 110000 (after 1 year) Æ 121000 (after 2 years) Æ 133100 (after 3 years and at the start of the fourth year).
38. Total people present = $700 + 500 + 800 = 2000$.
Indians = $0.2 \times 700 + 0.4 \times 500 + 0.1 \times 800 = 420 = 21\%$ of the population. Thus, 79% of the people were not Indians.
39. Price of a cow after increase = 2400. Price of a calf after 30% increase = 1820. Cost of 12 cows and 24 calves = $12 \times 2400 + 24 \times 1820 = 72480$
40. If we take Ram as 100, we will get Bobby as 125 and Chandilya as 83.33. This means Chandilya's goods are priced at $\frac{2}{3}^{\text{rd}}$ Bobby's and hence he sells his goods 33.33% cheaper than Bobby.
41. 1 Bottle Æ 0.5x metres
? Bottles Æ 400 meters
Using unitary method, we get no. of bottles = $400/0.5x = 800/x$ Bottles.
42. $(100 \times 0.8 \times 0.25)\% = 80000 \text{ kg}$ Æ 20% = 80000 kg. Thus, the total quantity of hematite mined = 400000.
43. The total cost for a year = $2,50,000 + 2\% \text{ of } 2,50,000 + 2000$
 $= 2,55,000 + 2000 = 2,57,000$
To get a return of 15% he must earn: $2,57,000 \times 0.15 = 38,550$ in twelve months.
Hence, the monthly rent should be $38550/12 = 3212.5$.
44. The sales price of the first shirt is $\frac{8}{7} \times 42 = \text{` } 48$.

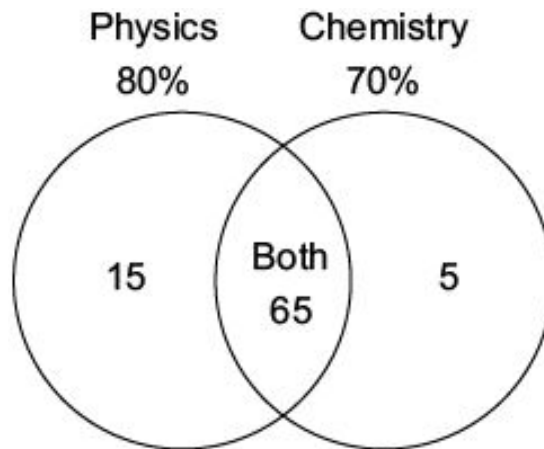
Hence, I am being offered a discount of ` 6 on a price of ` 48 – a 12.5% discount.

The sales price of the second shirt is $7/6 \times 36 = \text{` } 42$.

Hence, I am being offered a discount of ` 6 on ` 42 – a 14.28% discount. Hence, the second shirt is a better bargain.

45. 72% must have voted for Sonia Gandhi and 16% for Sushma Swaraj. Hence, $88 \times 3 = 264$.

46. The following Venn diagram would solve this problem:



We can clearly see from the above figure that 65% of the people passed both subjects. Since this value is given as 325, we get that the total number of students who appeared for the exam is 500.

47. Ravana spends 30% on house rent, 21% on children's education and 24% on clothes. Thus, he spends 75% of his total salary. He thus saves 25% of his salary which is given as being equal to 2500. Thus, his salary is ` 10000.

48. $100 \xrightarrow[\text{Sales increase}]{50\% \uparrow} 150 \xrightarrow[\text{Price drop}]{?} 82.5$ (final sales figure)

Hence, the required price drop is $67.5/150 = 45\%$ drop. Thus there is a drop of $250 \times .45 = 112.5$

49. A $C\%$ increase in income means the new income is $A(1 + C/100)$ while a $D\%$ increase in expenditure means that the new expenditure would be $X(1 + D/100)$. Thus, the new savings = $A(1 + C/100) - X(1 + D/100)$

50. In 2001, BMW = 15%, Maruti = 50% and hence Honda = 35%

Level of Difficulty (II)

$$1. \quad 100 \longrightarrow 150 \longrightarrow \underset{\text{(year 1)}}{75} \longrightarrow 112.5 \longrightarrow \underset{\text{(year 2)}}{56.25}$$

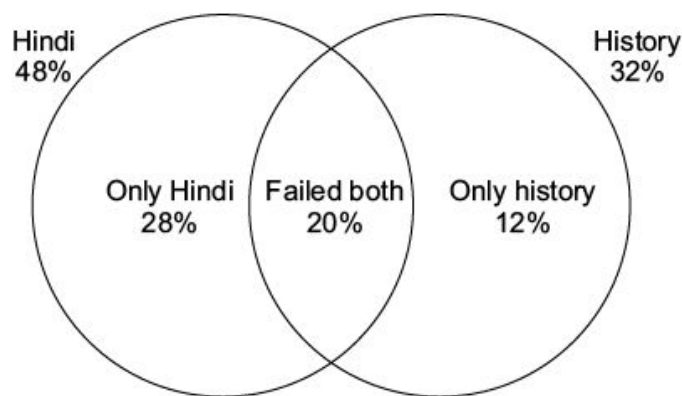
$$\longrightarrow 84.375 \longrightarrow 42.1875$$

Now, $42.1875 = \frac{1}{16}, 875$

Hence $1 \longrightarrow 400$

Also, year 2 donation is $56.25 \times 400 = 22500$

2. The following figure shows the percentage of failures:



From the figure it is clear that 60% of the people have failed in at least one subject, which means that 40% of the students would have passed in both subjects. This value is given as 880 people. Hence, there would be $880/0.4 = 2200$ students who would appear in the examination.

3. The thought process would go like:

If we assume 100 students

Total : 60 boys and 40 girls.

Fee waiver : 9 boys and 3 girls.

This means that a total of 12 people are getting a fee waiver. (But this figure is given as 90.)

Hence, 1 corresponds to 7.5.

Now, number of students not getting a fee waiver

= 51 boys and 37 girls

50% concession $\text{£} 25.5$ boys and 18.5 girls (i.e. a total of 44.)

Hence, the required answer = $44 \times 7.5 = 330$

4. Solve using options. Checking for option (b), gives us:

200000 £ 180000 £ 171000 £ 153900 £ 146205

(by consecutively decreasing 200000 by 10% and 5% alternately)

5. Total characters in her report = $25 \times 60 \times 75$.

Let the new no. of pages be n .

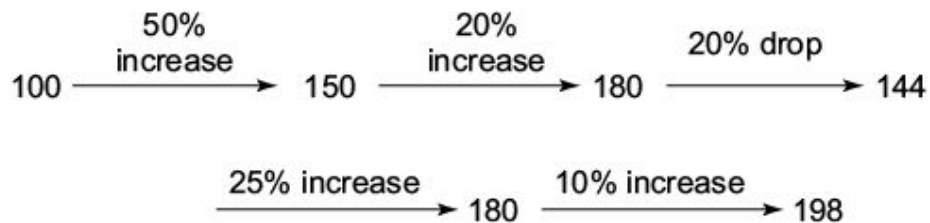
Then:

$$n \times 55 \times 90 = 25 \times 60 \times 75$$

$$n = 22.72$$

This means that her report would require 23 pages. A drop of 8% in terms of the pages.

6. The following percentage change thinking would give us the value of the percentage increase as 98%



7. The total raise of salary is 87.5% (That is what $15/8$ means here).

Using the options and PCG, you get option (c) as the correct answer.

8. October : November : December = 9 : 8 : 10.666 since, he got ` 40 more in December than October, we can conclude that $1.666 = 40 \text{ £ } 1 = 24$.

Thus, total Bonus for the three months is:

$$0.4 \times 27.666 \times 24 = 265.6$$

9. Solve through trial and error using the options. 12% (option a) is the only value that fits the situation.
10. 9% increase is offset by 8.26% decrease. Hence, option (b) is correct.
11. The expenditure increase can be calculated using PCG as:

100 \pm 112.5 \pm 123.75.

A 23.75% increase.

12. Rajesh's scores in each area is 65 and 82 respectively out of 100 each. Since, the exam is of a total of 250 marks (100+100+50) he needs a total of 195 marks in order to get his target of 78% overall. Thus, he should score $195 - 65 - 82 = 195 - 147 = 48$ marks in Sociology which would mean 96%.
13. The total wealth given would be 50% + 25% (which is got by 50% of the remaining 50%) + 12.5% (which is got by 50% of the remaining 25%). Thus, the total wealth given by him would be equivalent to 87.5% of the total. Since, this is equal to 130900 kilograms of gold, the total gold would be:
 $130900 \times \frac{8}{7} = 149600$.
14. Population at the start = 100.
Population after 2 years = $100 \times 1.08 \times 1.01 \times 1.08 \times 1.01 = 108.984$
Thus, the required percentage increase = 18.984%
15. After the migrations, 72.9% of the people would remain in the country. This would comprise females and males in the ratio of 1:2 (as given) and hence, the women's population left would be $\frac{1}{3}^{\text{rd}}$ of 72.9% = 24.3% which is given as being equal to 364500. Thus, the total population would be
 $364500 \times \frac{100}{24.3} = 1500000$
16. 24% of the total goes to urban Gujarat \$72 m
 $\therefore 1\% = \$ 3 \text{ mn}$.
The required value for Rural AP
= 50% of 20% = 10%
Hence, required answer = \$ 30 mn
17. In the previous question, the total FDI was \$ 300 mn.
A growth of 20% this year means a total FDI of \$360 mn.
The required answer is 12% of 10% of 360 mn
= 1.2% of 360 = \$4.32 mn.

18. The income goes to 120. Food expenditure has to be maintained at 25. (i.e. 20.833%)

Hence, percentage point drop from 25 to 20.833 is 4.16%

19. Assume the initial surface area as 100 on each side. A total of 6 such surfaces would give a total surface area of 600. Two surface areas would be impacted by the combined effect of length and breadth, two would be affected by length and height and two would be affected by breadth and height. Thus, the respective surface areas would be (110.25 twice, 126 twice and 126 twice) Thus, new surface area = $220.5 + 504 = 724.5$. A percentage increase of 20.75%. Option (d) is correct.
20. Option (c) fits the situation as if the ratio is 10:9, the value of B's salary would first go up from 10 to 12 and then come down from 12 to 9 (after a 25% decrease). On the other hand, the value of A's salary would go up from 9 to 11.25 and then come back to 9 (Note that a 25% increase followed by a 20% decrease gets one back to the starting value.)
21. Initial quantity of milk and water = 12 and 48 liters respectively. Since, this is already containing 20% milk, adding more milk to the mixture cannot make the mixture reach 15% milk. Hence, it is not possible.
22. On `100 he saves `6. On 115 he still saves `6. Thus, his expenditure goes up from 94 to 109- a percentage increase of 15 on 94 = 15.95%.
23. $B = 100, A = 150, C = 100, D = 160$. D is 160% of B . Note that this does not change if all the values are incremented by the same percentage value.
24. Think about this problem through alligation. Since, A spends 12% of his money and B spends 20% of his money and together they spend 15% of their money- we can conclude that the ratio of the money A had to the money B had would be 5:3. Hence, Total money with $A = 5 \times 1200/8 = 750$.
Money spent by $A = 12\%$ of $750 = 90$.
Money left with $A = 750 \times 90 = 660$.

25. Chanda would have spent 12% of Maya
Thus, her percentage of expenditure would be $0.12 M \times 100/C = 12 M/C$
26. Option (d) is correct and can be verified experimentally by using values for x, y, z and p .
27. The weekly change is equal to ` 1,68,000.
Hence, the daily collection will go up by $1,68,000/7 = 24,000$.
28. The total population of the town can be taken as $9 + 8 + 3 = 20$.
The number of literates would be:
 $80\% \text{ of } 9 + 70\% \text{ of } 8 + 90\% \text{ of } 3 = 7.2 + 5.6 + 2.7 = 15.5$
15.5 out of 20 represents a 77.5% literacy rate.
29. Solve using options. $2/25$ fits the requirement.
30. Let the exam be of 100 marks. A obtains 36 marks (10% or $1/10^{\text{th}}$ less than the pass marks) while B obtains 32 marks (11.11% or $1/9^{\text{th}}$ less than A). The sum of A and B's marks are $36 + 32 = 68$. To pass C can obtain 28 marks less than 68 – which is a percentage of $41(3/17)\%$. If C obtains 28% less marks than 68 or if C obtains 40% less marks than 68 he would still pass. Thus, option (d) is correct.
32. If $Z = 100, X = 80$ and $Y = 72$.
Thus, Y is less than X by 10%
33. Assume values of $x\% = 10\%$ and the original price as 100, then the final price = $K/100 = 99 \Rightarrow K = 9900$.
(Note: After an increase of 10% followed by a decrease of 10% a price of 100 would become 99).
Put these values of x , and K in the options. The option that gives a value of 100 for the original price should be the correct answer.
Option (d) is correct.
34. The correct answer should satisfy the following condition: If 'x' is the increased salary
 $x \times 0.8 \times 0.1 = (x - 4800) \times 0.8 \times 0.12$.
None of the first 3 options satisfies this.
In fact, solving for x we get $x = 25800$.

Option (d) is correct.

35. A sales tax of 7% on a price of 2568 would amount to a tax amount of 179.76. Since, the price is rounded off to the next higher integer, the tax would be rounded off to ₹180. This would also be the amount of discount (or reduction in price) that Reena is asking for.

36. The minimum price occurs at:

$$18 \times 30 + 6 \times 36 + 1 \times 40$$

$$\text{Hence, } 796/25 = 31.84$$

37. $36 \times 24 + 40 \times 1 = 904$

$$\text{Required answer} = 904/25 = 36.16.$$

38. If the ticket lots are halved, the maximum discount will be available for 9 tickets (25%). A maximum number of 16 tickets can be bought in ₹532 as: 9 tickets for ₹30 each. 6 tickets for ₹32 each and 1 ticket for ₹40

39. Solve using options.

Checking for option (a) will go as: According to this option 400 people have voted against the motion. Hence, originally 200 people must have favoured the motion. (Since, there is a 100% increase in the opponents)

This means that 200 people who were for the motion initially went against it.

This leaves us with 400 people who were for the motion initially (after the abduction.)

$1/3^{\text{rd}}$ of the original having been abducted, they should amount to half what is left.

This means that 600 (for) and 200 (against) were the original distribution of 800.

This option fits perfectly (given all the constraints) and hence is the correct answer.

40. 1 man is married to 1 woman.

$$\text{Hence, } 45\% \text{ of men} = 25\% \text{ of women.}$$

$$\text{i.e. } 0.45 M = 0.25 W$$

$$\text{Hence } \frac{0.45}{0.25} = \frac{M}{W}$$

Women to men ratio of 9:5

Using alligation, the required answer is 32.14

41. The required weight of the bucket to the water when full is 3:2.

If both the weights (bucket and water) are integers, then the total weight must be a multiple of 5.

Only option (c) shows this characteristic.

42. We do not have sufficient information to solve the question.

43. A 25% hike in the price would result in a 20% drop in consumption (if we are keeping expenditure constant). Thus, the drop in what he can buy of 20kg is equivalent to 20% of the original consumption. Hence, the original consumption should be 100 kg and the new consumption should be 80 kg. The increased price of rice would be $400/80 = ₹5$

44. Income of the salesman = $1200 + (1600 \times x)$

Where x is the number of ₹10000 sales he achieves over the initial ₹10000.

For $1200 + 1600 \times x = 7600$

We get $x = 4$.

This means that the sales value must be ₹50000.

45. A sales value of ₹9000 cannot be achieved.

46. This question is based on a product constancy situation. A 25% increment in the commission (How?? Note: When the commission goes up by 5 percentage points from 20 to 25, there is a 25% increment in the commission) would get offset by a 20% drop in the volume of the transaction. Option (d) is correct.

47. Out of a total of 100% votes; 80% voted. 16% were invalid and 20% went to the second placed candidate. This means that the maximum the winner can get is 44%. Options a, b and c are greater than 44% and hence cannot be correct. Hence, none of these.

48. At 12 noon, the watch would show the correct time (since till then the temperature range was below 40°C). The watch would gain 2% every hour between 12 and 4. An hour having 3600 seconds, it would gain 72 seconds in each of these hours. Thus, at 7 pm it would be $72 \times 4 = 288$ seconds ahead. The time exhibited would be 7: 04: 48.
49. Pepsi worth ` 16 would be containing 60 grams of vitamins.
50. Option (a) would cost: $6 + 7.5 = 13.5$
 Option (b) would cost: $12 + 3.2 = 15.2$
 Option (c) would cost: $4 + 3.2 + 2.8 = 10$
 Option (d) would cost: $12 + 2.8 = 14.8$
 Option (c) is the cheapest.

Level of Difficulty (III)

- Let the initial price of raw materials be 100. The new cost of the same raw material would be 115.
 The initial cost of labour would be 25 and the new cost would be 30% of 115 = 34.5
 The total cost initially would be `125.
 The total cost for the same usage of raw material would now be: $115 + 34.5 = 149.5$
 This cost has to be reduced to 125. The percentage reduction will be given by $24.5/149.5 = 17\%$ approx.
- Let the initial times allotted be: 50, 40 and 20 hours. Then, the time used in each activity is:
 20, 12 and 4 hours. Thus, 36 hours out of 110 are used in all.
 Hence, the answer is $36/110 = 32.72\%$
- The following structure would follow:
 Passed all: 5%
 Passed 4: 20% of 90% = 18%
 Passed 1: 25% of 90% = 22.5%
 Passed 2: 24.5%

Passed None: 5%

Passed 3: Rest ($100 - 5 - 18 - 22.5 - 24.5 - 5 = 25\%$)

But it is given that 300 people passed 3. Hence, $25\% = 300$.

Hence, 1200 students must have appeared in the test.

4. The third gallery making the capacity 'half as large again' means: an increase of 50%.

Further, it is given that : $4(\text{first} + \text{third}) = 12 (\text{second})$

In order to get to the correct answer, try to fit in the options into this situation.

(Note here that the question is asking you to find the capacity of the second gallery as a percentage of the first.)

If we assume option (a) as correct – 70% the following solution follows:

If second is 70, then first is 100 and first + second is 170. Then third will be 85 (50% of first + second).

Then the equation:

$4 \times (100 + 85)$ should be equal to 12×70

But this is not true.

Through trial and error, you can see that the third option fits correctly.

$4 \times (100 + 80) = 12 \times 60$.

Hence, it is the correct answer.

5. Let the initial percentage of salt be 10% in 100 liters of sea water in the flask.

10% of this is poured out (i.e. 10 liters are poured out) and the water heated so as to increase the percentage of salt in the beaker 5 times (we have assumed M as 5 here.)

This means that there will be 30% salt in the beaker. Since, the salt concentration is increased by only evaporating water, the amount of salt remains the same.

Initially the salt was 10% of 100 liters (= worth 10 liters). Hence, the water must have been worth 90 liters.

Now, since this amount of salt becomes worth 50% of the total solution, the amount of water left after evaporation would have been 1 liter and the total would be 2 liters.

When the 2 liters are mixed back again: The new concentration of salt in sea water would go up. In this specific case by alligation we would get the following alligation situation:

Mix 90 liters of 10% salted sea water with 2 liters of 50% salted sea water.

The result using alligation will be: $[10 + 40/46]$ % concentration of salted sea water. The value of the increase percentage will be $400/46$. (this will be the value of x)

Now, try to use the given options in order to match the fact that originally the flask contained 100 liters of sea water.

Use $M = 5$, $x = 400/46$,

Only option (b) matches the situation.

$$\frac{(9 \times 5 + 1) 400/46}{(5 - 1)} = 100$$

6. The only values that fit this situation are C 25%, B 30%, and A 45%. These are the percentage of votes polled. (Note: these values can be got either through trial and error or through solving $c + c + 5 + 1.5(c + 5) = 100\%$)

Then, 20% is 18000 (the difference between A & C .)

Hence, 90000 people must have voted and 100000 people must have been on the voter's list.

7. The net time lost over two weeks would be 0.25% of a week's time (since in the first week the clock loses $\frac{1}{2}\%$ and in the second week the clock gains $\frac{1}{4}\%$ on the true time.)

A week contains 168 hours. Hence, the clock loses 0.42 hours.i.e. 25.2 minutes or 25 minutes 12 seconds. Hence, the correct time would be 12:25:12.

8. Traveling for 2400 kms at 18 kmph, Vawal will use 133.33 liters of petrol every month. The increase in expenditure for Vawal will be $133.33 \times 0.7 \times 28 = \text{` 262 (approx)}$.

9. The required answer will be given by: $(7/107) \times 2400 = 157 \text{ km}$
10. The original expenditure is $28 \times 133.333 = \text{` } 3733.333$
 The new expenditure will be given by $28 \times 1.07 \times n/18$ where n = the no. of kilometers to travel.
 Since the new expenditure should increase by $\text{` } 200$, its value has to be equal to $\text{` } 3933.333$
 This gives us $n = 2363.15$
 Hence, the answer is e.
11. The shopkeeper would get the maximum revenue when everybody opts for a 4% resale of the right. In such a case, the revenue for the shopkeeper from each customer would be: 96% of 4000 = $4000 - 160 = 3840$. hence, total revenue is 38400.
12. Similarly, the highest discount would be if everybody opts for the 15% discount. In such a case, the total discount would be: $600 \times 10 = 6000$.
- 13-16.** Detailed solutions for 13–16 are given in the hints of LOD III.
- 17–23.** The average income estimated would be: Annual Income/14 (Underestimated savings).
 The average monthly expenditure would be: Annual expenditure/9 (Overestimated expenditure)
 17–19 are explained in the hints of LOD III.
20. $x/14 = 87$. Hence, annual income = 1218.
 New income = $1218/12 = 101.5$
 Change in estimated income due to the change in process of average calculation = $14.5/87 \approx 16.66\%$ increase.
21. Estimated monthly income would go up, while the estimated monthly expenditure would go down. Hence, Savings (estimated) would increase.
22. Cannot be determined since the percentage change would depend on the actual values which are not available for this question.
23. The estimated monthly expenditure would change from: $x/9$ to $x/11$.
 Hence, percentage drop in the ratio will be $2/11 \approx 18.18\%$
 24 to 29 are explained in the hints to LOD III.

31-34.The following table will give a clearer picture of the situation:

<i>Newspaper</i>	<i>Circulation (in 000)</i>	<i>Revenues</i>	<i>Commission</i>	<i>Net Revenues</i>
Deccan Emerald	373	746	20%	596.8
Times of Hindustan	247	494	25%	395.2
India's Times	297	594	30%	415.8

31. Reduction of $\frac{181 \times 100}{596.8} = 30.32\%$

32. The percentage difference between the revenues is: $(746 - 594) \times 100 / 746 = 20.37$

Hence, the required value is $30.32 / 20.37 = 1.488$

33. The day's cost of printing 373000 copies of Deccan Emerald is: $373000 \times 8 = 2984000$

Out of this, the paper recovers 596800. The remaining cost to be recovered would be: 2387200.

At ` 3000 per cc, 795.733 cc will have to be booked on any given day in order to obtain the cost. This represents 99.46% of the total value.

35. Times of Hindustan:

Total cost = $2,47,000 \times 7.5 = 18,52,500$

Net revenues from newspaper sales is 3,95,200

Cost to be covered through advertising = $18,52,500 - 3,95,200 = 14,57,300$.

At an ad rate of `1800 per cc, they would have to sell 809.61 cc i.e.73.6%

Similar calculations for India's Times will give 79.2%.

Hence, the percentage point difference = 5.6

36. If Ac 3rd costs 100, Ac 2nd would cost 120 and AC 1st would cost 190. 3 Tier ticket would cost : 47.5 and general ticket would cost 40.

AC 2nd ÷ 780 = 120

Then the difference between 3 Tier and general ticket would be: $7.5 \times 780 = 48.75$

37. Total cost $\text{£ } 100 + 120 + 190 + 47.5 + 40 = 497.5$

This gives $(497.5/120) \times 780 = 3233.75$.

43. Hursh Sarma's savings:

Month	Salary	Savings
1	10800	1080
2	10800	900
3	10800	900
4	10800	0
5	12000	1500
6	12000	1800
7	12000	2400
8	12000	1200
9	12000	1000
10	12000	1500
11	12000	1800
12	12000	2400

Required Ratio = $4800/900 = 5.333$

48. Assume he has 1200 francs, 1200 DM and 1200 Liras. If he converts everything to francs, the result will be:

1200 DM will convert to 240 Euros which will convert to 960 francs. But 51 Moolas = 1 franc. Thus the value of 1200 DM in terms of Moolas goes up from $1200 \times 36 = 43200$ to $960 \times 51 = 48960$. This increase in value has occurred only because of the change of currency. Hence, he should convert all his DM into Francs. However, before concluding on this you also will need to consider the effect of Liras.

It is evident that 1200 DM will yield 240 Euros, which would yield 720 Liras (since 1 euro is 3 lira), which in turn would yield 720×70

= 5040 Moolas.

Thus, it is evident that by converting DM into Liras the increase in value is higher than that achieved by converting DM into Francs.

Similarly, converting Francs to Liras also increases the value of the Francs.

1200×51 becomes equivalent to 900×70 .

Note: The thought process goes like this: 1200 Francs = 300 Euros (since 1 euro = 4 francs). Further 300 Euros equals 900 liras which equal 900×70 Moolas.

49. Cannot be determined since the conversion from dollar to Euro is not given, neither is the inter currency exchange rate between Lira, Francs and DMs.
50. Obviously, both a and c are required in order to answer this question.



Profit & Loss

INTRODUCTION

Traditionally, Profit & Loss has always been an important chapter for CAT. Besides, all other Management entrance exams like SNAP, CMAT, MAT, ATMA as well as Bank P.O. exams extensively use questions from this chapter. From the point of view of CAT, the relevance of this chapter has been gradually reducing. However, CAT being a highly unpredictable exam, my advice to students and readers would be to go through this chapter and solve it at least up to LOD II, so that they are ready for any changes in patterns.

Further, the Level of Difficulties at which questions are set in the various exams can be set as under:

LOD I: CAT, XLRI, IRMA, IIFT, CMAT, Bank PO aspirants, MAT, NIFT, NMAT, and SNAP and all other management exams.

LOD II: CAT, XLRI, IRMA (partially), etc.

LOD III: CAT, XLRI (students aiming for 60% plus in Maths in CAT).

THEORY

Profit & Loss are part and parcel of every commercial transaction. In fact, the entire economy and the concept of capitalism is based on the so called “Profit Motive”.

Profit & Loss in Case of Individual Transactions

We will first investigate the concept of Profit & Loss in the case of individual transactions. Certain concepts are important in such transactions. They are:

The price at which a person buys a product is the cost price of the product for that person. In other words, the amount paid or expended in either purchasing or producing an object is known as its Cost Price (also written as CP).

The price at which a person sells a product is the sales price of the product for that person. In other words, the amount got when an object is sold is called as the *Selling Price (SP)* of the object from the seller's point of view.

When a person is able to sell a product at a price higher than its cost price, we say that he has earned a profit. That is,

If $SP > CP$, the difference, $SP - CP$ is known as the profit or gain.

Similarly, if a person sells an item for a price lower than its cost price, we say that a loss has been incurred.

The basic concept of profit and loss is as simple as this.

If, however, $SP < CP$, then the difference, $CP - SP$ is called the loss.

It must be noted here that the Selling Price of the seller is the Cost Price of the buyer.

Thus we can say that in the case of profit the following formulae hold true:

1. Profit = $SP - CP$
2. $SP = \text{Profit} + CP$
3. $CP = SP - \text{Profit}$
4. Percentage Profit = $\frac{\text{Profit} \times 100}{CP}$

Percentage Profit is always calculated on CP unless otherwise stated.

Notice that

$$SP = CP + \text{Gain}$$

$$= CP + (\text{Gain on Re 1}) \times CP$$

$$= CP + (\text{Gain}\%/100) \times CP$$

Example: A man purchases an item for ₹ 120. If he sells it at a 20 per cent profit find his selling price.

Solution: The selling price is given by $120 + 120 \times 0.2 = 144$

$$= CP + (\text{Gain}\%/100) \times CP = CP \left[1 + \frac{\% \text{Gain}}{100} \right]$$

For the above problem, the selling price is given by this method as: Selling Price = $1.2 \times 120 = 144$.

Hence, we also have the following:

$$1. \quad SP = \left[1 + \frac{\% \text{Gain}}{100} \right] \times C.P = \frac{(100 + \text{Gain}\%) \times CP}{100}$$

$$2. \quad CP = \frac{100 \times SP}{(100 + \text{Gain}\%)}$$

In case of loss

$$1. \quad \text{Loss} = CP - SP$$

$$2. \quad SP = CP - \text{Loss}$$

$$3. \quad CP = SP + \text{Loss}$$

$$4. \quad \text{Loss}\% = \text{Loss on } ₹ 100 = \frac{\text{Loss} \times 100}{CP}$$

Percentage Loss is always calculated on CP unless otherwise stated.

The above situation (although it is the basic building block of Profit and Loss) is not the normal situation where we face Profit and Loss problems. In fact, there is a wide application of profit and loss in day-to-day business and economic transactions. It is in these situations that we normally have to work out profit and loss problems.

Having investigated the basic concept of profit and loss for an individual transaction of selling and buying one unit of a product, let us now look at the concept of profit and loss applied to day-to-day business and commercial transactions.

Profit & Loss as Applied to Business and Commercial Transactions

Profit & Loss when Multiple Units of a Product are Being Bought and Sold The basic concept of profit and loss remains unchanged for this situation. However, a common mistake in this type of problem can be avoided if the following basic principle is adopted:

Profit or Loss in terms of money can only be calculated when the number of items bought and sold are equal.

That is, Profit or Loss in money terms cannot be calculated unless we equate the number of products bought and sold.

This is normally achieved by equating the number of items bought and sold at 1 or 100 or some other convenient figure as per the problem asked.

Overlooking of this basic fact is one of the most common mistakes that students are prone to making in the solving of profit and loss problems.

Types of Costs In any business dealing, there is a situation of selling and buying of products and services. From the sellers point of view, his principle interest, apart from maximising the sales price of a product/service, is to minimise the costs associated with the selling of that product/service. The costs that a businessman/trader faces in the process of day-to-day business transaction can be subdivided into three basic categories:

- 1. Direct Costs or Variable Costs** This is the cost associated with direct selling of product/service. In other words, this is the cost that varies with every unit of the product sold. Hence, if the variable cost in selling a pen for ` 20 is ` 5, then the variable cost for selling 10 units of the same pen is $10 \times 5 = \text{` } 50$.

As is clear from the above example, that part of the cost that varies directly for every additional unit of the product sold is called as direct or variable cost.

Typical examples of direct costs are: Raw material used in producing one unit of the product, wages to labour in producing one unit of the product when the wages are given on a piece rate basis,

and so on. In the case of traders, the cost price per unit bought is also a direct cost (i.e. every such expense that can be tied down to every additional unit of the product sold is a direct cost).

2. **Indirect Costs (Overhead Costs) or Fixed Costs** There are some types of costs that have to be incurred irrespective of the number of items sold and are called as fixed or indirect costs. For example, irrespective of the number of units of a product sold, the rent of the corporate office is fixed. Now, whether the company sells 10 units or 100 units, this rent is fixed and is hence a fixed cost.

Other examples of indirect or fixed costs: Salary to executives and managers, rent for office, office telephone charges, office electricity charges.

Apportionment of indirect (or fixed) costs: Fixed Costs are apportioned equally among each unit of the product sold. Thus, if n units of a product is sold, then the fixed cost to be apportioned to each unit sold is given by

$$\frac{\text{Fixed costs}}{n}$$

3. **Semi-Variable Costs** Some costs are such that they behave as fixed costs under normal circumstances but have to be increased when a certain level of sales figure is reached. For instance, if the sales increase to such an extent that the company needs to take up additional office space to accommodate the increase in work due to the increase in sales then the rent for the office space becomes a part of the semi-variable cost.

The Concept of Margin or Contribution per unit The difference between the value of the selling price and the variable cost for a product is known as the margin or the contribution of the product. This margin goes towards the recovery of the fixed costs incurred in selling the product/service.

The Concept of the Break-even Point The break-even point is defined as the volume of sale at which there is no profit or no loss. In other words, the sales value in terms of the number of units sold at which the company

breaks even is called the break-even point. This point is also called the break-even sales.

Since for every unit of the product the contribution goes towards recovering the fixed costs, as soon as a company sells more than the break-even sales, the company starts earning a profit. Conversely, when the sales value in terms of the number of units is below the break-even sales, the company makes losses.

The entire scenario is best described through the following example.

Let us suppose that a *paan* shop has to pay a rent of ₹ 1000 per month and salaries of ₹ 4000 to the assistants.

Also suppose that this *paan* shop sells only one variety of *paan* for ₹ 5 each. Further, the direct cost (variable cost) in making one *paan* is ₹ 2.50 per *paan*, then the margin is ₹ $(5 - 2.50) = ₹ 2.50$ per *paan*.

Now, break-even sales will be given by:

Break-even-sales = Fixed costs/Margin per unit = $5000/2.5 = 2000$ *paans*.

Hence, the *paan* shop breaks-even on a monthly basis by selling 2000 *paans*.

Selling every additional *paan* after the 2000th *paan* goes towards increasing the profit of the shop. Also, in the case of the shop incurring a loss, the number of *paans* that are left to be sold to break-even will determine the quantum of the loss.

Note the following formulae:

$$\text{Profit} = (\text{Actual sales} - \text{Break-even sales}) \times \text{Contribution per unit}$$

Also in the case of a loss:

$$\text{Loss} = (\text{Break-even sales} - \text{Actual sales}) \times \text{Contribution per unit}$$

Also, if the break-even sales equals the actual sales, then we reach the point of no profit no loss, which is also the technical definition of the break-even point.

Note that the break-even point can be calculated on the basis of any time period (but is normally done annually or monthly).

Profit Calculation on the Basis of Equating the Amount Spent and the Amount Earned

We have already seen that profit can only be calculated in the case of the number of items being bought and sold being equal. In such a case, we take the difference of the money got and the money given to get the calculation of the profit or the loss in the transaction.

There is another possibility, however, of calculating the profit. This is done by equating the money got and the money spent. In such a case, the profit can be represented by the amount of goods left. This is so because in terms of money the person going through the transaction has got back all the money that he has spent, but has ended up with some amount of goods left over after the transaction. These left over items can then be viewed as the profit or gain for the individual in consideration.

Hence, profit when money is equated is given by Goods left. Also, cost in this case is represented by Goods sold and hence percentage profit =

$$\frac{\text{Goods left}}{\text{Goods sold}} \times 100.$$

Example: A fruit vendor recovers the cost of 25 mangoes by selling 20 mangoes. Find his percentage profit.

Solution: Since the money spent is equal to the money earned the percentage profit is given by:

$$\% \text{ Profit} = \frac{\text{Goods left}}{\text{Goods sold}} \times 100 = 5 \times 100/20 = 25\%$$

Concept of Mark Up

Traders/businessmen, while selling goods, add a certain percentage on the cost price. This addition is called percentage mark up (if it is in money terms), and the price thus obtained is called as the marked price (this is also the price printed on the product in the shop).

The operative relationship is

$$\text{CP} + \text{Mark up} = \text{Marked price}$$

or $CP + \% \text{ Mark up on } CP = \text{Marked Price}$

The product is normally sold at the marked price in which case the marked price = the selling price

If the trader/shopkeeper gives a discount, he does so on the marked price and after the discount the product is sold at its discounted price.

Hence, the following relationship operates:

$CP + \% \text{ Mark up (Calculated on } CP) = \text{Marked Price}$

$\text{Marked price} - \% \text{ Discount} = \text{Selling price}$

Use of PCG in Profit and Loss

1. The relationship between CP and SP is typically defined through a percentage relationship. As we have seen earlier, this percentage value is called as the percentage mark up. (And is also equal to the percentage profit if there is no discount).

Consider the following situation —

Suppose the SP is 25% greater than the CP. This relationship can be seen in the following diagram.

$CP \xrightarrow{25\% \uparrow} SP$

In such a case the reverse relationship will be got by the AÆBÆA application of PCG and will be seen as follows:

If the profit is 25% :

Example: $CP \xrightarrow{25\% \uparrow} SP \xrightarrow{20\% \downarrow} CP$

Suppose you know that by selling an item at 25%, profit the Sales price of a bottle of wine is ` 1600. With this information, you can easily calculate the cost price by reducing the sales price by 20%. Thus, the CP is

$1600 \xrightarrow[- 320]{20\% \downarrow} 1280$



WORKED-OUT PROBLEMS

Before we go into problems based on profit and loss, the reader should realize that there are essentially four phases of a profit and loss problem. These are connected together to get higher degrees of difficulty.

These are clues for (a) Cost calculations (b) Marked price calculations (c) Selling price calculations (d) Over-heads/fixed costs calculations.

It is left to the reader to understand the interrelationships between a , b , c and d above. (These have already been stated in the earlier part of this chapter.)

Problem 6.1 A shopkeeper sold goods for ₹ 2000 at a profit of 50%. Find the cost price for the shopkeeper.

Solution The shopkeeper sells his items at a profit of 50%. This means that the selling price is 150% of cost price (Since $CP + \% \text{ Profit} = SP$)

For short you should view this as $SP = 1.5 \text{ CP}$.

The problem with this calculation is that we know what 150% of the cost price is but we do not know what the cost price itself is. Hence, we have difficulty in directly working out this problem. The calculation will become easier if we know the percentage calculation to be done on the basis of the selling price of the goods.

Hence look at the equation from the angle $\therefore CP = SP/1.5$.

Considering the SP as $SP/1$, we have to find CP as $SP/1.5$. This means that the denominator is increasing by 50%. But from the table of denominator change to ratio change of the chapter of percentages, we can see that when the denominator increases by 50% the ratio decreases by 33.33%.

Interpret this as the CP can be got from the SP by reducing the SP by 33.33%. Hence, the answer is $2000 - (1/3) \times 2000 = ₹ 1333.33$

Also, this question can also be solved through options by going from CP (assumed from the value of the option) to the SP by increasing the assumed

CP by 50% to check whether the SP comes out to 2000. If a 50% increase in the assumed CP does not make the SP equal 2000 it means that the assumed CP is incorrect. Hence, you should move to the next option. Use logic to understand whether you go for the higher options or the lower options based on your rejection of the assumed option.

Note: The above question will never appear as a full question in the examination but might appear as a part of a more complex question. If you are able to interpret this statement through the denominator change to ratio change table, the time requirement will reduce significantly and you will gain a significant time advantage over this statement.

Problem 6.2 A man buys a shirt and a trousers for ₹ 371. If the trouser costs 12% more than the shirt, find the cost of the shirt.

Solution Here, we can write the equation:

$s + 1.12s = 371$ ∴ $s = 371/2.12$ (however, this calculation is not very easily done)

An alternate approach will be to go through options. Suppose the options are

- | | |
|-----------|-----------|
| (a) ₹ 125 | (b) ₹ 150 |
| (c) ₹ 175 | (d) ₹ 200 |

Checking for, say, ₹ 150, the thought process should go like:

Let s = cost of a shirt

If $s = 150$, $1.12s$ will be got by increasing s by 12% i.e. 12% of 150 = 18. Hence the value of $1.12s = 150 + 18 = 168$ and $s + 1.12s = 318$ is not equal to 371. Hence check the next higher option.

If $s = 175$, $1.12s = s + 12\% \text{ of } s = 175 + 21 = 196$. i.e. $2.12s = 371$.

Hence, Option (c) is correct.

Problem 6.3 A shopkeeper sells two items at the same price. If he sells one of them at a profit of 10% and the other at a loss of 10%, find the percentage profit/loss.

Generic question: A shopkeeper sells two items at the same price. If he sells one of them at a profit of $x\%$ and the other at a loss of $x\%$, find the

percentage profit/loss.

Solution The result will always be a loss of $[(x/10)]^2\%$. Hence, the answer here is $[(10/10)]^2\% = 1\%$ loss.

Problem 6.4 For Problem 6.3, find the value of the loss incurred by the shopkeeper if the price of selling each item is ₹ 160.

Solution When there is a loss of 10% ₹ 160 = 90% of CP_1 . $\therefore CP_1 = 177.77$

When there is a profit of 10% ₹ 160 = 110% of CP_2 $\therefore CP_2 = 145.45$

Hence total cost price = $177.77 + 145.45 = 323.23$ while the net realisation is ₹ 320.

Hence loss is ₹ 3.23.

Short cut for calculation: Since by selling the two items for ₹ 320 the shopkeeper gets a loss of 1% (from the previous problem), we can say that ₹ 320 is 99% of the value of the cost price of the two items. Hence, the total cost is given by $320/0.99$ (solution of this calculation can be approximately done on the percentage change graphic).

Problem 6.5 If by selling 2 items for ₹ 180 each the shopkeeper gains 20% on one and loses 20% on the other, find the value of the loss.

Solution The percentage loss in this case will always be $(20/10)^2 = 4\%$ loss.

We can see this directly as 360 ₹ 96% of the CP $\therefore CP = 360/0.96$. Hence, by percentage change graphic 360 has to be increased by 4.166 per cent = $360 + 4.166\%$ of 360 = $360 + 14.4 + 0.6 = ₹ 375$.

Hence, the loss is ₹ 15.

Problem 6.6 By selling 15 mangoes, a fruit vendor recovers the cost price of 20 mangoes. Find the profit percentage.

Solution Here since the expenditure and the revenue are equated, we can use $\text{percentage profit} = (\text{goods left} \times 100)/\text{goods sold} = 5 \times 100/15 = 33.33\%$.

Problem 6.7 A dishonest shopkeeper uses a 900 gram weight instead of 1 kilogram weight. Find his profit percent if he sells per kilogram at the same price as he buys a kilogram.

Solution Here again the money spent and the money got are equal. Hence, the percentage profit is got by $\text{goods left} \times 100 / \text{goods sold}$.

This gives us 11.11%.

Problem 6.8 A manufacturer makes a profit of 15% by selling a colour TV for ₹ 6900. If the cost of manufacturing increases by 30% and the price paid by the retailer is increased by 20%, find the profit percent made by the manufacturer.

Solution For this problem, the first line gives us that the cost price of the TV for the manufacturer is ₹ 6000.

(By question stem analysis you should be able to solve this part of the problem in the first reading and reach at the figure of 6000 as cost, before you read further. This can be achieved advantageously if your percentage rule calculations are strong. Hence, work on it. The better you can get at it the more it will benefit you. In fact, one of the principal reasons I get through the CAT every year is the strength in percentage calculation. Besides, percentage calculation will also go a long way in improving your scores in data Interpretation.)

Further, if you have got to the 6000 figure by the end of the first line, reading further you can increase this advantage by calculating while reading as follows:

Manufacturing cost increase by 30% \Rightarrow New manufacturing cost = 7800 and new selling price is $6900 + 20\% \text{ of } 6900 = 6900 + 1380 = 8280$.

Hence, profit = $8280 - 7800 = 480$ and profit percent = $480 \times 100 / 7800 = 6.15\%$.

Problem 6.9 Find a single discount to equal three consecutive discounts of 10%, 12% and 5%.

Solution Using percentage change graphic starting from 100: we get 100 \Rightarrow 88 \Rightarrow 83.6 \Rightarrow 75.24 (Note we can change percentages in any order).

Hence, the single discount is 24.76%.

Problem 6.10 A reduction in the price of petrol by 10% enables a motorist to buy 5 gallons more for \$180. Find the original price of petrol.

Solution 10% reduction in price $\hat{=}$ 11.11% increase in consumption.

But 11.11% increase in consumption is equal to 5 gallons. Hence, original consumption is equal to 45 gallons for \$180. Hence, original price = 4\$ per gallon.

Problem 6.11 Ashok bought an article and spent ₹ 110 on its repairs. He then sold it to Bhushan at a profit of 20%. Bhushan sold it to Charan at a loss of 10%. Charan finally sold it for ₹ 1188 at a profit of 10%. How much did Ashok pay for the article.

(a) ₹ 890

(b) ₹ 1000

(c) ₹ 780

(d) ₹ 840

Solution Solve through options using percentage rule and keep checking options as you read. Try to finish the first option-check before you finish reading the question for the first time. Also, as a thumb rule always start with the middle most convenient option. This way you are likely to be required lesser number of options, on an average.

Also note that LOD II and LOD III questions will always essentially use the same sentences as used in LOD I questions. The only requirement that you need to have to handle LOD II and III questions is the ability to string together a set of statements and interconnect them.

Problem 6.12 A dishonest businessman professes to sell his articles at cost price but he uses false weights with which he cheats by 10% while buying and by 10% while selling. Find his percentage profit.

Solution Assume that the businessman buys and sells 1 kg of items. While buying he cheats by 10%, which means that when he buys 1 kg he actually takes 1100 grams. Similarly, he cheats by 10% while selling, that is, he gives only 900 grams when he sells a kilogram. Also, it must be understood that since he purportedly buys and sells the same amount of goods and he is trading at the same price while buying and selling, money is already equated in this case. Hence, we can directly use: % Profit = $(\text{Goods left} \times 100 / \text{Goods sold}) = 200 \times 100 / 900 = 22.22\%$ (Note that you should not need

to do this calculation since this value comes from the fraction to percentage conversion table).

If you are looking at 70% plus net score in quantitative ability you should be able to come to the solution in about 25 seconds inclusive of problem reading time. And the calculation should go like this:

Money is equated $\text{₹ \% profit} = 2/9 = 22.22\%$

The longer process of calculation in this case would be involving the use of equating the amount of goods bought and sold and the money value of the profit. However, if you try to do this you will easily see that it requires a much higher degree of calculations and the process will tend to get messy.

The options for doing this problem by equating goods would point to comparing the price per gram bought or sold. Alternatively, we could use the price per kilogram bought and sold (which would be preferable to equating on a per gram basis for this problem).

Here the thought process would be:

Assume price per kilogram = ₹ 1000. Therefore, he buys 1100 grams while purchasing and sells 900 grams while selling.

To equate the two, use the following process:

	<i>Money paid</i>		<i>Amount of goods</i>
Buying	₹ 1000	1100	grams (Reduce this by 10%)
After reduction	₹ 900	990	grams
Selling	₹ 1000	900	grams (Increase this by 10%)
After increase	₹ 1100	990	

Problem 6.13 RFO Tripathi bought some oranges in Nagpur for ₹ 32. He has to sell it off in Yeotmal. He is able to sell off all the oranges in Yeotmal and on reflection finds that he has made a profit equal to the cost price of 40 oranges. How many oranges did RFO Tripathi buy?

Solution Suppose we take the number of oranges bought as x . Then, the cost price per orange would be ₹ $32/x$, and his profit would be $40 \times 32/x =$

$1280/x$.

To solve for x , we need to equate this value with some value on the other side of the equation. But, we have no information provided here to find out the value of the variable x . Hence, we cannot solve this equation.

Problem 6.14 By selling 5 articles for ₹ 15, a man makes a profit of 20%. Find his gain or loss percentage if he sells 8 articles for ₹ 18.4?

Questions of this type normally appear as part of a more complex problem in an exam like the CAT.

Remember, such a question should be solved by you as soon as you finish reading the question by solving-while-reading process, as follows.

By selling 5 articles for ₹ 15, a man makes a profit of 20% \therefore SP = 3. Hence, CP = 2.5, if he sells 8 articles for ₹ 18.4 \therefore SP = 2.3. Hence percentage loss = 8%. For solving this question through this method with speed you need to develop the skill and ability to calculate percentage changes through the percentage change graphic. For this purpose, you should not be required to use a pencil and a paper.

Problem 6.15 Oranges are bought at 12 for a rupee and are sold at 10 for a rupee. Find the percentage profit or loss.

Solution Since money spent and got are equated, use the formula for profit calculation in terms of goods left/goods sold.

This will give you percentage profit = $2/10 = 20\%$.

Alternatively, you can also equate the goods and calculate the percentage profit on the basis of money as

CP of 1 orange = 8.33 paise

SP of 1 orange = 10 paise

8.33 paise \therefore 10 paise (corresponds to a percentage increase of 20% on CP)

Problem 6.16 In order to maximise its profits, AMS Corporate defines a function. Its unit sales price is ₹ 700 and the function representing the cost of production = $300 + 2p^2$, where p is the total units produced or sold. Find the most profitable production level. Assume that everything produced is necessarily sold.

Solution The function for profit is a combination of revenue and costs. It is given by Profit = Revenue – Costs = $700p - (300 + 2p^2) = -2p^2 + 700p - 300$.

In order to find the maxima or minima of any quadratic function, we differentiate it and equate the differentiated equation to zero.

Thus, the differentiated profit function is $-4p + 700 = 0 \Rightarrow p = 175$. This value of production will yield the maximum profits in this case.

Note: Whether a quadratic function is maximum or minimum is decided by redifferentiating the differentiated equation. We then look at the sign of the constant term to determine whether the value got by equating the differentiated equation to zero corresponds to the maximum or the minimum. In the case of the constant term, left being negative, we say that the function is a maxima function and hence the solution point got would be a maximum point. In the event that the final constant term is positive, it is a minimum function.

Short cut Just look at the coefficient of x^2 in the function. If it is positive, equating the first differentiation to zero would yield the minimum point, and if the coefficient of x^2 is negative, the function is a maximum function.

Problem 6.17 For Problem 6.16, what is the value of the maximum profits for AMS Corporate?

Solution For this, continuing from the previous question's solution, we just put the value of $p = 175$ in the equation for profit. Thus, substitute $p = 175$ in the equation. Profit = $-2p^2 + 700p - 300$ and get the answer.

Problem 6.18 A shopkeeper allows a rebate of 25% to the buyer. He sells only smuggled goods and as a bribe, he pays 10% of the cost of the article. If his cost price is ₹ 2500, then find what should be the marked price if he desires to make a profit of 9.09%.

Solution Use solving-while-reading as follows: Cost price (= 2500) + Bribe (= 10% of cost of article = 250) = Total cost to the shopkeeper (2500

+ 250 = 2750).

He wants a profit of 9.09 percent on this value. Using fraction to percentage change table we get $2750 + 9.09\% \text{ of } 2750 = 2750 + 250 = ₹ 3000$.

But this ₹ 3000 is got after a rebate of 25%. Since we do not have the value of the marked price on which 25% rebate is to be calculated, it would be a good idea to work reverse through the percentage change graphic:

Going from the marked price to ₹ 3000 requires a 25% rebate. Hence the reverse process will be got by increasing ₹ 3000 by 33.33% and getting ₹ 4000.

[Notice the use of percentage change graphic in general and the product constancy table in particular in the solving of this question]

Problem 6.19 A man sells three articles, one at a loss of 10%, another at a profit of 20% and the third one at a loss of 25%. If the selling price of all the three is the same, find by how much percent is their average CP lower than or higher than their SP.

Solution

Note: It is always convenient to solve questions involving percentages by using the number 100. The reason for this is that it reduces the amount of effort required in calculating the solution. Hence, it goes without saying that the variable to be fixed at 100 should be the one with the highest number of calculations associated with it. Another thumb rule for this is that the variable to be fixed at 100 should be the one with which the most difficult calculation set is associated.

We have to calculate: $(\text{average CP} - \text{average SP})/\text{average SP}$.

Here, the selling price is equal in all three cases. Since the maximum number of calculations are associated with the SP, we assume it to be 100. This gives us an average SP of 100 for the three articles. Then, the first article will be sold at 111.11, the second at 83.33 and the third at 133.33. (The student is advised to be fluent at these calculations) Further, the CP of the three articles is $111.11 + 83.33 + 133.33 = 327.77$.

The average CP of the three articles is $327.77/3 = 109.2566$.

Hence, $(\text{average CP} - \text{average SP})/\text{average SP} = 9.2566\%$. higher

Any other process adopted for this problem is likely to require much more effort and time.

Note: This process will be feasible if you have worked well with the percentage calculation techniques of the previous chapter.

OceanofPDF.com

LEVEL OF DIFFICULTY (I)

1. By selling a watch for ₹ 495, a shopkeeper incurs a loss of 10%. Find the cost price of the watch for the shopkeeper.
(a) ₹ 545 (b) ₹ 550
(c) ₹ 555 (d) ₹ 565
2. By selling a cap for ₹ 34.40, a man gains 7.5%. What will be the CP of the cap?
(a) ₹ 32.80 (b) ₹ 32
(c) ₹ 32.40 (d) ₹ 28.80
3. A cellular phone when sold for ₹ 4600 fetches a profit of 15%. Find the cost price of the cellular phone.
(a) ₹ 4300 (b) ₹ 4150
(c) ₹ 4000 (d) ₹ 4500
4. A machine costs ₹ 375. If it is sold at a loss of 20%, what will be its cost price as a percentage of its selling price?
(a) 80% (b) 120%
(c) 110% (d) 125%
5. A shopkeeper sold goods for ₹ 2400 and made a profit of 25% in the process. Find his profit per cent if he had sold his goods for ₹ 2040.
(a) 6.25% (b) 7%
(c) 6.20% (d) 6.5%
6. A digital diary is sold for ₹ 935 at a profit of 10%. What would have been the actual profit or loss on it, if it had been sold for ₹ 810?
(a) ₹ 45 (b) ₹ 40
(c) ₹ 48 (d) ₹ 50
7. A music system when sold for ₹ 4500 gives a loss of 16.66% to the merchant who sells it. Calculate his loss or gain per cent, if he sells

it for ₹ 5703.75.

(a) Loss of 5.625%

(b) Profit of 8.33%

(c) Loss of 7%

(d) Profit of 5.625%

8. By selling bouquets for ₹ 63, a florist gains 5%. At what price should he sell the bouquets to gain 10% on the cost price?

(a) ₹ 66

(b) ₹ 69

(c) ₹ 72

(d) ₹ 72.50

9. A shopkeeper bought 240 chocolates at ₹ 9 per dozen. If he sold all of them at Re. 1 each, what was his profit per cent?

(a) $66\frac{1}{6}\%$

(b) $33\frac{1}{3}\%$

(c) 24%

(d) 27%

10. A feeding bottle is sold for ₹ 120. Sales tax accounts for one-fifth of this and profit one-third of the remainder. Find the cost price of the feeding bottle.

(a) ₹ 64

(b) ₹ 72

(c) ₹ 68

(d) ₹ 76

11. A coal merchant makes a profit of 20% by selling coal at ₹ 25 per quintal. If he sells the coal at ₹ 22.50 per quintal, what is his profit per cent on the whole investment?

(a) 6%

(b) 6.66%

(c) 7.5%

(d) 8%

12. The cost price of a shirt and a pair of trousers is ₹ 371. If the shirt costs 12% more than the trousers, find the cost price of the trouser.

(a) ₹ 125

(b) ₹ 150

(c) ₹ 175

(d) ₹ 200

13. A pet shop owner sells two puppies at the same price. On one he makes a profit of 20% and on the other he suffers a loss of 20%. Find his loss or gain per cent on the whole transaction.

(a) Gain of 4%

(b) No profit no loss

(c) Loss of 10%

(d) Loss of 4%

14. The marked price of a table is ₹ 1200, which is 20% above the cost price. It is sold at a discount of 10% on the marked price. Find the profit per cent.

(a) 10%

(b) 8%

(c) 7.5%

(d) 6%

15. 125 toffees cost ₹ 75. Find the cost of one million toffees if there is a discount of 40% on the selling price for this quantity.

(a) ₹ 3,00,000

(b) ₹ 3,20,000

(c) ₹ 3,60,000

(d) ₹ 4,00,000

16. A shopkeeper marks the price of an article at ₹ 80. Find the cost price if after allowing a discount of 10% he still gains 20% on the cost price.

(a) ₹ 53.33

(b) ₹ 70

(c) ₹ 75

(d) ₹ 60

17. In Question 16, what will be the selling price of the article if he allows two successive discounts of 5% each?

(a) ₹ 72

(b) ₹ 72.20

(c) ₹ 75

(d) ₹ 71.66

18. A dozen pairs of gloves quoted at ₹ 80 are available at a discount of 10%. Find how many pairs of gloves can be bought for ₹ 24.

(a) 4

(b) 5

(c) 6

(d) 8

19. Find a single discount equivalent to the discount series of 20%, 10%, 5%.

(a) 30%

(b) 31.6%

(c) 68.4%

(d) 35%

20. The printed price of a calculator is ₹ 180. A retailer pays ₹ 137.7 for it by getting successive discounts of 10% and another rate which is

illegible. What is the second discount rate?

- (a) 12% (b) 12.5%
- (c) 15% (d) 20%

21. How much percent more than the cost price should a shopkeeper mark his goods, so that after allowing a discount of 12.5% he should have a gain of 5% on his outlay?

- (a) 9.375 (b) 16.66%
- (c) 20% (d) 25%

22. In order to maintain the price line, a trader allows a discount of 10% on the marked price of goods in his shop. However, he still makes a gross profit of 17% on the cost price. Find the profit per cent he would have made on the selling price had he sold at the marked price.

- (a) 23.07% (b) 30%
- (c) 21.21% (d) 25%

23. A whole-seller allows a discount of 20% on the list price to a retailer. The retailer sells at 5% discount on the list price. If the customer paid ₹ 38 for an article, what profit is made by the retailer?

- (a) ₹ 10 (b) ₹ 8
- (c) ₹ 6 (d) ₹ 12

24. In Question 23, also find the retailer's percentage profit on his cost giving your answer correct to two decimal places.

- (a) 12.5% (b) 16.66%
- (c) 18.75% (d) 20%

25. The cost of production of a cordless phone set in 2011 is ₹ 900, divided between material, labour and overheads in the ratio 3 : 4 : 2. If the cordless phone set is marked at a price that gives a 20% profit on the component of price accounted for by labour, what is the marked price of the set?

- (a) ₹ 980 (b) ₹ 1080

(c) ₹ 960 (d) ₹ 1020

26. For Question 25, if subsequently in 2012, the cost of material, labour and overheads increased by 20%, 30% and 10% respectively, calculate the cost of manufacturing in 2012.

(a) ₹ 1150 (b) ₹ 1050
(c) ₹ 1080 (d) ₹ 1100

27. What should be the new marked price if the criteria for profit is to remain the same as for Question 25 above?

(a) ₹ 1320 (b) ₹ 1204
(c) ₹ 1244 (d) None of these

28. By selling a casserole for ₹ 960, a man incurs a loss of 4%. At what price should he sell the casserole to gain 16%?

(a) ₹ 1160 (b) ₹ 1080
(c) ₹ 1120 (d) None of these

29. A man sells 5 articles for ₹ 15 and makes a profit of 20%. Find his gain or loss percent if he sells 8 such articles for ₹ 18.40.

(a) 2.22% profit (b) 2.22% loss
(c) 8% loss (d) 8% profit

30. The cost price of 50 mangoes is equal to the selling price of 40 mangoes. Find the percentage profit.

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

31. A owns a house worth ₹ 10,000. He sells it to B at a profit of 15%. After some time, B sells it back to A at 15% loss. Find A's loss or gain percent.

(a) 2.25% gain (b) 6.25% gain
(c) 17.64% gain (d) 17.25% gain

32. A shopkeeper bought locks at the rate of 8 locks for ₹ 34 and sold them at the rate of 12 locks for ₹ 57. Calculate his gain percent.

- (a) 9.33% (b) 12.5%
(c) 11.11% (d) 11.76%

33. Anil bought an article at ₹ 200 and sold it at a profit of 10%. What would have been the increase in the profit percent if it was sold for ₹ 230?

- (a) 5% (b) 10%
(c) 15% (d) None of these

34. A makes an article for ₹ 120 and sells it to B at a profit of 25%. B sells it to C who sells it for ₹ 198, making a profit of 10%. What profit percent did B make?

- (a) 25% (b) 20%
(c) 16.66% (d) 15%

35. A reduction of 10% in the price of sugar enables a housewife to buy 6.2 kg. more for ₹ 279. Find the reduced price per kilogram

- (a) ₹ 5 (b) ₹ 4.5
(c) ₹ 4.05 (d) None of these

36. A man buys 50 kg of oil at ₹ 10 per kilogram and another 40 kg of oil at ₹ 12 per kilogram and mixes them. He sells the mixture at the rate of ₹ 11 per kilogram. What will be his gain percent if he is able to sell the whole lot?

- (a) $\frac{100}{98}\%$ (b) $100(10/49)\%$
(c) $10(1/49)\%$ (d) None of these

37. If the cost price of 30 articles is equal to the selling price of 20 articles, find the profit percent.

- (a) 33.33% (b) 40%
(c) 50% (d) 60%

38. A shopkeeper sells sugar in such a way that the selling price of 950 gm is the same as the cost price of one kilogram. Find his gain

percent.

- (a) 100/17% (b) 150/17%
(c) 5(5/19)% (d) 1/19%

39. A dealer buys eggs at ₹ 36 per gross. He sells the eggs at a profit of $12\frac{1}{2}\%$ on the cost price. What is the selling price per egg (approximately)?

- (a) 33 paise (b) 30 paise
(c) 29 paise (d) 28 paise

40. A sold a table to B at a profit of 20%. B sold the same table to C for ₹ 75 thereby making a profit of 25%. Find the price at which A bought the table from X if it is known that X gained 25% in the transaction.

- (a) ₹ 30 (b) ₹ 40
(c) ₹ 50 (d) ₹ 60

41. A sold a table to B at a profit of 15%. Later on, B sold it back to A at a profit of 20%, thereby gaining ₹ 69. How much did A pay for the table originally?

- (a) ₹ 300 (b) ₹ 320
(c) ₹ 345 (d) ₹ 350

42. A dealer sold two TV sets for ₹ 2400 each, gaining 20% on one and losing 20% on the other set. Find his net gain or net loss.

- (a) ₹ 300 loss (b) ₹ 200 loss
(c) ₹ 200 gain (d) ₹ 300 gain

43. On selling tea at ₹ 40 per kg a loss of 10% is incurred. Calculate the amount of tea (in kg) sold if the total loss incurred is ₹ 80.

- (a) 12 kg (b) 15 kg
(c) 18 kg (d) 20 kg

44. A colour TV and a VCP were sold for ₹ 12,000 each. The TV was sold at a loss of 20% whereas the VCP was sold at a gain of 20%. Find gain or loss in the whole transaction.

- (a) ₹ 1200 loss (b) ₹ 1000 loss
(c) ₹ 960 loss (d) ₹ 1040 loss

(Note: In this case there will always be a loss)

45. A man sells a TV set for ₹ 3450 and makes a profit of 15%. He sells another TV at a loss of 10%. If on the whole, he neither gains nor loses, find the selling price of the second TV set.
- (a) ₹ 4000 (b) ₹ 4400
(c) ₹ 4050 (d) ₹ 4500
46. A man sells an article at 5% above its cost price. If he had bought it at 5% less than what he paid for it and sold it for ₹ 2 less, he would have gained 10%. Find the cost price of the article.
- (a) ₹ 500 (b) ₹ 360
(c) ₹ 425 (d) ₹ 400
47. A briefcase was sold at a profit of 10%. If its cost price was 5% less and it was sold for ₹ 7 more, the gain would have been 20%. Find the cost price of the briefcase.
- (a) ₹ 175 (b) ₹ 200
(c) ₹ 225 (d) ₹ 160
48. A man sells a plot of land at 6% profit. If he had sold it at 10% profit, he would have received ₹ 200 more. What is the selling price of the land?
- (a) ₹ 5000 (b) ₹ 5300
(c) ₹ 4800 (d) ₹ 5500
49. Ashok bought an article and spent ₹ 110 on its repairs. He then sold it to Bhushan at a profit of 20%. Bhushan sold it to Charan at a loss of 10%. Charan finally sold it for ₹ 1188 at a profit of 10%. How much did Ashok pay for the article?
- (a) ₹ 890 (b) ₹ 1000
(c) ₹ 780 (d) ₹ 840

50. A man buys two cycles for a total cost of ₹ 900. By selling one for $\frac{4}{5}$ of its cost and other for $\frac{5}{4}$ of its cost, he makes a profit of ₹ 90 on the whole transaction. Find the cost price of lower priced cycle.
- (a) ₹ 360 (b) ₹ 250
(c) ₹ 300 (d) ₹ 420
51. A merchant bought two transistors, which together cost him ₹ 480. He sold one of them at a loss of 15% and other at a gain of 19%. If the selling price of both the transistors are equal, find the cost of the lower priced transistor.
- (a) ₹ 300 (b) ₹ 180
(c) ₹ 200 (d) ₹ 280
52. A manufacturer makes a profit of 15% by selling a colour TV for ₹ 5750. If the cost of manufacturing increases by 30% and the price paid by the retailer is increased by 20%, find the profit percent made by the manufacturer.
- (a) $6\frac{2}{13}\%$ (b) $4\frac{8}{13}\%$
(c) $6\frac{1}{13}\%$ (d) $7\frac{4}{13}\%$
53. The cost of manufacturing an article is made up of materials, labour and overheads in the ratio 4 : 3 : 2. If the cost of labour is ₹ 45, find the profit percent if the article is sold for ₹ 180.
- (a) 50% (b) 33.33%
(c) 25% (d) 20%
54. Two dealers X and Y selling the same model of refrigerator mark them under the same selling prices. X gives successive discounts of 25% and 5% and Y gives successive discounts of 16% and 12%. From whom is it more profitable to purchase the refrigerator?
- (a) From Y
(b) From X
(c) Indifferent between the two
(d) Cannot be determined

55. A sells a car priced at ₹ 36,000. He gives a discount of 8% on the first ₹ 20,000 and 5% on the remaining ₹ 16,000. His competitor *B* sells a car of the same make, priced at ₹ 36,000. If he wants to be competitive what percent discount should *B* offer on the marked price.
- (a) 5% (b) 5.5%
(c) 6.66% (d) 8.33%
56. An article costs ₹ 700 to a manufacturer who lists its price at ₹ 800. He sells it to a trader at a discount of 5%. The trader gets a further discount of 5% on his net payment for paying in cash. Calculate the amount that the trader pays to the manufacturer.
- (a) ₹ 722 (b) ₹ 720
(c) ₹ 725 (d) None of these
57. In Question 56, find the profit percent that the manufacturer makes on the sale.
- (a) 1500/7% (b) 22/7%
(c) 2000/7% (d) None of these
58. A firm dealing in furniture allows 4% discount on the marked price of each item. What price must be marked on a dining table that cost ₹ 400 to assemble, so as to make a profit of 20%?
- (a) ₹ 475 (b) ₹ 480
(c) ₹ 500 (d) ₹ 520
59. A shopkeeper allows a discount of 12.5% on the marked price of a certain article and makes a profit of 20%. If the article cost the shopkeeper ₹ 210, what price must be marked on the article?
- (a) ₹ 280 (b) ₹ 288
(c) ₹ 300 (d) None of these
60. A Camera shop allows a discount of 10% on the advertised price of a camera. What price must be marked on the camera, that costs him ₹ 600, so that he makes a profit of 20%?

- (a) ₹ 800 (b) ₹ 720
(c) ₹ 750 (d) ₹ 850

61. A watch dealer pays 10% custom duty on a watch that costs ₹ 250 abroad. For how much should he mark it, if he desires to make a profit of 20% after giving a discount of 25% to the buyer?

- (a) ₹ 400 (b) ₹ 440
(c) ₹ 275 (d) ₹ 330

62. A shopkeeper buys an article for ₹ 400 and marks it for sale at a price that gives him 80% profit on his cost. He, however, gives a 15% discount on the marked price to his customer. Calculate the actual percentage profit made by the shopkeeper.

- (a) 62% (b) 64%
(c) 53% (d) 54%

63. In the land of the famous milkman Merghese Durian, a milkman sells his buffalo for ₹ 720 at some profit. Had he sold his buffalo at ₹ 510, the quantum of the loss incurred would have been double that of the profit earned. What is the cost price?

- (a) ₹ 600 (b) ₹ 625
(c) ₹ 675 (d) None of these

64. A trader purchases apples at ₹ 60 per hundred. He spends 15% on the transportation. What should be the selling price per 100 to earn a profit of 20%?

- (a) ₹ 72 (b) ₹ 81.8
(c) ₹ 82.8 (d) ₹ 83.8

65. A dishonest dealer professes to sell at cost price but uses a 900 gram weight instead of a 1 kilogram weight. Find the percent profit to the dealer.

- (a) 10% (b) 11.11%
(c) 12.5% (d) None of these

OceanofPDF.com

LEVEL OF DIFFICULTY (II)

1. Mithilesh makes 750 articles at a cost of 60 paise per article. He fixes the selling price such that if only 600 articles are sold, he would have made a profit of 40% on the outlay. However, 120 articles got spoilt and he was able to sell 630 articles at this price. Find his actual profit percent as the percentage of total outlay assuming that the unsold articles are useless.
(a) 42% (b) 53%
(c) 47% (d) 46%
2. A manufacturer estimates that on inspection 12% of the articles he produces will be rejected. He accepts an order to supply 22,000 articles at ₹ 7.50 each. He estimates the profit on his outlay including the manufacturing of rejected articles, to be 20%. Find the cost of manufacturing each article.
(a) ₹ 6 (b) ₹ 5.50
(c) ₹ 5 (d) ₹ 4.50
3. The cost of setting up the type of a magazine is ₹ 1000. The cost of running the printing machine is ₹ 120 per 100 copies. The cost of paper, ink and so on is 60 paise per copy. The magazines are sold at ₹ 2.75 each. 900 copies are printed, but only 784 copies are sold. What is the sum to be obtained from advertisements to give a profit of 10% on the cost?
(a) ₹ 730 (b) ₹ 720
(c) ₹ 726 (d) ₹ 736
4. A tradesman fixed his selling price of goods at 30% above the cost price. He sells half the stock at this price, one-quarter of his stock at a discount of 15% on the original selling price and rest at a discount of 30% on the original selling price. Find the gain percent altogether.

- (a) 14.875% (b) 15.375%
 (c) 15.575% (d) 16.375%

5. A tradesman marks an article at ₹ 205 more than the cost price. He allows a discount of 10% on the marked price. Find the profit percent if the cost price is ₹ x .

- (a) $\frac{\left[\frac{x}{18450} - 10\right]}{x}$ (b) $\frac{[(18450)] - 10x}{x}$
 (c) $\frac{\left[\frac{x}{(18450)} - 100\right]}{x}$ (d) $\frac{\left[\frac{18450}{x} - 100\right]}{x}$

6. Dolly goes to a shop to purchase a doll priced at ₹ 400. She is offered 4 discount options by the shopkeeper. Which of these options should she opt for to gain maximum advantage of the discount offered?

- (a) Single discount of 30%
 (b) 2 successive discounts of 15% each
 (c) 2 successive discounts of 20% and 10%
 (d) 2 successive discounts of 20% and 12%

7. A dishonest dealer marks up the price of his goods by 20% and gives a discount of 10% to the customer. He also uses a 900 gram weight instead of a 1 kilogram weight. Find his percentage profit due to these maneuvers.

- (a) 8% (b) 12%
 (c) 20% (d) 16%

8. A dishonest dealer marks up the price of his goods by 20% and gives a discount of 10% to the customer. Besides, he also cheats both his supplier and his buyer by 100 grams while buying or selling 1 kilogram. Find the percentage profit earned by the shopkeeper.

- (a) 20% (b) 25%
(c) 32% (d) 27.5%

9. For Question 8, if it is known that the shopkeeper takes a discount of 10% from his supplier and he disregards this discount while marking up (i.e. he marks up at the undiscounted price), find the percentage profit for the shopkeeper if there is no other change from the previous problem.

- (a) 32% (b) 36.66%
(c) 40.33% (d) 46.66%

10. Cheap and Best, a *kirana* shop bought some apples at 4 per rupee and an equal number at 5 per rupee. He then sold the entire quantity at 9 for 2 rupees. What is his percentage profit or loss?

- (a) 1.23% loss (b) 6.66%
(c) 8.888% (d) No profit no loss

11. A watch dealer sells watches at ₹ 600 per watch. However, he is forced to give two successive discounts of 10% and 5% respectively. However, he recovers the sales tax on the net sale price from the customer at 5% of the net price. What price does a customer have to pay him to buy the watch?

- (a) ₹ 539.75 (b) ₹ 539.65
(c) ₹ 538.75 (d) ₹ 538.65

12. Deb bought 100 kg of rice for ₹ 1100 and sold it at a loss of as much money as he received for 20 kg rice. At what price did he sell the rice?

- (a) ₹ 9 per kg (b) ₹ 9.1666 per kg
(c) ₹ 9.5 per kg (d) ₹ 10.33 per kg

13. A carpenter wants to sell 40 chairs. If he sells them at ₹ 156 per chair, he would be able to sell all the chairs. But for every ₹ 6 increase in price, he will be left with one additional unsold chair. At what selling price would he be able to maximise his profits (assuming unsold chairs remain with him)?

(a) 198

(b) 192

(c) 204

(d) 210

Directions for Questions 14 and 15: Read the following and answer the questions that follow.

Doctors have advised Renu, a chocolate freak, not to take more than 20 chocolates in one day. When she went to the market to buy her daily quota, she found that if she buys chocolates from the market complex she would have to pay ₹ 3 more for the same number of chocolates than she would have spent had she bought them from her uncle Scrooge's shop, getting two sweets less per rupee. She finally decided to get them from Uncle Scrooge's shop paying only in one rupee coins.

14. How many chocolates did she buy?

(a) 12

(b) 9

(c) 18

(d) 15

15. How much would she have spent at the market complex?

(a) ₹ 6

(b) ₹ 12

(c) ₹ 9

(d) ₹ 5

16. A shopkeeper makes a profit of $Q\%$ by selling an object for ₹ 24. Had the cost price and selling price been interchanged, it would have led to a loss of $62.5Q\%$. With the latter cost price, what should be the new selling price to get a profit of $Q\%$?

(a) ₹ 34.40

(b) ₹ 32.50

(c) ₹ 25.60

(d) ₹ 38.4

17. Find the change in the percentage profit for a fruit vendor who, after finding 20% of the fruits rotten, increased his selling price by 10% over and above 15% that he was already charging?

(a) -15

(b) +11.5

(c) -13.8

(d) -11.5

Directions for Questions 18 and 19: Read the following and answer the questions that follow.

Ramu and Shyamu decided to sell their cars each at ₹ 36,000. While Ramu decided to give a discount of 8% on the first ₹ 8000, 5% on next ₹ 12,000 and 3% on the rest to buyer Sashi, Shyamu decided to give a discount of 7% on the first 12,000, 6% on the next 8,000 and 5% on the rest to buyer Rajesh. These discounts were, however, subject to the buyers making the payment on time failing which the discount gets reduced by 1% for every delay of a week. In each case, the selling price of 36,000 was arrived at by increasing the cost price by 25%.

18. If each of them got the payments on time, what is the approximate percentage profit of the person getting the higher profit?
(a) 19% (b) 21%
(c) 25% (d) 17%
19. If Sashi defaults by 1 and 2 weeks in the second and third payments respectively, what would be the profit of Ramu in the sale of the car?
(a) ₹ 5920 (b) ₹ 6240
(c) ₹ 5860 (d) ₹ 5980
20. What would be the difference in the profits if both the buyers default in each payment by a week?
(a) ₹ 200 (b) ₹ 300
(c) ₹ 400 (d) ₹ 500
21. Find the selling price of goods if two salesmen claim to make 25% profit each, one calculating it on cost price while another on the selling price, the difference in the profits earned being ₹ 100 and selling price being the same in both the cases.
(a) ₹ 2000 (b) ₹ 1600
(c) ₹ 2400 (d) ₹ 2500
22. A shopkeeper calculates percentage profit on the buying price and another on the selling price. What will be their difference in profits

if both claim a profit of 20% on goods sold for ₹ 3000?

- (a) ₹ 200 (b) ₹ 100
(c) ₹ 400 (d) ₹ 150

23. A pharmaceutical company made 3000 strips of tablets at a cost of ₹ 4800. The company gave away 1000 strips of tablets to doctors as free samples. A discount of 25% was allowed on the printed price. Find the ratio of profit if the price is raised from ₹ 3.25 to ₹ 4.25 per strip and if at the latter price, samples to doctors were done away with. (New profit/old profit)

- (a) 55.5 (b) 63.5
(c) 75 (d) 99.25

24. A merchant makes a profit of 20% by selling an article. What would be the percentage change in the profit percent had he paid 10% less for it and the customer paid 10% more for it?

- (a) 120% (b) 125%
(c) 133.33% (d) 150%

25. An article costing ₹ 20 was marked 25% above the cost price. After two successive discounts of the same percentage, the customer now pays ₹ 20.25. What would be the percentage change in profit had the price been increased by the same percentage twice successively instead of reducing it?

- (a) 3600% (b) 3200%
(c) 2800% (d) 4000%

26. Divya goes to buy fruits and after a lot of bargaining is able to get the price of a dozen apples reduced by Re. 1 from the initial price, thereby enabling her to get 1 apple extra for every rupee saved. (Getting no discount on the extra apple). What is the initial price of a dozen apples?

- (a) ₹ 10 (b) ₹ 13
(c) ₹ 12 (d) ₹ 15

27. The accounts of a company show sales of ₹ 12,600. The primary cost is 35% of sales and trading cost accounts for 25% of the gross profit. Gross profit is arrived at by excluding the primary cost plus the cost of advertising expenses of ₹ 1400, director's salary of ₹ 650 per annum plus 2% of annual sales as miscellaneous costs. Find the percentage profit (approx) on a capital investment of ₹ 14,000?
- (a) 35% (b) 31%
(c) 28% (d) Cannot be determined
28. Jonny has two cycles and one rickshaw. The rickshaw is worth ₹ 96. If he sells the rickshaw along with the first cycle, he has an amount double that of the value of the second cycle. But if he decides to sell the rickshaw along with the second cycle, the amount received would be less than the value of first cycle by ₹ 306. What is the value of first cycle?
- (a) ₹ 900 (b) ₹ 600
(c) ₹ 498 (d) None of these
29. David sells his Laptop to Goliath at a loss of 20% who subsequently sells it to Hercules at a profit of 25%. Hercules, after finding some defect in the laptop, returns it to Goliath but could recover only ₹ 4.50 for every ₹ 5 he had paid. Find the amount of Hercules' loss if David had paid ₹ 1.75 lakh for the laptop.
- (a) ₹ 3500 (b) ₹ 2500
(c) ₹ 17,500 (d) None of these
30. A dishonest shopkeeper, at the time of selling and purchasing, weighs 10% less and 20% more per kilogram respectively. Find the percentage profit earned by treachery. (Assuming he sells at Cost Price)
- (a) 30% (b) 20%
(c) 25% (d) 33.33%
31. A dealer marks articles at a price that gives him a profit of 30%. 6% of the consignment of goods was lost in a fire in his premises, 24%

was soiled and had to be sold at half the cost price. If the remainder was sold at the marked price, what percentage profit or loss did the dealer make on that consignment?

- (a) 2% (b) 2.5%
- (c) 3% (d) 6.2%

32. A book was sold for a certain sum and there was a loss of 20%. Had it been sold for ₹ 12 more, there would have been a gain of 30%. What would be the profit if the book were sold for ₹ 4.8 more than what it was sold for?

- (a) No profit, no loss (b) 20%
- (c) 10% (d) 25%

For questions 33 to 36 use the following data:

33. Two thousand people lived in Business Village of which 55% were male and the rest were female. The male population earned a profit of 5% and the female population earned 8% on an investment of ₹ 50 each. Find the change in the percentage profit of the village if the ratio of male to female gets reversed the next year, population remaining the same.

- (a) Drop of 0.3 (b) Increase of 0.3
- (c) Increase of 0.45 (d) Drop of 0.45

34. In Question 33, find the change in the percentage profit of the village, if the population increases by 10%. (Assume the ratio remains the same)

- (a) Increase of 10% (b) Increase of 11.11%
- (c) No change (d) Cannot be determined

35. For Question 34, find the percentage change in the profit.

- (a) Increase of 10% (b) Increase of 11.11%
- (c) No change (d) Cannot be determined

36. For Question 33, what would be the change in the percentage profit, if alongwith the reversal of the ratio of males to females, the profit

also increases by 1% for both males and females?

- (a) Drop of 1.3
- (b) Increase of 1.3
- (c) Increase of 0.8
- (d) None of these

37. A rickshaw dealer buys 30 rickshaws for ₹ 4725. Of these, 8 are four-seaters and the rest are two-seaters. At what price must he sell the four-seaters so that if he sells the two-seaters at $\frac{3}{4}$ th of this price, he makes a profit of 40% on his outlay?

- (a) ₹ 180
- (b) ₹ 270
- (c) ₹ 360
- (d) ₹ 450

38. A flat and a piece of land were bought by two friends Raghav and Sita respectively at prices of ₹ 2 lakh and ₹ 2.2 lakh. The price of the flat rises by 20 percent every year and that of land by 10% every year. After two years, they decide to exchange their possessions. What is percentage gain of the gainer?

- (a) 7.56%
- (b) 6.36%
- (c) 4.39%
- (d) None of these

39. A, B and C form a company. A invests half of C expecting a return of 10%. B invests three-fourths of C, expecting a return of 15% on it. C invests ₹ 3000 and the profit of the firm is 25%. How much would B's share of profit be more than that of A's share if B gets an additional 8% for managing the business? (Assume that their expectations with respect to returns on capital invested are met before profit is divided in the ratio of capitals invested).

- (a) 20%
- (b) 18%
- (c) 15%
- (d) Cannot be determined

40. A driver of a autorickshaw makes a profit of 20% on every trip when he carries 3 passengers and the price of petrol is ₹ 30 a litre. Find the percentage profit for the same journey if he goes for four passengers per trip and the price of petrol reduces to ₹ 24 litre. (Assume that revenue per passenger is the same in both the cases.)

- (a) 33.33%
- (b) 65.66%

(c) 100% (d) Data inadequate

41. Raghav bought 25 washing machines and microwave ovens for ₹ 2,05,000. He sold 80% of the washing machines and 12 microwave ovens for a profit of ₹ 40,000. Each washing machine was marked up by 20% over cost and each microwave oven was sold at a profit of ₹ 2,000. The remaining washing machines and 3 microwave ovens could not be sold. What is Raghav's overall profit/loss?
- (a) ₹ 1000 profit (b) ₹ 2500 loss
(c) ₹ 1000 loss (d) Cannot be determined
42. After selling a watch, Shyam found that he had made a loss of 10%. He also found that had he sold it for ₹ 27 more, he would have made a profit of 5%. The actual initial loss was what percentage of the profit earned, had he sold the watch for a 5% profit?
- (a) 23% (b) 150%
(c) 200% (b) 180%
43. Sambhu buys rice at ₹ 10/kg and puts a price tag on it so as to earn a profit of 20%. However, his faulty balance shows 1000 gm when it is actually 800 gm. What is his actual gain percentage?
- (a) 50% (b) 40%
(c) 18% (d) 10%
44. The profit earned when an article is sold for ₹ 800 is 20 times the loss incurred when it is sold for ₹ 275. At what price should the article be sold if it is desired to make a profit of 25%.
- (a) ₹ 300 (b) ₹ 350
(c) ₹ 375 (d) ₹ 400
45. A sells to B goods at five-thirds the rate of profit at which B has decided to sell it to C. C, on other hand, sells it to D at one-third the rate of profit at which B sold it to C. If D gives ₹ 2145 to C at 10% profit, how much did A buy it for?
- (a) ₹ 1000 (b) ₹ 2000

(c) ₹ 1500

(d) ₹ 1800

46. In the town of Andher Nagari Chaupat Raja, shopkeepers have to buy and sell goods in the range of ₹ 500 to ₹ 999. A shopkeeper in such a town decides not to buy or sell goods for amounts that contain the digit 9 or for amounts that add up to 13 or are a multiple of 13. What is the maximum possible profit he can earn?

(a) ₹ 388

(b) ₹ 389

(c) ₹ 488

(d) None of these

47. Manish bought a combined total of 25 monitors and printers. He marked up the monitors by 20% on the cost price, while each printer was marked up by ₹ 2000. He was able to sell 75% of the monitors and 2 printers and make a profit of ₹ 49,000. The remaining monitors and 3 printers could not be sold by him. Find his overall profit or loss if he gets no return on unsold items and it is known that a printer costs 50% of a monitor.

(a) Loss of ₹ 48,500

(b) Loss of 21,000

(c) Loss of ₹ 41,000

(d) Inadequate data

48. For Question 47, Manish's approximate percentage profit or loss is

(a) 14.37% loss

(b) 16.5% loss

(c) 12.14% loss

(d) Insufficient information

49. An orange vendor makes a profit of 20% by selling oranges at a certain price. If he charges ₹ 1.2 higher per orange he would gain 40%. Find the original price at which he sold an orange.

(a) ₹ 5

(b) ₹ 4.8

(c) ₹ 6

(d) None of these

50. The Mindworkzz prints 5000 copies of a magazine for ₹ 5,00,000 every month. In the July issue of the magazine, Mindworkzz distributed 500 copies free. Besides, it was able to sell $\frac{2}{3}$ of the remaining magazines at 20% discount. Besides, the remaining magazines were sold at the printed price of the magazine (which was ₹ 200). Find the percentage profit of Mindworkzz in the

magazine venture in the month of July (assume a uniform 20% of the sale price as the vendor's discount and also assume that Mindworkzz earns no income from advertising for the issue).

- (a) 56%
- (b) 24.8%
- (c) 28.5%
- (d) 22.6%

OceanofPDF.com

LEVEL OF DIFFICULTY (III)

The charges of a taxi journey are decided on the basis of the distance covered and the amount of the waiting time during a journey. Distance wise, for the first 2 kilometers (or any part thereof) of a journey, the metre reading is fixed at ₹ 10 (if there is no waiting). Also, if a taxi is boarded and it does not move, then the meter reading is again fixed at ₹ 10 for the first ten minutes of waiting. For every additional kilometre the meter reading changes by ₹ 5 (with changes in the meter reading being in multiples of Re. 1 for every 200 meters travelled). For every additional minute of waiting, the meter reading changes by ₹ 1. (no account is taken of a fraction of a minute waited for or of a distance less than 200 meters travelled). The net meter reading is a function of the amount of time waited for and the distance travelled.

The cost of running a taxi depends on the fuel efficiency (in terms of mileage/liter), depreciation (straight line over 10 years) and the driver's salary (not taken into account if the taxi is self owned).

Depreciation is ₹ 100 per day everyday of the first 10 years. This depreciation has to be added equally to the cost for every customer while calculating the profit for a particular trip. Similarly, the driver's daily salary is also apportioned equally across the customers of the particular day. Assume, for simplicity, that there are 50 customers every day (unless otherwise mentioned). The cost of fuel is ₹ 15 per liter (unless otherwise stated).

The customer has to pay 20% over the meter reading while settling his bill. Also assume that there is no fuel cost for waiting time (unless otherwise stated).

Based on the above facts, answer the following:

1. If Sardar Preetpal Singh's taxi is 14 years old and has a fuel efficiency of 12 km/litre of fuel, find his profit in a run from Howrah Station to Park Street (a distance of 7 km) if the stoppage time is 8 minutes. (Assume he owns the taxi)

- (a) ₹ 32.25 (b) ₹ 40.85
(c) ₹ 34.25 (d) ₹ 42.85
2. For question 2, Sardar Preetpal Singh's percentage profit is
(a) 391.42% (b) 380%
(c) 489.71% (d) 438.23%
3. For the same journey as in question 1 if on another day, with heavier traffic, the waiting time increases to 13 minutes, find the percentage change in the profit.
(a) 12% (b) 14%
(c) 13% (d) 16%
4. For Question 3, if Sardar Preetpal Singh idled his taxi for 7 minutes and if the fuel consumption during idling is 50 ml per minute, find the percentage decrease in the profits.
(a) 10.74% (b) 11.21%
(c) 10.87% (d) 9.94%

Directions for Questions 5 to 10: Answer questions based on this additional information:

Mr. Vikas Verma owns a fleet of 3 taxis, where he pays his driver ₹ 3000 per month. He also insists on keeping an attendant for ₹ 1500 per month in each of his taxis. Idling requires 50 ml of fuel for every minute of idling. For a moving taxi, the fuel consumption is given by 12 km/per litre. On a particular day, he received the following reports about the three taxis.

<i>Taxi code</i>	<i>Total kilometres</i>	<i>Waiting time</i>	<i>Waiting time with idling</i>	<i>Waiting time without idling</i>
A	260	190 min	30 min	
B	264	170 min	80 min	
C	275	180 min	60 min	

5. The maximum revenue has been generated by which taxi?

- (a) A (b) B
(c) C (d) Cannot be determined

If it is to be assumed that every customer travelled at least 2 kilometres:

6. Which of the three taxis generated the maximum revenue?

- (a) A (b) B
(c) C (d) Both A & B
(e) Cannot be determined

7. What percentage of the total revenue was generated by taxi B?

- (a) 32.30 (b) 33.36
(c) 34.32 (d) 34.36

8. The highest profit was yielded by which taxi?

- (a) A (b) B
(c) C (d) Both A & B

9. The taxi which had the highest percentage profit for the day was

- (a) A (b) B
(c) C (d) B & C

10. The profit as a percentage of costs for the day was:

- (a) 179.46% (b) 150.76%
(c) 163.28% (d) 173.48%

Directions for Questions 11 to 15: Read the following and answer the questions that follow.

The Coca-Cola Company is setting up a plant for manufacture and sale of the soft drink.

The investment for the plant is ` 10 crore (to be invested in plant, machinery, advertising, infrastructure, etc.).

The following information is available about the different bottle sizes planned:

<i>Bottle size</i>	<i>Bottling cost</i>	<i>Cost of liquid</i>	<i>Transportation cost</i>	<i>Sale price</i>	<i>Dealer margin</i>
300 ml	₹ 2	₹ 0.6	10 paise per bottle	₹ 10	₹ 3
500 ml	₹ 5	₹ 1	15 paise per bottle	₹ 18	₹ 6
1.5 litre	₹ 10	₹ 3	20 paise per bottle	₹ 40	₹ 12

Based on this information answer the questions given below:

11. For which bottle should Coca-Cola try to maximise sales to maximise its profits? (Assume that the total number of litres of Coca-Cola sold is constant irrespective of the break up of the sales in terms of the bottle sizes)
 - (a) 300 ml
 - (b) 500 ml
 - (c) 1.5 litres
 - (d) Indifferent between the three sizes
12. If the company sells only 300 ml bottles in the first year, how many bottles should it sell to recover the investment made in the first year only?
 - (a) 23,255,814
 - (b) 232,558,140
 - (c) 32,255,814
 - (d) 322,558,140
13. If sales of 300 ml bottles to 500 ml bottles is 4 : 1, and there is no sale of 1500 ml bottles how many 300 ml bottles will be required to recover the investment?
 - (a) 1,73,53,580
 - (b) 2,93,25,512
 - (c) 16,25,848
 - (d) 16,25,774
14. For Question 13, the total number of both the types to be sold in India in order to recover the whole investment is
 - (a) 3665890
 - (b) 2032310

(c) 21691975 (d) 21723165

15. If we add administrative costs @ Re. 1 per litre, which bottle size will have the maximum profitability?

- (a) 300 ml (b) 500 ml
(c) 1.5 litres (d) Indifferent between the three sizes

16. Hotel Chanakya in Chankyapuri has a fixed monthly cost of ₹ 1,000,00. The advertising cost is ₹ 10,000 per month. It has 5 A/C rooms, which cost ₹ 600 per day and 10 non-A/C rooms, which cost ₹ 350 per day. Direct costs are ₹ 100 per day for an A/C room, and ₹ 50 for a non-A/C room. In the month of April 2020, the occupancy rate of A/C rooms is 50% while that of non-A/C rooms is 45%. Find the profit of the hotel in rupee terms for the month of April 2020.

- (a) 33,600 (b) 28,800
(c) (32,000) Loss (d) (17,750) Loss

17. For the above question, keeping the A/C occupancy constant at 50%, what should be the minimum occupancy rate for non-A/C rooms for incurring no loss for the month?

- (a) 75.66% (b) 80.66%
(c) 83.33% (d) 86.66%

18. For Questions 15 and 16: ₹ 25,000 worth of advertising a sales promotion of 20% off on the bill doubles the occupancy rate. If this is done, what is the change in the profit or loss?

- (a) Reduction of loss by ₹ 5,900
(b) Reduction of loss to ₹ 5,900
(c) Reduction of loss by ₹ 26,100
(d) Both b and c

19. Advertising worth ₹ 50,000 is done for the sales promotion of A/C rooms (advertising a 20% reduction in the bill for A/C rooms). This leads to a doubling of the occupancy rate of A/C rooms. Besides, it

also has an effect of increasing non-A/C room occupancy by 20%. Is this advised?

- (a) Yes (b) No
(c) Indifferent (d) Cannot be determined

A restaurant has a pricing policy that allows for the following mark-ups:

Soups	Mark-up of	40%
Starters	Mark-up of	50%
Meals	Mark-up of	25%
Breads	Mark-up of	75%
Sweets	Mark-up of	75%

20. Mr. Amarnath and his family of 4 went to the restaurant and got a bill for: Soups (₹ 126), Starters (₹ 180), Meals (₹ 300), Breads (₹ 245) and Sweets (₹ 210). Find the profit for the restaurant.
- (a) ₹ 341 (b) ₹ 351
(c) ₹ 361 (d) ₹ 371
21. The approximate percentage profit for the restaurant on the bill is
- (a) 40% (b) 45%
(c) 50% (d) 55%
22. Which of these are true:
- (i) Profit increases if a part of the money spent on starters was spent on breads and another part of the starters was spent on snacks.
- (ii) Profit increases if a part of the money spent on meal items was spent on starters and another part spent on soups was spent on breads.
- (iii) Profit decreases if a certain amount (say x) of the spending on soups was spent on starters and the same amount (₹ x) of the spending on soups is spent on meal items.

- | | |
|--------------------|-------------------|
| (a) (ii) only | (b) (iii) only |
| (c) (ii) and (iii) | (d) All the three |

Directions for Questions 23 to 28: Read the following and answer the questions that follow.

Prabhat Ranjan inaugurates his internet cafe on the 1st of January 2003. He invests in 10 computers @ ₹ 30,000 per computer. Besides, he also invests in the other infrastructure of the centre, a sum of ₹ 1 lakh only. He charges his customers on the time spent on the internet a flat rate of ₹ 50 per hour. His initial investment on computers has to be written off equally in 3 years (1 lakh per year) and the infrastructure has to be written off in 5 years (@ ₹ 20,000 per year).

He has to pay a fixed rental of ₹ 8000 per month for the space and also hires an assistant at ₹ 2000 per month.

For every hour that he is connected to the internet, he has to bear a telephone charge of ₹ 20 irrespective of the number of machines operational on the internet at that time. On top of this, he also has to pay an electricity charge of ₹ 5 per computer per hour. Assume that there are no other costs involved unless otherwise mentioned. The internet cafe is open 12 hours a day and is open on all 7 days of the week. (Assume that if a machine is not occupied, it is put off and hence consumes no electricity).

23. Assuming a uniform 80% occupancy rate for the month of April 2003, find his profit or loss for the month.

- | | |
|----------------|-------------------|
| (a) ₹ 1,02,400 | (b) ₹ 1,22,400 |
| (c) ₹ 1,23,600 | (d) ₹ 1,20,733.33 |

24. If the occupancy rate drops to 60% in the month of June, what is the value of the profit for the month?

- | | |
|----------------|-----------------|
| (a) ₹ 90,000 | (b) ₹ 70,000 |
| (c) ₹ 1,23,600 | (d) ₹ 90,633.33 |

25. If Prabhat estimates a fixed occupancy rate of 80% during the peak hours of 2 to 8 pm and 40% in the off peak hours of 8 am to 2 pm find the expected profit for him in the month of July 2006.

- (a) ₹ 73,000 (b) ₹ 93,000
(c) ₹ 96,000 (d) ₹ 1,27,500
26. The percentage margin is defined as the margin as a percentage of the variable cost for an hour of operation. Find the percentage margin of the cyber cafe Prabhat runs.
- (a) 600 % (b) 533.33%
(c) 525% (d) Cannot be determined
27. For Question 25 above, how many 30-day months will be required for Prabhat to recover back the investment?
- (a) 3.58 months (b) 3.72 months
(c) 5.71 months (d) Cannot be determined
28. If the internet rates per hour have to be dropped drastically to ₹ 20 per hour in the fourth year of operation, what is Prabhat's expected profit for the calendar year 2010 assuming an average of 60% occupancy rate for the year?
- (a) ₹ 2,66,600 (b) ₹ 1,66,600
(c) ₹ 88,500 (d) ₹ 91,500

Directions for Questions 29 to 33: Read the following and answer the questions that follow.

A train journey from Patna to Delhi by the Magadh Express has 4 classes:
The fares of the 4 classes are as follows:

3 tier: ₹ 330	No. of berths per bogey: 72	No. of bogeys: 8
AC 3 tier: ₹ 898	No. of berths per bogey: 64	No. of bogeys: 2
AC 2 tier: ₹ 1388	No. of berths per bogey: 45	No. of bogeys: 2
AC first: ₹ 2691	No. of berths per bogey: 26	No. of bogeys: 1

Patna to Delhi distance: 1100 kilometres. Assume the train does not stop at any station unless otherwise indicated. Running cost per kilometre: AC bogey ₹ 25, non AC bogey ₹ 10.

29. Assuming full occupancy, a bogey of which class exhibits the highest profit margin?
- (a) AC 3 tier (b) AC 2 tier
(c) AC first class (d) 3 tier
30. Assuming full occupancy in all the classes, for a journey between Patna to Delhi, the profit margin (as a percentage of the running costs) of the class showing the lowest profit is approximately.
- (a) 116% (b) 127%
(c) 109% (d) None of these
31. What is the approximate profit for the railways in rupees if the Magadh Express runs at full occupancy on a particular day?
- (a) ₹ 250,000 (b) ₹ 275,000
(c) ₹ 300,000 (d) Cannot be determined
32. For Question 31, the percentage of the total profit that comes out of AC bogeys is (approximately)
- (a) 50% (b) 60%
(c) 70% (d) 80%
33. The highest revenue for a journey from Patna to Delhi will always be generated by
- (a) 3 tier (b) AC 3 tier
(c) AC 2 tier (d) Cannot be determined
34. A newspaper vendor sells three kinds of periodicals-dailies, weeklies and monthlies.
- The weeklies sell for ₹ 12 at a profit of 20%, the monthlies sell for ₹ 50 at a profit of 25%, while the dailies sell at ₹ 3 at a profit of 50%. If there is a government restriction on the total number of periodicals that one particular news vendor, can sell, and Kalu a newspaper vendor, has sufficient demand for all the three types of periodicals, what should he do to maximise profits?
- (a) Sell maximum weeklies

- (b) Sell maximum monthlies
 - (c) Sell maximum dailies
 - (d) Cannot be determined
35. Without the restriction mentioned in the problem above, what should the newspaper vendor do to maximise his profits if his capital is limited?
- (a) Sell maximum weeklies
 - (b) Sell maximum monthlies
 - (c) Sell maximum dailies
 - (d) Cannot be determined
36. A fruit vendor buys fruits from the fruit market at wholesale prices and sells them at his shop at retail prices. He operates his shop 30 days a month, as a rule. He buys in multiples of 100 fruits and sells them in multiples of a dozen fruits. He purchases mangoes for ₹ 425 per hundred and sells at ₹ 65 per dozen, he buys apples at ₹ 150 per hundred and sells at ₹ 30 per dozen, he buys watermelons (always of equal size) at ₹ 1800 per hundred and sells at ₹ 360 per dozen. Which of the three fruits yields him the maximum percentage profit?
- (a) Mangoes
 - (b) Apples
 - (c) Watermelons
 - (d) Both (b) and (c)
37. For Question 36, if he adds oranges, which he buys at ₹ 180 per hundred and sells at ₹ 33 per dozen, what can be his maximum profit on a particular day if he invests ₹ 1800 in purchasing fruits everyday and he sells everything that he buys?
- (a) ₹ 1200
 - (b) ₹ 1180
 - (c) ₹ 1260
 - (d) ₹ 1320
38. For Questions 36 and 37, if the fruit vendor hires you as a consultant and pays you 20% of his profit in the month of July 2006 as a service charge, what can be the maximum fees that you will get for your consultancy charges?

- (a) ₹ 7200 (b) ₹ 14,400
(c) ₹ 7440 (d) Cannot be determined

39. A newspaper costs ₹ 11 to print on a daily basis. Its sale price (printed) is ₹ 3. The newspaper gives a sales incentive of 40% on the printed price, to the newspaper vendors. The newspaper makes up for the loss through advertisements, which are charged on the basis of per column centimetre rates. The advertisement rates of the newspaper are ₹ 300 per cc (column centimetre). It has to give an incentive of 15% on the advertising bill to the advertising agency. If the newspaper has a circulation of 12,000 copies, what is the approximate minimum advertising booking required if the newspaper has to break-even on a particular day. (Assume there is no wastage)

- (a) 300 cc (b) 350 cc
(c) 435 cc (d) 450 cc

40. For Question 39, if it is known that the newspaper house is unable to recover 20% of its dues, what would be the approximate advertising booking target on a particular day in order to ensure the break-even point?

- (a) 375 cc (b) 438 cc
(c) 544 cc (d) 562.5 cc

ANSWER KEY

Level of Difficulty (I)

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (c) | 4. (d) |
| 5. (a) | 6. (b) | 7. (d) | 8. (a) |
| 9. (b) | 10. (a) | 11. (d) | 12. (c) |
| 13. (d) | 14. (b) | 15. (c) | 16. (d) |
| 17. (b) | 18. (a) | 19. (b) | 20. (c) |
| 21. (c) | 22. (b) | 23. (c) | 24. (c) |
| 25. (a) | 26. (d) | 27. (b) | 28. (a) |
| 29. (c) | 30. (b) | 31. (d) | 32. (d) |

33. (a)	34. (b)	35. (b)	36. (a)
37. (c)	38. (c)	39. (d)	40. (c)
41. (a)	42. (b)	43. (c)	44. (b)
45. (c)	46. (d)	47. (a)	48. (b)
49. (a)	50. (c)	51. (c)	52. (a)
53. (b)	54. (b)	55. (c)	56. (a)
57. (b)	58. (c)	59. (b)	60. (a)
61. (b)	62. (c)	63. (d)	64. (c)
65. (b)			

Level of Difficulty (II)

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

Level of Difficulty (III)

1. (d)	2. (c)	3. (b)	4. (a)
5. (d)	6. (c)	7. (b)	8. (c)
9. (a)	10. (b)	11. (a)	12. (a)
13. (a)	14. (c)	15. (a)	16. (c)
17. (b)	18. (d)	19. (b)	20. (b)
21. (c)	22. (c)	23. (a)	24. (b)
25. (a)	26. (d)	27. (d)	28. (b)
29. (c)	30. (c)	31. (b)	32. (b)
33. (d)	34. (b)	35. (c)	36. (d)

37. (a)

38. (a)

39. (c)

40. (c)

Hints

Level of Difficulty (II)

1. Cost of 750 articles = ₹ 450 outlay.
Hence, SP of 600 articles = ₹ 630. (@40% profit on his outlay)
∴ SP of each article = ₹ 1.05.
2. When the manufacturer makes 100 articles, he sells only 88.
Revenues = $88 \times 7.5 = ₹ 660$
But profit being 20% of outlay, total outlay is ₹ 550.
3. Total cost = Type + Running cost of printing machine + paper, ink
 $= 1000 + 120 \times 9 + 540 = 2620$
∴ Net sum to be recovered = ₹ 2882.
4. Assume CP of goods = 100.
Then marked price = 130.
$$\text{Revenues} = \frac{1}{2} \times 130 + \frac{1}{4} \times 0.85 \times 130 + \frac{1}{4} \times 0.7 \times 130$$
5. If CP = x , then marked price = $x + 205$ and
Selling price = $0.9x + 184.5$.
Profit = $184.5 - 0.1x$
7. Assume CP as 1 Re/gram.
Then, he sells 900 grams for ₹ 1080,
While the CP of 900 grams is ₹ 900.
8. He buys 1100 grams for ₹ 1000 and sells 900 grams for ₹ 1080.
To calculate profit percentage, either equate the money or the goods.
9. He buys 1100 grams for ₹ 900 and sells 900 grams for ₹ 1080.
To calculate percentage profit, either equate the money or equate the goods.
10. Take the LCM of 4 and 5 and assume 20 apples bought at each price.

Ensure that you equate either the goods or the money.

12. The loss is covered by the sale of 20 extra kgs of rice.
i.e. CP of 100 kg = SP of 120 kg
13. Profit maximisation is totally dependent on revenue maximisation, since the cost is constant.
- 14-15. Solve using options.
16. Difference between original CP and SP is $Q\%$, while the reverse difference is 62.5% of Q .
The only values satisfying these are 60% and 37.5% . Hence $Q = 60\%$.
17. If CP = 100, original marked price = 115 and new marked price = 126.5. But he now sells on 80% of his marked price.
21. Assume the SP to be 125 for both the salesmen.
24. If initial cost price is 100, then initial selling price will be 120. Then, the new cost price is 90, while the new selling price is 132.
25. The successive percentage drops in marked price to get the selling price are 10% each.
27. Primary cost = 0.35×12600
Gross profit = $12600 - (1400 + 650 + 252) - 0.35 \times 12600$.
\ Trading cost = 25% of Gross profit.
\ Net profit = Gross profit - 25% of Gross profit = 75% of Gross profit.
and percent profit = $\frac{\text{Net Profit}}{\text{Outlay}} \times 100$.
28. Solve using options.
29. Assume David's cost price as 100. Then, Goliath buys at 80, sells at 100 and buys back from Hercules at 90.
30. Buys 1200 when he pays for 1000 and sells 900 when he receives money for 1000.
- 33-36. Investments are ` 55000 for men and ` 45000 for women.

The rate of return being given, we can find out the percentage profit overall.

37. Solve through options.
39. A's share is only dependent on the ratio of capital investment.
40. Assume cost = 100 and SP = 120.
Then, when price of petrol is reduced ₹
Cost = 80 and SP = 160.
41. The number of washing machines plus the number of microwaves = 25.
Unsold items = 2 washing machines + 3 microwaves.
Goods sold = 8 washing machines + 12 microwaves = 80% of total value.
44. If L represents the loss, then $20L$ represents the profit. Hence, $L = \frac{525}{21} = 25$.
Hence, CP = 300.
45. A sells at 50% profit, while B sells at 30% profit.
46. The required profit will be given by:
Maximum possible selling price – Minimum possible purchase price.
50. Sales of 3000 copies for ₹160 and 1500 copies for ₹200 each.

Level of Difficulty (III)

- 1-10. Concentrate on creation of the revenue equation and the cost equations separately. Revenue from a journey will depend on
(a) length of journey (over 2 kilometres)
(b) time of waiting.
Besides, the fixed metre reading of ₹10 at the start is used up at the rate of 1 Re per 200 metres and/or 1 Re/minute of waiting.
11. Coca-Cola earns $(10 - 3) - (2 + 0.6 + 0.1) = ₹4.3$ per 300 ml bottle.
Similarly, for 500 ml bottle, the profit is $12 - 6.15 = ₹5.85$.
and for 1500 ml bottle, $28 - 13.2 = 14.8$ for 1500 ml bottle.
The profit per ml sold has to be maximised.

$$12. \frac{\text{Rs. 10 crore}}{4.3} = 2,32,55,814.$$

13-14. The earning for one set of 5 bottles = $4.3 \times 4 + 5.85 = ₹ 23.05$.

$$15. \text{Maximum profitability} = \frac{\text{Margin per bottle}}{\text{Cost per bottle}}.$$

16-19. Profit = Revenue – Expenses.

20-22. Observe the profitability rates for each type of item.

23. Revenues = 8 computers $\times ₹ 50/\text{hr} \times 12 \text{ hours} \times 30 \text{ days}$

$$\text{Costs} = \text{monthly cost} + \frac{\text{Depreciation}}{12} + \text{Hourly cost} \times 12 \text{ hours} \times$$

30 days.

24-28. Will be solved on the same principle as question 23.

29-33. Revenues = occupancy \times cost/ticket.

$$\frac{\text{Cost}}{\text{Kilometer}} \times \text{no. of kilometres.}$$

Solutions and Shortcuts

Level of Difficulty (I)

- $0.9 \times \text{Price} = 495 \text{ ₹ Price } 550.$
- The SP = 107.5% of the CP. Thus, $\text{CP} = 34.4/1.075 = ₹ 32.$
- $1.15 \times \text{Price} = 4600 \text{ ₹ Price} = 4000.$
- A loss of 20% means a cost price of 100 corresponding to a selling price of 80. CP as a percentage of the SP would then be 125%
- $2400 = 1.25 \times \text{cost price} \text{ ₹ Cost price} = 1920$
Profit at 2040 = ₹ 120
Percentage profit = $(120/2040) \times 100 = 6.25\%$
- $\text{CP} = 935/1.1 = 850.$ Selling this at 810 would mean a loss of ₹ 40 on a CP of ₹ 850.
- The CP will be ₹ 5400. Hence at an S.P. of 5703.75 the percentage profit will be 5.625%

8. $CP = 63/1.05 = 60$. Thus, the required SP for 10% profit $= 1.1 \times 60 = 66$.
9. The buying price is ₹ 9 per dozen, while the sales price is ₹ 12 per dozen – a profit of 33.33%
10. Sales tax $= 120/5 = 24$. Thus, the SP contains ₹ 24 component of sales tax. Of the remainder $(120 - 24 = 96)$ $1/3^{\text{rd}}$ is the profit. Thus, the profit $= 96/3 = 32$. Cost price $= 96 - 32 = 64$.
11. $C.P \times 1.2 = 25 \Rightarrow CP = 20.833$
At a selling price of ₹ 22.5, the profit percent $1.666/20.833 = 8\%$
12. Solve using options. Option (c) gives you ₹ 175 as the cost of the trouser. Hence, the shirt will cost 12% more i.e. $175 + 17.5 + 3.5 = 196$.
This satisfies the total cost requirement of ₹ 371.
13. The formula that satisfies this condition is:
Loss of $a^2/100\%$ (Where a is the common profit and loss percentage). Hence, in this case $400/100 = 4\%$ loss.
14. Use PCG as follows:

$$100 \xrightarrow{20\% \uparrow} 120 \xrightarrow{10\% \downarrow} 108$$
Hence, 8% is the correct answer.
15. The cost per toffee $= 75/125 = ₹ 0.6 = 60$ paise. Cost of 1 million toffees $= 600000$. But there is a discount of 40% offered on this quantity. Thus, the total cost for 1 million toffees is 60% of 600000 $= 360000$.
16. On a marked price of ₹ 80, a discount of 10% would mean a selling price of ₹ 72. Since this represents a 20% profit we get:
 $1.2 \times CP = 72 \Rightarrow CP = 60$.
17. The thought process in this question would go as follows:
 $80 - 5\% \text{ of } 80 = 76$ (after the first discount). $76 - 5\% \text{ of } 76 = 76 - 3.8 = 72.2$ (after the second discount)
18. For ₹ 72, we can buy a dozen pair of gloves. Hence, for ₹ 24 we can buy 4 pairs of gloves.

19. $100 \text{ ₹ } 80$ (after 20% discount) $\text{₹ } 72$ (after 10% discount) $\text{₹ } 68.4$ (after 5% discount).

Thus, the single discount which would be equivalent would be 31.6%.

20. $180 \times 0.9 \times x = 137.7 \text{ ₹ } x = 0.85$

Which means a 15% discount.

21. If you assume the cost price to be 100 and we check from the options, we will see that for Option (c) the marked price will be 120 and giving a discount of 12.5% would leave the shopkeeper with a 5% profit.

22. Solve by trial and error using the options. If he marks his goods 30% above the cost price he would be able to generate a 17% profit inspite of giving a 10% discount.

23. The customer pays ₹ 38 after a discount of 5%. Hence, the list price must be ₹ 40.

This also means that at a 20% discount, the retailer buys the item at ₹ 32.

Hence, the profit for the retailer will be ₹ 6 (38 – 32).

24. The profit would be given by the percentage value of the ratio $6/32 = 18.75\%$.

25. The labour price accounts for ₹ 400. Since the profit percentage gives a 20% profit on this component i.e. ₹ 80.

Hence, the marked price is ₹ 980.

26. The costs in 2006 were 300,400 and 200 respectively. An increase of 20% in material ₹ increase of 60. An increase of 30% in labor ₹ increase of 120. Increase of 10% in overheads ₹ increase of 20.

Total increase = $60 + 120 + 20 = 200$. New cost = $900 + 200 = 1100$

27. For a 20% profit on labour cost, he should mark his goods at $1100 + 20\% \text{ of } 520 = 1204$. Note, 520 is the new cost of labour after a 30% increase as described in Question 26.

28. $SP = 960 = 0.96 \times CP \text{ ₹ } CP = 1000$. To gain a profit of 16%, the marked price should be 116% of 1000 = 1160.

29. The SP per article = ` 3. This represents a profit of 20%. Thus, CP = $3/1.2 = 2.5$. 8 articles would cost ` 20 and hence selling at 18.40 would represent a loss of ` 1.6 which would mean an 8% loss on ` 20.

30. The percentage profit = $\frac{\text{Goods left}}{\text{Goods sold}} \times 100$
 $= 10/40 \times 100 = 25\%$

31. In the question, A's investment has to be considered as ` 10,000 (the house he puts up for sale).
 He sells at 11,500 and buys back at ` 9775. Hence his profit is ` 1725.

Required answer = $\frac{1725}{10000} \times 100 = 17.25$

32. For 12 locks, he would have paid ` 51, and sold them at ` 57. This would mean a profit percentage of 11.76%

33. $230/200 = 1.15$ ∴ the profit percentage would be 15% if sold at 230. Thus, the increase in profit percent = $15 - 10 = 5\%$.

34. A's selling price = $1.25 \times 120 = 150$. C's Cost price = B's selling price = $198/1.1 = 180$. Thus, B's profit = ` 30 and his profit percent = $30 \times 100/150 = 20\%$.

35. A 10% reduction in price increases the consumption by 11.11% (Refer Table 4.1). But the increase in consumption is 6.2 kg.

Hence, the consumption (original) will be $6.2 \times 9 = 55.8$ kg.

Hence, original price = $279/55.8 = `5$.

Hence, reduced price = ` 4.5

36. Total cost = $50 \times 10 + 40 \times 12 = 980$. Total revenue = $90 \times 11 = 990$. Gain percent = $(10 \times 100)/980 = 100/98 \%$.

37. Percentage profit = $\frac{\text{Goods left}}{\text{Goods sold}} \times 100$
 $= 10/20 \times 100 = 50\%$

38. The profit percent would be equal to $50 \times 100 / 950 = 5000/950 = 100/19\% = 5 (5/19)\%$

39. A gross means 144 eggs. Thus, the cost price per egg = 25 paise and the selling price after a 12.5% profit = 28 paise approx.
40. B sold the table at 25% profit at ₹ 75. Thus cost price would be given by: $CP_B \times 1.25 = 75$
 B's Cost price = ₹ 60.
 We also know that A sold it to B at 20% profit.
 Thus,
 $A's \text{ Cost price} \times 1.2 = 60$
 $\therefore A's \text{ cost price} = 50.$
41. 300 (A buys at this value) ₹ 345 (sells it to B at a profit of 15%) ₹ 404 (B sells it back to A at a profit of 20% gaining ₹ 69 in the process). Thus, A's original cost = ₹ 300.
42. Net loss = $(20/100)^2 = 4\%$ of cost price. Thus, 4800 (total money realized) represents 96% of the value. Thus, the cost price would be ₹ 5000 and the loss would be ₹ 200.
43. $CP \times 0.9 = 40$ ₹ $CP = ₹ 44.444$. Loss per kg = ₹ 4.44. To incur a loss of ₹ 80, we need to sell $80/4.44 = 18$ kgs of tea.
44. The CP of the TV ₹ $CP_{TV} \times 0.8 = 12000$ ₹ $CP_{TV} = 15000$
 The CP of the VCP ₹ $CP_{VCP} \times 1.2 = 12000$ ₹ $CP_{VCP} = 10000$.
 Total sales value = $12000 \times 2 = 24000$.
 Total cost price = $15000 + 10000 = 25000$. Loss = $25000 - 24000 = 1000$.
45. The profit of 15% amounts to ₹ 450. This should also be the actual loss on the second TV.
 Thus, the actual loss = ₹ 450 (10% of C.P.)
 Hence, the CP of the second set = ₹ 4500.
46. Let the cost price be P . Then, $P \times 0.95 \times 1.1 = P \times 1.05 - 2$ ₹ $P = 400$. Alternately, you could have solved this using options.
47. Let the cost price be P . Then, $P \times 0.95 \times 1.2 = P \times 1.1 + 7$ ₹ $P = 175$. Alternately, you could have solved this using options.
48. 4% of the cost price = ₹ 200.
 Thus, cost price = ₹ 5000

and selling price @ 6% profit = ₹ 5300.

49. From the last statement we have: Charan's cost price = $1188/1.1 = 1080$ = Bhushan's selling price. Then, Bhushan's CP would be given by the equation: $CP \times 0.9 = 1080$ ∴ CP for Bhushan = 1200 = SP for Ashok.

Also, Ashok gains 20%. Hence, CP for Ashok ∴ $CP \times 1.2 = 1200$ ∴ CP for Ashok = 1000 .

This includes a ₹ 110 component of repairs. Thus, the purchase price for Ashok would be $1000 - 110 = 890$.

50. Solve through the values given in the options. Option (c) is correct because at $4/5 \times 300 + 5/4 \times 600$ we see that the profit earned = ₹ 90.

51. Solve this question using the options. The first thing you should realize is that the cost of the lower priced item should be less than 240. Thus, we can reject options a and d. Checking option (c) we can see that if the lower priced item is priced at 200, the higher priced item would be priced at ₹ 280. Then:

$1.19 \times 200 = 238$ and $0.85 \times 280 = 238$. It can be seen that in this condition the values of the selling price of both the items would be equal (as required by the conditions given in the problem). Thus, option (c) is the correct answer.

52. Original Cost Price = ₹ 5000

New Cost Price = $1.3 \times 5000 = ₹ 6500$

Price paid by retailer = $1.2 \times 5750 = ₹ 6900$

Profit percentage = $(400/6500) \times 100 = 6\frac{2}{13}\%$

53. The total manufacturing cost of the article = $60 + 45 + 30 = 135$. SP = 180. Thus, profit = ₹ 45.

Profit Percent = $45 \times 100/135 = 33.33\%$

54. Assume marked price for both to be 100.

X's selling price = $100 \times 0.75 \times 0.95 = 71.25$

Y's selling price = $100 \times 0.84 \times 0.88 = 73.92$.

Buying from 'X' is more profitable.

55. The total discount offered by A = 8% on 20000 + 5% on 16000 = 1600 + 800 = 2400.

If B wants to be as competitive, he should also offer a discount of ` 2400 on 3600. Discount percentage = $2400 \times 100/36000 = 6.66\%$ discount.

56. The trader pays $800 \times 0.95 \times 0.95 = \text{` } 722$

57. Manufacturer's profit percentage
 $= (22/700) \times 100 = (22/7)\%$

58. For a cost price of ` 400, he needs a selling price of 480 for a 20% profit. This selling price is arrived at after a discount of 4% on the marked price. Hence, the marked price $MP = 480/0.96 = 500$.

59. Solve using options. Option (b) fits the situation as a 12.5% discount on 288 would mean a discount of ` 36. This would leave us with a selling price of 252 which represents a profit percent of 20% on ` 210.

60. If he marks the camera at 800, a 10% discount would still allow him to sell at 720 – a profit of 20%.

61. Cost price to the watch dealer
 $= 250 + 10\% \text{ of } 250 = \text{` } 275$
Desired selling price for 20% profit
 $= 1.2 \times 275 = 330$

But 330 is the price after 25% discount on the marked price.

Thus,

Marked price $\times 0.75 = 330 \Rightarrow MP = 440$

Hence, he should mark the item at ` 440.

62. If the cost price is 100, a mark up of 80% means a marked price of 180. Further a 15% discount on the marked price would be given by:
 $180 - 15\% \text{ of } 180 = 180 - 27 = 153$. Thus, the percentage profit is 53%.

63. A cost price of ` 650 would meet the conditions in the problem as it would give us a loss of 140 (if sold at 510) and a profit of 70 (when sold at 720)

64. Cost per 100 apples = $60 + 15\% \text{ of } 60 = ₹ 69$.
 Selling price @ 20% profit = $1.2 \times 69 = ₹ 82.8$
65. Profit percent = $(100/900) \times 100 = 11.11\%$

Level of Difficulty (II)

- Total outlay (initial investment) = $750 \times 0.6 = ₹ 450$.

By selling 600, he should make a 40% profit on the outlay. This means that the selling price for 600 should be $1.4 \times 450 = ₹ 630$

Thus, selling price per article = $630/600 = 1.05$. Since, he sells only 630 articles at this price, his total recovery = $1.05 \times 630 = 661.5$

Profit percent (actual) = $(211.5/450) \times 100 = 47\%$
- In order to solve this problem, first assume that the cost of manufacturing 1 article is ₹1. Then 100 articles would get manufactured for ₹100. For a 20% profit on this cost, he should be able to sell the entire stock for ₹120. However since he would be able to sell only 88 articles (given that 12% of his manufactured articles would be rejected) he needs to recover ₹120 from selling 88 articles only. Thus, the profit he would need would be given by the ratio 32/88.

Now it is given to us that his selling price is ₹7.5. The same ratio of profitability i.e. 32/88 is achieved if his cost per article is ₹ 5.5.
- The total cost to print 900 copies would be given by:

Cost for setting up the type + cost of running the printing machine + cost of paper/ink etc

$$= 1000 + 120 \times 9 + 900 \times 0.6 = 1000 + 1080 + 540 = 2620.$$

A 10% profit on this cost amounts to ₹ 262. Hence, the total amount to be recovered is ₹ 2882.

Out of this, 784 copies are sold for ₹ 2.75 each to recover ₹ 2156.

The remaining money has to be recovered through advertising.

Hence, The money to be recovered through advertising = $2882 - 2156 = ₹ 726$. Option (c) is correct.
- Total cost (assume) = 100.

Recovered amount = $65 + 0.85 \times 32.5 + 0.7 \times 32.5$

$$= 65 + 27.625 + 22.75 = 115.375$$

Hence, profit percent = 15.375%

5. Cost price = x

$$\text{Marked Price} = x + 205$$

$$\text{Selling Price} = 0.9x + 184.5$$

$$\text{Percentage Profit} = [(-0.1x + 184.5)/x] \times 100.$$

$$= \frac{18450 - 10x}{x}$$

6. She should opt for a straight discount of 30% as that gives her the maximum benefit.

7. If you assume that his cost price is 1 Re per gram, his cost for 1000 grams would be ₹ 1000. For supposed 1 kg sale he would charge a price of 1080 (after an increase of 20% followed by a decrease of 10%).

But, since he gives away only 900 grams the cost for him would be ₹ 900.

Thus he is buying at 900 and selling at 1080 – a profit percentage of 20%

8. While buying

He buys 1100 gram instead of 1000 grams (due to his cheating).

Suppose he bought 1100 grams for ₹ 1000

While selling:

He sells only 900 grams when he takes the money for 1 kg.

Now according to the problems he sells at a 8% profit (20% mark up and 10% discount).

Hence his selling price is ₹ 1080 for 900 grams.

To calculate profit percentage, we either equate the goods or the money.

In this case, let us equate the money as follows:

Buying;

1100 grams for ₹ 1000

Hence 1188 grams for ₹ 1080

Selling: 900 grams for ₹ 1080

Hence, profit% = $288/900 = 32\%$

(using goods left by goods sold formula)

9. The new situation is

Buying:

1100 grams for ₹ 900

Hence, 1320 grams for ₹ 1080

Selling: 900 grams for ₹ 1080

$$\text{Profit \%} = \frac{420}{900} \times 100 = 46.66\%$$

10. Assume he bought 20 apples each. Net investment is ₹ 5 + ₹ 4 = ₹ 9 for 40 apples. He would sell 40 apples @ $(40 \times 2)/9 = ₹ 8.888$ Æ Loss of ₹ 0.111 on ₹ 9 investment

Loss percentage = 1.23%

11. $600 - 10\% \text{ of } 600 = 540$. $540 - 5\% \text{ of } 540 = 513$. $513 + 5\% \text{ of } 513 = 538.65$

12. The problem is structured in such a way that you should be able to interpret that if he had sold 120 kg of rice he would recover the investment on 100 kg of rice.

$$\% \text{ Loss/Profit} = \frac{\text{Goods left}}{\text{Goods sold}} \times 100$$

$$(-20/120) \times 100 = 16.66\% \text{ loss.}$$

Since, cost price for Deb is ₹ 11; selling price per kg would be ₹ 9.166.

13. Comparisons have to be made between:

192×34 , 198×33 , 204×32 and 210×31 for the highest product amongst them.

The highest value of revenue is seen at a price of ₹ 198.

- 14 & 15: Using options from question 15. Suppose she had spent ₹ 6 at the market complex, she would spend ₹ 3 at her uncle's shop. The

other condition (that she gets 2 sweets less per rupee at the market complex) gets satisfied in this scenario if she had bought 12 chocolates overall. In such a case, her buying would have been 2 per Rupee at the market and 4 per rupee at Uncle Scrooge's shop.

Trial and error will show that this condition is not satisfied for any other option combination.

16. The given situation fits if we take Q as 60% profit and then the loss would be 37.5% (which is 62.5% of Q). Thus, if ₹ 24 is the cost price, the selling price should be $24 \times 1.6 = ₹ 38.4$
17. Assume the price of 1 kg as 100. He initially sells the kg at 115. His original profit is 15%. When he is able to sell only 80% of his items: his new revenue would be given by $80 \times 1.265 = 101.2$ on a cost of 100. Profit percentage = 1.2%

Change in profit percent = -13.8 (It drops from 15 to 1.2)

18. Ramu's total discount:

8% on 8000 = ₹ 640

5% on 12000 = ₹ 600

3% on 16000 = Rs. 480

Total = ₹ 1720 on ₹ 36000.

Hence, Realised value = 34280.

Shyamu's Discounts:

7% on 12000 = 840

6% on 8000 = 480

5% on 16000 = 800

₹ 2120 on ₹ 36000

Hence, Realised value = 33880.

The higher profit is for Ramu.

Also, the CP has a mark up of 25% for the Marked price. Thus the CP must have been 28800 (This is got by $36000 - 20\%$ of 36000 – PCG thinking)

Thus, the profit % for Ramu would be: $(5480 \times 100) / 28800 \approx 19\%$ approx.

19. In the case of the given defaults, the discount for Ramu would have gone down to:

4% on 12000 (the second payment) and the second discount would thus have been ₹480 meaning that the sale price would have risen by ₹120 (since there is a ₹120 drop in the discount)

1% on 16000 Æ A reduction of 2% of 16000 in the discount Æ a reduction of ₹320.

Hence, Ramu's profit would have gone up by ₹440 in all & would yield his new profit as:

$$5480 + 440 = ₹5920$$

20. The following working would show the answer:

Ramu's Discounts

$$7\% \text{ on } 8000 = ₹560$$

$$4\% \text{ on } 12000 = ₹480$$

$$2\% \text{ on } 16000 = \underline{\text{Rs. } 320}$$

$$\text{Total} = ₹1360 \text{ on } ₹36,000.$$

Shyamu's discounts:

$$6\% \text{ on } 12000 = 720$$

$$5\% \text{ on } 8000 = 400$$

$$4\% \text{ on } 16000 = \underline{640}$$

$$₹1760 \text{ on } ₹36000$$

Thus, their profits would vary by ₹400 (since their cost price is the same)

21. Solve using options. Option (a) fits as if we take SP as 2000, we get CP_1 as 1500 and CP_2 as 1600 which gives us the required difference of ₹100.

22. The first one would get a profit of ₹500 (because his cost would be 2500 for him to get a 20% profit on cost price by selling at 3000).

The second one would earn a profit of 600 (20% of 3000).

$$\text{Difference in profits} = ₹100$$

23. Find out the total revenue realization for both the cases:

Case 1: (Old) Total sales revenue = $2000 \times 3.25 \times 0.75$.

$\text{Profit}_{\text{old}} = \text{Total sales revenue} - 4800$

Case 2: (New) Total sales revenue = $3000 \times 4.25 \times 0.75$

$\text{Profit}_{\text{new}} = \text{Total sales revenue} - 4800$

The ratio of profit will be given by $\text{Profit}_{\text{new}} / \text{Profit}_{\text{old}}$

24. Profit in original situation = 20%.

In new situation, the purchase price of 90 (buys at 10% less) would give a selling price of 132 (sells at 10% above 120).

The new profit percent = $[(132 - 90) \times 100] / 90 = 46.66$

Change in profit percent = $[(46.66 - 20) \times 100] / 20 = 133.33\%$

25. The successive discounts must have been of 10% each. The required price will be got by reducing 25 by 10% twice consecutively. (use PCG application for successive change)

26. From the options you can work out that if the original price was ₹ 12 per dozen, the cost per apple would be ₹ 1.

If she is able to get a dozen apples at a reduced price (reduction of ₹ 1 per dozen), she would be able to purchase 1 extra apple for the ₹ 1 Rupee she saved. Thus, option (c) is correct.

27. The following calculations will show the respective costs:

Primary Cost: 35% of 12600 = 4410

Miscellaneous costs = 2% of 12600 = 252

Gross Profit = $12600 - 4410 - 1400 - 650 - 252 = 5888$

Trading cost = $0.25 \times 5888 = 1472$

Hence, Net profit = 4416.

Percentage profit = $4416 / 14000 = 31.54\%$

28. If we assume the value of the first cycle as ₹ 900. Then $900 + 96 = 996$ should be equal to twice the value of the second cycle. Hence, the value of the second cycle works out to be: 498.

Also $498 + 96 = 594$ which is ₹ 306 less than 900.

Hence, Option (a) fits the situation perfectly and will be the correct answer.

Note here that if you had tried to solve this through equations, you would have got stuck for a very long time.

29. David (100) Æ Goliath (80) Æ Hercules (100) Æ Goliath (90)
Hercules loss corresponds to 10 when David buys the laptop for 100.

Hence, Hercules's loss would be ₹17500 when David buys the laptop for ₹1,75,000.

30. While purchasing he would take 1200 grams for the price of 1000 grams.

While selling he would sell 900 grams for the price of 1000 grams. Since CP = SP, the profit earned is through the weight manipulations. It will be given by:

$$\text{Goods left/goods sold} = 300 \times 100/900 = 33.33\%$$

31. Assume that for 100 items the cost price is ₹100, then the selling price is ₹130. Since 24 is sold at half the price, he would recover $24 \times 1/2 = ₹12$ (since it is sold at half the cost price)

The remaining 70 would be sold at $70 \times 1.3 = ₹91$.

Total revenue = $91 + 12 = 103$ Æ a profit of 3% (on a cost of 100).

32. An increase in the price by ₹12 will correspond to 50% of the CP.

Hence, The CP is ₹24 and initially the book was being sold at ₹19.2.

Hence, if there is an increment of ₹4.8 in the selling price, there would be no profit or loss.

33. In the first year, the profit percentage would be:

$$\text{Old Profit Percentage} = \frac{0.55 \times 5 + 0.45 \times 8}{1} = 6.35\%$$

$$\text{New Profit Percentage} = \frac{0.55 \times 8 + 0.45 \times 5}{1} = 6.65$$

34. Since the ratio remains unchanged the percentage profit of the village will remain unchanged too.

35. The profit would increase by 10% as there is no change in the percentage profit.

36. Since the answer to question 33 is 0.3, if we increase the percentage profit for both men and women by 1 % the overall percentage profit would also go up by 1% - thus $0.3 + 1 = 1.3\%$

37. $x \times 8 + 0.75x \times 22 = 1.4 \times 4725 \Rightarrow x = 270$.

On an investment of ₹ 4725, a profit of 40% means a profit of 1890.

Hence, the targeted sales realization is ₹ 6615.

The required equation would be:

$$8p + 22(3p)/4 = 6615$$

$$\Rightarrow 8p + 33p/2 = 6615$$

In this expression for LHS to be equal to RHS, we need $33p/2$ to be an odd number. This can only happen when p is not a multiple of 4 (why?? Apply your mind). Hence, options a & c get eliminated automatically.

38. After 2 years, the flat would be worth ₹ 288000, while the land would be worth ₹ 266200. The profit percentage of the gainer would be given by:

$$(21800/266200) \times 100 = 8.189\%$$

Hence (d).

39. The total investment will be $A + B + C$.

C being 3000, B will be 2250 and A will be 1500.

The total investment is: 6750.

Returns to be given on their expectations:

$$A = 150, B = 337.5 \text{ and } C = 0.$$

From this point calculate the total profit, subtract A 's and B 's expected returns and B 's share of the profits for managing the business before dividing the profits in the ratio of capital invested. However, most of this information is unknown. Hence option (d) is correct.

40. The cost of the trip would be proportional to the price of petrol. So, if initially the cost is 100, the new cost would be 80. Also, initially since his profit is 20%, his revenue would be 120. When he takes 4 passengers instead of 3 his revenue would go up to 160 – and his profit would become 100% (cost 80 and revenue 160).

41. Total number of microwave ovens = 15
 Hence, washing machines = 10
 Thus, He sells 80% of both at a profit of ₹ 40,000.
 Cost of 80% of the goods = $0.8 \times 2,05,000 = 1,64,000$.
 Total amount recovered = $1,64,000 + 40,000 = 2,04,000$
 Hence, loss = ₹ 1000
42. Since the actual initial loss was 10% and it is to be compared to a profit of 5%, it is 200% of the profit. Option (c) is correct.
43. He would be selling 800 grams for ₹12. Since a kg costs ₹10 800 grams would cost ₹ 8.
 Hence, his profit percentage is 50%.
44. The interpretation of the first statement is that if the loss at 275 is L, the profit at 800 is 20L.
 Thus, $21L = 800 - 275 = 525 \Rightarrow L = 25$.
 Thus, the cost price of the item is ₹300.
 To get a profit of 25%, the selling price should be $1.25 \times 300 = 375$.
45. C's purchase price = $2145 \times \frac{10}{11} = 1950$
 B's rate of profit is 3 times C's rate of profit. Hence, B sells to C at 30% profit.
 B's price + 30% profit = 1950 (C's price).
 Hence, B's Price = 1500.
 Further, since A's profit rate is $\frac{5}{3}$ rd the rate of profit of B, A's profit percent would be $30 \times \frac{5}{3} = 50\%$.
 Thus, A's Price + 50% profit = 1500 (B's price)
 Thus, A's price = 1000
46. He would buy at 500 and sell at 888 to get a profit of 388
47. There were 5 printers (2 + 3) and 20 monitors. He sells 2 printers for a profit of ₹ 2000 each. Hence, profit from printer sales = ₹ 4000.
 Then, profit from monitor sales = ₹ 45000
 Thus, profit per monitor = $\frac{45000}{15} = ₹ 3000$

(Since, 15 monitors were sold in all.)

Hence, C.P. of monitor = ` 15000

And C.P. of Printer = ` 7500

Total cost = $15000 \times 20 + 7500 \times 5 = 3,37,500$

Total Revenues = $18000 \times 15 + 9500 \times 2 = 28,900$

Hence, loss of ` 48,500

48. $\text{Loss\%} = \frac{48,500}{3,37,500} \times 100 = 14.37\%$

49. By charging ` 1.2 more his profit should double to 40%. This means that his profit of 40% should be equal to ` 2.4. Thus, his cost price must be `6 and his original selling price should be 7.2. Hence, option (d) is correct.

50. Total cost = 5 lacs

Total revenue = $3000 \times 160 + 1500 \times 200$ – vendors discount of 20% of revenues

= $7.8 \text{ lacs} - 1.56 \text{ lacs} = 6.24 \text{ lacs}$.

Profit percent = $(1.24 \times 100)/5 = 24.8\%$



Interest

INTRODUCTION

The chapter on Interest forms another important topic from the CAT's point of view. However, this relevance/importance is only restricted to the use of interest and its concepts in Data Interpretation.

However, it's relevance to Data Interpretation remains as high as always.

Prior to studying this chapter however, you are required to ensure that a clear understanding of percentages and percentage calculation is a must. The faster you are at percentage calculation, the faster you will be in solving questions of interests.

However, questions on interest are still important for exams like MAT, SNAP, ATMA, CMAT, IRMA and Bank P.O. exams. Hence, if you are planning to go for the entire spectrum of management exams—this chapter retains its importance in terms of mathematics too.

Questions from LOD I and LOD II of the chapter regularly appear in exams like the Bank PO or others management exams.

CONCEPT OF TIME VALUE OF MONEY

The value of money is not constant. This is one of the principal facts on which the entire economic world is based. A rupee today will not be equal to a rupee tomorrow. Hence, a rupee borrowed today cannot be repaid by a rupee tomorrow. This is the basic need for the concept of interest. The rate

of interest is used to determine the difference between what is borrowed and what is repaid.

There are two basis on which interests are calculated:

Simple Interest It is calculated on the basis of a basic amount borrowed for the entire period at a particular rate of interest. The amount borrowed is the principal for the entire period of borrowing.

Compound Interest The interest of the previous year/s is/are added to the principal for the calculation of the compound interest.

This difference will be clear from the following illustration:

A sum of ₹ 1000 at 10% per annum will have

<i>Simple interest</i>		<i>Compound interest</i>
₹ 100	First year	₹ 100
₹ 100	Second year	₹ 110
₹ 100	Third year	₹ 121
₹ 100	Fourth year	₹ 133.1

Note that the previous years' interests are added to the original sum of ₹ 1000 to calculate the interest to be paid in the case of compound interest.

Terminology Pertaining to Interest

The man who lends money is the **Creditor** and the man who borrows money is the **Debtor**.

The amount of money that is initially borrowed is called the **Capital** or **Principal** money.

The period for which money is deposited or borrowed is called **Time**.

The extra money, that will be paid or received for the use of the principal after a certain period is called the **Total interest** on the capital.

The sum of the principal and the interest at the end of any time is called the **Amount**.

So, **Amount = Principal + Total Interest**.

Rate of Interest is the rate at which the interest is calculated and is always specified in percentage terms.

SIMPLE INTEREST

The interest of 1 year for every ` 100 is called the **Interest rate** per annum. If we say “the rate of interest per annum is $r\%$ ”, we mean that ` r is the interest on a principal of ` 100 for 1 year.

Relation Among Principal, Time, Rate Percent of Interest Per Annum and Total Interest

Suppose, Principal = ` P , Time = t years, Rate of interest per annum = $r\%$ and Total interest = ` I

Then
$$I = \frac{P \times t \times r}{100}$$

i.e. Total interest

$$= \frac{\text{Principal} \times \text{Time} \times \text{Rate of interest per annum}}{100}$$

Since the Amount = Principal + Total interest, we can write

$$\text{Amount (A)} = P + \frac{P \times t \times r}{100}$$
$$\text{Time} = \left(\frac{\text{Total interest}}{\text{Interest on the Principal for one year}} \right) \text{ years}$$

Thus, if we have the total interest as ` 300 and the interest per year is ` 50, then we can say that the number of years is $300/50 = 6$ years.

Note: The rate of interest is normally specified in terms of annual rate of interest. In such a case we take the time t in years.

However, if the rate of interest is specified in terms of 6-monthly rate, we take time in terms of 6 months.

Also, the half-yearly rate of interest is half the annual rate of interest. That is if the interest is 10% per annum to be charged six-monthly, we have to add interest every six months @ 5%.

COMPOUND INTEREST

In monetary transactions, often, the borrower and the lender, in order to settle an account, agree on a certain amount of interest to be paid to the lender on the basis of specified unit of time. This may be yearly or half-yearly or quarterly, with the condition that the interest accrued to the principal at a certain interval of time be added to the principal so that the total amount at the end of an interval becomes the principal for the next interval. Thus, it is different from simple interest.

In such cases, the interest for the first interval is added to the principal and this amount becomes the principal for the second interval, and so on.

The difference between the amount and the money borrowed is called the *compound interest* for the given interval.

Formula

Case 1: Let principal = P , time = n years and rate = $r\%$ per annum and let A be the total amount at the end of n years, then

$$A = P \left[1 + \frac{r}{100} \right]^n$$

Case 2: When compound interest is reckoned half-yearly.

If the annual rate is $r\%$ per annum and is to be calculated for n years.

Then in this case, rate = $(r/2)\%$ half-yearly and time = $(2n)$ half-years.

\ From the above we get

$$A = P \left[1 + \frac{r/2}{100} \right]^{2n}$$

Case 3: When compound interest is reckoned quarterly.

In this case, rate = $(r/4)\%$ quarterly and time = $(4n)$ quarter years.

\ As before,

$$A = P \left[1 + \frac{r/4}{100} \right]^{4n}$$

Note: The difference between the compound interest and the simple interest over two years is given by

$$Pr^2/100^2 \quad \text{or} \quad P \left(\frac{r}{100} \right)^2$$

DEPRECIATION OF VALUE

The value of a machine or any other article subject to wear and tear, decreases with time.

This decrease is called its *depreciation*.

Thus if V_0 is the value at a certain time and $r\%$ per annum is the rate of depreciation per year, then the value V_1 at the end of t years is

$$V_1 = V_0 \left[1 - \frac{r}{100} \right]^t$$

POPULATION

The problems on Population change are similar to the problems on Compound Interest. The formulae applicable to the problems on compound interest also apply to those on population. The only difference is that in the application of formulae, the annual rate of change of population replaces the rate of compound interest.

However, unlike in compound interest where the rate is always positive, the population can decrease. In such a case, we have to treat population change as we treated depreciation of value illustrated above.

The students should see the chapter on interests essentially as an extension of the concept of percentages. All the rules of percentage calculation,

which were elucidated in the chapter of percentages, will apply to the chapter on interests. Specifically, in the case of compound interests, the percentage rule for calculation of percentage values will be highly beneficial for the student.

Besides, while solving the questions on interests the student should be aware of the possibility of using the given options to arrive at the solution. In fact, I feel that the formulae on Compound Interest (CI) unnecessarily make a very simple topic overly mathematical. Besides, the CI formulae are the most unusable formulae available in this level of mathematics since it is virtually impossible for the student to calculate a number like 1.08 raised to the power 3, 4, 5 or more.

Instead, in my opinion, you should view CI problems simply as an extension of the concept of successive percentage increases and tackle the calculations required through approximations and through the use of the percentage rule of calculations.

Thus, a calculation: 4 years increase at 6% pa CI on ` 120 would yield an expression: 120×1.06^4 . It would be impossible for an average student to attempt such a question and even if one uses advanced techniques of calculations, one will end up using more time than one has. Instead, if you have to solve this problem, you should look at it from the following percentage change graphic perspective:

$$\begin{array}{l}
 120 \xrightarrow[\text{=7.2}]{+6\%} 127.2 \xrightarrow[6+1.62]{+6\%} \\
 134.82 \xrightarrow[6+2.1]{+6\%} 142.92 \xrightarrow[6+2.58]{+6\%} 15.15 \text{ (approx.)}
 \end{array}$$

If you try to check the answer on a calculator, you will discover that you have a very close approximation. Besides, given the fact that you would be working with options and given sufficiently comfortable options, you need not calculate so closely; instead, save time through the use of approximations.

APPLICATIONS OF INTEREST IN D.I.

The difference between Simple Annual Growth Rate and Compound Annual Growth Rate:

The Measurement of Growth Rates is a prime concern in business and Economics. While a manager might be interested in calculating the growth rates in the sales of his product, an economist might be interested in finding out the rate of growth of the GDP of an economy.

In mathematical terms, there are basically two ways in which growth rates are calculated. To familiarize yourself with this, consider the following example.

The sales of a brand of scooters increase from 100 to 120 units in a particular city. What does this mean to you? Simply that there is a percentage increase of 20% in the sales of the scooters. Now read further:

What if the sales moves from 120 to 140 in the next year and 140 to 160 in the third year? Obviously, there is a constant and uniform growth from 100 to 120 to 160 – i.e. a growth of exactly 20 units per year. In terms of the overall growth in the value of the sales over there years, it can be easily seen that the sale has grown by 60 on 100 i.e. 60% growth.

In this case, what does 20% represent? If you look at this situation as a plain problem of interests 20% represents the simple interest that will make 100 grow to 160.

In the context of D.I., this value of 20% interest is also called the Simple Annual Growth Rate. (SAGR)

The process for calculating SAGR is simply the same as that for calculating Simple Interest.

Suppose a value grows from 100 to 200 in 10 years – the SAGR is got by the simple calculation $100\%/10 = 10\%$

What is Compound Annual Growth Rate (CAGR)?

Let us consider a simple situation. Let us go back to the scooter company.

Suppose, the company increases it's sales by 20% in the first year and then again increases its' sales by 20% in the second year and also the third year. In such a situation, the sales (taking 100 as a starting value) trend can be easily tracked as below:

$$100 \xrightarrow[+20]{20\% \uparrow} 120 \xrightarrow[+24]{20\% \uparrow} 144 \xrightarrow[+28.8]{20\% \uparrow} 172.8$$

As you must have realised, this calculation is pretty similar to the calculation of Compound interests. In the above case, 20% is the rate of compound interest which will change 100 to 172.8 in three years.

This 20% is also called as the Compound Annual Growth Rate (CAGR) in the context of Data interpretation.

Obviously, the calculation of the CAGR is much more difficult than the calculation of the SAGR and the Compound Interest formula is essentially a waste of time for anything more than 3 years.

(upto three years, if you know your squares and the methods for the cubes you can still feasibly work things out – but beyond three years it becomes pretty much infeasible to calculate the compound interest).

So is there an alternative? Yes there is and the alternative largely depends on your ability to add well. Hence, before trying out what I am about to tell you, I would recommend you should strengthen yourself at addition.

Suppose you have to calculate the C.I. on ` 100 at the rate of 10% per annum for a period of 10 years.

You can combine a mixture of PCG used for successive changes with guesstimation to get a pretty accurate value.

In this case, since the percentage increase is exactly 10% (Which is perhaps the easiest percentage to calculate), we can use PCG all the way as follows:

$$\begin{aligned}
 &100 \xrightarrow[+10]{10\% \uparrow} 110 \xrightarrow[+4]{10\% \uparrow} 121 \xrightarrow[+12.1]{10\% \uparrow} 133.1 \\
 &\quad \xrightarrow[+13.31]{10\% \uparrow} 146.4 \\
 &\quad \xrightarrow[14.64]{10\% \uparrow} 161.04 \xrightarrow[16.10]{10\% \uparrow} 177.14 \xrightarrow[17.71]{10\% \uparrow} 194.8 \\
 &\quad \xrightarrow[19.48]{10\% \uparrow} \dots \\
 &214.3 \xrightarrow[21.43]{10\% \uparrow} 235.7 \xrightarrow[23.57]{10\% \uparrow} 259.2
 \end{aligned}$$

Thus, the percentage increase after 10 years @ 10% will be 159.2 (approx).

However, this was the easy part. What would you do if you had to calculate 12% CI for 10 years. The percentage calculations would obviously become much more difficult and infeasible. How can we tackle this situation?

$$100 \xrightarrow[\substack{+12}]{12\% \uparrow} 112 \xrightarrow[\substack{?}]{12\% \uparrow} ?$$

In order to understand how to tackle the second percentage increase in the above PCG, let's try to evaluate where we are in the question.

We have to calculate 12% of 112, which is the same as 12% of 100 + 12% of 12.

But we have already calculated 12% of 100 as 12 for the first arrow of the PCG. Hence, we now have to calculate 12% of 12 and add it to 12% of 100.

Hence the addition has to be:

$$12 + 1.44 = 13.44$$

Take note of the addition of 1.44 in this step. It will be significant later. The PCG will now look like:

$$100 \longrightarrow 112 \longrightarrow 125.44 \xrightarrow[\substack{?}]{12\% \uparrow} ?$$

We are now faced with a situation of calculating 12% of 125.44. Obviously, if you try to do this directly, you will have great difficulty in calculations. We can sidestep this as follows:

$$12\% \text{ of } 125.44 = 12\% \text{ of } 112 + 12\% \text{ of } 13.44.$$

But we have already calculated 12% of 112 as 13.44 in the previous step.

Hence, our calculation changes to:

$$12\% \text{ of } 112 + 12\% \text{ of } 13.44 = 13.44 + 12\% \text{ of } 13.44$$

But $12\% \text{ of } 13.44 = 12\% \text{ of } 12 + 12\% \text{ of } 1.44$. We have already calculated 12% of 12 as 1.44 in the previous step.

$$\text{Hence } 12\% \text{ of } 13.44 = 1.44 + 12\% \text{ of } 1.44$$

$$= 1.44 + 0.17 = 1.61 \text{ (approx)}$$

Hence, the overall addition is

$$13.44 + 1.61 = 15.05$$

Now, your PCG looks like:

$$100 \xrightarrow{+12} 112 \xrightarrow{+13.44} 125.44 \xrightarrow{+15.05} 140.49 \xrightarrow{+?} ?$$

You are again at the same point—faced with calculating the rather intimidating looking 12% of 140.49

$$12\% \text{ of } 140.49 = 12\% \text{ of } 125.44 + 12\% \text{ of } 15.05$$

already calculated

Compare this to the previous calculation:

$$12\% \text{ of } 125.44 = 12\% \text{ of } 112 + 12\% \text{ of } 13.44$$

already calculated

The only calculation that has changed is that you have to calculate 12% of 15.05 instead of 12% of 13.44. (which was approx 1.61). In this case it will be approximately 1.8. Hence you shall now add 16.85 and the PCG will look as:

$$100 \xrightarrow{+12} 112 \xrightarrow{+13.44} 125.44 \xrightarrow{+15.05} 140.49 \xrightarrow{+16.85} 166.34$$

If you evaluate the change in the value added at every arrow in the PCG above, you will see a trend—

The additions were:

+12, +13.44 (change in addition = 1.44), +15.05 (change in addition = 1.61), +16.85 (change in addition = 1.8)

If you now evaluate the change in the change in addition, you will realize that the values are 0.17, 0.19. This will be a slightly increasing series (And can be easily approximated).

Thus, the following table shows the approximate calculation of 12% CI for 10 years with an initial value of 100.

Thus, 100 becomes 309.78

(a percentage increase of 209.78%)

Similarly, in the case of every other compound interest calculation, you can simply find the trend that the first 2 – 3 years interest is going to follow and continue that trend to get a close approximate value of the overall percentage increase.

Thus for instance 7% growth for 7 years at C.I. would mean:

$$100 \xrightarrow{+7} 107 \xrightarrow{+7.49} 114.49 \xrightarrow{+8.01} 122.5$$

$$\begin{aligned}
 &\xrightarrow{+8.55} 131.05 \\
 &\xrightarrow{+9.11} 140.16 \xrightarrow{+9.75} 149.91 \xrightarrow{+10.35} 160.24
 \end{aligned}$$

At the end of	Principal (approx.)	Interest for the year	Change in Addition	Change in change in Addition
year 0	100	+12	1.44	
year 1	112	+13.44	1.61	0.17
year 2	125.44	+15.05	1.8	0.19
year 3	140.49	+16.85	2.01	0.21
year 4	157.36	+18.86	2.25	0.24
year 5	176.2	21.11	2.51	0.28
year 6	197.3	23.62	2.79	0.31
year 7	220.92	26.41	3.1	0.35
year 8	247.33	29.5	3.45	
year 9	276.83	32.95		
year 10	309.78			

This series is approximated giving all values in this table.

An approximate growth of 60.24%

The actual value (on a calculation) is around 60.57% – Hence as you can see we have a pretty decent approximation for the answer.

Note: The increase in the addition will need to be increased at a greater rate than as an A.P. Thus, in this case if we had considered the increase to be an A.P. the respective addition would have been:

+7, +7.49, +8.01, +8.55, +9.11, +9.69, +10.29.

However +7, +7.49, +8.01, +8.55, +9.11, +9.75, +10.35 are the actual addition used. Notice that using 9.75 instead of 9.69 is a deliberate adjustment, since while using C.I. the impact on the addition due to the interest on the interest shows an ever increasing behaviour.



WORKED-OUT PROBLEMS

Problem 7.1 The SI on a sum of money is 25% of the principal, and the rate per annum is equal to the number of years. Find the rate percent.

- (a) 4.5% (b) 6%
(c) 5% (d) 8%

Solution

Let principal = x , time = t years

Then interest = $x/4$, rate = $t\%$

Now, using the SI formula, we get

Interest = (Principal \times Rate \times Time)/100

$$\text{fi } x/4 = (x \times t \times t)/100$$

$$\text{fi } t^2 = 25$$

$$\text{fi } t = 5\%$$

Alternatively, you can also solve this by using the options, wherein you should check that when you divide 25 by the value of the option, you get the option's value as the answer.

Thus, $25/4.5 \neq 4.5$. Hence, option (a) is incorrect.

Also, $25/6 \neq 6$. Hence option (b) is incorrect.

Checking for option (c) we get, $25/5 = 5$. Hence, (c) is the answer.

Problem 7.2 The rate of interest for first 3 years is 6% per annum, for the next 4 years, 7 per cent per annum and for the period beyond 7 years, 7.5 percentages per annum. If a man lent out ₹ 1200 for 11 years, find the total interest earned by him?

- (a) ₹ 1002 (b) ₹ 912
(c) ₹ 864 (d) ₹ 948

Solution

Whenever it is not mentioned whether we have to assume SI or CI we should assume SI.

For any amount, interest for the 1st three years @ 6% SI will be equal to $6 \times 3 = 18\%$

Again, interest for next 4 years will be equal to $7 \times 4 = 28\%$.

And interest for next 4 years (till 11 years) $- 7.5 \times 4 = 30\%$

So, total interest = $18 + 28 + 30 = 76\%$

So, total interest earned by him = 76% of the amount

$$= \frac{(76 \times 1200)}{100} = ₹ 912$$

This calculation can be done very conveniently using the percentage rule as $75\% + 1\% = 900 + 12 = 912$.

Problem 7.3 A sum of money doubles itself in 12 years. Find the rate percentage per annum.

- | | |
|-----------|-----------|
| (a) 12.5% | (b) 8.33% |
| (c) 10% | (d) 7.51% |

Solution Let principal = x , then interest = x , time = 12 years.

Using the formula, $\text{Rate} = (\text{Interest} \times 100) / (\text{Principal} \times \text{Time})$

$$= (x \times 100) / (x \times 12) = 8.33\%$$

Alternatively: It is obvious that in 12 years, 100% of the amount is added as interest.

So, in 1 year = $(100/12)\%$ of the amount is added.

Hence, every year there is an addition of 8.33% (which is the rate of simple interest required).

Alternatively, you can also use the formula.

If a sum of money gets doubled in x years, then rate of interest = $(100/x)\%$.

Problem 7.4 A certain sum of money amounts to ₹ 704 in 2 years and ₹ 800 in 5 years. Find the principal.

- | | |
|-----------|-----------|
| (a) ₹ 580 | (b) ₹ 600 |
| (c) ₹ 660 | (d) ₹ 640 |

Solution Let the principal be ₹ x and rate = $r\%$.

Then, difference in between the interest of 5 years and of 2 years equals to

$$₹ 800 - ₹ 704 = ₹ 96$$

So, interest for 3 years = ₹ 96

Hence, interest/year = ₹ $96/3 = ₹ 32$

So, interest for 2 years $\text{Æ } 2 \times ₹ 32 = ₹ 64$

So, the principal = ₹ $704 - ₹ 64 = ₹ 640$

Thought process here should be

₹ 96 interest in 3 years $\text{Æ } ₹ 32$ interest every year.

Hence, principal = $704 - 64 = 640$

Problems 7.5 A sum of money was invested at SI at a certain rate for 3 years. Had it been invested at a 4% higher rate, it would have fetched ₹ 480 more. Find the principal.

(a) ₹ 4000

(b) ₹ 4400

(c) ₹ 5000

(d) ₹ 3500

Solution Let the rate be $y\%$ and principal be ₹ x and the time be 3 years.

Then according to the question = $(x(y + 4) \times 3)/100 - (xy \times 3)/100 = 480$

fi $xy + 4x - xy = 160 \times 100$

fi $x = (160 \times 100)/4 = ₹ 4000$

Alternatively: Excess money obtained = 3 years @ 4% per annum
= 12% of whole money

So, according to the question, 12% = ₹ 480

So, 100% = ₹ 4000 (answer arrived at by using unitary method.)

Problem 7.6 A certain sum of money trebles itself in 8 years. In how many years it will be five times?

(a) 22 years

(b) 16 years

(c) 20 years

(d) 24 years

Solution It trebles itself in 8 years, which makes interest equal to 200% of principal.

So, 200% is added in 8 years.

Hence, 400%, which makes the whole amount equal to five times of the principal, which will be added in 16 years.

Problem 7.7 If CI is charged on a certain sum for 2 years at 10% the amount becomes 605. Find the principal?

- (a) ₹ 550 (b) ₹ 450
(c) ₹ 480 (d) ₹ 500

Solution Using the formula, amount = Principal $(1 + \text{rate}/100)^{\text{time}}$

$$605 = p(1 + 10/100)^2 = p(11/10)^2$$

$$p = 605(100/121) = ₹ 500$$

Alternatively: Checking the options,

Option (a) ₹ 550

First year interest = ₹ 55, which gives the total amount ₹ 605 at the end of first year. So not a valid option.

Option (b) ₹ 450

First year interest = ₹ 45

Second year interest = ₹ 45 + 10% of ₹ 45 = 49.5

So, amount at the end of 2 years = 450 + 94.5 = 544.5

So, not valid.

Hence answer has to lie between 450 and 550 (since 450 yields a shortfall on ₹ 605 while 550 yields an excess.)

Option (c) ₹ 480

First year interest = ₹ 48

Second year interest = ₹ 48 + 10% of ₹ 48 = 52.8

So, amount at the end of 2 years = 580.8 ≠ 605

Option (d) ₹ 500

First year's interest = ₹ 50

Second year's interest = ₹ 50 + 10% of ₹ 50 = ₹ 55.

Amount = 605.

Note: In general, while solving through options, the student should use the principal of starting with the middle (in terms of value), more

convenient option. This will often reduce the number of options to be checked by the student, thus reducing the time required for problem solving drastically. In fact, this thumb rule should be used not only for the chapter of interests but for all other chapters in maths.

Furthermore, a look at the past question papers of exams like Lower level MBA exams and bank PO exams will yield that by solving through options and starting with the middle more convenient option, there will be significant time savings for these exams where the questions are essentially asked from the LOD I level.

Problem 7.8 If the difference between the CI and SI on a certain sum of money is ₹ 72 at 12 per cent per annum for 2 years, then find the amount.

- (a) ₹ 6000 (b) ₹ 5000
(c) ₹ 5500 (d) ₹ 6500

Solution Let the principal = x

Simple interest = $(x \times 12 \times 2)/100$

Compound interest = $x[1 + 12/100]^2 - x$

So, $x[112/100]^2 - x - 24x/100 = 72$

$x[112^2/100^2 - 1 - 24/100] = 72$ fi $x[12544/10000 - 1 - 24/100] = 72$

fi $x = 72 \times 10000/144 = ₹ 5000$

Alternatively: Simple interest and compound interest for the first year on any amount is the same.

Difference in the second year's interest is due to the fact that compound interest is calculated over the first year's interest also.

Hence, we can say that ₹ 72 = Interest on first year's interest @ 12% on first year's interest = ₹ 72.

Hence, first year's interest = ₹ 600 which should be 12% of the original capital. Hence, original capital = ₹ 5000 (this whole process can be done mentally).

You can also try to solve the question through the use of options as follows.

Option (a) ₹ 6000

First year's CI/SI = ₹ 720

Difference between second year's CI and SI = 12% of ₹ 720 = ₹ 72

Hence, not correct.

Option (b) ₹ 5000

First year's CI/SI = 12% of ₹ 5000 = ₹ 600

Difference between second year's CI and SI = 12% of 600 = ₹ 72 year's CI and SI = 12% of 600 = ₹ 72

Hence option (b) is the correct answer.

Therefore we need not check any other options.

Problem 7.9 The population of Jhumri Tilaiya increases by 10% in the first year, it increases by 20% in the second year and due to mass exodus, it decreases by 5% in the third year. What will be its population after 3 years, if today it is 10,000?

- | | |
|------------|------------|
| (a) 11,540 | (b) 13,860 |
| (c) 12,860 | (d) 12,540 |

Solution Population at the end of 1 year will be ₹ 10,000 + 10% of 10,000 = 11,000

At the end of second year it will be 11,000 + 20% of 11,000 = 13,200

At the end of third year it will be 13,200 - 5% of 13,200 = 12,540.

Problem 7.10 Seth Ankoosh Gawdekar borrows a sum of ₹ 1200 at the beginning of a year. After 4 months, ₹ 1800 more is borrowed at a rate of interest double the previous one. At the end of the year, the sum of interest on both the loans is ₹ 216. What is the first rate of interest per annum?

- | | |
|--------|---------|
| (a) 9% | (b) 6% |
| (c) 8% | (d) 12% |

Solution Let the rate of interest be = $r\%$

Then, interest earned from ₹ 1200 at the end of year = $(1200r)/100 = ₹ 12r$

Again, interest earned from ₹ 1800 at the end of year = $(1800/100) \times (8/12) \times 2r = ₹ 24r$

So, total interest earned = $36r$, which equals 216

if $r = 216/36 = 6\%$

Alternatively: Checking the options.

Option (a) 9%

Interest from ` 1200 = 9% of 1200 = 108

Interest from ` 1800 = two-thirds of 18% on ` 1800 = 12% on ` 1800 = ` 216

Total interest = ` 324

Option (b) 6%

Interest earned from ` 1200 = 6% on 1200 = ` 72

Interest earned from ` 1800 = two-thirds of 12% on ` 1800 = ` 144

(We were able to calculate the interest over second part very easily after observing in option (a) that interest earned over second part is double the interest earned over first part).

Total interest = ` 216

We need not check any other option now.

Problem 7.11 Rajiv lend out ` 9 to Anni on condition that the amount is payable in 10 months by 10 equal instalments of Re. 1 each payable at the start of every month. What is the rate of interest per annum if the first instalment has to be paid one month from the date the loan is availed.

Solution Money coming in : ` 9 today Money going out:

Re. 1 one month later + Re. 1, 2 months later ... + Re. 1, 10 months later.

The value of the money coming in should equal the value of the money going out for the loan to be completely paid off.

In the present case, for this to happen, the following equation has to hold:

$$\begin{aligned} & \text{` 9} + \text{Interest on ` 9 for 10 months} = (\text{Re. 1} + \text{Interest on Re. 1 for 9 months}) \\ & + (\text{Re. 1} + \text{interest on Re. 1 for 8 months}) \\ & + (\text{Re. 1} + \text{interest on Re. 1 for 7 months}) + (\text{Re. 1} + \text{interest on Re. 1 for 6 months}) \\ & + (\text{Re. 1} + \text{interest on Re. 1 for 5 months}) + (\text{Re. 1} + \text{interest on Re. 1 for 4 months}) \\ & + (\text{Re. 1} + \text{interest on Re. 1 for 3 months}) + (\text{Re. 1} + \text{interest on Re. 1 for 2 months}) \\ & + (\text{Re. 1} + \text{interest on Re. 1 for 1 months}) + (\text{Re. 1}) \end{aligned}$$

` 9 + Interest on ` 1 for 90 months = ` 10 + Interest on ` 10 for 45 months.

Æ Interest on Re. 1 for 90 months – Interest on Re. 1 for 45 months = ` 10 – ` 9

Æ Interest on Re. 1 for 45 months = Re. 1 (i.e. money would double in 45 months.)

Hence the rate of interest = $\frac{100\%}{45} = 2.222\%$

Note: The starting equation used to solve this problem comes from crediting the borrower with the interest due to early payment for each of his first nine instalments.

OceanofPDF.com

LEVEL OF DIFFICULTY (I)

1. ₹ 1200 is lent out at 5% per annum simple interest for 3 years. Find the amount after 3 years.
(a) ₹ 1380 (b) ₹ 1290
(c) ₹ 1470 (d) ₹ 1200
2. Interest obtained on a sum of ₹ 5000 for 3 years is ₹ 1500. Find the rate percent.
(a) 8% (b) 9%
(c) 10% (d) 11%
3. ₹ 2100 is lent at compound interest of 5% per annum for 2 years. Find the amount after two years.
(a) ₹ 2300 (b) ₹ 2315.25
(c) ₹ 2310 (d) ₹ 2320
4. ₹ 1694 is repaid after two years at compound interest. Which of the following is the value of the principal and the rate?
(a) ₹ 1200, 20% (b) ₹ 1300, 15%
(c) ₹ 1400, 10% (d) ₹ 1500, 12%
5. Find the difference between the simple and the compound interest at 5% per annum for 2 years on a principal of ₹ 2000.
(a) 5 (b) 105
(c) 4.5 (d) 5.5
6. Find the rate of interest if the amount after 2 years of simple interest on a capital of ₹ 1200 is ₹ 1440.
(a) 8% (b) 9%
(c) 10% (d) 11%
7. After how many years will a sum of ₹ 12,500 become ₹ 17,500 at the rate of 10% per annum?

- (a) 2 years (b) 3 years
(c) 4 years (d) 5 years

8. What is the difference between the simple interest on a principal of ` 500 being calculated at 5% per annum for 3 years and 4% per annum for 4 years?
- (a) ` 5 (b) ` 10
(c) ` 20 (d) ` 40
9. What is the simple interest on a sum of `700 if the rate of interest for the first 3 years is 8% per annum and for the last 2 years is 7.5% per annum?
- (a) ` 269.5 (b) ` 283
(c) ` 273 (d) ` 280
10. What is the simple interest for 9 years on a sum of ` 800 if the rate of interest for the first 4 years is 8% per annum and for the last 4 years is 6% per annum?
- (a) 400 (b) 392
(c) 352 (d) Cannot be determined
11. What is the difference between compound interest and simple interest for the sum of ` 20,000 over a 2 year period if the compound interest is calculated at 20% and simple interest is calculated at 23%?
- (a) ` 400 (b) ` 460
(c) ` 440 (d) ` 450
12. Find the compound interest on ` 1000 at the rate of 20% per annum for 18 months when interest is compounded half-yearly.
- (a) ` 331 (b) ` 1331
(c) ` 320 (d) ` 325
13. Find the principal if the interest compounded at the rate of 10% per annum for two years is ` 420.

- (a) ₹ 2000 (b) ₹ 2200
(c) ₹ 1000 (d) ₹ 1100

14. Find the principal if compound interest is charged on the principal at the rate of $16\frac{2}{3}\%$ per annum for two years and the sum becomes ₹ 196.

- (a) ₹ 140 (b) ₹ 154
(c) ₹ 150 (d) ₹ 144

15. The SBI lent ₹ 1331 to the Tata group at a compound interest and got ₹ 1728 after three years. What is the rate of interest charged if the interest is compounded annually?

- (a) 11% (b) 9.09%
(c) 12% (d) 8.33%

16. In what time will ₹ 3300 become ₹ 3399 at 6% per annum interest compounded half-yearly?

- (a) 6 months (b) 1 year
(c) $1\frac{1}{2}$ year (d) 3 months

17. Ranjan purchased a Maruti van for ₹ 1,96,000 and the rate of depreciation is $14\frac{2}{7}\%$ per annum. Find the value of the van after two years.

- (a) ₹ 1,40,000 (b) ₹ 1,44,000
(c) ₹ 1,50,000 (d) ₹ 1,60,000

18. At what percentage per annum, will ₹ 10,000 amount to 17,280 in three years? (Compound Interest being reckoned)

- (a) 20% (b) 14%
(c) 24% (d) 11%

19. Vinay deposited ₹ 8000 in ICICI Bank, which pays him 12% interest per annum compounded quarterly. What is the amount that he receives after 15 months?

- (a) ₹ 9274.2 (b) ₹ 9228.8
(c) ₹ 9314.3 (d) ₹ 9338.8
20. What is the rate of simple interest for the first 4 years if the sum of ₹ 360 becomes ₹ 540 in 9 years and the rate of interest for the last 5 years is 6%?
- (a) 4% (b) 5%
(c) 3% (d) 6%
21. Harsh makes a fixed deposit of ₹ 20,000 with the Bank of India for a period of 3 years. If the rate of interest be 13% SI per annum charged half-yearly, what amount will he get after 42 months?
- (a) 27,800 (b) 28,100
(c) 29,100 (d) 28,500
22. Ranjeet makes a deposit of ₹ 50,000 in the Punjab National Bank for a period of $2\frac{1}{2}$ years. If the rate of interest is 12% per annum compounded half-yearly, find the maturity value of the money deposited by him.
- (a) 66,911.27 (b) 66,123.34
(c) 67,925.95 (d) 65,550.8
23. Vinod makes a deposit of ₹ 100,000 in Syndicate Bank for a period of 2 years. If the rate of interest be 12% per annum compounded half-yearly, what amount will he get after 2 years?
- (a) 122,247.89 (b) 125,436.79
(c) 126,247.69 (d) 122436.89
24. What will be the simple interest on ₹ 700 at 9% per annum for the period from February 5, 1994 to April 18, 1994?
- (a) ₹ 12.60 (b) ₹ 11.30
(c) ₹ 15 (d) ₹ 13
25. Ajay borrows ₹ 1500 from two moneylenders. He pays interest at the rate of 12% per annum for one loan and at the rate of 14% per

annum for the other. The total interest he pays for the entire year is ` 186. How much does he borrow at the rate of 12%?

- (a) ` 1200
- (b) ` 1300
- (c) ` 1400
- (d) ` 300

26. A sum was invested at simple interest at a certain interest for 2 years. It would have fetched ` 60 more had it been invested at 2% higher rate. What was the sum?

- (a) ` 1500
- (b) ` 1300
- (c) ` 2500
- (d) ` 1000

27. The difference between simple and compound interest on a sum of money at 5% per annum is ` 25. What is the sum?

- (a) ` 5000
- (b) ` 10,000
- (c) ` 4000
- (d) Data insufficient

28. A sum of money is borrowed and paid back in two equal annual instalments of ` 882, allowing 5% compound interest. The sum borrowed was

- (a) ` 1640
- (b) ` 1680
- (c) ` 1620
- (d) ` 1700

29. Two equal sums were borrowed at 8% simple interest per annum for 2 years and 3 years respectively. The difference in the interest was ` 56. The sum borrowed were

- (a) ` 690
- (b) ` 700
- (c) ` 740
- (d) ` 780

30. In what time will the simple interest on ` 1750 at 9% per annum be the same as that on ` 2500 at 10.5% per annum in 4 years?

- (a) 6 years and 8 months
- (b) 7 years and 3 months
- (c) 6 years
- (d) 7 years and 6 months

31. In what time will ₹ 500 give ₹ 50 as interest at the rate of 5% per annum simple interest?
- (a) 2 years (b) 5 years
(c) 3 years (d) 4 years
32. Shashikant derives an annual income of ₹ 688.25 from ₹ 10,000 invested partly at 8% p.a. and partly at 5% p.a. simple interest. How much of his money is invested at 5% ?
- (a) ₹ 5000 (b) ₹ 4225
(c) ₹ 4800 (d) ₹ 3725
33. If the difference between the simple interest and compound interest on some principal amount at 20% per annum for 3 years is ₹ 48, then the principle amount must be
- (a) ₹ 550 (b) ₹ 500
(c) ₹ 375 (d) ₹ 400
34. Raju lent ₹ 400 to Ajay for 2 years, and ₹ 100 to Manoj for 4 years and received together from both ₹ 60 as interest. Find the rate of interest, simple interest being calculated.
- (a) 5% (b) 6%
(c) 8% (d) 9%
35. In what time will ₹ 8000 amount to 40,000 at 4% per annum? (simple interest being reckoned)
- (a) 100 years (b) 50 years
(c) 110 years (d) 160 years
36. What annual payment will discharge a debt of ₹ 808 due in 2 years at 2% per annum?
- (a) ₹ 200 (b) ₹ 300
(c) ₹ 400 (d) ₹ 350
37. A sum of money becomes 4 times at simple interest in 10 years. What is the rate of interest?

- (a) 10% (b) 20%
(c) 30% (d) 40%

38. A sum of money doubles itself in 5 years. In how many years will it become four fold (if interest is compounded)?

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

39. A difference between the interest received from two different banks on ₹ 400 for 2 years is ₹ 4. What is the difference between their rates?

- (a) 0.5% (b) 0.2%
(c) 0.23% (d) 0.52%

40. A sum of money placed at compound interest doubles itself in 3 years. In how many years will it amount to 8 times itself?

- (a) 9 years (b) 8 years
(c) 27 years (d) 7 years

41. If the compound interest on a certain sum for 2 years is ₹ 21. What could be the simple interest?

- (a) ₹ 20 (b) ₹ 16
(c) ₹ 18 (d) ₹ 20.5

42. Divide ₹ 6000 into two parts so that simple interest on the first part for 2 years at 6% p.a. may be equal to the simple interest on the second part for 3 years at 8% p.a.

- (a) ₹ 4000, ₹ 2000 (b) ₹ 5000, ₹ 1000
(c) ₹ 3000, ₹ 3000 (d) None of these

43. Divide ₹ 3903 between Amar and Akbar such that Amar's share at the end of 7 years is equal to Akbar's share at the end of 9 years at 4% p.a. rate of compound interest.

- (a) Amar = ₹ 2028, Akbar = ₹ 1875
(b) Amar = ₹ 2008, Akbar = ₹ 1000

(c) Amar = ₹ 2902, Akbar = ₹ 1001

(d) Amar = ₹ 2600, Akbar = ₹ 1303

44. A sum of money becomes $\frac{7}{4}$ of itself in 6 years at a certain rate of simple interest. Find the rate of interest.

(a) 12%

(b) 12.5%

(c) 8%

(d) 14%

45. Sanjay borrowed ₹ 900 at 4% p.a. and ₹ 1100 at 5% p.a. for the same duration. He had to pay ₹ 364 in all as interest. What is the time period in years?

(a) 5 years

(b) 3 years

(c) 2 years

(d) 4 years

46. If the difference between compound and simple interest on a certain sum of money for 3 years at 2% p.a. is ₹ 604, what is the sum?

(a) 5,00,000

(b) 4,50,000

(c) 5,10,000

(d) None of these

47. If a certain sum of money becomes double at simple interest in 12 years, what would be the rate of interest per annum?

(a) 8.33

(b) 10

(c) 12

(d) 14

48. Three persons Amar, Akbar and Anthony invested different amounts in a fixed deposit scheme for one year at the rate of 12% per annum and earned a total interest of ₹ 3,240 at the end of the year. If the amount invested by Akbar is ₹ 5000 more than the amount invested by Amar and the amount invested by Anthony is ₹ 2000 more than the amount invested by Akbar, what is the amount invested by Akbar?

(a) ₹ 12,000

(b) ₹ 10,000

(c) ₹ 7000

(d) ₹ 5000

49. A sum of ₹ 600 amounts to ₹ 720 in 4 years at Simple Interest. What will it amount to if the rate of interest is increased by 2%?

(a) ₹ 648

(b) ₹ 768

(c) ₹ 726

(d) ₹ 792

50. What is the amount of equal instalment, if a sum of ₹1428 due 2 years hence has to be completely repaid in 2 equal annual instalments starting next year.

(a) 700

(b) 800

(c) 650

(d) Cannot be determined

OceanofPDF.com

LEVEL OF DIFFICULTY (II)

1. A sum of money invested at simple interest triples itself in 8 years at simple interest. Find in how many years will it become 8 times itself at the same rate?
(a) 24 years (b) 28 years
(c) 30 years (d) 21 years
2. A sum of money invested at simple interest triples itself in 8 years. How many times will it become in 20 years time?
(a) 8 times (b) 7 times
(c) 6 times (d) 9 times
3. If ₹ 1100 is obtained after lending out ₹ x at 5% per annum for 2 years and ₹ 1800 is obtained after lending out ₹ y at 10% per annum for 2 years, find $x + y$.
(a) ₹ 2500 (b) ₹ 3000
(c) ₹ 2000 (d) ₹ 2200

Directions for Questions 4 to 6: Read the following and answer the questions that follow.

4. A certain sum of money was lent under the following repayment scheme based on Simple Interest:
8% per annum for the initial 2 years
9.5% per annum for the next 4 years
11% per annum for the next 2 years
12% per annum after the first 8 years
Find the amount which a sum of ₹ 9000 taken for 12 years becomes at the end of 12 years.
(a) 20,200 (b) 19,800
(c) 20,000 (d) 20,160

5. If a person repaid ₹ 22,500 after 10 years of borrowing a loan, at 10% per annum simple interest find out what amount did he take as a loan?
- (a) 11,225 (b) 11,250
(c) 10,000 (d) 7500
6. Mr. X, a very industrious person, wants to establish his own unit. For this he needs an instant loan of ₹ 5,00,000 and, every five years he requires an additional loan of ₹ 100,000. If he had to clear all his outstandings in 20 years, and he repays the principal of the first loan equally over the 20 years, find what amount he would have to pay as interest on his initial borrowing if the rate of interest is 10% p.a. Simple Interest.
- (a) ₹ 560,000 (b) ₹ 540,000
(c) ₹ 525,000 (d) ₹ 500,000
7. The population of a city is 200,000. If the annual birth rate and the annual death rate are 6% and 3% respectively, then calculate the population of the city after 2 years.
- (a) 212,090 (b) 206,090
(c) 212,000 (d) 212,180
8. A part of ₹ 38,800 is lent out at 6% per six months. The rest of the amount is lent out at 5% per annum after one year. The ratio of interest after 3 years from the time when first amount was lent out is 5 : 4. Find the second part that was lent out at 5%.
- (a) ₹ 26,600 (b) ₹ 28,800
(c) ₹ 27,500 (d) ₹ 28,000
9. If the simple interest is 10.5% annual and compound interest is 10% annual, find the difference between the interests after 3 years on a sum of ₹ 1000.
- (a) ₹ 15 (b) ₹ 12
(c) ₹ 16 (d) ₹ 11

10. A sum of ₹ 1000 after 3 years at compound interest becomes a certain amount that is equal to the amount that is the result of a 3 year depreciation from ₹ 1728. Find the difference between the rates of CI and depreciation. (Given CI is 10% p.a.). (Approximately)
- (a) 3.33% (b) 0.66%
- (c) 3% (d) 2%
11. The RBI lends a certain amount to the SBI on simple interest for two years at 20%. The SBI gives this entire amount to Bharti Telecom on compound interest for two years at the same rate annually. Find the percentage earning of the SBI at the end of two years on the entire amount.
- (a) 4% (b) $3\frac{1}{7}\%$
- (c) $3\frac{2}{7}\%$ (d) $3\frac{6}{7}\%$
12. Find the compound interest on ₹ 64,000 for 1 year at the rate of 10% per annum compounded quarterly (to the nearest integer).
- (a) ₹ 8215 (b) ₹ 8205
- (c) ₹ 8185 (d) None of these
13. If a principal P becomes Q in 2 years when interest $R\%$ is compounded half-yearly. And if the same principal P becomes Q in 2 years when interest $S\%$ is compound annually, then which of the following is true?
- (a) $R > S$ (b) $R = S$
- (c) $R < S$ (d) $R \leq S$
14. Find the compound interest at the rate of 10% for 3 years on that principal which in 3 years at the rate of 10% per annum gives ₹ 300 as simple interest.
- (a) ₹ 331 (b) ₹ 310
- (c) ₹ 330 (d) ₹ 333
15. The difference between CI and SI on a certain sum of money at 10% per annum for 3 years is ₹ 620. Find the principal if it is known

that the interest is compounded annually.

- (a) ` 200,000 (b) ` 20,000
(c) ` 10,000 (d) ` 100,000

16. The population of Mangalore was 1283575 on 1 January 2011 and the growth rate of population was 10% in the last year and 5% in the years prior to it, the only exception being 2009 when because of a huge exodus there was a decline of 20% in population. What was the population on January 1, 2005?

- (a) 1,000,000 (b) 1,200,000
(c) 1,250,000 (d) 1,500,000

17. According to the 2011 census, the population growth rate of Lucknow is going to be an increasing AP with first year's rate as 5% and common difference as 5%, but simultaneously the migration, rate is an increasing GP with first term as 1% and common ratio of 2. If the population on 31 December 2010 is 1 million, then find in which year will Lucknow witness its first fall in population?

- (a) 2015 (b) 2016
(c) 2017 (d) 2018

18. Mohit Anand borrows a certain sum of money from the Mindworkzz Bank at 10% per annum at compound interest. The entire debt is discharged in full by Mohit Anand on payment of two equal amounts of ` 1000 each, one at the end of the first year and the other at the end of the second year. What is the approximate value of the amount borrowed by him?

- (a) ` 1852 (b) ` 1736
(c) ` 1694 (d) ` 1792

19. In order to buy a car, a man borrowed ` 180,000 on the condition that he had to pay 7.5% interest every year. He also agreed to repay the principal in equal annual instalments over 21 years. After a certain number of years, however, the rate of interest has been reduced to 7%. It is also known that at the end of the agreed period,

he will have paid in all ` 270,900 in interest. For how many years does he pay at the reduced interest rate?

- (a) 7 years (b) 12 years
(c) 14 years (d) 16 years

20. A sum of ` 8000 is borrowed at 5% p.a. compound interest and paid back in 3 equal annual instalments. What is the amount of each instalment?

- (a) ` 2937.67 (b) ` 3000
(c) ` 2037.67 (d) ` 2739.76

21. Three amounts x , y and z are such that y is the simple interest on x and z is the simple interest on y . If in all the three cases, rate of interest per annum and the time for which interest is calculated is the same, then find the relation between x , y and z .

- (a) $xyz = 1$ (b) $x^2 = yz$
(c) $z = x^2y$ (d) $y^2 = xz$

22. A person lent out some money for 1 year at 6% per annum simple interest and after 18 months, he again lent out the same money at a simple interest of 24% per annum. In both the cases, he got ` 4704. Which of these could be the amount that was lent out in each case if interest is paid half-yearly?

- (a) ` 4000 (b) ` 4400
(c) ` 4200 (d) ` 3600

23. A person bought a motorbike under the following scheme: Down payment of ` 15,000 and the rest amount at 8% per annum for 2 years. In this way, he paid ` 28,920 in total. Find the actual price of the motorbike. (Assume simple interest).

- (a) ` 26,000 (b) ` 27,000
(c) ` 27,200 (d) ` 26,500

24. Hans Kumar borrows ` 7000 at simple interest from the village moneylender. At the end of 3 years, he again borrows ` 3000 and

closes his account after paying ` 4615 as interest after 8 years from the time he made the first borrowing. Find the rate of interest.

- (a) 3.5% (b) 4.5%
(c) 5.5% (d) 6.5%

25. Some amount was lent at 6% per annum simple interest. After one year, ` 6800 is repaid and the rest of the amount is repaid at 5% per annum. If the second year's interest is $\frac{11}{20}$ of the first year's interest, find what amount of money was lent out.

- (a) ` 17,000 (b) ` 16,800
(c) ` 16,500 (d) ` 17,500

26. An amount of ` 12820 due 3 years hence, is fully repaid in three annual instalments starting after 1 year. The first instalment is $\frac{1}{2}$ the second instalment and the second instalment is $\frac{2}{3}$ of the third instalment. If the rate of interest is 10% per annum, find the first instalment.

- (a) ` 2400 (b) ` 1800
(c) ` 2000 (d) ` 2500

Directions for Questions 27 and 28: Read the following and answer the questions that follow.

The leading Indian bank ISBI, in the aftermath of the Kargil episode, announced a loan scheme for the Indian Army. Under this scheme; the following options were available.

	<i>Loans upto</i>	<i>Soft loan</i>	<i>Interest (Normal)</i>
Scheme 1	` 50,000	50% of total	8%
Scheme 2	` 75,000	40% of total	10%
Scheme 3	` 100,000	30% of total	12%
Scheme 4	` 200,000	20% of total	14%

Soft loan is a part of the total loan and the interest on this loan is half the normal rate of interest charged.

27. Soldier *A* took some loan under scheme 1, soldier *B* under scheme 2, soldier *C* under scheme 3 and soldier *D* under scheme 4. If they get the maximum loan under their respective schemes for one year, find which loan is MUL (MUL—Maximum Utility Loan, is defined as the ratio of the total loan to interest paid over the time. Lower this ratio the better the MUL).
- (a) *A* (b) *B*
(c) *C* (d) *D*
28. Extending this plan, ISBI further announced that widows of all the martyrs can get the loans in which the proportion of soft loan will be double. This increase in the proportion of the soft loan component is only applicable for the first year. For all subsequent years, the soft loan component applicable on the loan, follows the values provided in the table. The widow of a soldier takes ` 40,000 under scheme 1 in one account for 1 year and ` 60,000 under scheme 2 for 2 years. Find the total interest paid by her over the 2 year period.
- (a) ` 11,600 (b) ` 10,000
(c) ` 8800 (d) None of these
29. A sum is divided between *A* and *B* in the ratio of 1 : 2. *A* purchased a car from his part, which depreciates $14\frac{2}{7}\%$ per annum and *B* deposited his amount in a bank, which pays him 20% interest per annum compounded annually. By what percentage will the total sum of money increase after two years due to this investment pattern (approximately)?
- (a) 20% (b) 26.66%
(c) 30% (d) 25%
30. Michael Bolton has \$90,000 with him. He purchases a car, a laptop and a flat for \$15,000, \$13,000 and \$35,000 respectively and puts the remaining money in a bank deposit that pays compound interest @15% per annum. After 2 years, he sells off the three items at 80%

of their original price and also withdraws his entire money from the bank by closing the account. What is the total change in his asset?

- (a) -4.5% (b) $+3.5\%$
(c) -4.32% (d) $+5.5\%$

ANSWER KEY

Level of Difficulty (I)

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

Level of Difficulty (II)

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 2. (c) | 3. (a) | 4. (d) |
| 5. (b) | 6. (c) | 7. (d) | 8. (b) |
| 9. (c) | 10. (d) | 11. (a) | 12. (d) |
| 13. (c) | 14. (a) | 15. (b) | 16. (b) |
| 17. (b) | 18. (b) | 19. (c) | 20. (a) |
| 21. (d) | 22. (c) | 23. (b) | 24. (d) |
| 25. (a) | 26. (c) | 27. (a) | 28. (b) |
| 29. (a) | 30. (c) | | |

Hints

Level of Difficulty (II)

3. $x + 0.1x = 1100$
 $y + 0.2y = 1800$
6. Interest will be charged on the initial amount borrowed, on the amount of principal still to be paid.
7. Required value = $200000 \times (1.03)^2$
(Solve using percentage change graphic)
9. $(1.105)^3 \times 1000 - 1.3 \times 1000$
12. $64000 \times (1.025)^4$
13. Half-yearly compounding always increases the value of the amount more than annual compounding. Since, increase over 2 years is equal, the annual compounding rate has to be more than the half-yearly compounding rate. Hence $S > R$.
15. Solve through options and use percentage change graphic.
16. If P is the population on 1 January 1995 then
 $P \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 0.8 \times 1.1 = 1283575$.
Use options and percentage change graphic to calculate.
20. $8000 \times (1.05)^3 = x \times (1.05)^2 + x \times (1.05) + x$.
24. Solve through options.
- 27-28. The meaning of the table is
Under Scheme 1 the maximum borrowing allowed is ` 50000. The normal interest to be charged is 8% per annum and for the soft loan component 4% per annum has to be charged. It is also given that 50% of the loan taken is the soft loan component.
29. Difference between the total values at the start and at the end is
$$\left(200 \times 1.2 \times 1.2 + 100 \times \frac{6}{7} \times \frac{6}{7} \right) - (200 + 100)$$
30. Final assets = $63000 \times 0.8 + 27000 \times (1.15)^2$
Calculate using percentage change graphic.

Solutions and Shortcuts

Level of Difficulty (I)

1. The annual interest would be ₹ 60. After 3 years the total value would be $1200 + 60 \times 3 = 1380$
2. The interest earned per year would be $1500/3=500$. This represents a 10% rate of interest.
3. $2100 + 5\% \text{ of } 2100 = 2100 + 105 = 2205$ (after 1 year). Next year it would become:
 $2205 + 5\% \text{ of } 2205 = 2205 + 110.25 = 2315.25$
4. $1400 \xrightarrow{10\% \uparrow} 1540 \xrightarrow{10\% \uparrow} 1694$.
5. Simple Interest for 2 years = $100 + 100 = 200$.
Compound interest for 2 years: Year 1 = $5\% \text{ of } 2000 = 100$.
Year 2: $5\% \text{ of } 2100 = 105$ ∴ Total compound interest = ₹ 205.
Difference between the Simple and Compound interest = $205 - 200 = ₹ 5$
6. Interest in 2 years = ₹ 240.
Interest per year = ₹ 120
Rate of interest = 10%
7. 12500 @ 10% simple interest would give an interest of ₹ 1250 per annum. For a total interest of ₹ 5000, it would take 4 years.
8. 5% for 3 years (SI) = 15% of the amount; At the same time 4% SI for 4 years means 16% of the amount. The difference between the two is 1% of the amount. $1\% \text{ of } 500 = ₹ 5$
9. $8\% \text{ @ } 700 = ₹ 56$ per year for 3 years
 $7.5\% \text{ @ } 700 = ₹ 52.5$ per year for 2 years
Total interest = $56 \times 3 + 52.5 \times 2 = 273$.
10. $8\% \text{ of } 800 \text{ for } 4 \text{ years} + 6\% \text{ of } 800 \text{ for } 4 \text{ years} = 64 \times 4 + 48 \times 4 = 256 + 192 = 448$. However, we do not know the rate of interest applicable in the 5th year and hence cannot determine the exact simple interest for 9 years.
11. Simple interest @ 23% = $4600 \times 2 = 9200$
Compound interest @ 20%

$$20000 \xrightarrow{20\% \uparrow} 24000 \xrightarrow{20\% \uparrow} 28800$$

Æ ` 8800 compound interest.

$$\text{Difference} = 9200 - 8800 = ` 400.$$

$$12. \quad 1000 \xrightarrow{10\% \uparrow} 1100 \xrightarrow{10\% \uparrow} 1210 \xrightarrow{10\% \uparrow} 1331.$$

$$\text{Compound interest} = 1331 - 1000 = ` 331$$

13. Solve using options. Thinking about option (a):

2000 Æ 2200 (after 1 year) Æ 2420 (after 2 years) which gives us an interest of `420 as required in the problem. Hence, this is the correct answer.

$$14. \quad P \times 7/6 \times 7/6 = 196 \text{ Æ } P = (196 \times 6 \times 6)/7 \times 7 = 144.$$

$$15. \quad 1331 \times 1.090909 \times 1.090909 \times 1.090909 = 1331 \times 12/11 \times 12/11 \times 12/11 = 1728. \text{ Hence, the rate of compound interest is } 9.09\%.$$

16. Since compounding is half yearly, it is clear that the rate of interest charged for 6 months would be 3%

$$3300 \xrightarrow{3\% \uparrow} 3399.$$

$$17. \quad \text{The value of the van would be } 196000 \times 6/7 \times 6/7 = 144000$$

18. Solve through options:

$$10000 \xrightarrow{20\% \uparrow} 12000 \xrightarrow{20\% \uparrow} 14400 \xrightarrow{20\% \uparrow} 17280.$$

19. 12% per annum compounded quarterly means that the amount would grow by 3% every 3 months.

Thus, 8000 Æ 8000 + 3% of 8000 = 8240 after 3 months Æ 8240 + 3% of 8240 = 8487.2 after 6 months and so on till five 3 month time periods get over. It can be seen that the value would turn out to be 9274.2.

20. For the last 5 years, the interest earned would be: 30% of 360 = 108. Thus, interest earned in the first 4 years would be ` 72 Æ ` 18 every year on an amount of ` 360- which means that the rate of interest is 5%

$$21. \quad \text{He will get } 20000 + 45.5\% \text{ of } 20000 = 29100.$$

[Note: In this case we can take 13% simple interest compounded half yearly to mean 6.5% interest getting added every 6 months.

Thus, in 42 months it would amount to $6.5 \times 7 = 45.5\%$]

22. $50000 \xrightarrow{6\% \uparrow} 53000 \xrightarrow{6\% \uparrow} 56180 \xrightarrow{6\% \uparrow} 59550.8 \xrightarrow{6\% \uparrow} 63123.84 \xrightarrow{6\% \uparrow} 66911.27$
23. $100000 + 6\% \text{ of } 100000 \text{ (after the first 6 months)} = 106000.$
 After 1 year: $106000 + 6\% \text{ of } 106000 = 112360$
 After $1 \frac{1}{2}$ years: $112360 + 6\% \text{ of } 112360 = 119101.6$
 After 2 years: $119101.6 + 6\% \text{ of } 119101.6 = 126247.69$
24. $(73/365) \times 0.09 \times 700 = \text{` } 12.6.$
 (Since the time period is 73 days)
25. The average rate of interest he pays is $186 \times 100/1500 = 12.4\%.$
 The average rate of interest being 12.4% , it means that the ratio in which the two amounts would be distributed would be 4:1 (using alligation). Thus, the borrowing at 12% would be $\text{` } 1200.$
26. Based on the information we have, we can say that there would have been $\text{` } 30$ extra interest per year. For 2% of the principal to be equal to $\text{` } 30$, the principal amount should be $\text{` } 1500$
27. The data is insufficient as we do not know the time period involved.
28. $882 \times (1.05) + 882 = P \times (1.05)^2$
 Solve for P to get $P = 1640$
29. The difference would amount to 8% of the value borrowed. Thus $56 = 0.08 \times \text{sum borrowed in each case}$ $\therefore \text{Sum borrowed} = \text{` } 700.$
30. $42\% \text{ on } 2500 = \text{` } 1050.$ The required answer would be: $1050/157.5 = 6 \text{ years and } 8 \text{ months}.$
31. Interest per year = $\text{` } 25.$ Thus, an interest of $\text{` } 50$ would be earned in 2 years.
32. The average Rate of interest is 6.8825% . The ratio of investments would be $1.1175: 1.8825$ (@ 5% is to 8%). The required answer = $10000 \times 1.1175/3 = 3725.$
33. Solve using options. If we try 500 (option b) for convenience, we can see that the difference between the two is $\text{` } 64$ (as the SI would amount to 300 and CI would amount to $100 + 120 + 144 = 364$).

Since, we need a difference of only ₹ 48 we can realize that the value should be $\frac{3}{4}$ th of 500. Hence, 375 is correct.

34. Total effective amount lent for 1 year
 $= ₹ 400 \times 2 + ₹ 100 \times 4 = ₹ 1200$
Interest being ₹ 60, Rate of interest 5%
35. The value would increase by 4% per year. To go to 5 times its original value, it would require an increment of 400%. At 4% SI it would take 100 years.
36. $A \times (1.02) + A = 808 \times (1.02)^2 \Rightarrow A = ₹ 400$
37. The sum becomes 4 times \Rightarrow the interest earned is 300% of the original amount. In 10 years the interest is 300% means that the yearly interest must be 30%.
38. It would take another 5 years to double again. Thus, a total of 10 years to become four fold.
39. The difference in Simple interest represents 1% of the amount invested. Since this difference has occurred in 2 years, annually the difference would be 0.5%.
40. If it doubles in 3 years, it would become 4 times in 6 years and 8 times in 9 years.
41. If we take the principal as 100, the CI @ 10% Rate of interest would be ₹ 21. In such a case, the SI would be ₹ 20.
42. $12\% \text{ of } x = 24\% \text{ of } (600 - x) \Rightarrow x = 4000$
Thus, the two parts should be ₹ 4000 and ₹ 2000.
43. Akbars' share should be such that at 4% p.a. compound interest it should become equal to Amar's share in 2 years. Checking thorough the options it is clear that option (a) fits perfectly as 1875 would become 2028 in 2 years @4% p.a. compound interest.
44. The total interest in 6 years = 75%
Thus per year = SI = 12.5%
45. The interest he pays per year would be $36 + 55 = 91$. Thus, in 4 years the interest would amount to ₹ 364.

46. Solve through trial and error using the values of the options. Option (a) 500000 fits the situation perfectly as the SI = ₹ 30000 while the CI = 30604.
47. $100/12 = 8.33\%$
48. 12% Rate of interest on the amount invested gives an interest of ₹ 3240. This means that $0.12 A = 3240 \Rightarrow A = ₹ 27000$. The sum of the investments should be ₹ 27000. If Akbar invests x , Amar invests $x - 5000$ and Anthony invests $x + 2000$. Thus:
 $x + x - 5000 + x + 2000 = 27000 \Rightarrow x = 10000$.
49. 600 becomes 720 in 4 years SI \Rightarrow SI per year = ₹ 30 and hence the SI rate is 5%.
 At 7% rate of interest the value of 600 would become 768 in 4 years. (600 + 28% of 600)
50. The rate of interest is not defined.
 Hence, option (d) is correct.

Level of Difficulty (II)

- In 8 years, the interest earned = 200%
 Thus, per year interest rate = $200/8 = 25\%$
 To become 8 times we need a 700% increase
 $700/25 = 28$ years.
- Tripling in 8 years means that the interest earned in 8 years is equal to 200% of the capital value. Thus, interest per year (simple interest) is 25% of the capital. In 20 years, total interest earned = 500% of the capital and hence the capital would become 6 times its original value.
- $x = ₹ 1000$ (As $1000 @ 5\%$ for 2 years = 1100).
 Similarly $y = ₹ 1500$.
 $x + y = 2500$.
- $9000 + 720 + 720 + 855 + 855 + 855 + 855 + 990 + 990 + 1080 + 1080 + 1080 + 1080$
 $= 9000 + 720 \times 2 + 855 \times 4 + 990 \times 2 + 1080 \times 4$
 $= 20160$

5. At 10% simple interest per year, the amount would double in 10 years. Thus, the original borrowin would be $22500/2 = 11250$.

6. The simple interest would be defined on the basis of the sum of the AP.

$$50000 + 47500 + 45000 + \dots + 2500 = 525000.$$

7. The yearly increase in the population is 3%. Thus, the population would increase by 3% each year. 200000 would become 206000 while 206000 would become 212180.

$$8. \frac{F \times (0.06) \times 6}{(38800 - F) \times 0.05 \times 2} = 5/4$$

where F is the first part.

$$1.44F = 19400 - 0.5F$$

$$F = 19400/1.94 = 10000.$$

Thus, the second part = $38800 - 10000 = 28800$

9. At 10% compound interest the interest in 3 years would be 33.1% = `331

At 10.5% simple interest the interest in 3 years would be 31.5% = `315

Difference = `16

10. The amount @ 10% CI could become ` 1331. Also, ` 1728 depreciated at $R\%$ has to become ` 1331.

Thus,

$$1728 \times [(100-R)/100]^3 = 1331 \text{ (approximately).}$$

The closest value of $R = 8\%$

Thus, the difference is 2%.

11. SBI would be paying 40% on the capital as interest over two years and it would be getting 44% of the capital as interest from Bharti Telecom. Hence, it earns 4%.

$$12. 64000 \times (1.025)^4 = 70644.025.$$

Interest 6644.025

Option (d). None of these is correct.

13. Since the interest is compounded half yearly at R% per annum, the value of R would be lesser than the value of S. (Remember, half yearly compounding is always profitable for the depositor).
14. At 10% per annum simple interest, the interest earned over 3 years would be 30% of the capital. Thus, 300 is 30% of the capital which means that the capital is 1000. In 3 years, the compound interest on the same amount would be 331.
15. Go through trial and error of the options. You will get:
 $20000 \times (1.3) = 26000$ (@ simple interest)
 $20000 \times 1.1 \times 1.1 \times 1.1 = 26620$ @ compound interest.
 Thus 20000 is the correct answer.
16. Solve through options to see that the value of 1200000 fits the given situation.
17. Population growth rate according to the problem:
 Year 1 = 5% , year 2 = 10% , year 3 = 15%
 Year 4 = 20%, year 5 = 25%, year 6 = 30%.
 Population decrease due to migration:
 Year 1 = 1% , year 2 = 2% , year 3 = 4%
 Year 4 = 8%, year 5 = 16%, year 6 = 32%.
 Thus, the first fall would happen in 2006.
18. $P + 2 \text{ years interest on } P = 1000 + 1 \text{ years interest on } 1000 + 1000$
 $\text{£ } 1.21P = 2100 \text{ £ } P = 1736 \text{ (approx).}$
19. Solve this one through options. Option (c) reduced rate for 14 years fits the conditions.
20. Let the repayment annually be X. Then:
 $8000 + 3 \text{ years interest on } 8000 \text{ (on compound interest of 5\%)} = X +$
 $2 \text{ years interest on } X + X + 1 \text{ years interest on } X + X \text{ £ } X =$
 2937.67
21. You can think about this situation by taking some values. Let $x = 100$, $y = 10$ and $z = 1$ (at an interest rate of 10%). We can see that
 $10^2 = 100 \text{ £ } y^2 = xz$
22. $4200 + (4 \% \text{ of } 4200) 3 \text{ times} = 4200 + 0.04 \times 3 \times 4200 = 4704.$

23. Solve using options. If the price is 27000, the interest on 12000 (after subtracting the down payment) would be 16% of 12000 = 1920. Hence, the total amount paid would be 28920.
24. The interest would be paid on
 7000 for 3 years + 10000 for 5 years.
 @ 6.5% the total interest for 8 years
 = 1365 + 3250
 = ₹ 4615
25. It can be seen that for 17000, the first year interest would be 1020, while the second year interest after a repayment of 6800 would be on 10200 @ 5% per annum. The interest in the second year would thus be ₹ 510 which is exactly half the interest of the first year. Thus, option (a) is correct.
26. Solve using options. Option (c) fits the situation as:
 $12820 = 2000 + 2 \text{ years interest on } 2000 + 4000 + 1 \text{ years interest on } 4000 + 6000$ (use 10% compound interest for calculation of interest) ₹
 $12820 = 2000 + 420 + 4000 + 400 + 6000$.
 Thus, option (c) fits the situation perfectly.
27. Interest for A = 6% of 50000.
 Interest for B, C and D the interest is more than 6%.
 Thus A's loan is MUL.
28. Interest she would pay under scheme 1:
 Year 1 the entire loan would be @ 4% – hence interest on 40000 = ₹ 1600.
 Total interest = 1600
 Interest on loan 2:
 In year 1: 80% of the loan (I.e 48000) would be on 5%, 12000 would be @ 10% – hence total interest = 3600
 Year 2: 40% of the loan (24000) would be on 5%, while the remaining loan would be on 10% – hence total interest = 4800

Thus, total interest on the two loans would be $1600 + 3600 + 4800 = 10000$.

29. Let the amounts be ₹100 and ₹200 respectively. The value of the 100 would become $100 \times \frac{6}{7} \times \frac{6}{7} = \frac{3600}{49} = 73.46$

The other person's investment of 200 would become $200 \times 1.2 \times 1.2 = 288$

The total value would become $288 + 73.46 = 361.46$

This represents approximately a 20% increase in the value of the amount after 2 year. Hence, option (a) is correct.

30. The final value would be:

$$0.8 \times 63000 + 27000 \times 1.15 \times 1.15 = 86107.5.$$

∴ Drop in value = 4.32%



Ratio, Proportion and Variation

INTRODUCTION

The concept of ratio, proportion and variation is an important one for the aptitude examinations. Questions based on this chapter have been regularly asked in the CAT exam (direct or application based). In fact, questions based on this concept regularly appear in all aptitude tests (XLRI, CMAT, NMIMS, SNAP, NIFT, IRMA, Bank PO, etc.).

Besides, this concept is very important in the area of Data Interpretation, where ratio change and ratio comparisons are very popular question types.

RATIO

When comparing any two numbers, sometimes, it is necessary to find out how many times one number is greater (or less) than the other. In other words, we often need to express one number as a fraction of the other.

In general, the ratio of a number x to a number y is defined as the quotient of the numbers x and y .

The numbers that form the ratio are called the terms of the ratio. The numerator of the ratio is called the *antecedent* and the denominator is called the *consequent* of the ratio.

The ratio may be taken for homogenous quantities or for heterogeneous quantities. In the first case, the ratio has no unit (or is unitless), while in the second case, the unit of the ratio is based on the units of the numerator and that of the denominator.

Ratios can be expressed as percentages. To express the value of a ratio as a percentage, we multiply the ratio by 100.

Thus, $4/5 = 0.8 = 80\%$

The Calculation of a ratio:

Percentage and decimal values

The calculation of ratio is principally on the same lines as the calculation of a percentage value.

Hence, you should see it as:

The ratio $2/4$ has a percentage value of 50% and it has a decimal value of 0.5.

It should be pretty obvious to you that in order to find out the decimal value of any ratio, calculate the percentage value using the percentage rule method illustrated in the chapter of percentage and then shift the decimal point 2 places to the left.

Thus a ratio which has a percentage value of 62.47% will have a decimal value of 0.6247.

Some Important Properties of Ratios

1. If we multiply the numerator and the denominator of a ratio by the same number, the ratio remains unchanged.

That is, $\frac{a}{b} = \frac{ma}{mb}$

2. If we divide the numerator and the denominator of a ratio by the same number, the ratio remains unchanged. Thus

$$a/b = \frac{(a/d)}{(b/d)}$$

3. Denominator equation method:

The magnitudes of two ratios can be compared by equating the denominators of the two ratios and then checking for the value of the numerator.

Thus, if we have to check for

$8/3$ vs $11/4$

We can compare $\frac{(8 \times 1.33)}{(3 \times 1.33)}$ vs $\frac{11}{4}$

That is, $\frac{10.66}{4} < \frac{11}{4}$

In fact, the value of a ratio has a direct relationship with the value of the numerator of the ratio. At the same time, it has an inverse relationship with the denominator of the ratio. Since the denominator has an inverse relationship with the ratio's value, it involves an unnecessary inversion in the minds of the reader. Hence, in my opinion, we should look at maintaining constancy in the denominator and work all the requisite calculations on the numerator's basis.

The reader should recall here the Product Constancy Table (or the denominator change to ratio change table) explained in the chapter of percentages to understand the mechanics of how a change in the denominator affects the value of the ratio. A clear understanding of these dynamics will help the student become much faster in solving the problems based on ratios.

4. The ratio of two fractions can be expressed as a ratio of two integers. Thus the ratio:

$$a/b : c/d = \frac{(a/b)}{(c/d)} = \frac{ad}{bc}$$

5. If either or both the terms of a ratio are a surd quantity, then the ratio will never evolve into integral numbers unless the surd quantities are equal. Use this principle to spot options in questions having surds.

Example: $\frac{\sqrt{3}}{\sqrt{2}}$ can never be represented by integers.

This principle can also be understood in other words as follows:

Suppose while solving a question, you come across a situation where $\sqrt{3}$ appears as a part of the process. In such a case, it would be safe to assume that $\sqrt{3}$ will also be part of the answer. Since

the only way the $\sqrt{3}$ can be removed from the answer is by multiplying or dividing the expression by $\sqrt{3}$.

Thus for instance, the formula for the area of an equilateral triangle is $(\sqrt{3}/4)a^2$.

Hence, you can safely assume that the area of any equilateral triangle will have $\sqrt{3}$ in its answer. The only case when this gets negated would be when the value of the side has a component which has the fourth root of three.

6. The multiplication of the ratios $\frac{a}{b}$ and $\frac{c}{d}$ yields:

$$a/b \times c/d = \frac{ac}{bd}$$

7. When the ratio a/b is compounded with itself, the resulting ratio is a^2/b^2 and is called the duplicate ratio. Similarly, a^3/b^3 is the triplicate ratio and $a^{0.5}/b^{0.5}$ is the sub-duplicate ratio of a/b .

8. If $a/b = c/d = e/f = g/h = k$ then

$$k = \frac{(a + c + e + g)}{(b + d + f + h)}$$

9. If $a_1/b_1, a_2/b_2, a_3/b_3 \dots a_n/b_n$ are unequal fractions

Then the ratio:

$$\frac{(a_1 + a_2 + a_3 + \dots + a_n)}{(b_1 + b_2 + b_3 + \dots + b_n)}$$

lies between the lowest and the highest of these fractions.

10. If we have two equations containing three unknowns as

$$a_1x + b_1y + c_1z = 0 \tag{1}$$

$$\text{and } a_2x + b_2y + c_2z = 0 \tag{2}$$

Then, the value of x , y and z cannot be resolved without having a third equation.

However, in the absence of a third equation, we can find the proportion $x : y : z$. This will be given by $b_1c_2 - b_2c_1 : c_1a_2 - c_2a_1 : a_1b_2 - a_2b_1$.

This can be remembered by writing as follows:

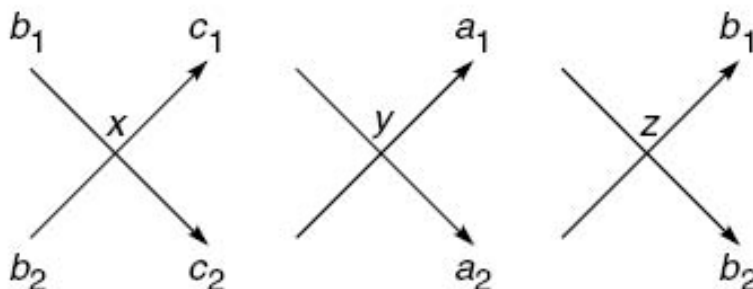


Fig. 8.1

Multiply the coefficients across the arrow indicated always taking a multiplication as positive if the arrow points downwards and taking it as negative if the arrow points upwards.

Thus x corresponds to $b_1c_2 - b_2c_1$ and so on.

11. If the ratio $a/b > 1$ (called a ratio of greater inequality) and if k is a positive number:

$$(a + k)/(b + k) < a/b \text{ and } (a - k)/(b - k) > a/b$$

Similarly if $a/b < 1$ then

$$(a + k)/(b + k) > a/b \text{ and } (a - k)/(b - k) < a/b$$

[The student should try assuming certain values and check the results]

12. Maintenance of equality when numbers are added in both the numerator and the denominators.

This is best illustrated through an example:

$$20/30 = (20 + 2)/(30 + 3)$$

i.e. $a/b = (a + c)/(b + d)$ if and only if $c/d = a/b$. In other words, the ratio of the additions should be equal to the original ratio to maintain equality of ratios when two different numbers are added in the numerator and denominator.

Consequently, if $c/d > a/b$ then $(a + c)/(b + d) > a/b$

and if $c/d < a/b$ then $(a + c)/(b + d) < a/b$

The practical applications of (11) and (12) is of immense importance for all aptitude exams.

MATHEMATICAL USES OF RATIOS

Use 1

As a bridge between 3 or more quantities:

Suppose you have a ratio relationship given between the salaries of two individuals A and B . Further, if there is another ratio relationship between B and C . Then, by combining the two ratios, you can come up with a single consolidated ratio between A , B and C . This ratio will give you the relationship between A and C .

Illustration

The Ratio of A 's salary to B 's salary is 2:3. The ratio of B 's salary to C 's salary is 4:5. What is the ratio of A 's salary to C 's salary?

Using the conventional process in this case:

Take the LCM of 3 and 4 (the two values representing B 's amount). The LCM is 12.

Then, convert B 's value in each ratio to 12.

Thus, Ratio 1 = 8/12 and Ratio 2 = 12/15

Thus, $A:B:C = 8:12:15$

Hence, $A:C = 8:15$

Further, if it were given that A 's salary was 800, you could derive the values of C 's salary (as 1500).

SHORTCUT for this process:

The LCM process gets very cumbersome especially if you are trying to create a bridge between more than 3 quantities.

Suppose, you have the ratio train as follows:

$$A:B = 2:3$$

$$B:C = 4:5$$

$$C:D = 6:11$$

$$D:E = 12:17$$

In order to create one consolidated ratio for this situation using the LCM process becomes too long.

The short cut goes as follows:

$A:B:C:D:E$ can be written directly as:

$$2 \times 4 \times 6 \times 12 : 3 \times 4 \times 6 \times 12 : 3 \times 5 \times 6 \times 12 : 3 \times 5 \times 11 \times 17$$

The thought algorithm for this case goes as:

To get the consolidated ratio $A:B:C:D:E$, A will correspond to the product of all numerators ($2 \times 4 \times 6 \times 12$) while B will take the first denominator and the last 3 numerators ($3 \times 4 \times 6 \times 12$). C on the other hand takes the first two denominators and the last 2 numerators ($3 \times 5 \times 6 \times 12$), D takes the first 3 denominators and the last numerator ($3 \times 5 \times 11 \times 12$) and E takes all the four denominators ($3 \times 5 \times 11 \times 17$).

In mathematical terms this can be written as:

$$\text{If } a/b = N_1/D_1, b/c = N_2/D_2, c/d = N_3/D_3 \text{ and } d/e = N_4/D_4 \text{ then } a : b : c : d : e \\ = N_1N_2N_3N_4 : D_1N_2N_3N_4 : D_1D_2N_3N_4 : D_1D_2D_3N_4 : D_1D_2D_3D_4$$

Use 2

Ratio as a Multiplier

This is the most common use of Ratios:

If $A:B$ is $3:1$, then the value of B has to be multiplied by 3 to get the value of A .

CALCULATION METHODS related to RATIOS

(A) Calculation methods for Ratio comparisons:

There could be four broad cases when you might be required to do ratio comparisons:

The table below clearly illustrates these:

	<i>Numerator</i>	<i>Denominator</i>	<i>Ratio</i>	<i>Calculations</i>
Case 1	Increases	Decreases	Increase	Not required
Case 2	Increases	Increases	May Increase or Decrease	Required
Case 3	Decreases	Increases	Decreases	Not required
Case 4	Decreases	Decreases	May Increase or Decrease	Required

In case 2 and 4 in the table, calculations will be necessitated. In such a situation, the following process can be used for ratio comparisons.

1. The Cross Multiplication Method

Two ratios can be compared using the cross multiplication method as follows. Suppose you have to compare

12/17 with 15/19

Then, to test which ratio is higher cross multiply and compare 12×19 and 15×17 .

If 12×19 is bigger the Ratio 12/17 will be bigger. If 15×17 is higher, the ratio 15/19 will be higher.

In this case, 15×17 being higher, the Ratio 15/19 is higher.

Note: In real time usage (esp. in D.I.) this method is highly impractical and calculating the product might be more cumbersome than calculating the percentage values.

Thus, this method will not be able to tell you the answer if you have to

compare $\frac{3743}{5624}$ with $\frac{3821}{5783}$

2. Percentage value comparison method:

Suppose you have to compare: $\frac{173}{212}$ with $\frac{181}{241}$

In such a case just by estimating the 10% ranges for each ratio you can clearly see that —

the first ratio is $> 80\%$ while the second ratio is $< 80\%$

Hence, the first ratio is obviously greater.

This method is extremely convenient if the two ratios have their values in different 10% ranges.

However, this problem will become slightly more difficult, if the two ratios fall in the same 10% range. Thus, if you had to compare $\frac{173}{212}$ with $\frac{181}{225}$, both the values would give values between 80 – 90%. The next step would be to calculate the 1% range.

The first ratio here is 81 – 82% while the second ratio lies between 80 – 81%

Hence the first ratio is the larger of the two.

Note: For this method to be effective for you, you'll first need to master the percentage rule method for calculating the percentage value of a ratio. Hence if you cannot see that 169.6 is 80% of 212 or for that matter that 81% of 212 is 171.72 and 82% is 172.84 you will not be able to use this method effectively. (This is also true for the next method.) However, once you can calculate percentage values of 3 digit ratios to 1% range, there is not much that can stop you in comparing ratios. The CAT and all other aptitude exams normally do not challenge you to calculate further than the 1% range when you are looking at ratio comparisons.

3. Numerator denominator percentage change method:

There is another way in which you can compare close ratios like $\frac{173}{212}$ and $\frac{181}{225}$. For this method, you need to calculate the percentage changes in the numerator and the denominator.

Thus:

$173 \text{ } \text{Æ} \text{ } 181$ is a % increase of 4 – 5%

While $212 \text{ } \text{Æ} \text{ } 225$ is a % increase of 6 – 7%.

In this case, since the denominator is increasing more than the numerator, the second ratio is smaller.

This method is the most powerful method for comparing close ratios—provided you are good with your percentage rule calculations.

(B) Method for calculating the value of a percentage change in the ratio:

PCG (Percentage Change Graphic) gives us a convenient method to calculate the value of the percentage change in a ratio.

Suppose, you have to calculate the percentage change between 2 ratios. This has to be done in two stages as:

$$\begin{array}{l} \text{Original Ratio} \xrightarrow[\text{numerator}]{\text{Effect of}} \text{Intermediate Ratio} \\ \xrightarrow[\text{Denominator}]{\text{Effect of}} \text{Final Ratio} \end{array}$$

Thus if 20/40 becomes 22/50

Effect of numerator = 20 \rightarrow 22 (10% increase)

Effect of denominator = 50 \rightarrow 40 (25% decrease) (reverse fashion)

Overall effect on the ratio:

$$100 \xrightarrow[\text{Numerator Effect}]{10\% \uparrow} 110 \xrightarrow[\text{Denominator Effect}]{25\% \downarrow} 82.5$$

Hence, overall effect = 17.5% decrease.

PROPORTION

When two ratios are equal, the four quantities composing them are said to be proportionals. Thus if $a/b = c/d$, then a, b, c, d are proportionals. This is expressed by saying that a is to b as c is to d , and the proportion is written as

$$a : b :: c : d$$

or

$$a : b = c : d$$

- The terms a and d are called the extremes while the terms b and c are called the means.
- **If four quantities are in proportion, the product of the extremes is equal to the product of the means.**

Let a, b, c, d be the proportionals.

Then by definition $a/b = c/d$

$$ad = bc$$

Hence if any three terms of proportion are given, the fourth may be found.

Thus if a, c, d are given, then $b = ad/c$.

• **If three quantities a, b and c are in continued proportion, then $a : b = b : c$**

$$ac = b^2$$

In this case, b is said to be a *mean proportional* between a and c ; and c is said to be a *third proportional* to a and b .

• **If three quantities are proportionals the first is to the third as the duplicate ratio of the first to the second.**

That is: for $a : b :: b : c$

$$a : c = a^2 : b^2$$

• If four quantities a, b, c and d form a proportion, many other proportions may be deduced by the properties of fractions. The results of these operations are very useful. These operations are

1. **Invertendo:** If $a/b = c/d$ then $b/a = d/c$

2. **Alternando:** If $a/b = c/d$, then $a/c = b/d$

3. **Componendo:** If $a/b = c/d$, then $\left(\frac{a+b}{b}\right) = \left(\frac{c+d}{d}\right)$

4. **Dividendo:** If $a/b = c/d$, then $\left(\frac{a-b}{b}\right) = \left(\frac{c-d}{d}\right)$

5. **Componendo and Dividendo:** If $a/b = c/d$, then $(a+b)/(a-b) = (c+d)/(c-d)$

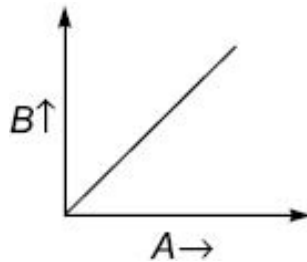
VARIATION

Essentially there are two kinds of proportions that two variables can be related by:

(1) Direct Proportion

When it is said that A varies directly as B , you should understand the following implications:

- (a) **Logical implication:** When A increases B increases
- (b) **Calculation implication:** If A increases by 10%, B will also increase by 10%
- (c) **Graphical implications:** The following graph is representative of this situation.

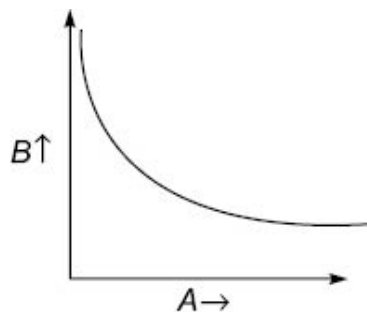


- (d) **Equation implication:** The ratio A/B is constant.

(2) Inverse Proportion:

When A varies inversely as B , the following implications arise.

- (a) **Logical implication:** When A increases B decreases
- (b) **Calculation implication:** If A decreases by 9.09%, B will increase by 10%.
- (c) **Graphical implications:** The following graph is representative of this situation.



- (d) **Equation implication:** The product $A \times B$ is constant.

A quantity ' A ' is said to vary directly as another ' B ' when the two quantities depend upon each other in such a manner that if B is changed, A is changed in the same ratio.

Note: The word directly is often omitted, and A is said to vary as B .

The symbol \propto is used to denote variation. Thus, $A \propto B$ is read “ A varies as B ”.

If $A \propto B$ then, $A = KB$ where K is any constant.

Thus to find $K = A/B$, we need one value of A and a corresponding value of B .

where $K = 3/12 = 1/4$ fi $A = B \times (1/4)$.

A quantity A is said to vary inversely as another B when A varies directly as the reciprocal of B . Thus if A varies inversely as B , $A = m/B$, where m is constant.

A quantity is said to vary jointly as a number of others when it varies directly as their product. Thus A varies jointly as B and C , when $A = mBC$.

If A varies as B when C is constant, and A varies as C when B is constant, then A will vary as BC when both B and C vary.

The variation of A depends partly on that of B and partly on that of C . Assume that each letter variation takes place separately, each in its turn producing its own effect on A .



WORKED-OUT PROBLEMS

Problem 8.1 ₹ 5783 is divided among Sherry, Berry, and Cherry in such a way that if ₹ 28, ₹ 37 and ₹ 18 be deducted from their respective shares, they have money in the ratio 4 : 6 : 9. Find Sherry's share.

- (a) ₹ 1256 (b) ₹ 1228
(c) ₹ 1456 (d) ₹ 1084

Solution The problem clearly states that when we reduce 28, 37 and 18 rupees respectively from Sherry's, Berry's and Cherry's shares, the resultant ratio is: 4 : 6 : 9.

Thus, if we assume the reduced values as

4x, 6x and 9x, we will have ₹

Sherry's share ₹ 4x + 28, Berry's share ₹ 6x + 37 and Cherry's share ₹ 9x + 18 and thus we have

$$(4x + 28) + (6x + 37) + (9x + 18) = 5783$$

$$₹ 19x = 5783 - 83 = 5700$$

Hence, $x = 300$.

Hence, Sherry's share is ₹ 1228.

Note: For problems based on this chapter we are always confronted with ratios and proportions between different number of variables. For the above problem we had three variables which were in the ratio of 4 : 6 : 9. When we have such a situation we normally assume the values in the same proportion, using one unknown 'x' only (in this example we could take the three values as 4x, 6x and 9x respectively).

Then, the total value is represented by the addition of the three giving rise to a linear equation, which on solution, will result in the answer to the value of the unknown 'x'.

However, the student should realise that most of the time this unknown 'x' is not needed to solve the problem. This is illustrated through the following alternate approach to solving the above problem:

Assume the three values as 4, 6 and 9

Then we have

$$(4 + 28) + (6 + 37) + (9 + 18) = 5783$$

$$\text{Æ } 19 = 5783 - 83 = 5700 \text{ Æ } 1 = 300$$

Hence, $4 + 28 = 1228$.

While adopting this approach the student should be careful in being able to distinguish the numbers in bold as pointing out the unknown variable.

Problem 8.2 Two numbers are in the ratio $P : Q$. When 1 is added to both the numerator and the denominator, the ratio gets changed to R/S . Again, when 1 is added to both the numerator and the denominator, it becomes $1/2$. Find the sum of P and Q .

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

Solution The normal process of solving this problem would be through the writing of equations.

Approach 1: We have: Final ratio is $x/2x$.

$$\text{Then, } \frac{x-2}{2x-2} = P/Q$$

$$\text{Then, } Qx - 2Q = 2Px - 2P$$

$$2(P - Q) = x(2P - Q) \text{ (At this stage we see that the solution is a complex one)}$$

$$\text{Approach 2: } \frac{R+1}{S+1} = \frac{1}{2}$$

$$2R + 2 = S + 1 \text{ Æ } R = \frac{S-1}{2}$$

Now, $\frac{P+1}{Q+1} = \frac{R}{S} = \frac{S-1}{2S}$ (At this time we realise that we are getting stuck)

Start from front:

$\frac{P+2}{Q+2} = 1/2 \Rightarrow 2P+4 = Q+2$ (Again the solution is not visible and we are likely to get stuck)

Note: Such problems should never be attempted by writing the equations since this process takes more time than is necessary to solve the problem and is impractical in the exam situation due to the amount of time required in writing.

Besides, in complex problems where the final solution is not visible to the student while starting off, many a times the student has to finally abort the problem midway. This results in an unnecessary wastage of time if the student has attempted to write equations.

In fact, the student should realise that selecting the correct questions to solve in aptitude exams like the CAT is more important than being aware of how all the problems are solved.

The following process will illustrate the option based solution process.

Option A: It has $P + Q = 3$. The possible values of P/Q are $1/2$ or $2/1$.

Using $1/2$, we see that on adding 2 to both the numerator and the denominator we get

$3/4$ (Not the required value.)

Similarly, we see that $2/1$ will also not give the answer. We should also realise that the numerator has to be lower than the denominator to have the final value of $1/2$.

Next we try **Option B**, where we have

$1/3$ as the only possible ratio.

Then we get the final value as $3/5$ (Not equal to $1/2$) Hence, we reject option B.

Next we try **Option C**, where we have

$1/4$ or $2/3$

Checking for $1/4$ we get $3/6 = 1/2$. Hence, the option is correct.

Problem 8.3 If 10 persons can clean 10 floors by 10 mops in 10 days, in how many days can 8 persons clean 8 floors by 8 mops?

- (a) $12 \frac{1}{2}$ days (b) 8 days
(c) 10 days (d) $8 \frac{1}{3}$ days

Solution Do not get confused by the distractions given in the problem. 10 men and 10 days means 100 man-days are required to clean 10 floors.

That is, 1 floor requires 10 man-days to get cleaned. Hence, 8 floors will require 80 man-days to clean.

Therefore, 10 days are required to clean 8 floors.

Problem 8.4 Three quantities A , B , C are such that $AB = KC$, where K is a constant. When A is kept constant, B varies directly as C ; when B is kept constant, A varies directly C and when C is kept constant, A varies inversely as B .

Initially, A was at 5 and $A : B : C$ was $1 : 3 : 5$. Find the value of A when B equals 9 at constant C .

- (a) 8 (b) 8.33
(c) 9 (d) 9.5

Solution Initial values are 5, 15 and 25.

Thus we have $5 \times 15 = K \times 25$.

Hence, $K = 3$.

Thus, the equation is $AB = 3C$.

For the problem, keep C constant at 25. Then, $A \times 9 = 3 \times 25$.

i.e. $A = 75/9 = 8.33$

Problem 8.5 If $x/y = 3/4$, then find the value of the expression, $(5x - 3y)/(7x + 2y)$.

- (a) $3/21$ (b) $5/29$
(c) $3/29$ (d) $5/33$

Solution Assume the values as $x = 3$ and $y = 4$.

Then we have

$$\frac{(15 - 12)}{(21 + 8)} = 3/29$$

Problem 8.6 ` 3650 is divided among 4 engineers, 3 MBAs and 5 CAs such that 3 CAs get as much as 2 MBAs and 3 Engineers as much as 2 CAs. Find the share of an MBA.

- (a) 300 (b) 450
(c) 475 (d) None of these

Solution

$$4E + 3M + 5C = 3650$$

Also, $3C = 2M$, that is, $M = 1.5 C$

and $3E = 2C$ that is, $E = 0.66C$

$$\text{Thus, } 4 \times 0.66C + 3 \times 1.5 C + 5C = 3650$$

$$C = 3650/12.166$$

$$\text{That is, } C = 300$$

$$\text{Hence, } M = 1.5 C = 450$$

Problem 8.7 The ratio of water and milk in a 30 litre mixture is 7 : 3. Find the quantity of water to be added to the mixture in order to make this ratio 6 : 1.

- (a) 30 (b) 32
(c) 33 (d) 35

Solution Solve while reading Æ As you read the first sentence, you should have 21 litres of water and 9 litres of milk in your mind.

In order to get the final result, we keep the milk constant at 9 litres.

Then, we have 9 litres, which corresponds to 1

Hence, ‘?’ corresponds to 6.

Solving by using unitary method we have

54 litres of water to 9 litres of milk.

Hence, we need to add 33 litres of water to the original mixture.

Alternatively, we can solve this by using options. The student should try to do the same.

Problem 8.8 Three containers A , B and C are having mixtures of milk and water in the ratio of $1 : 5$, $3 : 5$ and $5 : 7$ respectively. If the capacities of the containers are in the ratio $5 : 4 : 5$, find the ratio of milk to water, if the mixtures of all the three containers are mixed together.

Solution Assume that there are 500, 400 and 500 litres respectively in the 3 containers.

Then we have, 83.33, 150 and 208.33 litres of milk in each of the three containers.

Thus, the total milk is 441.66 litres. Hence, the amount of water in the mixture is

$$1400 - 441.66 = 958.33 \text{ litres.}$$

Hence, the ratio of milk to water is

$$441.66 : 958.33 \text{ } \approx 53 : 115 \text{ (Using division by 0.33333)}$$

The calculation thought process should be:

$$(441 \times 3 + 2) : (958 \times 3 + 1) = 1325 : 2875.$$

Dividing by 25 $\approx 53 : 115$.

LEVEL OF DIFFICULTY (I)

1. Divide ₹ 1870 into three parts in such a way that half of the first part, one-third of the second part and one-sixth of the third part are equal.
(a) 241, 343, 245 (b) 400, 800, 670
(c) 470, 640, 1160 (d) None of these
2. Divide ₹ 500 among A , B , C and D so that A and B together get thrice as much as C and D together, B gets four times of what C gets and C gets 1.5 times as much as D . Now the value of what B gets is
(a) 300 (b) 75
(c) 125 (d) 150
3. If $\frac{a}{b+c} = \frac{b}{c+a} = \frac{c}{a+b}$, then each fraction is equal to
(a) $(a+b+c)^2$ (b) $1/2$
(c) $1/4$ (d) 0
4. If $6x^2 + 6y^2 = 13xy$, what is the ratio of x to y ?
(a) 1 : 4 (b) 3 : 2
(c) 4 : 5 (d) 1 : 2
(Hint: Use options to solve fast)
5. If $a : b = c : d$ then the value of $\frac{a^2 + b^2}{c^2 + d^2}$ is
(a) $1/2$ (b) $\frac{a+b}{c+d}$
(c) $\frac{a-b}{c-d}$ (d) $\frac{ab}{cd}$

6. A crew can row a certain course up the stream in 84 minutes; they can row the same course down stream in 9 minutes less than they can row it in still water. How long would they take to row down with the stream.
(a) 45 or 23 minutes (b) 63 or 12 minutes
(c) 60 minutes (d) 19 minutes
7. If a, b, c, d are in continued proportion then $\frac{a-d}{b-c} \geq x$. What is the value of x .
(a) 2 (b) 3
(c) 1 (d) 0
8. If 4 examiners can examine a certain number of answer books in 8 days by working 5 hours a day, for how many hours a day would 2 examiners have to work in order to examine twice the number of answer books in 20 days.
(a) 6 (b) $7\frac{1}{2}$
(c) 8 (d) 9
9. If a, b, c, d are proportional, then $(a-b)(a-c)/a =$
(a) $a+c+d$ (b) $a+d-b-c$
(c) $a+b+c+d$ (d) $a+c-b-d$
10. In a mixture of 40 litres, the ratio of milk and water is 4 : 1. How much water must be added to this mixture so that the ratio of milk and water becomes 2 : 3.
(a) 20 litres (b) 32 litres
(c) 40 litres (d) 30 litres
11. If A varies as C , and B varies as C , then which of the following is false:
(a) $(A+B) \propto C$ (b) $(A-B) \propto 1/C$
(c) $\sqrt{AB} \propto C$ (d) $AB \propto C^2$

12. If three numbers are in the ratio of $1 : 2 : 3$ and half the sum is 18, then the ratio of squares of the numbers is:
- (a) $6 : 12 : 13$ (b) $1 : 2 : 4$
(c) $36 : 144 : 324$ (d) $3 : 5 : 7$
13. The ratio between two numbers is $3 : 4$ and their LCM is 180. The first number is:
- (a) 6. (b) 45
(c) 1. (d) 20
14. A and B are two alloys of argentine and brass prepared by mixing metals in proportions $7 : 2$ and $7 : 11$ respectively. If equal quantities of the two alloys are melted to form a third alloy C , the proportion of argentine and brass in C will be:
- (a) $5 : 9$ (b) $5 : 7$
(c) $7 : 5$ (d) $9 : 5$
15. If 30 men working 7 hours a day can do a piece of work in 18 days, in how many days will 21 men working 8 hours a day do the same work?
- (a) 24 days (b) 22.5 days
(c) 30 days (d) 45 days
16. The incomes of A and B are in the ratio $3 : 2$ and their expenditures are in the ratio $5 : 3$. If each saves ₹ 1000, then, A 's income can be:
- (a) ₹ 3000 (b) ₹ 4000
(c) ₹ 6000 (d) ₹ 9000
17. If the ratio of sines of angles of a triangle is $1 : 1 : \sqrt{2}$, then the ratio of square of the greatest side to sum of the squares of other two sides is
- (a) $3 : 4$ (b) $2 : 1$
(c) $1 : 1$ (d) $1 : 2$

18. Divide ₹ 680 among A, B and C such that A gets $\frac{2}{3}$ of what B gets and B gets $\frac{1}{4}$ th of what C gets. Now the share of C is:
- (a) ₹ 480 (b) ₹ 300
(c) ₹ 420 (d) ₹ 360
19. A, B, C enter into a partnership. A contributes one-third of the whole capital while B contributes as much as A and C together contribute. If the profit at the end of the year is ₹ 84,000, how much would each receive?
- (a) 24,000, 20,000, 40,000
(b) 28,000, 42,000, 14,000
(c) 28,000, 42,000, 10,000
(d) 28,000, 14,000, 42,000
20. The students in three batches at Mindworkzz are in the ratio 2 : 3 : 5. If 20 students are increased in each batch, the ratio changes to 4 : 5 : 7. The total number of students in the three batches before the increases were
- (a) 1. (b) 90
(c) 100 (d) 150
21. The speeds of three cars are in the ratio 2 : 3 : 4. The ratio between the times taken by these cars to travel the same distance is
- (a) 2 : 3 : 4 (b) 4 : 3 : 2
(c) 4 : 3 : 6 (d) 6 : 4 : 3
22. If a , b , c and d are proportional then the mean proportion between $a^2 + c^2$ and $b^2 + d^2$ is
- (a) ac/bd (b) $ab + cd$
(c) $a/b + d/c$ (d) $a^2/b^2 + c^2/d^2$
23. A number z lies between 0 and 1. Which of the following is true?
- (a) $z > \sqrt{z}$ (b) $z > 1/z$

(c) $z^3 > z^2$

(d) $1/z > \sqrt{z}$

24. ` 2250 is divided among three friends Amar, Bijoy and Chandra in such a way that $1/6$ th of Amar's share, $1/4$ th of Bijoy's share and $2/5$ th of Chandra's share are equal. Find Amar's share.
- (a) ` 720 (b) ` 1080
(c) ` 450 (d) ` 1240
25. After an increment of 7 in both the numerator and denominator, a fraction changes to $3/4$. Find the original fraction.
- (a) $5/12$ (b) $7/9$
(c) $2/5$ (d) $3/8$
26. The difference between two positive numbers is 10 and the ratio between them is 5 : 3. Find the product of the two numbers.
- (a) 375 (b) 175
(c) 275 (d) 125
27. If 30 oxen can plough $1/7$ th of a field in 2 days, how many days 18 oxen will take to do the remaining work?
- (a) 30 days (b) 20 days
(c) 15 days (d) 18 days
28. A cat takes 5 leaps for every 4 leaps of a dog, but 3 leaps of the dog are equal to 4 leaps of the cat. What is the ratio of the speed of the cat to that of the dog?
- (a) 11 : 15 (b) 15 : 11
(c) 16 : 15 (d) 15 : 16
29. The present ratio of ages of A and B is 4 : 5. 18 years ago, this ratio was 11 : 16. Find the sum total of their present ages.
- (a) 90 years (b) 105 years
(c) 110 years (d) 80 years
30. Four numbers in the ratio 1 : 3 : 4 : 7 add up to give a sum of 105. Find the value of the biggest number.

- (a) 4. (b) 35
(c) 4. (d) 63
31. Three men rent a farm for ₹ 7000 per annum. A puts 110 cows in the farm for 3 months, B puts 110 cows for 6 months and C puts 440 cows for 3 months. What percentage of the total expenditure should A pay?
(a) 20% (b) 14.28%
(c) 16.66% (d) 11.01%
32. 10 students can do a job in 8 days, but on the starting day, two of them informed that they are not coming. By what fraction will the number of days required for doing the whole work get increased?
(a) $\frac{4}{5}$ (b) $\frac{3}{8}$
(c) $\frac{3}{4}$ (d) $\frac{1}{4}$
33. A dishonest milkman mixed 1 litre of water for every 3 litres of milk and thus made up 36 litres of milk. If he now adds 15 litres of milk to the mixture, find the ratio of milk and water in the new mixture.
(a) 12 : 5 (b) 14 : 3
(c) 7 : 2 (d) 9 : 4
34. ₹ 3000 is distributed among A, B and C such that A gets $\frac{2}{3}$ rd of what B and C together get and C gets $\frac{1}{2}$ of what A and B together get. Find C's share.
(a) ₹ 750 (b) ₹ 1000
(c) ₹ 800 (d) ₹ 1200
35. If the ratio of the ages of Maya and Chhaya is 6 : 5 at present, and fifteen years from now, the ratio will get changed to 9 : 8, then find Maya's present age.
(a) 24 years (b) 30 years
(c) 18 years (d) 33 years

36. At constant temperature, pressure of a definite mass of gas is inversely proportional to the volume. If the pressure is reduced by 20%, find the respective change in volume.
- (a) -16.66% (b) $+25\%$
(c) -25% (d) $+16.66\%$
37. If ₹ 58 is divided among 150 children such that each girl and each boy gets 25 p and 50 p respectively. Then how many girls are there?
- (a) 5. (b) 54
(c) 6. (d) 62
38. If 391 bananas were distributed among three monkeys in the ratio $\frac{1}{2} : \frac{2}{3} : \frac{3}{4}$, how many bananas did the first monkey get?
- (a) 102 (b) 108
(c) 112 (d) 104
39. A mixture contains milk and water in the ratio 5 : 1. On adding 5 litres of water, the ratio of milk to water becomes 5 : 2. The quantity of milk in the mixture is:
- (a) 16 litres (b) 25 litres
(c) 32.5 litres (d) 22.75 litres
40. A beggar had ten paise, twenty paise and one rupee coins in the ratio 10 : 17 : 7 respectively at the end of day. If that day he earned a total of ₹ 57, how many twenty paise coins did he have?
- (a) 114 (b) 171
(c) 95 (d) 85
41. Vijay has coins of the denomination of Re. 1, 50 p and 25 p in the ratio of 12 : 10 : 7. The total worth of the coins he has is ₹ 75. Find the number of 25 p coins that Vijay has
- (a) 48 (b) 72
(c) 60 (d) None of these

42. If two numbers are in the ratio of 5 : 8 and if 9 be added to each, the ratio becomes 8 : 11. Now find the lower number.
- (a) 5 (b) 10
(c) 15 (d) None of these
43. What number must be taken from each term of the fraction $\frac{27}{35}$ that it may become 2 : 3?
- (a) 9 (b) 10
(c) 11 (d) None of these
44. If x varies inversely as $y^2 - 1$ and is equal to 24 when $y = 10$, find x when $y = 5$.
- (a) 99 (b) 101
(c) 91 (d) 93
45. If x varies as y , and $y = 7$ when $x = 18$, find x when $y = 21$
- (a) 36 (b) 54
(c) 72 (d) 18
46. A varies jointly as B and C ; and $A = 6$ when $B = 3$, $C = 2$; find A when $B = 5$, $C = 7$.
- (a) 17.5 (b) 35
(c) 70 (d) 105
47. If x varies as y directly, and as z inversely, and $x = 14$ when $y = 10$; find z when $x = 49$, $y = 45$.
- (a) $\frac{14}{10}$ (b) 10
(c) $\frac{10}{14}$ (d) Cannot be determined
48. A cask contains a mixture of 49 litres of wine and water in the proportion 5 : 2. How much water must be added to it so that the ratio of wine to water may be 7 : 4?
- (a) 3.5 (b) 6
(c) 7 (d) None of these

49. A cask contains 12 gallons of mixture of wine and water in the ratio 3 : 1. How much of the mixture must be drawn off and water substituted, so that wine and water in the cask may become half and half.
- (a) 3 litres (b) 5 litres
(c) 6 litres (d) None of these
50. The total number of pupils in three classes of a school is 333. The number of pupils in classes I and II are in the ratio 3 : 5 and those in classes II and III are in the ratio 7 : 11. Find the number of pupils in the class that had the highest number of pupils.
- (a) 63 (b) 105
(c) 165 (d) 180

LEVEL OF DIFFICULTY (II)

1. If the work done by $(x - 1)$ men in $(x + 1)$ days is to the work done by $(x + 2)$ men in $(x - 1)$ days is in the ratio 9 : 10, then the value of x is
 - (a) 10
 - (b) 12
 - (c) 8
 - (d) 15
2. The duration of a railway journey varies as the distance and inversely as the velocity; the velocity varies directly as the square root of the quantity of coal used, and inversely as the number carriages in the train. In a journey of 50 km in half an hour with 18 carriages, 100 kg of coal is required. How much coal will be consumed in a journey of 42 km in 28 minutes with 16 carriages.
 - (a) 64 kg
 - (b) 49 kg
 - (c) 25 kg
 - (d) 36 kg
3. The weight of a circular disc varies as the square of the radius when the thickness remains the same; it also varies as the thickness when the radius remains the same. Two discs have their thicknesses in the ratio of 9:8; the ratio of the radii if the weight of the first is twice that of the second is
 - (a) 4 : 3
 - (b) 5 : 2
 - (c) 2 : 1
 - (d) 1 : 2
4. If a and b are positive integers then $\sqrt{2}$ always lies between:
 - (a) $(a + b)/(a - b)$ and ab
 - (b) a/b and $(a + 2b)/(a + b)$
 - (c) a and b
 - (d) $ab/(a + b)$ and $(a - b)/ab$
5. The cost of digging a pit was ₹ 1,347. How much will it cost (approximately) if the wages of workmen per day had been

increased by $\frac{1}{8}$ of the former wages and length of the working day increased by $\frac{1}{20}$ of the former period?

- (a) ₹ 1443 (b) ₹ 1234
(c) ₹ 1439 (d) ₹ 1000

6. A vessel contains a litres of wine, and another vessel contains b litres of water. c litres are taken out of each vessel and transferred to the other if $c \times (a + b) = ab$. If A and B are the respective values of the amount of wine contained in the respective containers after this operation, then what can be said about the relationship between A and B .

- (a) $A = B$ (b) $\frac{A - C}{B - C} > 2$

- (c) $A - B = 4c$ (d) None of these

7. If sum of the roots and the product of the roots of a quadratic equation S are in the ratio of $2 : 1$, then which of the following is true?

- (a) $f(S) < 0$ (b) $(b^2 - 4ac) < 0$
(c) S is a perfect square (d) None of these

8. A factory employs skilled workers, unskilled workers and clerks in the proportion $8 : 5 : 1$, and the wages of a skilled worker, an unskilled worker and a clerk are in the ratio $5 : 2 : 3$. When 20 unskilled workers are employed, the total daily wages of all amount to ₹ 318. The wages paid to each category of workers are

- (a) ₹ 240, ₹ 60, ₹ 18
(b) ₹ 200, ₹ 90, ₹ 28
(c) ₹ 150, ₹ 108, ₹ 60
(d) ₹ 250, ₹ 50, ₹ 18

9. If $a : b = c : d$, and $e : f = g : h$, then $(ae + bf) : (ae - bf) = ?$

- (a) $\frac{(e + f)}{(e - f)}$ (b) $\frac{(cg + dh)}{(cg - dh)}$

(c) $\frac{cg + dh}{cg - dh}$

(d) $\frac{e - f}{e + f}$

10. Brass is an alloy of copper and zinc. Bronze is an alloy containing 80% of copper, 4 % of zinc and 16% of tin. A fused mass of brass and bronze is found to contain 74% of copper, 16% of zinc, and 10% of tin. The ratio of copper to zinc in Brass is:

(a) 64% and 36%

(b) 33% and 67%

(c) 50% and 75%

(d) 35% and 65%

11. The Lucknow Indore Express without its rake can go 24 km an hour, and the speed is diminished by a quantity that varies as the square root of the number of wagons attached. If it is known that with four wagons its speed is 20 km/h, the greatest number of wagons with which the engine can just move is

(a) 144

(b) 140

(c) 143

(d) 124

12. If x varies as y then $x^2 + y^2$ varies as

(a) $x + y$

(b) $x - y$

(c) $x^2 - y^2$

(d) None of these

13. If $f(x) = \frac{(x+1)}{(x-1)}$, then the ratio of x to $f(y)$ where $y = f(x)$ is

(a) $x : y$

(b) $x^2 : y^2$

(c) $1 : 1$

(d) $y : x$

14. A contractor employs 200 men to build a bund. They finish $\frac{5}{6}$ of the work in 10 weeks. Then rain sets in and not only does the work remain suspended for 4 weeks but also half of the work already done is washed away. After the rain, when the work is resumed, only 140 men turn up. The total time in which the contractor is able to complete the work assuming that there are no further disruptions in the schedule is

(a) 25 weeks

(b) 26 weeks

(c) 24 weeks

(d) 20 weeks

15. In a journey of 48 km performed by tonga, rickshaw and cycle in that order, the distance covered by the three ways in that order are in the ratio of 8 : 1 : 3 and charges per kilometre in that order are in the ratio of 8 : 1 : 4. If the tonga charges being 24 paise per kilometre, the total cost of the journey is

(a) ₹ 9.24

(b) ₹ 10

(c) ₹ 12

(d) None of these

16. A bag contains 25 paise, 50 paise and 1 Re. coins. There are 220 coins in all and the total amount in the bag is ₹ 160. If there are thrice as many 1 Re. coins as there are 25 paise coins, then what is the number of 50 paise coins?

(a) 60

(b) 40

(c) 120

(d) 80

Directions for Questions 17 to 19: Read the following and answer the questions that follow.

Tuliram runs in a triathlon consisting of three phases in the following manner. Running 12 km, cycling 24 km and swimming 5 km. His speeds in the three phases are in the ratio 2 : 6 : 1. He completes the race in n minutes. Later, he changes his strategy so that the distances he covers in each phase are constant but his speeds are now in the ratio 3 : 8 : 1. The end result is that he completes the race taking 20 minutes more than the earlier speed. It is also known that he has not changed his running speed when he changes his strategy.

17. What is his initial speed while swimming?

(a) $\frac{1}{2}$ km/min

(b) 0.05 km/min

(c) 0.15 km/min

(d) None of these

18. If his speeds are in the ratio 1:3:1, with the running time remaining unchanged, what is his finishing time?

(a) $\frac{500}{3}$ min

(b) $\frac{250}{3}$ min

(c) 200/3 min

(d) 350/3 min

19. What is Tuliram's original speed of running?

(a) 9 kmph

(b) 18 kmph

(c) 54 kmph

(d) 12 kmph

20. Concentrations of three wines A , B and C are 10%, 20% and 30% respectively. They are mixed in the ratio $2 : 3 : x$ resulting in a 23% concentration solution. Find x .

(a) 7

(b) 6

(c) 5

(d) 4

21. The cost of an article (which is composed of raw materials and wages) was 3 times the value of the raw materials used. The cost of raw materials increased in the ratio $3 : 7$ and wages increased in the ratio $4 : 9$. Find the present cost of the article if its original cost was ₹ 18.

(a) ₹ 41

(b) ₹ 30

(c) ₹ 40

(d) ₹ 46

22. In a co-educational school there are 15 more girls than boys. If the number of girls is increased by 10% and the number of boys is also increased by 16%, there would be 9 more girls than boys. What is the number of students in the school?

(a) 140

(b) 125

(c) 265

(d) 255

23. At IIM Bangalore class of 1995, Sonali, a first year student has taken 10 courses, earning grades A (worth 4 points each), B (worth 3 points each) and C (worth 2 points each). Her grade point average is 3.2, and if the course in which she got C 's were deleted, her GPA in the remaining courses would be 3.333. How many A 's, B 's and C 's did she get?

(a) 3, 1 and 6

(b) 1, 3 and 6

(c) 3, 6 and 1

(d) 1, 6 and 3

24. Total expenses of running the hostel at Harvard Business School are partly fixed and partly varying linearly with the number of boarders. The average expense per boarder is \$70 when there are 25 boarders and \$60 when there are 50 boarders. What is the average expense per boarder when there are 100 boarders?

- (a) 55
- (b) 56
- (c) 54
- (d) 50

25. The speed of the engine of Gondwana Express is 42 km/h when no compartment is attached, and the reduction in speed is directly proportional to the square root of the number of compartments attached. If the speed of the train carried by this engine is 24 km/h when 9 compartments are attached, the maximum number of compartments that can be carried by the engine is

- (a) 49
- (b) 48
- (c) 46
- (d) 47

Three drunkards agree to pool their vodka and decided to share it with a fourth drunkard (who had no vodka) at a price equal to 5 roubles a litre. The first drunkard contributed 1 litre more than the second and the second contributed a litre more than the third. Then all four of them divided the vodka equally and drank it. The fourth drunkard paid money, which was divided in the ratio of each drunkard's contribution towards his portion. It was found that the first drunkard should get twice as much money as the second. Based on this information answer the questions 26–28. (Assume that all shares are integral).

26. How much money did the second drunkard get (in roubles)?

- (a) 8
- (b) 10
- (c) 5
- (d) Data insufficient

27. How many litres of vodka was consumed in all by the four of them?

- (a) 12
- (b) 16
- (c) 10
- (d) None of these

28. What proportion of the fourth drunkard's drink did the second drunkard contribute?
- (a) $\frac{1}{3}$ (b) $\frac{2}{3}$
(c) $\frac{1}{2}$ (d) None of these
29. In Ramnagar Colony, the ratio of school going children to non-school going children is 5 : 4. If in the next year, the number of non-school going children is increased by 20%, making it 35,400, what is the new ratio of school going children to non-school going children?
- (a) 4 : 5 (b) 3 : 2
(c) 25 : 24 (d) None of these
30. A precious stone weighing 35 grams worth ₹ 12,250 is accidentally dropped and gets broken into two pieces having weights in the ratio of 2 : 5. If the price varies as the square of the weight then find the loss incurred.
- (a) ₹ 5750 (b) ₹ 6000
(c) ₹ 5500 (d) ₹ 5000
31. On his deathbed, Mr. Kalu called upon his three sons and told them to distribute all his assets worth ₹ 525,000 in the ratio of $\frac{1}{15} : \frac{1}{21} : \frac{1}{35}$ amongst themselves. Find the biggest share amongst the three portions.
- (a) 17,500 (b) 245,000
(c) 10,500 (d) 13,250
32. Three jackals—Paar, Maar and Taar together have 675 loaves of bread. Paar has got three times as much as Maar but 25 loaves more than Taar. How many does Taar have?
- (a) 175 (b) 275
(c) 375 (d) None of these
33. King Sheru had ordered the distribution of apples according to the following plan : for every 20 apples the elephant gets, the zebra

should get 13 apples and the deer should get 8 apples. Now his servant Shambha jackal is in a fix. Can you help him by telling how much should he give to the elephant if there were 820 apples in total?

- (a) 140 (b) 160
(c) 200 (d) 400

34. In the famous Bhojpur island, there are four men for every three women and five children for every three men. How many children are there in the island if it has 531 women?

- (a) 454 (b) 1180
(c) 1070 (d) 389

35. Which of the following will have the maximum change in their values if 5 is added to both the numerator and denominator of all the fractions?

- (a) $\frac{3}{4}$ (b) $\frac{2}{3}$
(c) $\frac{4}{7}$ (d) $\frac{5}{7}$

36. 40 men could have finished the whole project in 28 days but due to the inclusion of a few more men, work got done in $\frac{3}{4}$ of the time. Find out how many more men were included (in whole numbers).

- (a) 12 (b) 13
(c) 14 (d) None of these

37. Mr AM, the magnanimous cashier at XYZ Ltd., while distributing salary, adds whatever money is needed to make the sum a multiple of 50. He adds ₹ 10 and ₹ 40 to A's and B's salary respectively and then he realises that the salaries of A, B and C are now in the ratio 4 : 5 : 7. The salary of C could be

- (a) ₹ 2300 (b) ₹ 2150
(c) ₹ 1800 (d) ₹ 2100

38. A mother divided an amount of ₹ 61,000 between her two daughters aged 18 years and 16 years respectively and deposited their shares in a bond. If the interest rate is 20% compounded annually and if

each received the same amount as the other when she attained the age of 20 years, their shares are

- (a) ₹ 35,600 and ₹ 25,400
- (b) ₹ 30,500 each
- (c) ₹ 24,000 and ₹ 37,000
- (d) None of these

Directions for Questions 39 to 41: Read the passage below and answer the questions that follow:

Anshu gave Bobby and Chandana as many pens as each one of them already had. Then Chandana gave Anshu and Bobby as many pens as each already had. Now each had an equal number of pens. The total number of pens is 72.

39. How many pens did Bobby have initially?

- (a) 24
- (b) 18
- (c) 12
- (d) 6

40. How many pens did Chandana have initially?

- (a) 24
- (b) 18
- (c) 12
- (d) 6

41. How many pens did Anshu have initially?

- (a) 30
- (b) 36
- (c) 42
- (d) 48

42. The volume of a pyramid varies jointly as its height and the area of its base; and when the area of the base is 60 square dm and the height 14 dm, the volume is 280 cubic dm. What is the area of the base of a pyramid whose volume is 390 cubic dm and whose height is 26 dm?

- (a) 40
- (b) 45
- (c) 50
- (d) None of these

43. The expenses of an all boys' institute are partly constant and partly vary as the number of boys. The expenses were ₹ 10,000 for 150 boys and ₹ 8400 for 120 boys. What will the expenses be when there are 330 boys?
- (a) 18,000 (b) 19,600
(c) 22,400 (d) None of these
44. The distance of the horizon at sea varies as the square root of the height of the eye above sea-level. When the distance is 14.4 km, the height of the eye is 18 metres. Find, in kilometres, the distance when the height of the eye is 8 metres.
- (a) 4.8 km (b) 7.2 km
(c) 9.6 km (d) 12 km
45. A mixture of cement, sand and gravel in the ratio of 1 : 2 : 4 by volume is required. A person wishes to measure out quantities by weight. He finds that the weight of one cubic foot of cement is 94 kg, of sand 100 kg and gravel 110 kg. What should be the ratio of cement, sand and gravel by weight in order to give a proper mixture?
- (a) 47 : 100 : 220 (b) 94 : 100 : 220
(c) 47 : 200 : 440 (d) None of these

LEVEL OF DIFFICULTY (III)

1. An alloy of gold and silver is taken in the ratio of 1 : 2, and another alloy of the same metals is taken in the ratio of 2 : 3. How many parts of the two alloys must be taken to obtain a new alloy consisting of gold and silver that are in the ratio 3 : 5?
(a) 3 and 5 (b) 2 and 9
(c) 2 and 5 (d) 1 and 5
2. There are two quantities of oil, with the masses differing by 2 kg. The same quantity of heat, equal to 96 kcal, was imparted to each mass, and the larger mass of oil was found to be 4 degrees cooler than the smaller mass. Find the mass of oil in each of the two quantities.
(a) 6 and 8 (b) 4 and 6
(c) 2 and 9 (d) 4 and 9
3. There are two alloys of gold and silver. In the first alloy, there is twice as much gold as silver, and in the second alloy there is 5 times less gold than silver. How many times more must we take of the second alloy than the first in order to obtain a new alloy in which there would be twice as much silver as gold?
(a) Two times (b) Three times
(c) Four times (d) Ten times
4. Calculate the weight and the percentage of zinc in the zinc-copper alloy being given that the latter's alloy with 3 kg of pure zinc contains 90 per cent of zinc and with 2 kg of 90% zinc alloy contains 84% of zinc.
(a) 2.4 kg or 80% (b) 1.4 kg or 88%
(c) 3.4 kg or 60% (d) 7.4 kg or 18%
5. Two solutions, the first of which contains 0.8 kg and the second 0.6 kg of salt, were poured together and 10 kg of a new salt solution

were obtained. Find the weight of the first and of the second solution in the mixture if the first solution is known to contain 10 per cent more of salt than the second.

- (a) 4 kg, 6 kg (b) 3 kg, 7 kg
(c) 4 kg, 9 kg (d) 5 kg, 9 kg

6. From a full barrel containing 729 litres of honey we pour off ' a ' litre and add water to fill up the barrel. After stirring the solution thoroughly, we pour off ' a ' litre of the solution and again add water to fill up the barrel. After the procedure is repeated 6 times, the solution in the barrel contains 64 litres of honey. Find a .

- (a) 243 litres (b) 81 litres
(c) 2.7 litres (d) 3 litres

7. In two alloys, the ratios of nickel to tin are 5 : 2 and 3 : 4 (by weight). How many kilograms of the first alloy and of the second alloy should be alloyed together to obtain 28 kg of a new alloy with equal contents of nickel and tin?

- (a) 9 kg of the first alloy and 22 kg of the second
(b) 17 kg of the first alloy and 11 kg of the second
(c) 7 kg of the first alloy and 21 kg of the second
(d) 8 kg and 20 kg respectively

8. In two alloys, aluminium and iron are in the ratios of 4 : 1 and 1 : 3. After alloying together 10 kg of the first alloy, 16 kg of the second and several kilograms of pure aluminium, an alloy was obtained in which the ratio of aluminium to iron was 3 : 2. Find the weight of the new alloy.

- (a) 15 (b) 35
(c) 65 (d) 95

9. There are two alloys of gold, silver and platinum. The first alloy is known to contain 40 per cent of platinum and the second alloy 26 per cent of silver. The percentage of gold is the same in both alloys. Having alloyed 150 kg of the first alloy and 250 kg of the second,

we get a new alloy that contains 30 per cent of gold. How many kilogram of platinum is there in the new alloy?

- (a) 170 kg (b) 175 kg
(c) 160 kg (d) 165 kg

10. Two alloys of iron have different percentage of iron in them. The first one weighs 6 kg and second one weighs 12 kg. One piece each of equal weight was cut off from both the alloys and the first piece was alloyed with the second alloy and the second piece alloyed with the first one. As a result, the percentage of iron became the same in the resulting two new alloys. What was the weight of each cut-off piece?

- (a) 4 kg (b) 2 kg
(c) 3 kg (d) 5 kg

11. Two litres of a mixture of wine and water contain 12% water. They are added to 3 litres of another mixture containing 7% water, and half a litre of water is then added to whole. What is the percentage of water in resulting concoction?

- (a) $17\frac{2}{7}\%$ (b) $15\frac{7}{11}\%$
(c) $17\frac{3}{11}\%$ (d) $16\frac{2}{3}\%$

12. Three vessels having volumes in the ratio of 1 : 2 : 3 are full of a mixture of coke and soda. In the first vessel, ratio of coke and soda is 2 : 3, in second, 3 : 7 and in third, 1 : 4. If the liquid in all the three vessels were mixed in a bigger container, what is the resulting ratio of coke and soda?

- (a) 4:11 (b) 5:7
(c) 7:11 (d) 7:5

13. Two types of tea are mixed in the ratio of 3 : 5 to produce the first quality and if they are mixed in the ratio of 2 : 3, the second quality is obtained. How many kilograms of the first quality has to be mixed with 10 kg of the second quality so that a third quality having the two varieties in the ratio of 7 : 11 may be produced?

(a) 5 kg

(b) 10 kg

(c) 8 kg

(d) 9 kg

14. A toy weighing 24 grams of an alloy of two metals is worth ₹ 174, but if the weights of metals in alloy be interchanged, the toy would be worth ₹ 162. If the price of one metal be ₹ 8 per gram, find the price of the other metal in the alloy used to make the toy.

(a) ₹ 10 per gram

(b) ₹ 6 per gram

(c) ₹ 4 per gram

(d) ₹ 5 per gram

15. The weight of three heaps of gold are in the ratio 5 : 6 : 7. By what fractions of themselves must the first two be increased so that the ratio of the weights may be changed to 7 : 6 : 5?

(a) $\frac{24}{25}, \frac{2}{5}$

(b) $\frac{48}{50}, \frac{4}{5}$

(c) $\frac{48}{50}, \frac{3}{5}$

(d) $\frac{24}{25}, \frac{3}{7}$ ■

16. An alloy of gold, silver and bronze contains 90% bronze, 7% gold and 3% silver. A second alloy of bronze and silver only is melted with the first and the mixture contains 85% of bronze, 5% of gold and 10% of silver. Find the percentage of bronze in the second alloy.

(a) 75%

(b) 72.5%

(c) 70%

(d) 67.5%

17. Gunpowder can be prepared by saltpetre and nitrous oxide. Price of saltpetre is thrice the price of nitrous oxide. Notorious gangster Kallu Bhai sells the gunpowder at ₹ 2160 per 10 g, thereby making a profit of 20%. If the ratio of saltpetre and nitrous oxide in the mixture be 2 : 3, find the cost price of saltpetre.

(a) ₹ 210/gm

(b) ₹ 300/gm

(c) ₹ 120/gm

(d) None of these

18. Two boxes A and B were filled with a mixture of rice and dal—in A in the ratio of 5 : 3, and in B in the ratio of 7 : 3. What quantity must

be taken from the first to form a mixture that shall contain 8 kg of rice and 3 kg of dal?

- (a) 4 kg
- (b) 5 kg
- (c) 6 kg
- (d) This cannot be achieved

19. A person buys 18 local tickets for ₹ 110. Each first class ticket costs ₹ 10 and each second class ticket costs ₹ 3. What will another lot of 18 tickets in which the number of first class and second class tickets are interchanged cost?

- (a) 112
- (b) 118
- (c) 121
- (d) 124

20. Two jars having a capacity of 3 and 5 litres respectively are filled with mixtures of milk and water. In the smaller jar 25% of the mixture is milk and in the larger 25% of the mixture is water. The jars are emptied into a 10 litre cask whose remaining capacity is filled up with water. Find the percentage of milk in the cask.

- (a) 55%
- (b) 50%
- (c) 45%
- (d) None of these

21. Two cubes of bronze have their total weight equivalent to 60 kg. The first piece contains 10 kg of pure zinc and the second piece contains 8 kg of pure zinc. What is the percentage of zinc in the first piece of bronze if the second piece contains 15 per cent more zinc than the first?

- (a) 15%
- (b) 25%
- (c) 55%
- (d) 24%

22. Sonu gets a jewellery made of an alloy of copper and silver. The alloy with a weight of 8 kg contains p per cent of copper. What piece of a copper-silver alloy containing 40 per cent of silver must be alloyed with the first piece in order to obtain a new alloy with the minimum percentage of copper if the weight of the second piece is 2 kg?

- (a) 2 kg for $p > 60$, a kg, where $a \in [0, 2]$, for $p = 60$, 0 kg for $0 < p < 60$
- (b) 0 kg for $p > 60$, a kg, where $a \in [0, 2]$, for $p = 60$, 2 kg for $0 < p < 60$
- (c) 0 kg for $p > 60$, a kg, where $a \in [0, 3]$, for $p = 70$, 0 kg for $0 < p < 70$
- (d) None of these

23. From a vessel filled up with pure spirit to the brim, two litres of spirit was removed and 2 litres of water were added. After the solution was mixed, 2 litres of the mixture was poured off and again 2 litres of water was added. The solution was stirred again and 2 litres of the mixture was removed and 2 litres of water was added. As a result of the above operations, the volume of water in the vessel increased by 3 litres than the volume of spirit remaining in it. How many litres of spirit and water were there in the vessel after the above procedure was carried out?

- (a) 0.7 litre of spirit and 3.7 litres of water
- (b) 1.5 litres of spirit and 4.5 litres of water
- (c) 8.5 litre of spirit and 11.5 litres of water
- (d) 0.5 litre of spirit and 3.5 litres of water

24. There are two qualities of milk—Amul and Sudha having different prices per litre, their volumes being 130 litres and 180 litres respectively. After equal amounts of milk was removed from both, the milk removed from Amul was added to Sudha and vice-versa. The resulting two types of milk now have the same price. Find the amount of milk drawn out from each type of milk.

- (a) 58.66
- (b) 75.48
- (c) 81.23
- (d) None of these

25. Assume that the rate of consumption of coal by a locomotive varies as the square of the speed and is 1000 kg per hour when the speed is 60 km per hour. If the coal costs the railway company ₹ 15 per 100 kg and if the other expenses of the train be ₹ 12 per hour, find a

formula for the cost in paise per kilometre when the speed is S km per hour.

(a) $1200 + \frac{5S^2}{18}$

(b) $1200 + \frac{75S^2}{18}$

(c) $\frac{1200}{S} + \frac{75S}{18}$

(d) None of these

ANSWER KEY

Level of Difficulty (I)

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

Level of Difficulty (II)

- | | | | |
|---------|---------|---------|---------|
| 1. (c) | 2. (a) | 3. (a) | 4. (b) |
| 5. (a) | 6. (d) | 7. (d) | 8. (a) |
| 9. (b) | 10. (a) | 11. (c) | 12. (d) |
| 13. (c) | 14. (c) | 15. (a) | 16. (a) |
| 17. (d) | 18. (b) | 19. (b) | 20. (c) |
| 21. (a) | 22. (c) | 23. (c) | 24. (a) |
| 25. (b) | 26. (c) | 27. (a) | 28. (a) |
| 29. (c) | 30. (d) | 31. (b) | 32. (b) |
| 33. (d) | 34. (b) | 35. (b) | 36. (c) |

37. (d)

38. (d)

39. (d)

40. (a)

41. (c)

42. (b)

43. (b)

44. (c)

45. (a)

Level of Difficulty (III)

1. (a)

2. (a)

3. (a)

4. (a)

5. (a)

6. (a)

7. (c)

8. (b)

9. (a)

10. (a)

11. (c)

12. (a)

13. (c)

14. (b)

15. (a)

16. (b)

17. (b)

18. (d)

19. (d)

20. (c)

21. (b)

22. (a)

23. (d)

24. (b)

25. (c)

Hints**Level of Difficulty (II)**

1. Check the equation: $\frac{(x-1)(x+1)}{(x+2)(x-1)} = \frac{9}{10}$

Through options

2. $S = k \frac{\sqrt{Q}}{N}$ where Q is the quantity of coal used per km and N is the number of carriages.

$$100 = k \frac{\sqrt{2}}{18}$$

$$\therefore k = \frac{1800}{\sqrt{2}} = 900\sqrt{2} \text{ and}$$

$$S = 900\sqrt{2} \times \frac{\sqrt{Q}}{N}$$

$$\text{Then } 150 = 900\sqrt{2} \times \frac{\sqrt{Q}}{16}$$

3. $\frac{w_1}{w_2} = \frac{r_1^2 t_1}{r_2^2 t_2} = \frac{2w_2}{w_2}$

5. $1347 \times 1.125 \times 0.9523$
6. Assume values of a , b and c such that they satisfy $c(a + b) = ab$.
Then $A = a - c$ and $B = c$
8. Number of workers—32 skilled, 20 unskilled and 4 clerks.
Then, wages are divided in the ratio 160 : 40 : 12.
11. $S = 24 - k\sqrt{N}$

13. $y = \frac{(x+1)}{(x-1)}, f(y) = \frac{\frac{x+1}{x-1} + 1}{\frac{x+1}{x-1} - 1} = x$

14. 2000 man weeks = $\frac{5}{6}$ of the total work.

\ Total work = 2400 man weeks

Work left after disruption = 1400 men weeks.

17–19. Let the running speed be $2x$, then $6x$ and x are the cycling and swimming speeds respectively

Then, $\frac{n}{60} = \frac{12}{2x} + \frac{24}{6x} + \frac{5}{x}$ (1)

Also, $\frac{n+20}{60} = \frac{12}{3y} + \frac{24}{8y} + \frac{5}{y}$ (2)

And $3y = 2x$ (3)

23. Solve using options

24. Variable cost per boarder = $\frac{60 \times 50 - 70 \times 25}{25} = 50$

26–28. Let the contributions be C , $C + 1$ and $C + 2$. Total Vodka = $3C + 3 = 3(C + 1)$

The total Vodka should be divisible into 4 parts.

Hence, C can take values like 3, 7, 11 etc.

Proceed with trial and error and check the value for which all conditions are met.

31. The ratio is 7 : 5 : 3

34. Ratios are 3 : 4 and 3 : 5 i.e. 9 : 12 : 20
37. The question asks for a possible answer and not for a definite answer.

44. $D = k\sqrt{h}$

$$k = \frac{14.4}{3\sqrt{2}}$$

Level of Difficulty (III)

1. One alloy contains 33.33% gold, the other contains 40% gold. The mixture must contain 37.5% gold. Solve using alligation.

2. $\frac{96}{x} - \frac{96}{(x+2)} = 4$ (Required difference). Check using options.

3.
$$\begin{array}{ccccc} 33.33 & & 66.66 & & 83.33 \\ | & & | & & | \\ \text{1st} & & & & \text{2nd} \\ \text{Alloy} & & & & \text{Alloy} \end{array} \quad \text{gives } 1 : 2$$

4. Check using options whether the given conditions of mixing are met.

Option (a) gives : 2.4 kg of zinc @ 80% concentration. i.e. 3 kg alloy of 80% zinc concentration is mixed with 3 kg of pure zinc. Satisfies the given condition.

5. Solve using options the following equation $\frac{0.8}{x} - \frac{0.6}{10-x} = 0.1$

7. Check the options.

8. 80% aluminium (4: 1) and 25% aluminium (1 : 3) have to be mixed with pure aluminium to obtain an alloy with 60% aluminium.

$$\frac{10 \times 0.8 + 16 \times 0.25 + x}{10 + 16 + x} = 0.6$$

9. Since the percentage of gold in both alloys is the same, any mixture of the two will contain the same percentage concentration of gold.

Hence, we get

First alloy : Gold : Silver : Platinum

	30 :	30 :	40
AND Second alloy:	Gold :	Silver :	Platinum
	30 :	26 :	44

10. Let 'w' be the weight of the cut off piece.

$$\text{Then, } \frac{6-w}{w} = \frac{w}{12-w}$$

13. First alloy has 37.5% of the first tea type. Similarly, the second alloy has 40% of the first tea type. The mixture should contain 42.85% of the first tea type. This is not possible.
16. When one alloy having 7% gold is mixed with another alloy having no gold, the result is a new alloy with 5% gold. Hence, ratio of mixing is 2 : 5.
19. $10x + (18 - x) \times 3 = 110$
20. Out of 8 liters milk and water mixture poured into the 10 liter cask, the milk is $0.25 \times 3 + 0.75 \times 5 = 4.5$.
21. $\frac{8}{x} - \frac{10}{60-x} = 0.15$.
22. Since the second alloy contains 60% copper, the requirement for the minimisation of copper will be fulfilled by option 2. Note, that the values of the number of kgs required of the second alloy will depend on the value of p.
24. Solve through options.
25. Total cost = Other expenses (paise/km) + Coal cost (paise/km).

$$\text{Coal Consumption} = k \times s^2$$

$$\backslash 1000 = k \times 60^2$$

$$k = \frac{5}{18} \text{ and Coal consumption} = \frac{5}{18} \times s^2$$

\ Required expression is

$$\text{Total cost} = \frac{1200}{s} + \frac{5}{18} s \times 15.$$

Solutions and Shortcuts

Level of Difficulty (I)

1. Solve this question using options. $1/2$ of the first part should equal $1/3^{\text{rd}}$ of the second part and $\frac{1}{6}$ of the third part. This means that the first part should be divisible by 2, the second one by 3, and the third one by 6. Looking at the options, none of the first 3 options has its third number divisible by 6. Thus, option (d) is correct.

2. $(A + B) = 3 (C + D) \Rightarrow A + B = 375$ and $C + D = 125$.

Also, since C gets 1.5 times D we have

$C = 75$ and $D = 50$, and $B = 4 C = 300$.

3. The given condition has a , b and c symmetrically placed. Thus, if we use $a = b = c = 2$ (say) we get each fraction as $1/2$.
4. Solve using options. Since $x > y > 0$ it is clear that a ratio of $x:y$ as $3:2$ fits the equation.
5. $1 : 2 = 3 : 6$ So, $(a^2 + b^2)/(c^2 + d^2) = 5/45 = 1/9$

From the given options, only ab/cd gives us this value.

6. If you try to solve this question through equations, the process becomes too long and almost inconclusive. The best way to approach this question is by trying to use options.

The question asks us to find the time in which the boat can move downstream.

The basic situation in this question is:

Percentage increase over still water speed while going downstream
= Percentage decrease over still water speed while going upstream.

(Since: $S_{\text{downstream}} = S_{\text{boat}} + S_{\text{stream}}$ and $S_{\text{upstream}} = S_{\text{boat}} - S_{\text{stream}}$)

Hence, the percentage increase in time while going upstream should match the percentage decrease in time while going downstream in such a way that the percentage change in the speed is same in both the cases).

Testing for option (a):

Time_{upstream} = 84 minutes (given)

Time_{downstream} = 45 minutes (first value from the option)

Time_{Stillwater} = 54 minutes (45 + 9)

% increase in time when going upstream = $30/54$

[**Note:** The percentage increase should be written as $30 \times 100 / 54$. However, as I have repeatedly pointed out right from the chapter of percentages, you need to be able to look at % values of ratios directly by using the Percentage rule for calculations)

% decrease in time when going downstream = $9/54 = 16.66\%$

Since, the % decrease is 16.66%, this should correspond to a % increase in speed by 20% (Since, product speed \times time is constant).

This means that the speed should drop by 20% while going upstream and hence the time should increase by 25% while going upstream. But, $30/54$ does not give us a value of 25% increase. Hence this option is incorrect.

Testing for option (b):

Time_{upstream} = 84 minutes (given)

Time_{downstream} = 63 minutes (first value from the option)

Time_{Stillwater} = 72 minutes (63 + 9)

% increase in time when going upstream = $12/72 = 16.66\%$

% decrease in time when going downstream = $9/72 = 12.5\%$

Since, the % decrease is 12.5%, this should correspond to a % increase in speed by 14.28% (Since, product speed \times time is constant).

This means that the speed should drop by 14.28% while going upstream and hence the time should increase by 16.66% while going upstream. This is actually occurring. Hence, this option is correct.

Options (c) & (d) can be seen to be incorrect in this context.

7. Experimentally if you were to take the value of a, b, c , and d as $1 : 2 : 4 : 8$, you get the value of the expression as 3.5. If you try other values for a, b, c and d experimentally you can see that while you can approach 3, you cannot get below that.

For instance,

$$1 : 1.1 :: 1.21 : 1.331$$

Gives us: $-0.331/-0.11$ which is slightly greater than 3.

8. $4 \times 8 \times 5 = 160$ man-hours are required for 'x' no. of answer sheets. So, for '2x' answer sheets we would require 320 man-hours $= 2 \times 20 \times n \text{ } \text{ } n = 8$ Hours a day.

9. Assume a set of values for a, b, c, d such that they are proportional i.e. $a/b = c/d$. Suppose we take $a:b$ as $1:4$ and $c:d$ as $3:12$ we get the given expression:

$(a - b)(a - c)/a = -3 \times -2/1 = 6$. This value is also given by $a + d - b - c$ and hence option (b) is correct.

10. In 40 litres, milk = 32 and water = 8. We want to create $2 : 3$ milk to water mixture, for this we would need: 32 milk and 48 water. (Since milk is not increasing). Thus, we need to add 40 litres of water.

11. Option (b) is not true.

12. $1 : 2 : 3 \text{ } \text{ } x, 2x$ and $3x$ add up to 36.

So the numbers are: 6, 12 and 18.

Ratio of squares = $36 : 144 : 324$.

13. The numbers would be $3x$ and $4x$ and their LCM would be $12x$. This gives us the values as 45 and 60. The first number is 45.

14. Since equal quantities are being mixed, assume that both alloys have 18 kgs (18 being a number which is the LCM of 9 and 18).

The third alloy will get, 14 kg of argentine from the first alloy and 7 kg of argentine from the second alloy. Hence, the required ratio: $21:15 = 7:5$

15. The total number of manhours required $= 30 \times 7 \times 18 = 3780$

$21 \times 8 \times \text{no. of days } \text{ } 3780/168 = 22.5$ days

Note, you could have done this directly by: $(30 \times 7 \times 18)/(21 \times 8)$.

16. Solve using options. Option (c) fits the situation as if you take A's income as ₹ 6,000, B's income will become ₹ 4,000 and if they each save ₹ 1,000, their expenditures would be ₹ 5,000 , ₹ 3,000 respectively. This gives the required 5: 3 ratio.
17. The given ratio for sines would only be true for a 45-45-90 triangle. The sides of such a triangle are in the ratio $1:1:\sqrt{2}$. The square of the longest side is 2 while the sum of the squares of the other two sides is also 2. Hence, the required ratio is 1:1.
18. Solve by options. Option (a) $C = 480$ fits perfectly because if $C = 480$, $B = 120$ and $A = 80$.
19. A's contribution = 33.33%
 B's contribution = 50%
 C's contribution = 16.66%
 Ratio of profit sharing = Ratio of contribution
 = 2 : 3 : 1
 Thus, profit would be shared as : 28000 : 42000 : 14000.
20. $2x + 20 : 3x + 20 : 5x + 20 = 4 : 5 : 7$ $\Rightarrow x = 10$ and initially the number of students would be 20, 30 and 50 \Rightarrow a total of 100.
21. The ratio of time would be such that speed \times time would be constant for all three. Thus if you take the speeds as $2x$, $3x$ and $4x$ respectively, the times would be $6y$, $4y$ and $3y$ respectively.
22. Again in order to solve this question, try to assume values for a , b , c and d such that $a:b = c:d$ (i.e. a , b , c and d are proportional). Let us say we assume $a = 1$, $b = 4$, $c = 3$ and $d = 12$ we get:
 $a^2 + c^2 = 10$ and $b^2 + d^2 = 160$. The mean proportional between 10 and 160 is 40. $ab + cd$ gives us this value and can be checked by taking another set of values to see that it still works.
23. Option (d) is true since $1/z$ will be greater than 1 and \sqrt{z} would be less than 1.
24. Amar's share should be divisible by 6. Option d gets rejected by this logic.

Further: $A + B + C = 2250$. If Amar's share is 720 (acc. To option a) Bijoy's share should be 480 & Chandra's share should be 300. (Gives us a total of $720 + 480 + 300 = 1500$).

But the required total is 2250 (50% more than 1500). Since all relationships are linear, 1500 will increase to 2250 if we increase all values by 50%. Hence, Amar's share should be 1080.

25. Trial and error would give us $\frac{2}{5}$ as the original fraction.
26. Their ratio being 5:3, the difference according to the ratio is 2. But this difference is 10. To get the values, expand the ratio 5 times. This gives 25 and 15 as the required values. Hence, the product is 375.
27. 60 oxen days = $\frac{1}{7}$ of the field \therefore 420 oxen days are required to plough the field. Thus, the remaining work would be 360 oxen days. With 18 oxen, it would take 20 days.
28. Assume that 1 cat leap is equal to 3 metres and 1 dog leap is equal to 4 metres.
Then the speed of the cat in one unit time = $3 \times 5 = 15$ meters.
Also, the speed of the dog in one unit time = $4 \times 4 = 16$ meters.
The required ratio is 15:16
29. $4x$, and $5x$ are their current ages. According to the problem, $4x - 18 : 5x - 18 = 11:16 \therefore x = 10$ and hence the sum total of their present ages is 90 years ($40 + 50$).
30. $x + 3x + 4x + 7x = 105 \therefore x = 7$
Thus, $7x = 49$.
31. The share of the rent is on the basis of the ratio of the number of cow months. A uses 330 cow months (110×3), B uses 660 (110×6) and C uses 1320 cow months (440×3)
Hence, the required ratio is: $330:660:1320 = 1:2:4$
32. $10 \times 8 = 80$ man days is required for the job. If only 8 students turn up, they would require 10 days to complete the task. The number of days is increasing by $\frac{1}{4}$.
33. The initial amount of water is 9 liters and milk is 27 liters. By adding 15 liters of milk the mixture becomes 42 milk and 9 water \therefore 14:3 the required ratio.

34. From the first statement $A = 1200$ and $B + C = 1800$. From the second statement $C = 1000$ and $A + B = 2000$.
35. $6x + 15 : 5x + 15 = 9 : 8$
 $\therefore 45x + 135 = 48x + 120$
 $3x = 15 \therefore x = 5$
 Maya's present age $= 6x = 30$
36. Since pressure and volume are inversely proportional, we get that if one is reduced by 20% the other would grow by 25%. Option (b) is correct.
37. Solve using options.
 For option (c), 68 girls. Hence, 82 boys
 Amount with Girls $= 68 \times 0.25 = 17$
 Amount with Boys $= 82 \times 0.5 = 41$.
 Total of ₹ 58.
 Thus, option (c) fits the conditions.
38. The ratio $: 1/2 : 2/3 : 3/4$
 Converts to $6 : 8 : 9$ (on multiplying by 12)
 Thus, the first monkey would get $(391/23) \times 6 = 102$ bananas.
39. Let the values of milk and water be $5x$ and x respectively. Then when we add 5 liters of water to this mixture, water would become $x + 5$.
 Now: $5x/(x + 5) = 5:2 \therefore x = 5$. Thus, $5x$ is 25.
40. The ratio of the values of the three coins are:
 $10 \times 10 : 17 \times 20 : 7 \times 100 = 100:340:700$
 $= 5:17:35$ is the ratio of division of value of coins.
 Thus, 20 paise coins correspond to ₹ 17. Hence, there will be 85 coins.
41. Ratio of no. of coins $= 12 : 10 : 7$
 Ratio of individual values of coins $= 1 : 0.5 : 0.25$
 Ratio of gross value of coins $= 12 : 5 : 1.75$
 $= 48 : 20 : 7 \therefore 75 \text{ ₹}$

Thus, he has 7 in 25 paisa coins. Which means that he would have 28 such coins.

42. Solve using options. $15/24$ becomes $24/33 \approx 8/11$

43. $\frac{27-11}{35-11} = 16/24 = 2/3$.

Thus option (c) is correct.

44. $x = k/(y^2-1)$. This gives $k = 24 \times 99 = 2376$.

The equation becomes $x = 2376/(24) = 99$.

45. $x = ky \approx 18 = 7k \approx k = 18/7$

Hence, $x = 18/7 \times y$

When $y = 21$, $x = 54$.

46. $A = K \times B \times C \approx$ It is known that when $A = 6$, $B = 3$ and $C = 2$.
Thus we get $6 = 6K \approx K = 1$.

Thus, our relationship between A , B and C becomes $A = B \times C$.

Thus, when $B = 5$ and $C = 7$ we get $A = 35$.

47. $x = ky/z$

We cannot determine the value of k from the given information and hence cannot answer the question.

48. Initial wine = 35 litres

Initial water = 14 litres

Since, we want to create 7 : 4 mixture of wine and water by adding only water, it means that the amount of wine is constant at 35 litres.

Thus 7 : 4 = 35 : 20. So, we need 6 litres of water.

49. If we were to draw out 4 litres of wine and substitute it with plain water, the ratio of wine to water would become 1:1. Hence, option (d) is correct.

50. The overall ratio is: 21:35:55. Dividing 333 in 111 parts (21 + 35 + 55) each part will be 3 and Class III will have the highest number of pupils $\approx 55 \times 3 = 165$

Level of Difficulty (II)

1. By taking the value of $x = 8$ from Option (c), the required ratio of 9:10 is achieved.

2. $T = KD/V$. $V = (K_1 Q^{1/2})/N$ where K and K_1 are constants, T is the time duration of the journey, Q is the quantity of coal used and N is the number of carriages.

Thus, $T = (KDN)/(K_1 Q^{1/2})$ or $T = (K_2 DN)/(Q^{1/2})$ \therefore if we take K/K_1 as K_2 .

From the information provided in the question: $30 = (K_2 \times 50 \times 18)/10$ $24 K_2 = 1/3$

Thus, the equation becomes: $T = (DN)/(3Q^{1/2})$. Then, when $D = 42$, $T = 28$, and $N = 16$ we get:

$$28 = 42 \times 16/(3Q^{1/2}) \therefore Q = 64$$

3. $\frac{2w_2}{w_2} = \frac{9r_1^2}{8r_2^2}$

Thus, $r_1/r_2 = 4:3$

4. Suppose you take $a = 3$ and $b = 2$. It can be clearly seen that the square root of 2 does not lie between 2 and 3. Hence, option c is incorrect.

Further with these values for a and b option a also can be ruled out since it means that the value should lie between 5 and 6 which it obviously does not.

Also, Option d gives $6/5$ and $1/6$. This means that the value should lie between 0.1666 and 1.2 (which it obviously does not). Hence, option (b) is correct.

5. $(1347 \times 1.125)/1.05 = 1443$.

6. The constraint given to us for the values of a , b , and c is

$$c(a + b) = a \times b$$

So, if we take $a = 6$, $b = 3$ and $c = 2$, we have $18 = 18$ and a feasible set of values for a , b and c respectively. With this set of values, we can complete the operation as defined and see what happens.

A. Wine left in the first vessel = $4 = (6 - 2)$

B. Wine in the second vessel = 2

With these values none of the first 3 options matches. Thus, option (d) is correct.

7. The only information available here is that $-b/c$ should be equal to $2/1$. This is not sufficient to make any of the first three options as conclusions. Hence, option (d) is correct.

8. The ratio of total salaries will be:

40:10:3. This gives 53 corresponds to 318. Hence, 1 corresponds to 6.

Thus the wages are: 240, 60 and 18 respectively.

9. Solve by taking values of a, b, c, d and e, f, g , and h independently of each other

$$a = 1, b = 2, c = 3, d = 6$$

$$\text{and } e = 3, f = 9, g = 4$$

$$\text{and } h = 12$$

$$\text{gives } (ae + bf) : (ae - bf) = 21 : -15 = -7/5$$

$$\text{Option (b) } (cg + dh)/(cg - dh) = 84/-60 = -7/5.$$

10. Since Brass has 0% tin and bronze has 16% tin, the ratio of mixing in the fused mass must be 3:5. Using alligation as follows:

	10	6
	<hr/>	
0% tin	10% tin	16% tin
<hr/>		
Brass	Fused mass	Bronze

Hence, 6:10 or 3:5

Then, percentage of copper in brass can be got as follows:

x	74	80
<hr/>		
Brass	Fused mass	Bronze
3		5

$$x = 64\%$$

11. Speed = $24 - k \div N$.

Putting value of $N = 4$ we get:

$20 = 24 - 2k$. Hence, $k = 2$

Thus the equation is: $S = 24 - 2 \div N$

This means that when $N = 144$, the speed will become zero. Hence, the train can just move when 143 wagons are attached.

12. x varies as y , means $x = ky$. This does not have any relation to the variance of $x^2 + y^2$.

13. Let $x = 5$

Then $f(x) = 6/4 = 1.5 = y$

And $f(y) = 2.5/0.5 = 5$.

Thus, the ratio of $x : f(y) = 1 : 1$

Note: Even if you take some other value of y , you would still get the same answer.

14. 2000 man weeks before the rain, $5/6^{\text{th}}$ of the work is completed. Hence, 2400 men weeks will be the total amount of work. However, due to the rain half the work gets washed off. This means that 1000 man weeks worth of work must have got washed off. This leaves 1400 men weeks of work to be completed by the 140 men. They will take 10 more weeks and hence the total time required is 24 weeks.

15. Total distances covered under each mode = 32, 4 and 12 km respectively.

Total charges = $32 \times 24 + 4 \times 3 + 12 \times 12 = 924$ paise
= ₹ 9.24.

16. The no. of coins of 1 Re = $3x$ and 25p = x .

Conventionally, we can solve this using equations as follows.

$$A + B + C = 220 \quad (1)$$

$$A = 3C \quad (2)$$

$$A + 0.5B + 0.25C = 160 \quad (3)$$

We have a situation with 3 equations and 3 unknowns. and we can solve for

A (no. of 1 Re coins),

B (no. of 50 paise coins)

and C (no. of 25 paise coins)

However, a much smarter approach would be to go through the options. If we check option (a) – no. of 50 paise coins = 60 we would get the number of 1 Re coins as 120 and the number of 25 paise coins as 40.

$$120 \times 1 + 60 \times 0.5 + 40 \times 0.25 = 160$$

This fits the conditions perfectly and is hence the correct answer.

17–19. In order to solve this question, if you try going through equation and expressions, it would lead you in to a very long drawn solution.

$$\text{Thus: } 12/2x + 24/6x + 5/x = n/60$$

$$\text{and } 12/3y + 24/8y + 5/y = n + 20/60$$

We also know that $3y = 2x$.

In order to handle this expression, you can try substituting the values of the speeds. Also, we know that his running speed (initially) is twice his swimming speed.

Question 17 is asking us his swimming speed, while 19 is asking us his running speed. So the answer of the two questions should be in the ratio 1 : 2.

However, a scrutiny of the options shows us that none of the 4 options (values) in question 17 have a value which is half the values provided for in 19. (you would need to check for this after converting the values into kmph).

So, we can start by checking individual options from question 19.

Amongst the 4 values (9, 18, 54, and 12) 12 kmph is the easiest to check.

Checking for it we have:

$$\text{Scenario 1: } 12/12 + 24/36 + 5/6 = 1 + 1 \text{ hr} + 40 \text{ mins} \\ + 50 \text{ mins} = 2 \text{ hr } 30 \text{ minutes.}$$

$$\text{Scenario 2: } 12/12 + 24/32 + 5/4 = 1 \text{ hr} + 45 \text{ minutes} \\ + 1 \text{ hr } 15 \text{ minutes} = 3 \text{ hrs.}$$

This doesn't match the condition of 20 minutes extra.

If you check for 18 kmph, you will get all values fitting in perfectly.
Scenario 1 would give you 1 hr 40 minutes and Scenario 2 would give you 2 hours.

Answers are: 17. d

18. b

19. b

20. $(20 + 60 + 30x)/(2 + 3 + x) = 23 \Rightarrow 80 + 30x = 115 + 23x \Rightarrow x = 5.$

21. Assume raw materials cost as 150 and total cost as 450. (Thus, wages cost is 300)

Since, the cost of raw materials goes up in the ratio of 3:7 the new raw material cost would become 350 and the new wages cost would become in the ratio 4:9 as 675.

The new cost would become, 1025.

Since 450 become 1025 (change in total cost), unitary method calculation would give us that 18 would become ₹ 41.

22. Solve using options. For option (c), we will get that initially there are 125 boys and 140 girls. After the given increases, the number of boys would be 145 and the number of girls would become 154 which gives a difference of 9 as required.

23. From the question, it is evident that after leaving out the C courses, Sonali's GPA goes to 3.33. This means that the number of subjects she must have had after leaving out the C's must be a multiple of 3. This only occurs in Option c. Hence, that is the answer.

24. When there are 25 boarders, the total expenses are \$1750. When there are 50 boarders, the total expenses are \$ 3000. The change in expense due to the coming in of 25 boarders is \$ 1250. Hence, expense per boarder is equal to \$50. This also means that when there are 25 boarders, the variable cost would be $25 \times 50 = \$1250$. Hence, \$500 must be the fixed expenses.

So for 100 boarders, the total cost would be: \$ 500 (fixed) + \$ 5000 = \$5500

25. $S = 42 - k \div n$

$24 = 42 - k \times 3 \Rightarrow k = 6$

$$\text{So, } S = 42 - 6 \div n$$

For 49 compartments the train would not move. Hence it would move for 48 compartments.

26-28:

Let the third drunkard get in x litres. Then the second will contribute $x + 1$ and the first will contribute $x + 2$ litres. Thus in all they have $3x + 3$ litres of the drink. Using option a in question 27, this value is 12, giving x as 3.

Also, each drunkard will drink 3 litres.

Thus, the first drunkard brings 5 litres and the second 4 litres. Their contribution to the fourth drunkard will be in the ratio 2:1 and hence their share of money would be also in the ratio 2:1. Hence, this option is correct for question 27.

Hence, for question 26, the second drunkard will get 5 roubles (for his contribution of 1 litre to the fourth) and for question 28, the answer would be 1:3

$$29. \quad 5 : 4 \text{ } \mathcal{A} \text{ } 5 : 4.8 \text{ } \mathcal{A} \text{ } 25 : 24.$$

Option (c) is correct.

$$30. \quad P = K \times W^2 \text{ } \mathcal{A} \text{ } 12250 = K \times 35^2 \text{ } \mathcal{A} \text{ } K = 10.$$

Thus our price and weight relationship is: $P = 10W^2$.

When the two pieces are in the ratio 2:5 (weight wise) then we know that their weights must be 10 grams and 25 grams respectively. Their values would be:

$$10 \text{ gram piece: } 10 \times 10^2 = \text{t` } 1000;$$

$$25 \text{ gram piece: } 10 \times 25^2 = \text{t` } 6250.$$

Total Price = $1000 + 62450 = 7250$. From an initial value of 12250, this represents a loss of t` 5000.

31. The ratio of distribution should be:

$$21 \times 35 : 15 \times 35 : 15 \times 21 \text{ } \mathcal{A} \text{ } 147 : 105:63 \text{ } \mathcal{A} \text{ } 7:5:3$$

The biggest share will be worth: $7 \times 525000/15 = 245000$.

$$32. \quad P + M + T = 675 \text{ } \mathcal{A} \text{ } 3M + M + 3M - 25 = 675 \text{ } \mathcal{A} \text{ } 7M = 700. \text{ Hence, } M = 100. P = 300 \text{ and } T = 275.$$

33. Ratio of distribution = 20 : 13 : 8
So the elephant should get $(20/41) \times 820 = 400$.
34. Women : Men = 3 : 4
Men : Children = 3 : 5
Æ Women : Men : children = 9 : 12 : 20
In the ratio, 9 Æ 531 Women
Thus, 20 Æ 1180 children.
35. $2/3$ becomes $7/8$ a change from 0.666 to 0.875 while the other changes are smaller than this. For instance $4/7$ becomes $9/12$ a change from 0.5714 to 0.75 which is smaller than the change in $2/3$. Similarly the other options can be checked and rejected.
36. Since, the work gets done in 25% less time there must have been an addition of 33.33% men.
This would mean 13.33 men extra Æ which would mean 14 extra men (in whole nos.)
37. From the given options, we just need to look for a multiple of 7. 2100 is the only option which is a multiple of 7 and is hence the correct answer.
38. This is a simple question if you can catch hold of the logic of the question. i.e. the younger daughter's share must be such after adding a CI of 20% for two years, she should get the same value as her elder sister.
None of the options meets this requirement. Hence, None of these is correct.
- 39-41. You should realise that when Anshu gives her pens to Bobby & Chandana, the number of pens for both Bobby & Chandana should double. Also, the number of pens for Anshu & Bobby should also double when Chandana gives off her pens. Further the final condition is that each of them has 24 pens. The following table will emerge on the basis of this logic.

	<i>Anshu</i>	<i>Bobby</i>	<i>Chandana</i>
Final	24	24	24

Second round	12	12	48
Initial	42	6	24

42. $V = kAH \Rightarrow 280 = k \times 60 \times 14 \Rightarrow 280 = 840k$. Thus, $k = 1/3$ and the equation becomes:

$$V = AH/3 \text{ and } 390 = 26A/3 \Rightarrow A = 45.$$

43. Expenses for 120 boys = 8400
Expenses for 150 boys = 10000.

Thus, variable expenses are ₹ 1600 for 30 boys.

If we add 180 more boys to make it 330 boys, we will get an additional expense of $1600 \times 6 = ₹ 9600$.

Total expenses are ₹ 19600.

44. Let the distance be d . Then, $d/14.4 = \sqrt{8}/\sqrt{18} \Rightarrow d = 9.6$

45. 47 : 100 : 220 would give: 0.5 cubic feet of Cement, 1 cubic feet of sand and 2 cubic feet of gravel. Required ratio 1 : 2 : 4 is satisfied.

Level of Difficulty (III)

1. You can use alligation between 33.33% and 40% to get 37.5%. Hence the ratio of mixing must be 2.5:4.16 \Rightarrow 3:5

6. Check each of the options as follows:

Suppose you are checking option b which gives the value of a as 81 litres.

Then, it is clear that when you are pouring out 81 litres, you are leaving $8/9$ of the honey in the barrel.

Thus the amount of honey contained after 6 such operations will be given by:

$729 \times (8/9)^6$. If this answer has to be correct this value must be equal to 64 (which it clearly is not since the value will be in the form of a fraction.)

Hence, this is not the correct option. You can similarly rule out the other options.

7. It is clear that if 7 kg of the first is mixed with 21 kg of the second you will get $5 + 9 = 14$ kg of nickel and 14 kg of tin. You do not

need to check the other options since they will go into fractions.

10. The piece that is cut off should be such that the fraction of the first to the second alloy in each of the two new alloys formed should be equal.

If you cut off 4 kg, the respective ratios will be:

First alloy: 2 kg of first alloy and 4 kg of second alloy

Second alloy: 4 kg of first alloy and 8 kg of the second alloy. It can easily be seen that the ratios are equal to 1:2 in each case.

13. This is again the typical alligation situation.

The required ratio will be given by $(7/18 - 3/8) : (2/5 - 7/18)$

Alternately, you can also look at it through options. It can be easily seen that if you take 8 kg of the first with 10 kg of the second you will get the required 7:11 ratio.

17. The cost of making one gram of gun powder would be ₹ 180. This will contain 0.4 gm of saltpetre and 0.6 gm of nitrous oxide. Check through options.

At the rate of saltpetre of 300/gm, the nitrous oxide will cost ₹ 100/gm. The total cost of 0.4 grams of saltpetre will be 120 and 0.6 grams of nitrous oxide will be ₹ 60 giving the total cost as 180.

20. There will be a total of 4.5 litres of milk (25% of 3 + 75% of 5) giving a total of 4.5. Hence, 45%.

23. Go through the options as follows:

According to option d, if the initial quantity of spirit is 4 litres, half the spirit is taken out when 2 litres are drawn out. Thus the spirit after three times of the operation would be:

$4 \times (1/2)^2 = 0.5$ litres. This matches the option. You can check for yourself that the first three options will not work.

9 Chapter

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 $\frac{1}{a}$ of the work.

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

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

$$+ \frac{1}{b}.$$

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

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.

$$\text{One day's work} = 1/10 + 1/12 = (12 + 10)/120$$

[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 $\propto \frac{100}{a}$ % of the work.

If B does a work in b days, then in one day B does $\propto \frac{100}{b}$ % 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 $\frac{7}{9}$ 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, $18.33 \times 5 = 91.66$ 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 (Æ means 10% work) and B can do the same work in 12 days (Æ 8.33% work Æ 18.33% work in a day in 5 days 91.66% work Æ leaves 8.33% work to be done Æ which can be done in $8.33/18.33$

of a day = $\frac{5}{11}$ 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 o Time and Work

The equation that applies to Time and Work problems is

Work Rate \times Time = Work done

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

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 \times 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 \times Time = Work done (or work to be done)

Thus, if the work to be done is doubled, the product of *work rate* \times *time* also has to be doubled. Similarly, if the work to be done increases by 20%, the product of *work rate* \times *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 contractor 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 $\propto 50 \times 50 = 2500$ 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% = $2500 \times 1.5 = 3750$ 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 meters, 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 meters, 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 $(200 \times 10 \times 20)/(400 \times 10 \times 15) = (20 \times 8 \times 10)/(25 \times 12 \times d_2)$

$d_2 = 5.333/0.6666 = 8$ 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.

$$d_2 = 10 \times \dots$$

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 \propto hence, multiply by $10/10$ (no change in d_2)

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

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

Number of hours per day is increasing \propto 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 $1/3$ rd 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 $= 8 \times 12 = 96$ man-days.

or total work to be done $= 20 \times 10 = 200$ woman-days.

Since, the work is the same, we can equate $96 \text{ man-days} = 200 \text{ woman-days}$.

Hence, $1 \text{ man-day} = 2.08333 \text{ woman-days}$.

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

12 men are equal to $12 \times 2.08333 = 25$ women

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

That is, 40 women working per day.

Hence, $40 \times \text{no. of days} = 200 \text{ woman days}$

Number of days = 5 days.

OceanofPDF.com



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 $\frac{1}{10}$ and 1 day's work for B is $\frac{1}{12}$.

Then, working together, the work in one day is equal to:

$$\frac{1}{10} + \frac{1}{12} = \frac{11}{60} \text{ of the work. Thus working together they need } 60/11$$

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 = $100/18.33 \approx 5.55$ days.

This can be calculated as

@ 18.33% per day in 5 days, they will cover $18.33 \times 5 = 91.66\%$.
(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:

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

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

$$A's \text{ work} + B's \text{ work} - C's \text{ work} = 10\% + 8.33\% - 5\% = 13.33\%$$

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 = $50 \times 25 = 1250$ man-days
Æ 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 Æ 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.

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) \times 50 (men) \times 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) \times 50 (men) \times z (work units per man-day) = 1875 \therefore
 $z = 1.5$

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: $30A + 30B = 100\%$ work

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

Since, $A = 2B \therefore$ we have $A = 2.22\%$ $\therefore A$ 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 $\therefore 90$ 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 $\frac{1}{2}$ of the work in 8 days while Kalu can do $\frac{1}{3}$ 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 $\frac{19}{23}$ of the work and Vijay and Sanjay together $\frac{8}{23}$ 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 which *A* and *B* will fill the cistern separately will be respectively?

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

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

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 $\frac{1}{3}$ rd 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 $\frac{6}{7}$ th 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 $\frac{3}{8}$ of the tank in 3 minutes. A third set of 8 pipes (set Z) can empty $\frac{5}{10}$ 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 diameter and fills the tank at 5 gallons/min. The outlet of the tank is twice the diameter 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 diameter*)

- (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 liters/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 $\frac{2}{3}$ of a certain job in 6 days. B can complete $\frac{1}{3}$ of the same job in 8 days and C can complete $\frac{3}{4}$ 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 $\frac{37}{100}$ 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 $\frac{1}{5}$ 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) $\frac{1}{4}[2(x+y) - \sqrt{(2x^2 + 4y^2)}]$
(b) $\frac{1}{4}[2(x-y) - \sqrt{(2x^2 + 4y^2)}]$
(c) Either a or b
(d) $\frac{1}{4}[2(x-y) - \sqrt{(2x^2 - 4y^2)}]$

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) $40 \text{ m}^3/\text{min}$ (b) $50 \text{ m}^3/\text{min}$
- (c) $60 \text{ m}^3/\text{min}$ (d) $80 \text{ m}^3/\text{min}$

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 $\frac{1}{3}$ of the tank by itself. It was then found that the tank was $\frac{5}{6}$ 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 inlets to fill up the dam?

(a) 8 min

(b) 10 min

(c) 12 min

(d) None of these

OceanofPDF.com

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:

	<i>Expert man-days required</i>	<i>Non-expert man-days required</i>
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 sepoy's
 - (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 sepoy's
 - (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:

<i>Gas discharge@</i>	<i>Loss of heat</i>
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) | | |

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) | | |

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 (II)

2. They drill at planned rate for 3 days (say x)
 $3x + 5(x + 8) = 280$
5. Work left = $\frac{1}{7}$ th of original work. A would have done it in $\frac{z}{3}$ hours.
- 6–10.** First set of ten pipes operate at 10%/min (filling) i.e. Filling done by 1 pipe = 1%/minute
Second set of five pipes operate at 12.5%/minute (filling)
i.e. Filling done by 1 pipe = 2.5%/minute
Set Z (Emptying) = 5%/minute.
Emptying per pipe = 0.625%/minute.
11. $8A = 12B = 15D$.
13. Since (rate of filling or emptying) \propto diameter, the emptying rate is 10 gallons/minute.
14. The net flow in the original situation is 5 litres/minutes. The required answer will be such that when it is doubled, the increase in emptying rate (in litres/minute) should be more than 5 litres/minute.
15. Required answer = $\frac{\text{work left after 3 days}}{Y\text{'s work rate}}$.
17. Ditch dug per day = $\frac{324}{6} = 54$ metres

$$x + (x + y) + (x + 2y) = 54$$

$$10(x + 2y) = 14x$$

Use options to solve.

18. Work done on the first three days is 37%. Hence, work done on the next 7 days is 63%.

Since, this is $A + B$'s work we get

One day's work of $(A + B) = 9\%$

Also, $5A = 4B$.

Hence $A = 4\%$ and $B = 5\%$

B , turns out to be the fastest worker.

19. Solve through options.
 20. Work done by the first typist in 2 minutes = 20%.
 Hence, the first typist's work rate = 10% per minute.
 22. Solve through options.
 23. Solve through options.
 24. Let x hours be required to complete the work together.

Then, $\frac{1}{(x + 4.5)} + \frac{1}{(x + 8)} = \frac{1}{x}$. Check the options to see which one fits the equation.

$$27. A + B = \frac{50\%}{1.2} = 41.66\%$$

(where A and B represent the work per hour of pipes A and B respectively).

Solve using options to see which one fits the remaining conditions of the problem.

For example, if we check option b (4 hrs), then we get that the work of the faster pipe (say A) = 25%. Then $B = 16.66\%$.

Then B was open for $4/2 = 2$ hours and A was open for $6/3 = 2$ hours.

$$\text{Work done} = 25\% \times 2 + 16.66\% \times 2 = 83.33\% = \frac{5}{6} \text{ of work.}$$

Hence, this option is correct.

28. Let the discharges per pipe be A and B litres/hr.

$$\text{Then } 17(A + B) = 425$$

$$\text{i.e. } A + B = 25$$

From this point of the solution, proceed to check the conditions of the question through options.

29. Difference in times required by the first man (A) and the second man (B) = 3 hours. Also, if t_A and t_B are the respective times, then

$$2t_B - t_A = 8 \text{ and } t_B - t_A = 3$$

30. Let the work/minute of the four pipes be A , B , C and D respectively.

$$\text{Then, } D - A = 1.66\% \text{ and } D + A = 5\%$$

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

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

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

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

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

[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 $\text{A} \ 11.66 \times 8 = 93.33\%$
This will leave 6.66% of the work. This will correspond to $\frac{4}{7}$ of the ninth day since in $\frac{6.66}{11.66}$ 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 $A = 1.66\% \text{ A} \ 60 \text{ days.}$
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 $\text{A} \ 30$
7. $24 \text{ man days} + 18 \text{ women days} = 20 \text{ man days} + 28 \text{ woman days}$
 $\text{A} \ 4 \text{ man days} = 10 \text{ woman days.}$
 $\text{A} \ 1 \text{ man day} = 2.5 \text{ woman days}$
Total work = $24 \text{ man days} + 18 \text{ woman days} = 60 \text{ woman days} + 18 \text{ woman days} = 78 \text{ woman days.}$
Hence, $1 \text{ man} + 1 \text{ woman} = 3.5 \text{ women}$ can do it in $78/3.5 = 156/7 = 22(2/7) \text{ days.}$
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 $100/12.5 = 8 \text{ days.}$

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.

$$(1/16 + 1/18) \times n = 1$$

$$\therefore n = 288/34 = 144/17$$

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

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

20. After 100 days and 4500 mandays, only $1/6^{\text{th}}$ 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 $200 \times \text{no. of men}$ should correspond to five times times the original product.

$$\begin{array}{ccccc} & \text{TIME} & & & \\ 100 & \xrightarrow[+100]{100\% \text{ increase}} & 200 & \xrightarrow[+300 \text{ required}]{?} & 500 \end{array}$$

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:

$$(1/12 + 1/8)t = 1 \therefore t = 24/5 = 4.8 \text{ days}$$

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. $40n = 30(n + 5) \therefore n = 15$

24. $12 \times 5 \text{ man days} + 16 \times 5 \text{ Boy days}$
 $= 13 \times 4 \text{ man days} + 24 \times 4 \text{ Boy days}$
 $\therefore 8 \text{ man days} = 16 \text{ Boy days}$
 $1 \text{ man day} = 2 \text{ Boy days}.$

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 = $15 \times 210 = 3150$ mandays.
 After 100 days, work done = $15 \times 100 = 1500$ 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)
 $A + V = 19/23$
 $V + S = 8/23$
 $\therefore A + 2V + S = 27/23$ (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 = $4 \times 200 = 800$ 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 $A = 2B$ \therefore 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 $A = 10\%$ $\therefore V = 6.66\%$. 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. $24 \times 8 \times 10 = N \times 10 \times 6$ $\therefore N = 32$

40. $n \times 20 = (n - 12) \times 32$ $\therefore n = 32$.

41. $12 \times 18 = 12 \times 6 + 16 \times t$ $\therefore t = 9$

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) \therefore A's work = 6.66%

B (10 days) \therefore B's work = 10%

C (6 days) \therefore 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 $17.5 \times 5 = 87.5\%$. On the sixteenth day, work done = 10% \therefore 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:

$36(2C + C) = 1 \therefore 108C = 1$

$C = 1/108$

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.

Level of Difficulty (II)

1. $25(n - 12) = 21n + 300$. Solving this equation, $n = 150$. Hence, the first division harvest 3150 tons.
2. Let n be the number of meters planned per day. Start from the options to find the number of planned days. In the options the 2 feasible values are 30 meters and 27 meters (as these divide 270). Suppose we check for 30 meters 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 meters 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 $6/7^{\text{th}}$ of the work in $2z$ hours .

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

Thus, to do $1/7^{\text{th}}$ 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:
 $10 + 12.5 - 5 = 17.5\% \Rightarrow$ 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 $\therefore n \times (1/14 + 1/16) = 1$

$\therefore n = 112/15 = 7$ hrs 28 minutes.

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

Thus, $8(1/14 + 1/16) - 8 \times (1/L) = 1 \therefore 8/L$

$= 8(15/112) - 1$

$1/L = 15/112 - 1/8$

$= 1/112.$

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. $X \therefore 12$ days $\therefore 8.33\%$ of the work per day.

Y \approx 18 days \approx 5.55% of the work per day

Z \approx 10 days \approx 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 4 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 meters. 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, 21 meters for the first, second and third diggers respectively. Hence, (a) is the correct answer.

18. The equations are:

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

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

(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% ($= 3 \times 9\%$) 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 \times (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 $3 \times 3.66 = 10$ 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 \times (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 $3 \times 5 = 15$ 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 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) & (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 $425/17 = 25$ liters 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 Æ 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 liters per minute the second pipe would need to deliver 4 liters per minute).

Thus, if the delivery of the first pipe is $3n$ liters per minute, the delivery of the second pipe would be $4n$ liters 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 Æ 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 liter per minute the second pipe would need to deliver 3 liters per minute).

Thus, if the delivery of the first pipe is $2n$ liters per minute, the delivery of the second pipe would be $3n$ liters 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 25%.

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 .

$$A + B + C = 8.33\%$$

$$B + C + D = 6.66\%$$

$$A + D = 5\%$$

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

$$\text{and } A + B + C + D = 10\%$$

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

OceanofPDF.com

10

Chapter

Time, Speed and Distance

INTRODUCTION

The concepts underlying the chapter of Time, Speed and Distance (TSD) are amongst the most important for the purpose of the Maths section in aptitude exams. The basic concepts of TSD are used in solving questions based on motion in a straight line, relative motion, circular motion, problems based on trains, problem based on boats, clocks, races, etc. Besides, these concepts can also be used for the creation of new types of problems. Your ability to solve these problems will depend only on the depth of your understanding.

Due to this diversity in the possibilities for question setting, this chapter is very important for CAT aspirants. Besides, all other exams based on Aptitude (CMAT, XLRI, FMS, IIFT, Bank PO) also require the use of TSD. This chapter is one of the most important chapters in the entire portion of quantitative aptitude. The students are therefore advised to closely understand the concepts contained in this chapter to be comfortable with the problems related to this topic in the examination.

THEORY OF TSD

Concept of Motion and Mathematical Representation of Motion

Motion/movement occurs when a body of any shape or size changes its position with respect to any external stationary point. Thus, when a person travels from city A to city B, we say that he has moved from city A to city B. In general, whenever a body moves with respect to a stationary point, we say that the body has undergone a displacement/motion with respect to the starting point. Thus, for motion to have occurred, there must have been some displacement with respect to a stationary point on the ground.

The mathematical model that describes motion has three variables, namely: Speed, Time and Distance. The interrelationship between these three is also the most important formula for this chapter, namely:

$\text{Speed} \times \text{Time} = \text{Distance}$ (Equation for the description of one motion of one body)

The above equation is the mathematical description of the movement of a body. In complex problems, students tend to get confused regarding the usage of this equation and often end up mixing up the speed, time and distance of different motions of different bodies.

It must be mentioned here that this formula is the cornerstone of the chapter Time, Speed and Distance.

Besides, this formula is also the source of the various formulae applied to the problems on the applications of time, speed and distance—to trains, boats and streams, clocks and races, circular motion and straight line motion.

In the equation above, *speed* can be defined as the rate at which distance is covered during the motion. It is measured in terms of *distance* per unit time and may have any combination of units of distance and time in the numerator and the denominator respectively. (m/s, km/hour, m/min, km/min, km/day, etc.)

When we say that the speed of a body is S kmph, we mean to say that the body moves with S kmph towards or away from a stationary point (as the case may be).

Time (t) is the time duration over which the movement/motion occurs/has occurred. The unit used for measuring time is synchronous with the denominator of the unit used for measuring speed. Thus, if the speed is measured in terms of km/h then time is measured in hours.

Distance (d) is the displacement of the body during the motion.

The above equation, as is self-evident, is such that the interrelationship between the three parameters defines the value of the third parameter if two of the three are known. Hence we can safely say that if we know two of the three variables describing the motion, then the motion is fully described and every aspect of it is known.

The Proportionalities Implicit in the Equation $S \times T = D$

The above equation has three implicit proportionality dimensions each of which has its own critical bearing on the solving of time, speed and distance problems.

1. Direct proportionality between time and distance (when the speed is constant) time \propto distance

Illustration

A car moves for 2 hours at a speed of 25 kmph and another car moves for 3 hours at the same speed. Find the ratio of distances covered by the two cars.

Solution: Since, the speed is constant, we can directly conclude that time \propto distance.

$$\text{Hence } \frac{t_A}{t_B} = \frac{d_A}{d_B}$$

Since, the times of travel are 2 and 3 hours respectively, the ratio of distances covered is also 2/3.

Note: This can be verified by looking at the actual distances travelled—being 50 km and 75 km in this case.

2. Direct Proportionality between speed and distance (when the time is constant) speed \propto distance

(a) A body travels at S_1 kmph for the first 2 hours and then travels at S_2 kmph for the next two hours. Here two motions of one

body are being described and between these two motions the time is constant hence speed will be proportional to the distance travelled.

- (b) *Two cars start simultaneously from A and B respectively towards each other with speeds of S_1 kmph and S_2 kmph. They meet at a point C....* Here again, the speed is directly proportional to the distance since two motions are described where the time of both the motions is the same, that is, it is evident here that the first and the second car travel for the same time.

In such a case the following ratios will be valid:

$$S_1/S_2 = d_1/d_2$$

Illustrations

- (i) A car travels at 30 km/h for the first 2 hours of a journey and then travels at 40 km/h for the next 2 hours of the journey. Find the ratio of the distances travelled at the two speeds.

Solution: Since time is constant between the two motions described, we can use the proportionality between speed and distance.

$$\text{Hence, } d_1/d_2 = s_1/s_2 = 3/4$$

Alternatively, you can also think in terms of percentage as d_2 will be 33.33% higher than d_1 since S_2 is 33.33% higher than S_1 and time is constant.

- (ii) Two cars leave simultaneously from points A and B on a straight line towards each other. The distance between A and B is 100 km. They meet at a point 40 km from A. Find the ratio of their speeds.

Solution: Since time is the same for both the motions described, we have ratio of speed = ratio of distance.

$$S_A/S_B = 40/60 = 2/3$$

- (iii) Two cars move simultaneously from points A and B towards each other. The speeds of the two cars are 20 m/s and 25 m/s respectively.

Find the meeting point if $d(AB) = 900$ km.

Solution: For the bodies to meet, the time of travel is constant (since the two cars have moved simultaneously).

Hence, speed ratio = distance ratio

$\therefore 4/5 = \text{distance ratio}$

Hence, the meeting point will be 400 km from A and 500 km from B.

3. Inverse proportionality between speed and time (when the distance is constant) Speed $\propto 1/\text{time}$

(a) A body travels at S_1 kmph for the first half of the journey and then travels at S_2 kmph for the second half of the journey. Here two motions of one body are being described and between these two motions the distance travelled is constant. Hence the speed will be inversely proportional to the time travelled for.

(b) Two cars start simultaneously from A and B respectively towards each other. They meet at a point C and reach their respective destinations B and A in t_1 and t_2 hours respectively... Here again, the speed is inversely proportional to the time since two motions are described where the distance of both the motions is the same, that is, it is evident here that the first and the second car travel for the distance, viz., AB.

In such a case, the following ratio will be valid:

$$S_1/S_2 = t_2/t_1 \text{ i.e. } S_1 t_1 = S_2 t_2 = S_3 t_3 = K$$

Illustrations

- (i) A train meets with an accident and moves at $3/4$ its original speed. Due to this, it is 20 minutes late. Find the original time for the journey beyond the point of accident.

Solution: Speed becomes $3/4$ (Time becomes $4/3$)

Extra time = $1/3$ of normal time = 20 minutes

Normal time = 60 minutes

Alternatively, from the table on product constancy in the chapter of percentages, we get that a 25% reduction in speed leads to a 33.33% increase in time.

But, 33.33% increase in time is equal to 20 minutes increase in time.

Hence, total time (original) = 60 minutes.

- (ii) A body travels half the journey at 20 kmph and the other half at 30 kmph. Find the average speed.

Solution: The short-cut process is elucidated in the chapter on ‘averages’. Answer = 24 kmph.

- (iii) A man travels from his house to his office at 5 km/h and reaches his office 20 minutes late. If his speed had been 7.5 km/h, he would have reached his office 12 minutes early. Find the distance from his house to his office.

Solution: Notice that here the distance is constant. Hence, speed is inversely proportional to time.

Solving mathematically

$$S_1/S_2 = t_2/(t_2 + 32)$$

$$5/7.5 = t_2/(t_2 + 32)$$

$$5t_2 + 160 = 7.5 t_2$$

$$t_2 = 160/2.5 = 64 \text{ minutes}$$

Hence, the distance is given by $7.5 \times 64/60 = 8 \text{ km}$.

Alternatively, using the Product Constancy Table from the chapter of percentages. If speed increases by 50%, then time will decrease by 33.33%.

But the decrease is equal to 32 minutes.

Hence, original time = 96 minutes and new time is 64 minutes.

Hence, the required distance = $5 \times 96/60 \text{ km} = 8 \text{ km}$.

or distance = $7.5 \times 64/60 \text{ km} = 8 \text{ km}$

[**Note:** The entire process can be worked out mentally while reading the problem.]

CONVERSION BETWEEN kmph to m/s

$$1 \text{ km/h} = 1000 \text{ m/h} = 1000/3600 \text{ m/s} = 5/18 \text{ m/s}.$$

Hence, to convert y km/h into m/s multiply by $5/18$.

$$\text{Thus, } y \text{ km/h} = \frac{5y}{18} \text{ m/s}.$$

And vice versa : $y \text{ m/s} = 18 y/5 \text{ km/h}$. To convert from m/s to kmph, multiply by $18/5$.

Relative Speed : Same Direction and Opposite Direction

Normally, when we talk about the movement of a body, we mean the movement of the body with respect to a stationary point. However, there are times when we need to determine the movement and its relationships with respect to a moving point/body. In such instances, we have to take into account the movement of the body/point with respect to which we are trying to determine relative motion.

Relative movement, therefore, can be viewed as the movement of one body relative to another moving body.

The following formulae apply for the relative speed of two **independent** bodies with respect to each other:

Case I: Two bodies are moving in *opposite* directions at speeds S_1 and S_2 respectively.

The relative speed is defined as $S_1 + S_2$

Case II: Two bodies are moving in the *same direction*.

The relative speed is defined as

- (a) $S_1 - S_2$ when S_1 is greater than S_2 .
- (b) $S_2 - S_1$ when S_1 is lesser than S_2 .

In other words, the relative speed can also be defined as the positive value of the difference between the two speeds, that is, $|S_1 - S_2|$.

Motion in a Straight Line

Problems on situations of motion in a straight line are one of the most commonly asked questions in the CAT and other aptitude exams. Hence a proper understanding of the following concepts and their application to problem solving will be extremely important for the student.

Motion in a straight line is governed by the rules of relative speed enumerated above.

A. Two or more bodies starting from the same point and moving in the same direction: Their relative speed is $S_1 - S_2$.

(a) *In the case of the bodies moving to and fro between two points A and B:* The faster body will reach the end first and will meet the second body on its way back. The relative speed $S_1 - S_2$ will apply till the point of reversal of the faster body and after that the two bodies will start to move in the opposite directions at a relative speed of $S_1 + S_2$. The relative speed governing the movement of the two bodies will alternate between $S_1 - S_2$ and $S_1 + S_2$ everytime any one of the bodies reverses directions. However, if both the bodies reverse their direction at the same instant, there will be no change in the relative speed equation.

In this case, the description of the motion of the two bodies between two consecutive meetings will also be governed by the proportionality between speed and distance (since the time of movement between any two meetings will be constant).

Distances covered in this case: For every meeting, the total distance covered by the two bodies will be $2D$ (where D is the distance between the extreme points). However, notice that the value of $2D$ would be applicable only if both the bodies reverse the direction between two meetings. In case only one body has reversed direction, the total distance would need to be calculated on a case-by-case basis. The respective coverage of the distance is in the ratio of the individual speeds.

Thus, for the 9th meeting (if both bodies have reversed direction between every 2 meetings) the total distance covered will be $9 \times 2D = 18D$.

This will be useful for solving problems that require the calculation of a meeting point.

(b) *In the case of the bodies continuing to move in the same direction without coming to an end point and reversing directions:* The faster body will take a lead and will keep increasing the lead and the movement of the two bodies will be governed by the relative speed equation: $S_1 - S_2$.

Here again, if the two bodies start simultaneously, their movement will be governed by the direct proportionality between speed and distance.

B. Moving in the opposite direction: Their relative speed will be initially given by $S_1 + S_2$.

(a) *In the case of the bodies moving to and fro between two points A and B starting from opposite ends of the path:* The two bodies will move towards each other, meet at a point in between A and B, then move apart away from each other. The faster body will reach its extreme point first followed by the slower body reaching its extreme point next. Relative speed will change every time; one of the bodies reverses direction.

The position of the meeting point will be determined by the ratio of the speeds of the bodies (since the 2 movements can be described as having the time constant between them).

Distances covered in the above case: For the first meeting, the total distance covered by the two bodies will be D (the distance between the extreme points). The coverage of the distance is in the ratio of the individual speeds.

Thereafter, as the bodies separate and start coming together, the combined distance to be covered is $2D$. Note that if only one body is reversing direction between two meetings, this would not be the case and you will have to work it out.

Thus, for the 10th meeting (if both bodies have reverse direction between every 2 meetings) the total distance covered will be $D + 9 \times 2D = 19D$.

This will be useful for solving of problems that require the calculation of a meeting point.

Illustrations

- (i) Two bodies A and B start from opposite ends P and Q of a straight road. They meet at a point $0.6D$ from P. Find the point of their fourth meeting.

Solution: Since time is constant, we have ratio of speeds as 3 : 2.

Also, total distance to be covered by the two together for the fourth meeting is $7D$. This distance is divided in a ratio of 3 : 2 and thus we have that A will cover $4.2D$ and B will cover $2.8D$.

The fourth meeting point can then be found out by tracking either A or B 's movement. A , having moved a distance of $4.2D$, will be at a point $0.2D$ from P . This is the required answer.

- (ii) A starts walking from a place at a uniform speed of 2 km/h in a particular direction. After half an hour, B starts from the same place and walks in the same direction as A at a uniform speed and overtakes A after 1 hour 48 minutes. Calculate the speed of B .

Solution: Start solving as you read the question. From the first two sentences you see that A is 1 km ahead of B when B starts moving.

This distance of 1 km is covered by B in $9/5$ hours [1 hour 48 minutes = $1(4/5) = 9/5$ hours].

The equation operational here $(S_B - S_A) \times T = \text{initial distance}$

$$(S_B - 2) \times 9/5 = 1$$

Solving, we get $S_B = 23/9$ km/h.

- (b) *In the case of the bodies continuing to move in the same direction without coming to an end point and reversing directions:* The bodies will meet and following their meeting they will start separating and going away from each other. The relative speed will be given by $S_1 + S_2$ initially while approaching each other and, thereafter, it will be $S_1 + S_2$ while moving away from each other.

Important: The student is advised to take a closer look and get a closer understanding of these concepts by taking a few examples with absolute values of speed, time and distance. Try to visualise how two bodies separate and then come together. Also, clearly understand the three proportionalities in the equation $s \times t = d$, since these are very important tools for problem solving.

Concept of Acceleration

Acceleration is defined as the rate of change of speed.

Acceleration can be positive (speed increases) or negative (speed decreases & also known as deceleration)

The unit of acceleration is speed per unit time (e.g. m/s^2)

For instance, if a body has an initial speed of 5 m/s and a deceleration of 0.1 m/s^2 it will take 50 seconds to come to rest.

Final speed = Initial speed + Acceleration \times Time

Some more examples:

- (i) Water flows into a cylindrical beaker at a constant rate. The base area of the beaker is 24 cm^2 . The water level rises by 10 cm every second. How quickly will the water level rise in a beaker with a base area of 30 cm^2 .

Solution: The flow of water in the beaker is $24 \text{ cm}^2 \times 10 \text{ cm/s} = 240 \text{ cm}^3/\text{s}$.

If the base area is 30 cm^2 then the rate of water level rise will be $240/30 = 8 \text{ cm/s}$.

Note: In case of confusion in such questions the student is advised to use dimensional analysis to understand what to multiply and what to divide.

- (ii) A 2 kilowatt heater can boil a given amount of water in 10 minutes. How long will it take for
- (a) a less powerful heater of 1.2 kilowatts to boil the same amount of water?
 - (b) a less powerful heater of 1.2 kilowatts to boil double the amount of water?

Solution:

- (a) The heating required to boil the amount of water is $2 \times 10 = 20$ kilowatt minutes. At the rate of 1.2 kilowatt, this heat will be generated in $20/1.2$ minutes = 16.66 minutes.
- (b) When the water is doubled, the heating required is also doubled. Hence, heating required = 40 kilowatt minutes. At the rate of 1.2 kilowatt, this heat will be generated in $40/1.2 = 33.33$ minutes.

AN APPLICATION OF ALLIGATION IN TIME, SPEED AND DISTANCE

Consider the following situation:

Suppose a car goes from A to B at an average speed of S_1 and then comes back from B to A at an average speed of S_2 . If you had to find out the average speed of the whole journey, what would you do?

The normal short cut given for this situation gives the average speed as:

$$\frac{2S_1 S_2}{S_1 + S_2}$$

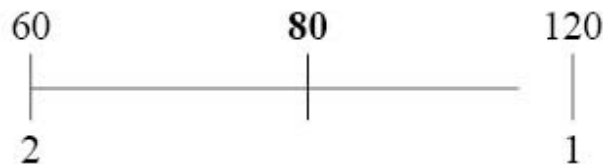
However, this situation can be solved very conveniently using the process of alligation as explained below:

Since, the two speeds are known to us, we will also know their ratio. The ratio of times for the two parts of the journey will then be the inverse ratio of the ratio of speeds. (Since the distance for the two journeys are equal). The answer will be the weighted average of the two speeds (weighted on the basis of the time travelled at each speed)

The process will become clear through an example:

A car travels at 60 km/h from Mumbai to Poona and at 120 km/h from Poona to Mumbai. What is the average speed of the car for the entire journey.

Solution



The process of alligation, will be used here to give the answer as 80. (*Note: For the process of alligation, refer to the chapter of Alligations.*)

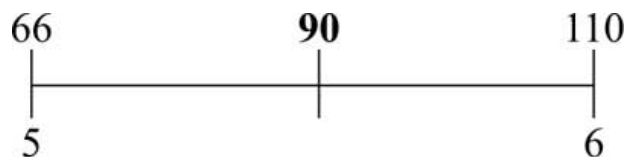
Note here, that since the speed ratio is 1:2, the value of the time ratio used for calculating the weighted average will be 2:1.

What will happen in case the distances are not constant?

For instance, if the car goes 100 km at a speed of 66kmph and 200 km at a speed of 110 kmph, what will be the average speed?

In this case the speed ratio being 6:10 i.e. 3:5 the inverse of the speed ratio will be 5:3. This would have been the ratio to be used for the time ratio in case the distances were the same (for both the speeds). But since the distances are different, we cannot use this ratio in this form. The problem is overcome by multiplying this ratio (5:3) by the distance ratio (in this case it is 1:2) to get a value of 5:6. This is the ratio which has to be applied for the respective weights. Hence, the alligation will look like:

Solution



Thus the required answer is 90 kmph. (The student is advised to check this value through normal mathematical processes.)

APPLICATIONS OF TIME, SPEED AND DISTANCE

Trains

Trains are a special case in questions related to time, speed and distance because they have their own theory and distinct situations.

The basic relation for trains problems is the same: $\text{Speed} \times \text{Time} = \text{Distance}$.

The following things need to be kept in mind before solving questions on trains:

- (a) When the train is crossing a moving object, the speed has to be taken as the **relative speed** of the train with respect to the object. All the rules for relative speed will apply for calculating the relative speed.
- (b) The distance to be covered when crossing an object whenever a train crosses an object will be equal to: **Length of train + Length of object**

Thus, the following cases will yield separate equations, which will govern the crossing of the object by the train:

For each of the following situations the following notations have been used:

S_T = Speed of train S_O = Speed of object t = time

L_T = Length of train L_O = Length of object

Case I: Train crossing a stationary object without length:

$$S_T \times t = L_T$$

Case II: Train crossing a stationary object with length:

$$S_T \times t = (L_T + L_O)$$

Case III: Train crossing a moving object without length:

- In opposite direction: $(S_T + S_O) \times t = L_T$
- In same direction: $(S_T - S_O) \times t = L_T$

Case IV: Train crossing a moving object with length:

- In opposite direction: $(S_T + S_O) \times t = (L_T + L_O)$
- In same direction: $(S_T - S_O) \times t = (L_T + L_O)$

[Note: In order for a train to completely cross a stationary point on the ground, the train has to traverse a distance that is equal to its entire length.

This can be visualised by remembering yourself stationary on a railway platform and being crossed by a train. You would say that the train starts crossing you when the engine of the train comes in line with you. Also, you would say that you have been crossed by the train when the end of the guard's compartment comes in line with you. Thus, the train would have travelled its own length in crossing you].

Illustrations

- (i) A train crosses a pole in 8 seconds. If the length of the train is 200 metres, find the speed of the train.

Solution: In this case, it is evident that the situation is one of the train crossing a stationary object without length. Hence, Case I is applicable here.

Thus, $S_T = 200/8 = 25 \text{ m/s} \text{ } \text{Æ} \text{ } 25 \times \frac{18}{5} = 90 \text{ kmph.}$

- (ii) A train crosses a man travelling in another train in the opposite direction in 8 seconds. However, the train requires 25 seconds to cross the same man if the trains are travelling in the same direction. If the length of the first train is 200 metres and that of the train in which the man is sitting is 160 metres, find the speed of the first train.

Solution: Here, the student should understand that the situation is one of the train crossing a moving object without length. Thus the length of the man's train is useless or redundant data.

Then applying the relevant formulae after considering the directions of the movements we get the equations:

$$S_T + S_M = 25$$

$$S_T - S_M = 8$$

$$S_T = \frac{33}{2} = \frac{33 \times 18}{2 \times 5} = 59.4 \text{ kmph}$$

Boats and Streams

The problems of boats and streams are also dependent on the basic equation of time, speed and distance : $\text{Speed} \times \text{Time} = \text{Distance}$.

However, as in the case of trains the adjustments to be made for solving questions on boats and streams are:

The boat has a speed of its own, which is also called the *speed of the boat in still water* (S_B).

Another variable that is used in boats and streams problems is the *speed of the stream* (S_S).

The speed of the movement of the boat is dependent on whether the boat is moving:

- (a) In still water the speed of movement is given by $\text{Æ} S_B$.

- (b) While *moving upstream* (or against the flow of the water), the speed of movement is given by $S_U = S_B - S_S$
- (c) While *moving downstream* (or with the flow of the water), the speed of movement is given by $S_D = S_B + S_S$

The time of movement and the distance to be covered are to be judged by the content of the problem.

Circular motion: A special case of movement is when two or more bodies are moving around a circular track.

The relative speed of two bodies moving around a circle in the same direction is taken as $S_1 - S_2$.

Also, when two bodies are moving around a circle in the opposite direction, the speed of the two bodies is taken to be $S_1 + S_2$.

The peculiarity inherent in moving around a circle in the same direction is that when the faster body overtakes the slower body it goes ahead of it. And for every unit time that elapses, the faster body keeps increasing the distance by which the slower body is behind the faster body. However, when the distance by which the faster body is in front of the slower body becomes equal to the circumference of the circle around which the two bodies are moving, the faster body again comes in line with the slower body. This event is called as overlapping or lapping of the slower body by the faster body. We say that the slower body has been lapped or overlapped by the faster body.

First meeting: Three or more bodies start moving simultaneously from the same point on the circumference of the circle, in the same direction around the circle. They will first meet again in the LCM of the times that the fastest runner takes in totally overlapping each of the slower runners.

For instance, if A , B , C and D start clockwise from a point X on the circle such that A is the fastest runner then we can define T_{AB} as the time in which A completely overlaps B , T_{AC} as the time in which A completely overlaps C and T_{AD} as the time in which A completely overlaps D . Then the LCM of T_{AB} , T_{AC} and T_{AD} will be the time in which A , B , C and D will be together again for the first time.

First meeting at starting point: Three or more bodies start moving simultaneously from the same point on the circumference of a circle, in the same direction around the circle. Their first meeting at the starting point will occur after a time that is got by the LCM of the times that each of the bodies takes to complete one full round.

For instance, if A , B and C start from a point X on the circle such that T_A , T_B and T_C are the times in which A , B and C respectively cover one complete round around the circle, then they will all meet together at the starting point in the LCM of T_A , T_B and T_C .

Clocks

Problems on clocks are based on the movement of the minute hand and that of the hour hand as well as on the relative movement between the two. In my opinion, it is best to solve problems on clocks by considering a clock to be a circular track having a circumference of 60 km and each kilometre being represented by one minute on the dial of the clock. Then, we can look at the minute hand as a runner running at the speed of 60 kmph while we can also look at the hour hand as a runner running at an average speed of 5 kmph.

Since, the minute hand and the hour hand are both moving in the same direction, the relative speed of the minute hand with respect to the hour hand is 55 kmph, that is, for every hour elapsed, the minute hand goes 55 km (minute) more than the hour hand.

(Beyond this slight adjustment, the problems of clocks require a good understanding of unitary method. This will be well illustrated through the solved example below.)

Important Information

Number of right angles formed by a clock: A clock makes 2 right angles between any 2 hours. Thus, for instance, there are 2 right angles formed between 12 to 1 or between 1 and 2 or between 2 and 3 or between 3 and 4 and so on.

However, contrary to expectations, the clock does not make 48 right angles in a day. This happens because whenever the clock passes between the time period 2–4 or between the time period 8–10 there are not 4 but only 3 right angles.

This happens because the second right angle between 2–3 (or 8–9) and the first right angle between 3–4 (or 9–10) are one and the same, occurring at 3 or 9.

Right angles are formed when the distance between the minute hand and the hour hand is equal to 15 minutes.

Exactly the same situation holds true for the formation of straight lines. There are 2 straight lines in every hour. However, the second straight line between 5–6 (or 11–12) and the first straight line between 6–7 (or 12–1) coincide with each other and are represented by the straight line formed at 6 (or 12).

Straight lines are formed when the distance between the minute hand and the hour hand is equal to either 0 minutes or 30 minutes.

Illustration

At what time between 2–3 p.m. is the first right angle in that time formed by the hands of the clock?

Solution: At 2 p.m. the minute hand can be visualised as being 10 kilometres behind the hour hand. (considering the clock dial to be a race track of circumference 60 km such that each minute represents a kilometre). Also, the first right angle between 2–3 is formed when the minute hand is 15 kilometres ahead of the hour hand.

Thus, the minute hand has to cover 25 kilometres over the hour hand.

This can be written using the unitary method:

Distance covered by the minute hand over the hour hand.

55 kilometres _____ in 1 hour

25 kilometres _____ in what time?

Æ $\frac{5}{11}$ of an hour.

Thus, the first right angle between 2–3 is formed at $\frac{5}{11}$ hours past 2 o'clock.

This can be converted into minutes and seconds using unitary method again as:

1 hour _____ 60 minutes

5/11 hours _____ ? minutes

Æ $300/11$ minutes = 27 (3/11) minutes

1 minute _____ 60 seconds

3/11 minutes _____ ? seconds Æ $180/11$ seconds = 16.3636 seconds.

Hence, the required answer is: **2 : 27 : 16.36 seconds.**

OceanofPDF.com

LEVEL OF DIFFICULTY (I)

1. The Sinhagad Express left Pune at noon sharp. Two hours later, the Deccan Queen started from Pune in the same direction. The Deccan Queen overtook the Sinhagad Express at 8 p.m. Find the average speed of the two trains over this journey if the sum of their average speeds is 70 km/h.
(a) 34.28 km/h (b) 35 km/h
(c) 50 km/h (d) 12 km/h
2. Walking at $\frac{3}{4}$ of his normal speed, Abhishek is 16 minutes late in reaching his office. The usual time taken by him to cover the distance between his home and his office is
(a) 48 minutes (b) 60 minutes
(c) 42 minutes (d) 62 minutes
3. Ram and Bharat travel the same distance at the rate of 6 km per hour and 10 km per hour respectively. If Ram takes 30 minutes longer than Bharat, the distance travelled by each is
(a) 6 km (b) 10 km
(c) 7.5 km (d) 20 km
4. Two trains for Mumbai leave Delhi at 6 : 00 a.m. and 6 : 45 am and travel at 100 kmph and 136 kmph respectively. How many kilometres from Delhi will the two trains be together?
(a) 262.4 km (b) 260 km
(c) 283.33 km (d) 275 km
5. Two trains, Calcutta Mail and Bombay Mail, start at the same time from stations Kolkata and Mumbai respectively towards each other. After passing each other, they take 12 hours and 3 hours to reach Mumbai and Kolkata respectively. If the Calcutta Mail is moving at the speed of 48 km/h, the speed of the Bombay Mail is

- (a) 24 km/h (b) 22 km/h
(c) 21 km/h (d) 96 km/h

6. Shyam's house, his office and his gym are all equidistant from each other. The distance between any 2 of them is 4 km. Shyam starts walking from his gym in a direction parallel to the road connecting his office and his house and stops when he reaches a point directly east of his office. He then reverses direction and walks till he reaches a point directly south of his office. The total distance walked by Shyam is

- (a) 6 km (b) 9 km
(c) 16 km (d) 12 km

7. Lonavala and Khandala are two stations 600 km apart. A train starts from Lonavala and moves towards Khandala at the rate of 25 km/h. After two hours, another train starts from Khandala at the rate of 35 km/h. How far from Lonavala will they will cross each other?

- (a) 250 km (b) 300 km
(c) 279.166 km (d) 475 km

8. Walking at $\frac{3}{4}$ of his normal speed, a man takes $2\frac{1}{2}$ hours more than the normal time. Find the normal time.

- (a) 7.5 h (b) 6 h
(c) 8 h (d) 12 h

9. Alok walks to a viewpoint and returns to the starting point by his car and thus takes a total time of 6 hours 45 minutes. He would have gained 2 hours by driving both ways. How long would it have taken for him to walk both ways?

- (a) 8 h 45 min (b) 7 h 45 min
(c) 5 h 30 min (d) 6 h 45 min

10. Sambhu beats Kalu by 30 metres or 10 seconds. How much time was taken by Sambhu to complete a race 1200 meters.

- (a) 6 min 30 s (b) 3 min 15 s

(c) 12 min 10 s

(d) 2 min 5 s

11. What is the time taken by Chandu to cover a distance of 360 km by a motorcycle moving at a speed of 10 m/s?

(a) 10 h

(b) 5 h

(c) 8 h

(d) 6 h

12. Without stoppage, a train travels a certain distance with an average speed of 60 km/h, and with stoppage, it covers the same distance with an average speed of 40 km/h. On an average, how many minutes per hour does the train stop during the journey?

(a) 20 min/h

(b) 15 min/h

(c) 10 min/h

(d) 10 min/h

13. Rajdhani Express travels 650 km in 5 h and another 940 km in 10 h. What is the average speed of train?

(a) 1590 km/h

(b) 168 km/h

(c) 106 km/h

(d) 126 km/h

14. Rishikant, during his journey, travels for 20 minutes at a speed of 30 km/h, another 30 minutes at a speed of 50 km/h, and 1 hour at a speed of 50 km/h and 1 hour at a speed of 60 km/h. What is the average velocity?

(a) 51.18 km/h

(b) 63 km/h

(c) 39 km/h

(d) 48 km/h

15. A car travels from A to B at V_1 km/h, travels back from B to A at V_2 km/h and again goes back from A to B at V_2 km/h. The average speed of the car is:

(a) $\frac{2V_1 V_2}{V_1 + 2V_2}$

(b) $\frac{2V_1 V_2}{V_2 + 2V_1}$

(c) $\frac{3V_1 V_2}{V_2 + 2V_1}$

(d) $\frac{3V_1 V_2}{V_1 + 2V_2}$

16. Narayan Murthy walking at a speed of 20 km/h reaches his college 10 minutes late. Next time he increases his speed by 5 km/h, but finds that he is still late by 4 minutes. What is the distance of his college from his house?
- (a) 20 km (b) 6 km
(c) 12 km (d) None of these
17. Jayshree goes to office at a speed of 6 km/h and returns to her home at a speed of 4 km/h. If she takes 10 hours in all, what is the distance between her office and her home?
- (a) 24 km (b) 12 km
(c) 10 km (d) 30 km
18. A motor car does a journey in 17.5 hours, covering the first half at 30 km/h and the second half at 40 km/h. Find the distance of the journey.
- (a) 684 km (b) 600 km
(c) 120 km (d) 540 km
19. Sujit covers a distance in 40 minutes if he drives at a speed of 60 kilometer per hour on an average. Find the speed at which he must drive at to reduce the time of the journey by 25%?
- (a) 60 km/h (b) 70 km/h
(c) 75 km/h (d) 80 km/h
20. Manish travels a certain distance by car at the rate of 12 km/h and walks back at the rate of 3 km/h. The whole journey took 5 hours. What is the distance he covered on the car?
- (a) 12 km (b) 30 km
(c) 15 km (d) 6 km
21. A railway passenger counts the telegraph poles on the rail road as he passes them. The telegraph poles are at a distance of 50 metres. What will be his count in 4 hours, if the speed of the train is 45 km per hour?

- (a) 600 (b) 2500
(c) 3600 (d) 5000

22. Two trains *A* and *B* start simultaneously in the opposite direction from two points *A* and *B* and arrive at their destinations 9 and 4 hours respectively after their meeting each other. At what rate does the second train *B* travel if the first train travels at 80 km per hour.

- (a) 60 km/h (b) 100 km/h
(c) 120 km/h (d) 80 km/h

23. Vinay fires two bullets from the same place at an interval of 12 minutes but Raju sitting in a train approaching the place hears the second report 11 minutes 30 seconds after the first. What is the approximate speed of train (if sound travels at the speed of 330 metre per second)?

- (a) 660/23 m/s (b) 220/7 m/s
(c) 330/23 m/s (d) 110/23 m/s

24. A car driver, driving in a fog, passes a pedestrian who was walking at the rate of 2 km/h in the same direction. The pedestrian could see the car for 6 minutes and it was visible to him up to a distance of 0.6 km. What was the speed of the car?

- (a) 30 km/h (b) 15 km/h
(c) 20 km/h (d) 8 km/h

25. Harsh and Vijay move towards Hosur starting from IIM, Bangalore, at a speed of 40 km/h and 60 km/h respectively. If Vijay reaches Hosur 200 minutes earlier than Harsh, what is the distance between IIM, Bangalore, and Hosur?

- (a) 600 km (b) 400 km
(c) 900 km (d) 200 km

26. A journey of 192 km takes 2 hours less by a fast train than by a slow train. If the average speed of the slow train be 16 kmph less than that of fast train, what is the average speed of the faster train?

- (a) 32 kmph (b) 16 kmph
(c) 12 kmph (d) 48 kmph

27. A passenger train takes 2 h less for a journey of 300 kilometres if its speed is increased by 5 kmph over its usual speed. Find the usual speed.

- (a) 10 kmph (b) 12 kmph
(c) 20 kmph (d) 25 kmph

28. If Arun had walked 1 km/h faster, he would have taken 10 minutes less to walk 2 kilometre. What is Arun's speed of walking?

- (a) 1 kmph (b) 2 kmph
(c) 3 kmph (d) 6 kmph

29. A plane left half an hour later than the scheduled time and in order to reach its destination 1500 kilometre away in time, it had to increase its speed by 33.33 per cent over its usual speed. Find its increased speed.

- (a) 250 kmph (b) 500 kmph
(c) 750 kmph (d) 1000 kmph

30. A train moves at a constant speed of 120 km/h for one kilometre and at 40 kmph for the next one kilometre. What is the average speed of the train?

- (a) 48 kmph (b) 50 kmph
(c) 80 kmph (d) 60 kmph

31. A cyclist moving on a circular track of radius 100 metres completes one revolution in 2 minutes. What is the average speed of cyclist (approximately)?

- (a) 314 m/minute (b) 200 m/minute
(c) 300 m/minute (d) 900 m/minute

32. A person travelled a distance of 200 kilometre between two cities by a car covering the first quarter of the journey at a constant speed of 40 km/h and he remaining three quarters at a constant speed of x

km/h. If the average speed of the person for the entire journey was 53.33 km/h what is the value of x ?

- (a) 55 km/h
- (b) 60 km/h
- (c) 70 km/h
- (d) 80 km/h

33. A car travels $\frac{1}{3}$ of the distance on a straight road with a velocity of 10 km/h, the next $\frac{1}{3}$ with a velocity of 20 km/h and the last $\frac{1}{3}$ with a velocity of 60 km/h. What is the average velocity of the car for the whole journey?

- (a) 18 km/h
- (b) 10 km/h
- (c) 20 km/h
- (d) 15 km/h

34. Two cars started simultaneously toward each other from town A and B , that are 480 km apart. It took the first car travelling from A to B 8 hours to cover the distance and the second car travelling from B to A 12 hours. Determine at what distance from A the two cars meet.

- (a) 288 km
- (b) 200 km
- (c) 300 km
- (d) 196 km

35. Walking at $\frac{3}{4}$ of his usual speed, a man is 16 minutes late for his office. The usual time taken by him to cover that distance is

- (a) 48 minutes
- (b) 60 minutes
- (c) 42 minutes
- (d) 62 minutes

36. A and B travel the same distance at the rate of 8 kilometre and 10 kilometre an hour respectively. If A takes 30 minutes longer than B , the distance travelled by B is

- (a) 6 km
- (b) 10 km
- (c) 16 km
- (d) 20 km

37. Two trains for Patna leave Delhi at 6 a.m. and 6:45 a.m. and travel at 98 kmph and 136 kmph respectively. How many kilometres from Delhi will the two trains meet?

- (a) 262.4 km
- (b) 260 km
- (c) 200 km
- (d) None of these

38. Two trains A and B start from station X to Y , Y to X respectively. After passing each other, they take 12 hours and 3 hours to reach Y and X respectively. If train A is moving at the speed of 48 km/h, the speed of train B is
- (a) 24 km/h (b) 96 km/h
(c) 21 km/h (d) 20 km/h
39. X and Y are two stations 600 km apart. A train starts from X and moves towards Y at the rate of 25 km/h. Another train starts from Y at the rate of 35 km/h. How far from X they will cross each other?
- (a) 250 km (b) 300 km
(c) 450 km (d) 475 km
40. A starts from a point that is on the circumference of a circle, moves 600 metre in the North direction and then again moves 800 metre East and reaches a point diametrically opposite the starting point. Find the diameter of the circle?
- (a) 1000 m (b) 500 m
(c) 800 m (d) 900 m
41. Ram and Shyam run a race of 2000 m. First, Ram gives Shyam a start of 200 m and beats him by 30 s. Next, Ram gives Shyam a start of 3 min and is beaten by 1000 metres. Find the time in minutes in which Ram and Shyam can run the race separately.
- (a) 8, 10 (b) 4, 5
(c) 5, 9 (d) 6, 9
42. A motorboat went downstream for 28 km and immediately returned. It took the boat twice as long to make the return trip. If the speed of the river flow were twice as high, the trip downstream and back would take 672 minutes. Find the speed of the boat in still water and the speed of the river flow.
- (a) 9 km/h, 3 km/h (b) 9 km/h, 6 km/h
(c) 8 km/h, 2 km/h (d) 12 km/h, 3 km/h

43. A train requires 7 seconds to pass a pole while it requires 25 seconds to cross a stationary train which is 378 metres long. Find the speed of the train.
- (a) 75.6 km/h (b) 75.4 km/h
(c) 76.2 km/h (d) 21 km/h
44. A boat sails downstream from point A to point B , which is 10 km away from A , and then returns to A . If the actual speed of the boat (in still water) is 3 km/h, the trip from A to B takes 8 hours less than that from B to A . What must the actual speed of the boat for the trip from A to B to take exactly 100 minutes?
- (a) 1 km/h (b) 2 km/h
(c) 3 km/h (d) 4 km/h
45. A boat sails down the river for 10 km and then up the river for 6 km. The speed of the river flow is 1 km/h. What should be the minimum speed of the boat for the trip to take a maximum of 4 hours?
- (a) 2 kmph (b) 3 kmph
(c) 4 kmph (d) 5 kmph
46. A man rows 6 km/h in still water. If the river is running at 3 km per hour, it takes him 45 minutes to row to a place and back. How far is the place?
- (a) 1.12 km (b) 1.25 km
(c) 1.6875 km (d) 2.5 km
47. A boat goes 40 km upstream in 8 h and a distance of 49 km downstream in 7 h. The speed of the boat in still water is
- (a) 5 km/h (b) 5.5 km/h
(c) 6 km/h (d) 6.5 km/h
48. Two trains are running on parallel lines in the same direction at speeds of 40 kmph and 20 kmph respectively. The faster train crosses a man in the second train in 36 seconds. The length of the faster train is

- (a) 200 metres (b) 185 metres
(c) 225 metres (d) 210 metres

49. The speed of the boat in still water is 12 km/h and the speed of the stream is 2 km/h. A distance of 8 km, going upstream, is covered in
(a) 1 h (b) 1 h 15 min
(c) 1 h 12 min (d) None of these
50. A boat goes 15 km upstream in 80 minutes. The speed of the stream is 5 km/h. The speed of the boat in still water is
(a) 16.25 km/h (b) 16 km/h
(c) 15 km/h (d) 17 km/h
51. In a stream, B lies in between A and C such that it is equidistant from both A and C . A boat can go from A to B and back in 6 h 30 minutes while it goes from A to C in 9 h. How long would it take to go from C to A ?
(a) 3.75 h (b) 4 h
(c) 4.25 h (d) 4.5 h
52. Two trains pass each other on parallel lines. Each train is 100 metres long. When they are going in the same direction, the faster one takes 60 seconds to pass the other completely. If they are going in opposite directions they pass each other completely in 10 seconds. Find the speed of the slower train in km/h.
(a) 30 km/h (b) 42 km/h
(c) 48 km/h (d) 60 km/h
53. Vinay runs 100 metres in 20 seconds and Ajay runs the same distance in 25 seconds. By what distance will Vinay beat Ajay in a hundred metre race?
(a) 10 m (b) 20 m
(c) 25 m (d) 12 m
54. In a 100 m race, Shyam runs at 1.66 m/s. If Shyam gives Sujit a start of 4 m and still beats him by 12 seconds, what is Sujit's speed?

- (a) 1.11 m/s (b) 0.75 m/s
(c) 1.33 m/s (d) 1 km/h

55. At a game of billiards, A can give B 15 points in 60 and A can give C 20 in 60. How many points can B give C in a game of 90?

- (a) 11 (b) 13
(c) 10 (d) 14

56. In a 500 m race, the ratio of speed of two runners Vinay and Shyam is 3 : 4. If Vinay has a start of 140 m then Vinay wins by

- (a) 15 m (b) 20 m
(c) 25 m (d) 30 m

57. How many seconds will a caravan 120 metres long running at the rate 10 m/s take to pass a standing boy.

- (a) 10 s (b) 12 s
(c) 11 s (d) 14 s

58. Two trains are travelling in the same direction at 50 km/h and 30 km/h respectively. The faster train crosses a man in the slower train in 18 seconds. Find the length of the faster train.

- (a) 0.1 km (b) 1 km
(c) 1.5 km (d) 1.4 km

59. Two trains for Howrah leave Muzaffarpur at 8:30 a.m. and 9:00 a.m. respectively and travel at 60 km/h and 70 km/h respectively. How many kilometres from Muzaffarpur will the two trains meet?

- (a) 210 km (b) 180 km
(c) 150 km (d) 120 km

60. Without stoppage, a train travels at an average speed of 75 km/h and with stoppages it covers the same distance at an average speed of 60 km/h. How many minutes per hour does the train stop?

- (a) 10 minutes (b) 12 minutes
(c) 14 minutes (d) 18 minutes

61. A boat rows 16 km up the stream and 30 km downstream taking 5 h each time. The velocity of the current
- (a) 1.1 km/h (b) 1.2 km/h
(c) 1.4 km/h (d) 1.5 km/h
62. Vijay can row a certain distance downstream in 6 h and return the same distance in 9 h. If the stream flows at the rate of 3 km/h, find the speed of Vijay in still water.
- (a) 12 km/h (b) 13 km/h
(c) 14 km/h (d) 15 km/h
63. Subbu can row 6 km/h in still water. When the river is running at 1.2 km/h, it takes him 1 hour to row to a place and back. How far in the place?
- (a) 2.88 km (b) 2.00 km
(c) 3.12 km (d) 2.76 km
64. A dog is passed by a train in 8 seconds. Find the length of the train if its speed is 36 kmph.
- (a) 70 m (b) 80 m
(c) 85 m (d) 90 m
65. A lazy man can row upstream at 16 km/h and downstream at 22 km/h. Find the man's rate in still water (in kmph).
- (a) 19 (b) 14
(c) 17 (d) 18
66. A man can row 30 km upstream and 44 km downstream in 10 hours. It is also known that he can row 40 km upstream and 55 km downstream in 13 hours. Find the speed of the man in still water.
- (a) 4 km/h (b) 6 km/h
(c) 8 km/h (d) 12 km/h
67. In a stream that is running at 2 km/h, a man goes 10 km upstream and comes back to the starting point in 55 minutes. Find the speed

of the man in still water.

- (a) 20 km/h
- (b) 22 km/h
- (c) 24 km/h
- (d) 28 km/h

68. A man goes down stream at x km/h and upstream at y km/h. The speed of the boat in still water is

- (a) $0.5(x + y)$
- (b) $0.5(x - y)$
- (c) $x + y$
- (d) $x - y$

69. The length of the minutes hand of a clock is 8 cm. Find the distance travelled by its outer end in 15 minutes.

- (a) $4p$ cm
- (b) $8p$ cm
- (c) $12p$ cm
- (d) $16p$ cm

70. Between 5 a.m. and 5 p.m. of a particular day for how many times are the minute and the hour hands together?

- (a) 11
- (b) 22
- (c) 33
- (d) 44

71. At what time are the hands of clock together between 2 and 3 p.m.?

- (a) $2/11$ hours past 2 p.m.
- (b) $2/9$ hours past 2 p.m.
- (c) 2:10 p.m.
- (d) None of these

72. A motorboat went down the river for 14 km and then up the river for 9 km. It took a total of 5 hours for the entire journey. Find the speed of the river flow if the speed of the boat in still water is 5 km/h.

- (a) 1 kmph
- (b) 1.5 kmph
- (c) 2 kmph
- (d) 3 kmph

73. A motorboat whose speed in still water is 10 km/h went 91 km downstream and then returned to its starting point. Calculate the speed of the river flow if the round trip took a total of 20 hours.

- (a) 3 km/h (b) 4 km/h
(c) 6 km/h (d) 8 km/h

74. In a race of 600 meters, Ajay beats Vijay by 60 metres and in a race of 500 meters Vijay beats Anjay by 25 meters. By how many meters will Ajay beat Anjay in a 400 meter race?

- (a) 48 m (b) 52 m
(c) 56 m (d) 58 m

75. A motorboat whose speed in still water is 15 kmph goes 30 km downstream and comes back in a total 4 hours 30 min. Determine the speed of the stream.

- (a) 2 kmph (b) 3 kmph
(c) 4 kmph (d) 5 kmph

LEVEL OF DIFFICULTY (II)

1. The J&K Express from Delhi to Srinagar was delayed by snowfall for 16 minutes and made up for the delay on a section of 80 km travelling with a speed 10 km per hour higher than its normal speed. Find the original speed of the J&K Express (according to the schedule)
(a) 60 km/h (b) 66.66 km/h
(c) 50 km/h (d) 40 km/h
2. Ayrton Senna had to cover a distance of 60 km. However, he started 6 minutes later than his scheduled time and raced at a speed 1 km/h higher than his originally planned speed and reached the finish at the time he would reach it if he began to race strictly at the appointed time and raced with the assumed speed. Find the speed at which he travelled during the journey described.
(a) 25 km/h (b) 15 km/h
(c) 10 km/h (d) 6 km/h
3. Amitabh covered a distance of 96 km two hours faster than he had planned to. This he achieved by travelling 1 km more every hour than he intended to cover every 1 hour 15 minutes. What was the speed at which Amitabh travelled during the journey?
(a) 16 km/h (b) 26 km/h
(c) 36 km/h (d) 30 km/h
4. An urgent message had to be delivered from the house of the Peshwas in Pune to Shivaji who was camping in Bangalore. A horse rider travels on horse back from Pune to Bangalore at a constant speed. If the horse increased its speed by 6 km/h, it would take the rider 4 hours less to cover that distance. And travelling with a speed 6 km/h lower than the initial speed, it would take him 10 hours more than the time he would have taken had he travelled at a speed 6

kmph higher than the initial speed. Find the distance between Pune and Bangalore.

- (a) 120 km (b) 600 km
(c) 720 km (d) 750 km

5. A pedestrian and a cyclist start simultaneously towards each other from Aurangabad and Paithan which are 40 km apart and meet 2 hours after the start. Then they resumed their trips and the cyclist arrives at Aurangabad 7 hours 30 minutes earlier than the pedestrian arrives at Paithan. Which of these could be the speed of the pedestrian?

- (a) 4 km/h (b) 5 km/h
(c) 3 km/h (d) 6 km/h

6. Two motorists met at 10 a.m. at the Dadar railway station. After their meeting, one of them proceeded in the East direction while the other proceeded in the North direction. Exactly at noon, they were 60 km apart. Find the speed of the slower motorist if the difference of their speeds is 6 km/h.

- (a) 28 km/h (b) 18 km/h
(c) 9 km/h (d) 19 km/h

7. Two cyclists start simultaneously towards each other from Aurangabad and Ellora, which are 28 km apart. An hour later they meet and keep pedalling with the same speed without stopping. The second cyclist arrives at Ellora 35 minutes later than the first arrives at Aurangabad. Find the speed of the cyclist who started from Ellora.

- (a) 12 km/h (b) 16 km/h
(c) 15 km/h (d) 10 km/h

8. Two ants start simultaneously from two ant holes towards each other. The first ant covered 8% of the distance between the two ant holes in 3 hours, the second ant covered $\frac{7}{120}$ of the distance in 2

hours 30 minutes. Find the speed (feet/h) of the second ant if the first ant travelled 800 feet to the meeting point.

- (a) 15 feet/h (b) 25 feet/h
(c) 45 feet/h (d) 35 feet/h

9. A bus left point X for point Y . Two hours later a car left point X for Y and arrived at Y at the same time as the bus. If the car and the bus left simultaneously from the opposite ends X and Y towards each other, they would meet 1.33 hours after the start. How much time did it take the bus to travel from X to Y ?

- (a) 2 h (b) 4 h
(c) 6 h (d) 8 h

10. A racetrack is in the form of a right triangle. The longer of the legs of the track is 2 km more than the shorter of the legs (both these legs being on a highway). The start and end points are also connected to each other through a side road. The escort vehicle for the race took the side road and rode with a speed of 30 km/h and then covered the two intervals along the highway during the same time with a speed of 42 km/h. Find the length of the racetrack.

- (a) 14 km (b) 10 km
(c) 24 km (d) 36 km

11. Two planes move along a circle of circumference 1.2 km with constant speeds. When they move in different directions, they meet every 15 seconds and when they move in the same direction, one plane overtakes the other every 60 seconds. Find the speed of the slower plane.

- (a) 0.04 km/s (b) 0.03 km/s
(c) 0.05 km/s (d) 0.02 km/s

12. Karim, a tourist leaves Ellora on a bicycle. Having travelled for 1.5 h at 16 km/h, he makes a stop for 1.5 h and then pedals on with the same speed. Four hours after Karim started, his friend and local guide Rahim leaves Ellora on a motorcycle and rides with a speed

of 28 km/h in the same direction as Karim had gone. What distance will they cover before Rahim overtakes Karim?

- (a) 88 km (b) 90.33 km
(c) 93.33 km (d) 96.66 km

13. A tourist covered a journey partly by foot and partly by tonga. He walked for 90 km and rode the tonga for 10 km. He spent 4 h less on the tonga than on walking. If the tourist had reversed the times he travelled by foot and on tonga, the distances travelled on each part of the journey would be equal. How long did he ride the tonga?

- (a) He rode for 6 hours (b) He rode for 4 hours
(c) He rode for 2 hours (d) He rode for 5 hours

14. Two Indian tourists in the US cycled towards each other, one from point *A* and the other from point *B*. The first tourist left point *A* 6 hrs later than the second left point *B*, and it turned out on their meeting that he had travelled 12 km less than the second tourist. After their meeting, they kept cycling with the same speed, and the first tourist arrived at *B* 8 hours later and the second arrived at *A* 9 hours later. Find the speed of the faster tourist.

- (a) 4 km/h (b) 6 km/h
(c) 9 km/h (d) 2 km/h

15. Two joggers left Delhi for Noida simultaneously. The first jogger stopped 42 min later when he was 1 km short of Noida and the other one stopped 52 min later when he was 2 km short of Noida. If the first jogger jogged as many kilometres as the second and the second as many kilometres as the first, the first one would need 17 min less than the second. Find the distance between Delhi and Noida.

- (a) 5 km (b) 15 km
(c) 25 km (d) 35 km

16. A tank of 4800 m^3 capacity is full of water. The discharging capacity of the pump is $10 \text{ m}^3/\text{min}$ higher than its filling capacity.

As a result the pump needs 16 min less to discharge the fuel than to fill up the tank. Find the filling capacity of the pump.

- (a) $50 \text{ m}^3/\text{min}$ (b) $25 \text{ m}^3/\text{min}$
(c) $55 \text{ m}^3/\text{min}$ (d) $24 \text{ m}^3/\text{min}$

17. An ant climbing up a vertical pole ascends 12 meters and slips down 5 meters in every alternate hour. If the pole is 63 meters high how long will it take it to reach the top?

- (a) 18 hours
(b) 17 hours
(c) 16 hours 35 minutes
(d) 16 hours 40 minutes

18. Two ports A and B are 300 km apart. Two ships leave A for B such that the second leaves 8 hours after the first. The ships arrive at B simultaneously. Find the time the slower ship spent on the trip if the speed of one of them is 10 km/h higher than that of the other.

- (a) 25 hours (b) 15 hours
(c) 10 hours (d) 20 hours

19. An ant moved for several seconds and covered 3 mm in the first second and 4 mm more in each successive second than in its predecessor. If the ant had covered 1 mm in the first second and 8 mm more in each successive second, then the difference between the path it would cover during the same time and the actual path would be more than 6 mm but less than 30 mm. Find the time for which the ant moved (in seconds).

- (a) 5 s (b) 4 s
(c) 6 s (d) 2 s

20. The Sabarmati Express left Ahmedabad for Mumbai. Having travelled 300 km, which constitutes 66.666 per cent of the distance between Ahmedabad and Mumbai, the train was stopped by a red signal. Half an hour later, the track was cleared and the engine-

driver, having increased the speed by 15 km per hour, arrived at Mumbai on time. Find the initial speed of the Sabarmati Express.

- (a) 50 kmph
- (b) 60 kmph
- (c) 75 kmph
- (d) 40 kmph

21. Two swimmers started simultaneously from the beach, one to the south and the other to the east. Two hours later, the distance between them turned out to be 100 km. Find the speed of the faster swimmer, knowing that the speed of one of them was 75% of the speed of the other.

- (a) 30 kmph
- (b) 40 kmph
- (c) 45 kmph
- (d) 60 kmph

22. A motorcyclist left point *A* for point *B*. Two hours later, another motorcyclist left *A* for *B* and arrived at *B* at the same time as the first motorcyclist. Had both the motorcyclists started simultaneously from *A* and *B* travelling towards each other, they would have met in 80 minutes. How much time did it take the faster motorcyclist to travel from *A* to *B*?

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

23. Two horses started simultaneously towards each other and meet each other 3 h 20 min later. How much time will it take the slower horse to cover the whole distance if the first arrived at the place of departure of the second 5 hours later than the second arrived at the point of departure of the first?

- (a) 10 hours
- (b) 5 hours
- (c) 15 hours
- (d) 6 hours

24. The difference between the times taken by two buses to travel a distance of 350 km is 2 hours 20 minutes. If the difference between their speeds is 5 kmph, find the slower speed.

- (a) 35 kmph
- (b) 30 kmph
- (c) 25 kmph
- (d) 20 kmph

25. One bad day, at 7 a.m. I started on my bike at the speed of 36 kmph to meet one of my relatives. After I had travelled some distance, my bike went out of order and I had to stop. After resting for 35 minutes, I returned home on foot at a speed of 14 kmph and reached home at 1 p.m. Find the distance from my house at which my bike broke down.
- (a) 54 km (b) 63 km
(c) 72 km (d) None of these

Direction for Questions 26 to 30: Read the following data and answer the questions that follow.

Three brothers, Ram, Shyam and Mohan, travelled by road. They all left the college at the same time—12 noon. The description of the motions of the three are detailed below:

Name	Ram	Shyam	Mohan
Phase I	Bus for 2 hours @ 10 mph	Bike for @ 1 hours 30 mph	Foot for 3 hours @ 3.33 mph
Phase II	Bike for 1.5 hours @ 40 mph	Foot for 3 hours @ 3.33 mph	Bus for 3 hours @ 10 mph
Phase III	Foot for 3 hours @ 3.33 mph	Bus for 4 hours @ 10 mph	Bike for 2 hours @ 30 mph

26. When did Ram overtake Shyam?
- (a) 3:15 p.m. (b) 2:22 p.m.
(c) 2:30 p.m. (d) 2:20 p.m.
27. At what distance from the start does Mohan overtake Shyam?
- (a) 40 miles (b) 57 miles
(c) 70 miles (d) 80 miles
28. If Ram travelled by bike instead of foot in the last leg of his journey (for the same distance as he had covered by foot), what is the difference in the times of Ram and Mohan to cover 90 miles?

- (a) 6 h 50 minutes (b) 10 h 40 minutes
(c) 3 hrs 55 minutes (d) 4 hrs 10 minutes
29. If all of them travelled a distance of 100 miles, who reached first and at what time (assume the last leg time increases to cover 100 miles)?
(a) Mohan at 6 p.m. (b) Ram at 8 p.m.
(c) Shyam at 6 p.m. (d) Mohan at 8 p.m.
30. In the above question, who reached last and at what time?
(a) Ram at 9:30 p.m. (b) Ram at 10 p.m.
(c) Shyam at 9:30 p.m. (d) Shyam at 10 p.m.
31. A motorcyclist rode the first half of his way at a constant speed. Then he was delayed for 5 minutes and, therefore, to make up for the lost time he increased his speed by 10 km/h. Find the initial speed of the motorcyclist if the total path covered by him is equal to 50 km.
(a) 36 km/h (b) 48 km/h
(c) 50 km/h (d) 62 km/h
32. Ram Singh and Priyadarshan start together from the same point on a circular path and walk around, each at his own pace, until both arrive together at the starting point. If Ram Singh performs the circuit in 3 minutes 44 seconds and Priyadarshan in 6 minutes 4 seconds, how many times does Ram Singh go around the path?
(a) 8 (b) 13
(c) 15 (d) Cannot be determined
33. Ravi, who lives in the countryside, caught a train for home earlier than usual yesterday. His wife normally drives to the station to meet him. But yesterday he set out on foot from the station to meet his wife on the way. He reached home 12 minutes earlier than he would have done had he waited at the station for his wife. The car travels at a uniform speed, which is 5 times Ravi's speed on foot. Ravi reached home at exactly 6 O'clock. At what time would he have

reached home if his wife, forewarned of his plan, had met him at the station?

- (a) 5 : 48 (b) 5 : 24
(c) 5 : 00 (d) 5 : 36

34. Hemant and Ajay start a two-length swimming race at the same moment but from opposite ends of the pool. They swim in lane and at uniform speeds, but Hemant is faster than Ajay. They first pass at a point 18.5 m from the deep end and having completed one length, each one is allowed to rest on the edge for exactly 45 seconds. After setting off on the return length, the swimmers pass for the second time just 10.5 m from the shallow end. How long is the pool?

- (a) 55.5 m (b) 45 m
(c) 66 m (d) 49 m

35. Rahim sets out to cross a forest. On the first day, he completes $\frac{1}{10}$ th of the journey. On the second day, he covers $\frac{2}{3}$ rd of the distance travelled the first day. He continues in this manner, alternating the days in which he travels $\frac{1}{10}$ th of the distance still to be covered, with days on which he travels $\frac{2}{3}$ of the total distance already covered. At the end of seventh day, he finds that $22\frac{1}{2}$ km more will see the end of his journey. How wide is the forest?

- (a) $66\frac{2}{3}$ km (b) 100 km
(c) 120 km (d) 150 km

36. The metro service has a train going from Mumbai to Pune and Pune to Mumbai every hour, the first one at 6 a.m. The trip from one city to other takes $4\frac{1}{2}$ hours, and all trains travel at the same speed. How many trains will you pass while going from Mumbai to Pune if you start at 12 noon?

- (a) 8 (b) 10
(c) 9 (d) 13

37. The distance between two towns is x km. A car travelling between the towns covers the first k km at an average speed of y km/h and

the remaining distance at z km/h. The time taken for the journey is

(a) $\frac{k}{y} + \frac{(x - k)}{z}$

(b) $ky + \frac{(k - x)}{z}$

(c) $\frac{k}{y} + \frac{(k - x)}{z}$

(d) $ky + z(x - k)$

38. Two rifles are fired from the same place at a difference of 11 minutes 45 seconds. But a man who is coming towards the place in a train hears the second sound after 11 minutes. Find the speed of train.

(a) 72 km/h

(b) 36 km/h

(c) 81 km/h

(d) 108 km/h

Directions for Questions 39 and 40: Read the following and answer the questions that follow.

The Kalinga Express started from Patna to Tata at 7 p.m. at a speed of 60 km/h. Another train, Rajdhani Express, started from Tata to Patna at 4 a.m. next morning at a speed of 90 km/h. The distance between Patna to Tata is 800 km.

39. How far from Tata will the two trains meet?

(a) 164 km

(b) 156 km

(c) 132 km

(d) 128 km

40. At what time will the two trains meet?

(a) 5 : 32 a.m.

(b) 5 : 28 a.m.

(c) 5 : 36 a.m.

(d) 5 : 44 a.m.

Directions for Questions 41 to 43: Read the following and answer the question that follow.

A naughty bird is sitting on top of a car. It sees another car approaching it at a distance of 12 km. The speed of the two cars is 60 kmph each. The bird starts flying from the first car and moves towards the second car, reaches the second car and comes back to the first car and so on. If the speed at

which the bird flies is 120 kmph then answer the following questions. Assume that the two cars have a crash.

41. The total distance travelled by the bird before the crash is
 - (a) 6 km
 - (b) 12 km
 - (c) 18 km
 - (d) None of these
42. The total distance travelled by the bird before it reaches the second car for the second time is
 - (a) 10.55 km
 - (b) 11.55 km
 - (c) 12.33 km
 - (d) None of these
43. The total number of times that the bird reaches the bonnet of the second car is (theoretically):
 - (a) 12 times
 - (b) 18 times
 - (c) Infinite times
 - (d) Cannot be determined
44. A dog sees a cat. It estimates that the cat is 25 leaps away. The cat sees the dog and starts running with the dog in hot pursuit. If in every minute, the dog makes 5 leaps and the cat makes 6 leaps and one leap of the dog is equal to 2 leaps of the cat. Find the time in which the cat is caught by the dog (assume an open field with no trees)
 - (a) 12 minutes
 - (b) 15 minutes
 - (c) 12.5 minutes
 - (d) None of these
45. Two people A and B start from P and Q (distance = D) at the same time towards each other. They meet at a point R , which is at a distance $0.4D$ from P . They continue to move to and fro between the two points. Find the distance from point P at which the fourth meeting takes place.
 - (a) $0.8D$
 - (b) $0.6D$
 - (c) $0.3D$
 - (d) $0.4D$
46. A wall clock gains 2 minutes in 12 hours, while a table clock loses 2 minutes in 36 hours; both are set right at noon on Tuesday. The

correct time when they both show the same time next would be

- (a) 12:30 night (b) 12 noon
(c) 1:30 night (d) 12 night

47. Two points A and B are located 48 km apart on the riverfront. A motorboat must go from A to B and return to A as soon as possible. The river flows at 6 km/h. What must be the least speed of the motorboat in still water for the trip from A to B and back again to be completed in not more than six hours (assume that the motorboat does not stop at B)?

- (a) 18 km/h (b) 16 km/h
(c) 25 km/h (d) 46 km/h

48. Two *ghats* are located on a riverbank and are 21 km apart. Leaving one of the *ghats* for the other, a motorboat returns to the first *ghat* in 270 minutes, spending 40 min of that time in taking the passengers at the second *ghat*. Find the speed of the boat in still water if the speed of the river flow is 2.5 km/h?

- (a) 10.4 km/h (b) 12.5 km/h
(c) 22.5 km/h (d) 11.5 km/h

49. A train leaves Muzaffarpur for Hazipur at 2:15 p.m. and travels at the rate of 50 kmph. Another train leaves Hazipur for Muzaffarpur at 1:35 p.m. and travels at the rate of 60 kmph. If the distance between Hazipur and Muzaffarpur is 590 km at what distance from Muzaffarpur will the two trains meet?

- (a) 200 km (b) 300 km
(c) 250 km (d) 225 km

50. A dog after travelling 50 km meets a *swami* who counsels him to go slower. He then proceeds at $\frac{3}{4}$ of his former speed and arrives at his destination 35 minutes late. Had the meeting occurred 24 km further the dog would have reached its destination 25 minutes late. The speed of the dog is

- (a) 48 km/h (b) 36 km/h

(c) 54 km/h

(d) 58 km/h

OceanofPDF.com

LEVEL OF DIFFICULTY (III)

- Two people started simultaneously towards each other from Siliguri and Darjeeling, which are 60 km apart. They met 5 hours later. After their meeting, the first person, who travelled from Siliguri to Darjeeling, decreased his speed by 1.5 km/h and the other person, who travelled from Darjeeling to Siliguri, increased his speed by 1.5 km/h. The first person is known to arrive at Darjeeling 2.5 hours earlier than the second person arrived at Siliguri. Find the initial speed of the first person.
(a) 4.5 km/h (b) 6 km/h
(c) 7.5 km/h (d) 9 km/h
- Two friends Arun and Nishit, on their last day in college, decided to meet after 20 years on a river. Arun had to sail 42 km to the meeting place and Nishit had to sail $35\frac{5}{7}$ per cent less. To arrive at the meeting place at the same time as his friend Nishit, Arun started at the same time as Nishit and sailed with the speed exceeding by 5 km/h the speed of Nishit. Find the speed of Arun.
(a) 10 kmph (b) 14 km/h
(c) 9 kmph (d) Both b and c
- Three cars leave Patna for Ranchi after equal time intervals. They reach Ranchi simultaneously and then leave for Vizag, which is 120 km from Ranchi. The first car arrives there an hour after the second car, and the third car, having reached Vizag, immediately reverses the direction and 40 km from Vizag meets the first car. Find the speed of the first car.
(a) 30 km/h (b) 19 km/h
(c) 32 km/h (d) 22 km/h
- Two sea trawlers left a sea port simultaneously in two mutually perpendicular directions. Half an hour later, the shortest distance

between them was 17 km, and another 15 min later, one sea trawler was 10.5 km farther from the origin than the other. Find the speed of each sea trawler.

- (a) 16 km/h, 30 km/h (b) 18 km/h, 24 km/h
(c) 20 km/h, 22 km/h (d) 18 km/h, 36 km/h

5. Shaurya and Arjit take a straight route to the same terminal point and travel with constant speeds. At the initial moment, the positions of the two and the terminal point form an equilateral triangle. When Arjit covered a distance of 80 km, the triangle becomes right-angled. When Arjit was at a distance of 120 km from the terminal point, the Shaurya arrived at the point. Find the distance between them at the initial moment assuming that there are integral distances throughout the movements described.

- (a) 300 km (b) 240 km
(c) 200 km (d) 225 km

6. Mrinalini and Neha travel to Connaught Place along two straight roads with constant speeds. At the initial moment, the positions of Mrinalini, Neha, and Connaught Place form a right triangle. After Mrinalini travelled 30 km, the triangle between the points became equilateral. Find the distance between Mrinalini and Neha at the initial moment if at the time Mrinalini arrived at Connaught Place, Neha had to cover 6.66 km to reach Connaught Place.

- (a) $10\sqrt{3}$ km (b) $12\sqrt{3}$ km
(c) $30\sqrt{5}$ km (d) None of these

7. Three cars started simultaneously from Ajmer to Benaras along the same highway. The second car travelled with a speed that was 10 km/h higher than the first car's speed and arrived at Benaras 1 hour earlier than the first car. The third car arrived at Benaras 33.33 minutes earlier than the first car, travelling half the time at the speed of the first car and the other half at the speed of the second car. Find the total distance covered by these three cars during their journey between Ajmer and Benaras.

- (a) 360 km (b) 600 km
(c) 540 km (d) 840 km

8. Three sprinters A , B , and C had to sprint from points P to Q and back again (starting in that order). The time interval between the starting times of the three sprinters A , B and C was 5 seconds each. Thus C started 10 seconds after A , while B started 5 seconds after A . The three sprinters passed a certain point R , which is somewhere between P and Q , simultaneously (none of them having reached point Q yet). Having reached Q and reversed the direction, the third sprinter met the second one 9 m short of Q and met the first sprinter 15 m short of Q . Find the speed of the first sprinter if the distance between PQ is equal to 55 m.

- (a) 4 m/s (b) 3 m/s
(c) 2 m/s (d) 1 m/s

9. Two trains start from the same point simultaneously and in the same direction. The first train travels at 40 km/h, and the speed of the second train is 25 per cent more than the speed of the first train. Thirty minutes later, a third train starts from the same point and in the same direction. It overtakes the second train 90 minutes later than it overtook the first train. What is the speed of the third train?

- (a) 20 km/h (b) 40 km/h
(c) 60 km/h (d) 80 km/h

10. A passenger train left town Alpha for town Beta. At the same time, a goods train left Beta for Alpha. The speed of each train is constant throughout the whole trip. Two hours after the trains met, they were 450 km apart. The passenger train arrived at the place of destination 16 hours after their meeting and the goods train, 25 hours after the meeting. How long did it take the passenger train to make the whole trip?

- (a) 21 hours (b) 28 hours
(c) 14 hours (d) None of these

11. Two ducks move along the circumference of a circular pond in the same direction and come alongside each other every 54 minutes. If they moved with the same speeds in the opposite directions, they would meet every 9 minutes. It is known that when the ducks moved along the circumference in opposite directions, the distance between them decreased from 54 to 14 feet every 48 seconds. What is the speed of the slower duck?
- (a) 20 feet/min (b) 15 feet/min
(c) 30 feet/min (d) 20.83 feet/min
12. Dev and Nishit started simultaneously from opposite points X and Y on a straight road, at constant speeds. When Dev had covered 40% of the distance from X to Y , Nishit was 4 km away from Dev after having crossed Dev. When Nishit had covered half the way, Dev was 10 km short of the mid point. Find a possible of the time it took Dev to cover the distance from X to Y to the time it took Nishit to cover the same distance.
- (a) $\left[\frac{1+\sqrt{3}}{2} \right]$ (b) $\frac{3\sqrt{2}+4}{2\sqrt{2}+1}$
(c) Either a or b (d) None of these
13. For Question 12 which of these is a possible value of the distance between the points X and Y :
- (a) $20(2 + \sqrt{3})$ (b) $20(1 + \sqrt{2})$
(c) 60 km (d) Both (a) and (b)
14. Two ships sail in a fog towards each other with the same speed. When they are 4 km apart, the captains decelerate the engines for 4 minutes with a deceleration rate of 0.1 m/s^2 , and then the ships continue sailing with the speeds attained. For what range of values of the initial speed V_0 will the ships avoid collision?
- (a) $0 < V_0 < 10 \text{ m/s}$ (b) $0 < V_0 < 20 \text{ m/s}$
(c) $0 < V_0 < 30 \text{ m/s}$ (d) None of these

15. Three points A , B and C are located at the vertices of an equilateral triangle with sides equal to 168 metres. A donkey called Dinky starts from A to B at 60 metres/hour and at the same time a cow called Moo starts from B to C at 30 metres/hour. In what time after their departure will the distance between the donkey and the cow be the least?
- (a) 2 h (b) 3 h
(c) 0.5 h (d) 8 h
16. A train has to travel the distance between Aurangabad and Daulatabad, equal to 20 km, at a constant speed. It travelled half the way with the specified speed and stopped for three minutes, to arrive at Daulatabad on time, it had to increase its speed by 10 km/h for the rest of the way. Next time the train stopped half-way for five minutes. By what speed must it increase its speed for the remaining half of the distance to arrive at Daulatabad as per the schedule?
- (a) 10 kmph (b) 20 kmph
(c) 15 kmph (d) 16 kmph
17. Nishit travels from Patna to Kolkata, a distance of 200 km at the speed of 40 km/h. At the same time, Ravi starts from Kolkata at a speed of 20 kmph along a road, which is perpendicular to the road on which Nishit is travelling. When will Nishit and Ravi be closest to each other?
- (a) In 1.5 hours (b) In 4 hours
(c) In 3.33 hours (d) In 5 hours
18. Two towns are at a distance of 240 km from each other. A motorist takes 8 hours to cover the distance if he travels at a speed of V_0 km/h from town A to an intermediate town C , and then continues on his way with an acceleration of x km/hr². He needs the same time to cover the whole distance if he travels from A to C at V_0 km/h and from C to B at V_1 km/h or from A to C at V_1 km/h and from C to B

at V_0 km/h. Find V_0 if the acceleration 'x' is double V_0 in magnitude and $V_0 \propto V_1$.

- (a) 15 km/h
- (b) 10 km/h
- (c) 20 km/h
- (d) 8 km/h

19. Jaideep travels from Alaska, which is on a highway, to Burgen, which is 16 km from the highway. The distance between Alaska and Burgen along a straight line is 34 km. At what point should Jaideep turn from the highway to reach Burgen in the shortest possible time, if his speed along the highway is 10 km/h and 6 km/h otherwise.

- (a) 30 km away from A
- (b) 20 km away from A
- (c) 18 km away from A
- (d) 15 km away from A

20. An object begins moving at time moment $t = 0$ and 4 s after the beginning of the motion, attains the acceleration of 3 m/s^2 . Find the speed of the object 6 s after the beginning of motion if it is known that the speed of the body varies accordingly to the law $v(t) = (t^2 + 2b.t + 4) \text{ m/s}$ and the object moves along a straight line.

- (a) 22 m/s
- (b) 10 m/s
- (c) 30 m/s
- (d) 15 m/s

21. For problem 20, find the distance covered by the object in the first 7 seconds if we assume that the speed of the object in a particular second is the speed it attains at the start of the second.

- (a) 15 metres
- (b) 14 metres
- (c) 10 metres
- (d) 5 metres

22. Three *ghats* X, Y and Z on the Yamuna in Delhi are located on the river bank. The speed of the river flow is 8 km/h in the direction of its flow, *Ghat Y* being located midway between X and Z. A raft and a launch leave Y at the same time, the raft travelling down the river to Z and the launch travelling to X. The speed of the launch in still

(a) $8 < V < 24$ km/h (b) $8 < V < 16$ km/h
(c) $8 < V < 20$ km/h (d) $12 < V < 24$ km/h

23. A pedestrian left point A for a walk, going with the speed of 5 km/h . When the pedestrian was at a distance of 6 km from A , a cyclist followed him, starting from A and cycling at a speed 9 km/h higher than that of the pedestrian. When the cyclist overtook the pedestrian, they turned back and returned to A together, at the speed of 4 km/h . At what v will the time spent by the pedestrian on his total journey from A to A be the least?
(a) 5 km/h (b) 6 km/h
(c) 6.1 kmph (d) 5.5 km/h
24. A cyclist left point A for point B and travelled at the constant speed of 25 km/h . When he covered the distance of 8.33 km , he was overtaken by a car that left point A twelve minutes after the cyclist and travelled at a constant speed too. When the cyclist travelled another 30 km , he encountered the car returning from B . Assume that the car did not stop at point B . Find the distance between A and B .
(a) 39.5833 km (b) 41.0833 km
(c) 60.833 km (d) 43.33 km
25. A robot began moving from point A in a straight line at 6 p.m. with an initial speed of 3 m/s . One second later, the speed of the robot became equal to 4 m/s . Find the acceleration of the robot at the end of the 2nd second if its speed changes by the law $s(t) = (at^2 + 2t + (b))$
(a) 1 m/s^2 (b) -2 m/s^2
(c) 0 m/s^2 (d) 2 m/s^2

26. For Question 25, the distance of the robot from point A after 6 seconds will be (assuming that for every second the robot travels at a constant speed equal to its starting speed for that second and any acceleration occurs at the start of the next second)
- (a) 45 m (b) 36 m
(c) 10 m (d) 17 m
27. Two friends Amit and Akshay began moving simultaneously from point A along a straight line in the same direction: Amit started moving at the speed of 5 m/s and moved with an uniform acceleration of 4 m/s^2 , while his friend Akshay moved at a uniform speed. The limits for Akshay's speed (S) so that he should first leave Amit behind and then get overtaken by Amit at a distance of 18 m from A are
- (a) $5 < S < 9$ (b) $3 < S < 5$
(c) $4 < S < 8$ (d) None of these
28. On the banks of the river Ganges there are two bathing points in Varanasi and Patna. A *diya* left in the river at Varanasi reaches Patna in 24 hours. However, a motorboat covers the whole way to and fro in exactly 10 hours. If the speed of the motorboat in still water is increased by 40%, then it takes the motorboat 7 hours to cover the same way (from Varanasi to Patna and back again). Find the time necessary for the motorboat to sail from Varanasi to Patna when its speed in still water is not increased.
- (a) 3 hours (b) 4 hours
(c) 4.8 hours (d) None of these
29. Two friends started walking simultaneously from points A and B towards each other. 144 minutes later the distance between them was 20% of the original distance. How many hours does it take the faster walker to cover the distance AB if he needs eight hours less to travel the distance than his friend (assume all times to be in whole numbers and in hours)?
- (a) 3 hours (b) 6 hours

(c) 12 hours (d) 4 hours

30. Two cars left points A and B simultaneously, travelling towards each other. 9 hours after their meeting, the car travelling from A arrived at B , and 16 hours after their meeting, the car travelling from B arrived at A . How many hours did it take the slower car to cover the whole distance?

(a) 36 hours (b) 21 hours

(c) 25 hours (d) 28 hours

31. A pedestrian and a cyclist left Nagpur for Buti Bori at the same time. Having reached Buti Bori, the cyclist turned back and met the pedestrian an hour after the start. After their meeting, the pedestrian continued his trip to Buti Bori and the cyclist turned back and also headed for Buti Bori. Having reached Buti Bori, the cyclist turned back again and met the pedestrian 30 mins after their first meeting. Determine what time it takes the pedestrian to cover the distance between Nagpur and Buti Bori.

(a) 1 hour (b) 2 hours

(c) 2.5 hours (d) 3 hours

32. Points A , B and C are at the distances of 120, 104.66 and 112 km from point M respectively. Three people left these points for point M simultaneously: the first person started from point A , the second from B and the third from C . The first person covered the whole way at a constant speed and arrived at M an hour before the second and the third persons (who arrived simultaneously). The third person covered the whole way at a constant speed. The second person, having travelled 72 km at the same speed as the first, stopped for 2 hours. The rest of the way he travelled at a speed that is less than the speed of the third person by the same amount as the speed of the third is less than that of the first. Determine the speed of the first person.

(a) 6 kmph (b) 5 kmph

(c) 4 kmph (d) 3 kmph

33. Two people started simultaneously from points A and B towards each other. At the moment the person who started from A had covered two-thirds of the way, the other person had covered 2 km less than half the total distance. If it is known that when the person who started from B had covered $1/4$ of the way, the other person was 3 km short of the mid point. Find the distance between A and B . The speeds of the two people were constant.
- (a) $(15 - 3\sqrt{17})$ km (b) $(15 + 3\sqrt{17})$ km
- (c) Both a and b (d) $3\sqrt{17} - 5$ km
34. Sohan and Lallan left their house simultaneously. Thirty six minutes later, Sohan met his uncle travelling to their house, while Lallan met the uncle twelve minutes after Sohan. Twenty four minutes after his meeting with Lallan, the uncle rang the door bell at Sohan and Lallan's house. Assume each person travels at a constant speed. Find the ratio of the speeds of Sohan to Lallan to the uncle.
- (a) 1 : 2 : 2 (b) 1 : 3 : 2
- (c) 3 : 1 : 3 (d) 2 : 1 : 2
35. The distance between two towns—Aurangabad and Jalna is 80 km. A bus left Aurangabad and travelled at a constant speed towards Jalna. Thirty minutes later, Deepak Jhunjhunwala left Aurangabad in his car towards Jalna. He overtook the bus in thirty minutes and continued on his way to Jalna. Without stopping at Jalna, he turned back and again encountered the bus 80 minutes after he had left Aurangabad. Determine the speed of the bus.
- (a) 40 kmph (b) 45 kmph
- (c) 50 kmph (d) None of these
36. Rohit left Mahabaleshwar for Nashik at 6 a.m. An hour and a half later Vimal, whose speed was 5 km/h higher than that of Rohit left Mahabaleshwar. At 10 : 30 p.m. of the same day the distance between the two friends was 21 km. Find the speed of Vimal.
- (a) 40 kmph (b) 41 kmph

(c) 69 kmph

(d) Either b or c

37. Aurangzeb and Babar with their troops left from Delhi and Daulatabad towards each other simultaneously. Each of them marched at a constant speed and, having arrived at their respective points of destination, went back at once. Their first meeting was 14 km from Daulatabad, and the second meeting, eight hours after the first meeting was at a distance of 2 km from Delhi. Find the distance between the Delhi and Daulatabad.

(a) 30 km

(b) 25 km

(c) 35 km

(d) None of these

38. Two tourists left simultaneously point A for point B , the first tourist covers each kilometre 2 minutes faster than the second. After travelling 30 per cent of the way, the first tourist returned to A , stopped there for 102 minutes and again started for B . The two tourists arrived at B simultaneously. What is the distance between A and B if the second tourist covered it in 2.5 hours?

(a) 60 km

(b) 70 km

(c) 45 km

(d) None of these

39. Amar and Akbar left Bhubaneshwar simultaneously and travelled towards Cuttack. Amar's speed was 15 km/h and that of Akbar was 12 km/h. Half an hour later, Anthony left Bhubaneshwar and travelled in the same direction. Some time later, he overtook Akbar and 90 minutes further on he overtook Amar. Find Anthony's speed.

(a) 18 kmph

(b) 24 kmph

(c) 20 kmph

(d) 16 kmph

40. Two bodies, moving along a circle in the same direction, meet every 49 minutes. Had they moved at the same speeds in the opposite directions, they would meet every 7 minutes. If, moving in the opposite directions, the bodies are at the distance of 40 m from each other along the arc at time $t = 0$, then at $t = 24$ seconds, their distance will be 26 metres (the bodies do not meet during those 24 seconds). Find the speed of the faster body in metres per minute.

- (a) 15 (b) 20
(c) 25 (d) None of these

41. The distance between Varanasi and Lucknow is 220 km. Two buses start from these towns towards each other. They can meet halfway if the first bus leaves 2 hours earlier than the second. If they start simultaneously, they will meet in 4 hours. Find the speeds of the buses.

- (a) $17.5(3 + \sqrt{5})$ km/h, $17.5(1 + \sqrt{5})$ km/h
(b) $27.5(3 + \sqrt{5})$ km/h, $27.5(1 + \sqrt{5})$ km/h
(c) $27.5(3 - \sqrt{5})$ km/h, $27.5(\sqrt{5} - 1)$ km/h
(d) None of these

42. A road passes through the towns Sangamner and Yeotmal. A cyclist started from Sangamner in the direction of Yeotmal. At the same time, two pedestrians started from Yeotmal travelling at the same speed, the first of them towards Sangamner and the other in the opposite direction. The cyclist covered the distance between the towns in half an hour and, continued ahead in the same direction. He overtook the second pedestrian, 1.2 hours after he met the first pedestrian. Determine the time the cyclist spent travelling from Sangamner to the point of the meeting with the first pedestrian (assuming the speeds of the cyclist and the pedestrians to be constant).

- (a) 24 min (b) 18 min
(c) 30 min (d) Cannot be determined

43. Two people A and B start moving from P and Q that are 200 km apart, towards each other A is on a moped and B on foot. They meet at a point R when A gives B a lift to P and returns to his original path to reach Q . On reaching Q he finds that he has taken 2.6 times his normal time. B on the other hand realises that he has saved 40 minutes over his normal travel time. Find the ratio of their speeds.

- (a) 3 : 2 (b) 4 : 3

- (c) 3 : 1 (d) None of these

44. For Question 43, find the speed of the moped.

- (a) 160 kmph (b) 180 kmph
(c) 200 kmph (d) None of these

45. Three friends A , B and C start from P to Q that are 100 km apart. A is on a moped while B is riding pillion and C walks on. A takes B to a point R and returns to pick up C on the way and takes him to point Q . B , on the other hand, walks to Q from point R (R is the mid-point between P and Q).

If the ratio of speeds of the three people is 5 : 2 : 2, find where will the last person be when the first person reaches Q .

- (a) 12.85 km from Q (b) 12.75 km from Q
(c) 16.66 km from Q (d) 83.33 km from P

46. A motorboat moves from point A to point B and back again, both points being located on the river-bank. If the speed of the boat in still water is doubled, then the trip from A to B and back again would take 20% of the time that the motorboat usually spends in the journey. How many times is the actual speed of the launch higher than the speed of the river flow?

- (a) $\sqrt{\frac{3}{2}}$ (b) $\frac{\sqrt{3}}{3}$
(c) $\frac{2}{3}$ (d) $\frac{3}{2}$

47. A watch loses $\frac{2}{3}\%$ time during the 1st week and gains $\frac{1}{3}\%$ time during the next week. If on a Sunday noon, it showed the right time, what time will it show at noon on the Sunday after the next.

- (a) 11 : 26 : 24 a.m. (b) 10 : 52 : 18 a.m.
(c) 10 : 52 : 48 a.m. (d) 11 : 36 : 24 a.m.

48. Clocks A , B and C strikes every hour. B slows down and takes 2 min longer than A per hour while C become faster and takes 2 min less

than A per hour. If they strike together at 12 midnight, when will they strike together again

- (a) 10 a.m. (b) 11 a.m.
(c) 9 p.m. (d) 8 p.m.

49. A boat went down the river for a distance of 20 km. It then turned back and returned to its starting point, having travelled a total of 7 hours. On its return trip, at a distance of 12 km from the starting point, it encountered a log, which had passed the starting point at the moment at which the boat had started downstream. The downstream speed of the boat is

- (a) 7 kmph (b) 13 kmph
(c) 16 kmph (d) 10 kmph

50. Two boats go downstream from point X to point Y . The faster boat covers the distance from X to Y 1.5 times as fast as the slower boat. It is known that for every hour the slower boat lags behind the faster boat by 8 km. However, if they go upstream, then the faster boat covers the distance from Y to X in half the time as the slower boat. Find the speed of the faster boat in still water.

- (a) 12 kmph (b) 20 kmph
(c) 24 kmph (d) 25 kmph

ANSWER KEY

Level of Difficulty (I)

- | | | | |
|---------|---------|---------|---------|
| 1. (a) | 2. (a) | 3. (c) | 4. (c) |
| 5. (d) | 6. (d) | 7. (c) | 8. (a) |
| 9. (a) | 10. (a) | 11. (a) | 12. (a) |
| 13. (c) | 14. (a) | 15. (c) | 16. (d) |
| 17. (a) | 18. (b) | 19. (d) | 20. (a) |
| 21. (c) | 22. (c) | 23. (c) | 24. (d) |
| 25. (b) | 26. (d) | 27. (d) | 28. (c) |
| 29. (d) | 30. (d) | 31. (a) | 32. (b) |

33. (a)	34. (a)	35. (a)	36. (d)
37. (d)	38. (b)	39. (a)	40. (a)
41. (b)	42. (a)	43. (a)	44. (d)
45. (c)	46. (c)	47. (c)	48. (a)
49. (d)	50. (a)	51. (b)	52. (a)
53. (b)	54. (c)	55. (c)	56. (b)
57. (b)	58. (a)	59. (a)	60. (b)
61. (c)	62. (d)	63. (a)	64. (b)
65. (a)	66. (c)	67. (b)	68. (a)
69. (a)	70. (a)	71. (a)	72. (c)
73. (a)	74. (d)	75. (d)	

Level of Difficulty (II)

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

Level of Difficulty (III)

1. (c)	2. (b)	3. (a)	4. (a)
5. (b)	6. (d)	7. (b)	8. (d)
9. (c)	10. (d)	11. (d)	12. (b)
13. (b)	14. (b)	15. (a)	16. (d)
17. (b)	18. (c)	19. (c)	20. (b)
21. (b)	22. (a)	23. (b)	24. (c)
25. (b)	26. (d)	27. (a)	28. (b)

- | | | | |
|---------|---------|---------|---------|
| 29. (d) | 30. (d) | 31. (b) | 32. (a) |
| 33. (c) | 34. (d) | 35. (a) | 36. (d) |
| 37. (d) | 38. (a) | 39. (a) | 40. (b) |
| 41. (d) | 42. (b) | 43. (d) | 44. (d) |
| 45. (a) | 46. (a) | 47. (c) | 48. (b) |
| 49. (d) | 50. (b) | | |

Hints

Level of Difficulty (II)

- The train saves 16 minutes by travelling faster over a section of 80 km.

$$\text{Thus, } \frac{80}{S} - \frac{80}{S+10} = \frac{16}{60} = 0.2666$$

Check the options.

- $\frac{60}{S} - \frac{60}{S+1} = \frac{6}{60}$. Check the options to solve.

- Solve through options.
- Solve through options.
- Relative speed (in opposite direction) = 20 km/hr.
Use the options after this.

- The question is based on Pythagoras' triplets.

- Assume the distance between the two ant holes is 600 feet. Then, the first ant's speed is 16 feet/hr while the second ant's speed is 14 feet/hr.

If the first ant covers 800 feet, the second will cover 700 feet (since, distance is proportional to speed). Hence total distance is 1500 feet and required speed is $14 \times 2.5 = 35$ feet/hr.

- Solve through options.
- Solve using options as follows.

Check for option (a). (He rode for 6 hours)

Then, walking time = 10 hrs

Thus, speed of the tonga = 1.66 km/hr

And speed of walking = 9 km/hr.

As per the question, if the times are reversed, the distances travelled by each mode will be equal.

Thus, 10×1.66 should be equal to 6×9 .

But, this is not so. Hence, move to the next option.

- 14. Solve using options.
- 15. Solve using options, the following equations.

$$\text{Speed of first} = \left(\frac{x-1}{42} \times 60 \right) \text{ km/hr} = S_A$$

$$\text{Speed of second} = \frac{x-2}{52} \times 60 \text{ km/hr} = S_B.$$

$$\text{Then, } \frac{x-2}{S_B} - \frac{x-1}{S_A} = \frac{17}{60}$$

- 19. The first pattern of movement is

$$3 + 7 + 11 + 15 + 19 + 23$$

The second pattern of movement is

$$1 + 9 + 17 + 25 + 33 + 41$$

It is evident that the difference in the net movements between the second pattern and the first pattern is more than 6 mm and less than 30 mm for a movement of 4 seconds.

- 20. By increasing speed by 15 kmph, the time reduces by 30 minutes.
- 22. Given that they meet in 80 minutes, when moving towards each other, the sum of their speeds should be such that they cover 1.25% of the distance per minute (i.e. 75% of the distance per hour).
- 25. Ratio of time taken in going and coming back is 7 : 18.
Also, total time of travel is 325 minutes.

26-30. Chart out the distances covered by the three of them in each leg of their journeys.

- 32. The answer would have been 13, if the question had stated the initial directions of their walking. Hence, we cannot determine the answer.

33. Solve on the basis of the would be wife's movement.
36. The train will meet all trains that start from Pune between 8 a.m. and 4 p.m.
38. Assume speed of sound = 330 m/s.
Then, distance covered by sound in 45 seconds = distance covered by the trains in 11 minutes.
- 39-40. Use the concept of relative speed to solve.
41. The bird will fly for the time which the two cars take in approaching one another.
42. Chart the relative movements of the two cars and the bird.
46. The wall clock gains 6 minutes in 36 hours, while the table clock loses 2 minutes in 36 hours. Hence, time differential in 36 hours = 8 minutes. For them to show the same time again, we need a total time differential of 12 hours.
48. Solve through options.

Level of Difficulty (III)

1. The first person who travels from Siliguri to Darjeeling is obviously faster than the second. Hence, reject Options (a) and (b). Then, check all the conditions with Options (c) and (d) and select the one which satisfies the conditions.
2. Since distance to be travelled by Nishit is $35\frac{5}{7}\%$ less, his speed will also be $35\frac{5}{7}\%$ less than Arun's speed. Check the options with the conditions that Arun's speed is 5 kmph higher than that of Nishit.
3. Let S_1 , S_2 and S_3 be the speeds of the three cars.

$$\text{Then: } \frac{120}{S_1} - \frac{120}{S_2} = 1 \text{ hour} \quad (1)$$

It is also known that the speed of the third car is double the speed of the first car.

With these realisations, check for factors of 120 which can satisfy the equation above.

[Note that in equations like (1) above, normally the respective values of S_1 and S_2 will be factors of 120.]

5. If the side of the initial equilateral triangle is S , then when Arjit covers $(S - 120)$ kms, Shaurya covers S kilometres. Also, when Arjit covers a distance of 80 kilometres, Shaurya covers a distance such that the resultant triangle is right angled.

Check these conditions through options.

6. Solve through a process similar to the previous question.
7. If S_1 is the speed of the first car, then $(S_1 + 10)$ will be the second car's speed. If t_1 hours is the time required for the first car, then $(t_1 - 1)$ hours is the time required for the second car in covering the same distance, while that of the third car is $\left(t_1 - \frac{33.33}{60}\right)$ hours.

Check these conditions through options.

10. The relative speed is 225 km/hr.
11. The sum of the speeds of the ducks is 50 feet/min
Hence, circumference = $9 \times 50 = 450$ feet and difference of speeds = $\frac{450}{54} = 8.33$.
15. Use options to solve.
16. Through trial and error try to find the initial speed of the train, so that the first condition is met.
17. Use options to solve.
18. Let the distance $AC = d$

$$\text{Then, } \frac{d}{V_0} + \frac{240 - d}{V_1} = \frac{d}{V_1} + \frac{240 - d}{V_0}$$

If $V_0 \neq V_1$, then the above condition will be satisfied only if $d = 120$ km.

19. The time required will be represented by

$$\frac{\text{Distance travelled on highway}}{10} + \frac{\text{Distance travelled on side roads}}{10}$$

This has to be minimised, check the options.

20-21. Acceleration is $\frac{dv}{dt} = 2t + 2b$

At $t = 4$, the acceleration is given to be 3.

Hence, $b = \frac{-5}{2}$

Hence, the velocity equation becomes

$$V_{(t)} = t^2 - 5t + 4$$

29. Total time taken to cover the entire distance together = $144 \times \frac{5}{4} =$

180 minutes = 3 hours.

Hence, distance covered per hour = 33.33% of the total by both of them combined.

Check this condition for all the options.

31. Suppose A and B are the points where the first and the second meetings took place.

The total distance covered by the pedestrian and the cyclist before the first meeting = Twice the distance between Nagpur and Buti Bori.

Total time taken is 1 hour.

Total distance covered by the pedestrian and the cyclist between the two meetings = Twice the distance between A and Buti Bori.

and time taken is half an hour.

Hence, A is the mid-point. This will result in a GP.

32. Solve through options by checking all the conditions given in the question.

33. If $2d$ is the distance between A and B, then

$$\frac{\frac{2}{3} \times 2d}{d-2} = \frac{d-3}{2d \times \frac{1}{4}}$$

34. In 24 minutes, the uncle covers the distance for which Lallan requires 48 minutes.

35. Check the options for all the conditions.

36. Vimal could either be 21 km behind Rohit or 21 km ahead of Rohit.

37. If d is the distance between Delhi and Daulatabad, then you will get the following equation.

$$\frac{d-14}{14} = \frac{28+(d-16)}{(d-14)+2}$$

38. Check the conditions through the options.

47. The net time loss is $1/3\%$ of 168 hours.

49. In the time taken by the boat in traveling $d + (d - 12)$ kms, the log travels 12 km. Let, S_B be the speed of the boat in still water and, S_S be the speed of the stream.

Then

$$\frac{12}{S_S} = \frac{20}{(S_S + S_B)} + \frac{8}{(S_B - S_S)} \quad (1)$$

It is also known that,

$$\frac{20}{(S_S + S_B)} + \frac{20}{(S_B - S_S)} = 7 \text{ hours} \quad (2)$$

Solve through options.

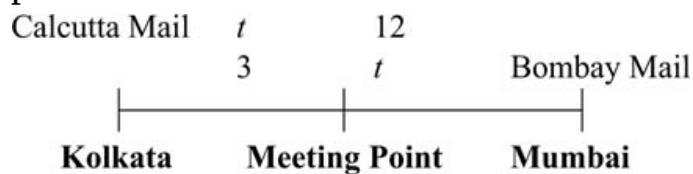
Solutions and Shortcuts

Level of Difficulty (I)

- The ratio of time for the travel is 4:3 (Sinhagad to Deccan Queen). Hence, the ratio of speeds would be 3:4. Since, the sum of their average speeds is 70 kmph, their respective speeds would be 30 and

40 kmph respectively. Use alligation to get the answer as 34.28 kmph.

2. When speed goes down to three fourth (i.e. 75%) time will go up to $4/3^{\text{rd}}$ (or 133.33%) of the original time. Since, the extra time required is 16 minutes, it should be equated to $1/3^{\text{rd}}$ of the normal time. Hence, the usual time required will be 48 minutes.
3. Since, the ratio of speeds is 3:5, the ratio of times would be 5:3. The difference in the times would be 2 (if looked at in the 5:3 ratio context.) Further, since Ram takes 30 minutes longer, 2 corresponds to 30. Hence, using unitary method, 5 will correspond to 75 and 3 will correspond to 45 minutes. Hence at 10 kmph, Bharat would travel 7.5 km.
4. The train that leaves at 6 am would be 75 km ahead of the other train when it starts. Also, the relative speed being 36 kmph, the distance from Mumbai would be:
 $(75/36) \times 136 = 283.33 \text{ km}$
5. If you assume that the initial stretch of track is covered by the two trains in time t each, the following figure will give you a clearer picture.



From the above figure, we can deduce that,

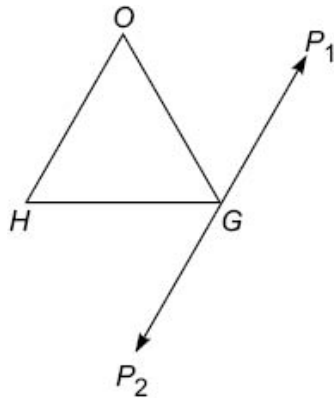
$$t/3 = 12/t.$$

Hence, $t^2 = 36$, gives us $t = 6$.

Hence, the distance between Kolkata to the starting point is covered by the Calcutta Mail in 6 hours, while the same distance is covered by the Bombay Mail in 3 hours.

Hence, the ratio of their speeds would be 1:2. Hence, the Bombay Mail would travel at 96 kmph.

6.



From the figure above we see that Shyam would have walked a distance of $4 + 4 + 4 = 12$ km. (G to P_1 , P_1 to G and G to P_2).

7. When the train from Khandala starts off, the train from Lonavala will already have covered 50 kms. Hence, 550 km at a relative speed of 60 kmph will take $550/60$ hrs. From this, you can get the answer as:
 $50 + (550/60) * 25 = 279.166$ km.
8. When his speed becomes $3/4^{\text{th}}$, his time would increase by $1/3^{\text{rd}}$. Thus, the normal time = 7.5 hrs. (since increased time = 2.5 hrs).
9. Since he gains 2 hours by driving both ways (instead of walking one way) the time taken for driving would be 2 hours less than the time taken for walking. Hence, he stands to lose another two hours by walking both ways. Hence his total time should be 8 hrs 45 minutes.
10. Kalu's speed = 3 m/s.
 For 1200 m, Kalu would take 400 seconds and Sambhu would take 10 seconds less. Hence, 390 seconds.
11. Since Chandu is moving at a speed of 10 m/s and he has to cover 360 km or 360000 meters, the time taken would be given by $360000/10$ seconds = 36000 seconds = $36000/60$ minutes = 600 minutes = 10 hours.
12. Since the train travels at 60 kmph, it's speed per minute is 1 km per minute. Hence, if it's speed with stoppages is 40 kmph, it will travel 40 minutes per hour.
13. Total distance/Total time = $1590/15 = 106$ kmph.
14. The distance covered in the various phases of his travel would be:

10 km + 25 km + 50 km + 60 km. Thus the total distance covered = 145 km in 2 hours 50 minutes Æ

145 km in 2.8333 hours Æ 51.18 kmph

15. The average speed would be given by:

$$\frac{\frac{3d}{\frac{d}{v_1} + \frac{d}{v_2} + \frac{d}{v_2}}}{\frac{3d}{\frac{d}{v_1} + \frac{d}{v_2} + \frac{d}{v_2}}} = \frac{3v_1v_2}{2v_1 + v_2}$$

16. By increasing his speed by 25%, he will reduce his time by 20%. (This corresponds to a 6 minute drop in his time for travel—since he goes from being 10 minutes late to only 4 minutes late.) Hence, his time originally must have been 30 minutes. Hence, the required distance is 20 kmph \times 0.5 hours = 10 km.

17. $d/6 + d/4 = 10 \text{ } \text{Æ} \text{ } d = 24 \text{ km.}$

18. If the car does half the journey @ 30 kmph and the other half at 40 kmph it's average speed can be estimated using weighted averages.

Since, the distance traveled in each part of the journey is equal, the ratio of time for which the car would travel would be inverse to the ratio of speeds. Since, the speed ratio is 3:4, the time ratio for the two halves of the journey would be 4:3. The average speed of the car would be:

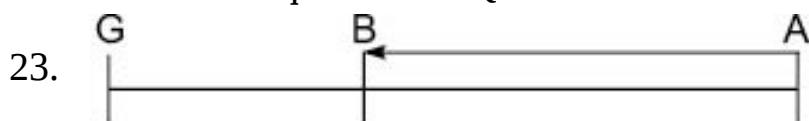
$$(30 \times 4 + 40 \times 3)/7 = 240/7 \text{ kmph.}$$

It is further known that the car traveled for 17.5 hours (which is also equal to 35/2 hours).

$$\text{Thus, total distance} = \text{average speed} \times \text{total time} = (240 \times 35)/(2 \times 7) = 120 \times 5 = 600 \text{ km}$$

19. To reduce the time of the journey by 25%, he should increase his speed by 33.33% or $1/3^{\text{rd}}$. Thus, required speed = 80 kmph.
20. You can solve this question using the options. Option (a) fits the given situation best as if we take the distance as 12 km he would have taken 1 hour to go by car and 4 hours to come back walking—a total of 5 hours as given in the problem.
21. In four hours, the train will travel 180 km (180,000 metres). The number of poles would be $180,000/50 = 3600$.

22. Is the same question as Question No. 5.



In the above figure, the train travels from A to B in 11:30 minutes.

Suppose, you denote the time at which the first gunshot is heard as $t = 0$. Also, if you consider the travel of the sound of the second the gunshot is heard at point B at $t = 11:30$ minutes. Also, the second gunshot should reach point B at $t = 12$ minutes. Hence, the sound of the 2nd gunshot would take 30 seconds to travel from B to A.

$$\text{Thus, } \frac{S_{\text{train}}}{S_{\text{sound}}} = \frac{t_{\text{sound}}}{t_{\text{train}}}$$

$$S_{\text{train}} = 330 \times \frac{30}{690} = \frac{330}{23} \text{ m/s.}$$

24. In 6 minutes, the car goes ahead by 0.6 km. Hence, the relative speed of the car with respect to the pedestrian is equal to 6 kmph, since, the pedestrian is walking at 2 kmph, hence, the net speed is 8 kmph.

25. At 40 kmph, Harsh would cover $(200/60) \times 40$ km.
 $= 400/3$ km. $= 133.33$ km.

This represents the distance by which Vijay would be ahead of Harsh, when Vijay reaches the endpoint means in essence that Vijay must have travelled for $133.33/20$ hours ≈ 6.66 hours

Hence, the distance is $60 \times 6.66 = 400$ km.

26. Solve this question using the values given in the options. Option (d) can be seen to fit the situation given by the problem as it gives us the following chain of thought:

If the average speed of the faster train is 48 kmph, the average speed of the slower train would be 32 kmph. In this case, the time taken by the faster train ($192/48 = 4$ hours) is 2 hours lesser than the time taken by the slower train ($192/32 = 6$ hours). This satisfies the condition given in the problem and hence option (d) is correct.

27. The required speed s would be satisfying the equation:

$$300/s - 300/(s + 2) = 5$$

Solving for s from the options it is clear that $s = 25$.

28. Solve through options using trial and error. For usual speed 3 kmph we have:

Normal time $\text{Æ } 2/3 \text{ hours} = 40 \text{ minutes}$.

At 4 kmph the time would be $2/4 \text{ hrs}$, this gives us a distance of 10 minutes. Hence option (c) is correct.

29. By increasing the speed by 33.33%, it would be able to reduce the time taken for travel by 25%. But since this is just able to overcome a time delay of 30 minutes, 30 minutes must be equivalent to 25% of the time originally taken. Hence, the original time must have been 2 hours and the original speed would be 750 kmph. Hence, the new speed would be 1000 kmph.

30. The average speed would be given by:

$$\frac{(120 \times 1 \times 40 \times 3)}{4} = 60 \text{ kmph.}$$

31. The length of the circular track would be equal to the circumference of the circle. In 2 minutes thus, the cyclist covers $3.14 \times 200 = 628$ meters (using the formula for the circumference of a circle).

Thus, the cyclist's speed would be $628/2 = 314 \text{ meters/minute}$.

32. The total time taken by the motorist would be $200/53.333 = 200 \times 3/160 = 3.75 \text{ hours} = 3 \text{ hours } 45 \text{ minutes}$. In the first half of the journey the motorist covers $1/4^{\text{th}}$ the distance @ 40kmph. This means that he takes $50/40 = 1.25 \text{ hours} = 1 \text{ hour } 15 \text{ minutes}$ in covering the first 50 kms. This also means that he covers the remaining distance of 150 km in 2 hours 30 minutes Æ a speed of 60 kmph. Hence, option (b) is correct.

33. Assume a distance of 60 km in each stretch. Get the average speed by the formula. Total distance/ Total time = $180/10 = 18 \text{ kmph}$.

34. The speed of the first car would be 60 kmph while the speed of the second car would be 40 kmph. The relative speed of the two cars would be 100 kmph. To cover 480 km they would take $480/100 =$

4.8 hours Æ In 4.8 hours, the car traveling from A to B would have traveled $4.8 \times 60 = 288$ kms.

35. At $3/4^{\text{th}}$ speed, extra time = $1/3^{\text{rd}}$ of time = 16 minutes.
Normal time = 48 minutes.
36. Solve using options. The value in option (d) fits the situation as $20/8 - 20/10 = 2.5 - 2 = 0.5$ hours = 30 minutes.
37. $[73.5 \times 136]/38$. Same logic as for Question 4.
38. The time taken before their meeting would be given by $t^2 = 12 \times 3 = 36$ Æ $t = 6$ hours. This means that their ratio of speeds is 1:2. Since train A is traveling slower, the speed of train B would be double the speed of train A. Required answer = $48 \times 2 = 96$. (Please take a look at the solution of question number 5).
39. The distance would get divided in the ratio of speeds (since time is constant). Thus, the distance ratio would be 5 : 7 and required distance = $5/12 \times 600 = 250$ km.
40. The diameter of the circle would be given by the hypotenuse of the right triangle with legs 600 and 800 respectively. Hence, the required diameter = 1000 meters.
41. When Ram runs 2000 m, Shyam runs (1800 – 30s)
When Ram runs 1000 m, Shyam runs (2000 – 180s).
Then:
$$2000/1000 = \frac{1800 - 30s}{2000 - 180s}$$

Solving , we get $s = 6.66$ m/s
Thus, Shyam's speed = 400 m/minute and he would take 5 minutes to cover the distance. Option (b) fits.
42. From the situation described in the first condition itself we can see that the speed of coming back has to be double the speed of going downstream. Checking the options, only option (a) fits this condition i.e. Downstream speed = $2 \times$ Upstream speed.
Hence, option (a) is correct.
43. $7 \times S_t = L_t$ (1)

$$25 \times S_t = L_t + 378 \quad (2)$$

Solving, $S_t = 21$ m/sec.

$$= 21 \times 18/5 = 75.6 \text{ kmph.}$$

44. In order to solve this, you first need to think of the speed of the river flow (if the speed of the boat in still water is 3 kmph). If we take the speed of the river flow as s , we get downstream speed as $3 + s$ and upstream speed as $3 - s$.

$$10/(3 - s) - 10/(3 + s) = 8 \text{ hours} \quad \therefore s = 2 \text{ kmph.}$$

Note: It is obvious that since the difference between the downstream time and the upstream time is 8 hours, the upstream and downstream speeds would both be factors of 10. The only value of s such that both $3 + s$ and $3 - s$ are factors of 10 is $s = 2$.

If the boat needs to reach 10 km downstream in 100 minutes (1.66 hours) it means: $10/1.66 = 6$ kmph is the downstream speed.

Since, the speed of the stream is 2 kmph, the required speed of the boat = 4 kmph

45. Solve through options. For option (c) at 4 kmph, the boat would take exactly 4 hours to cover the distance.

$$46. \quad x/9 + x/3 = 3/4 \quad \therefore 4x/9 = 3/4 \quad \therefore x = 27/16 \text{ kms} = 1.6875 \text{ kms.}$$

$$47. \quad \text{Upstream speed} = 40/8 = 5 \text{ kmph.}$$

$$\text{Downstream speed} = 49/7 = 7 \text{ kmph.}$$

Speed in still water = average of upstream and downstream speed = 6 kmph.

$$48. \quad (20 \times 5/18) \times 36 = L_t \quad \therefore L_t = 200 \text{ m.}$$

$$49. \quad 8/(12 - 2) = 8/10 = 0.8 \text{ hours}$$

$$50. \quad 15 \text{ km upstream in 80 minutes} \quad \therefore 15/1.33 = 11.25 \text{ kmph. (upstream speed of the boat).}$$

Thus, still water speed of the boat

$$= 11.25 + 5 = 16.25 \text{ kmph}$$

51. Since A to C is double the distance of A to B , it is evident that the time taken for A to C and back would be double the time taken from A to B and back (i.e. double of 6.5 hours = 13 hours). Since going

from A to C takes 9 hours, coming back from C to A would take 4 hours (Since $9 + 4 = 13$).

52. $(S_f - S_s) \times 60 = 200$

Where S_f and S_s are speeds of the faster and slower train respectively

$$\therefore S_f - S_s = 3.33$$

Also, $(S_f + S_s) \times 10 = 200$.

$$\therefore S_f + S_s = 20.$$

Solving we get $S_s = 8.33$ m/s

$$= 8.33 \times 18/5 = 30 \text{ kmph.}$$

53. Speed of Vinay = 5 m/s, Speed of Ajay = 4m/s. In a hundred meter race, Vinay would take 20 seconds to complete and in this time Ajay would only cover 80 meters. Thus, Vinay beats Ajay by 20 meters in a hundred meter race.

54. Solve using options 1.33 m/s fits perfectly.

55. Solve using options 1.33 m/s fits perfectly. When A scores 60 points B scores 45, and C scores 40.

Thus, when B scores 90, C would score 80. So, B can give C 10 points in 90.

56. When Shyam does 500, Vinay does 375. Since Vinay has a start of 140 m, it means that Vinay only needs to cover 360 m to reach the destination.

When Vinay does 360, Shyam would cover 480 m and lose by 20 m. (Since the ratio of their speeds is 3 : 4)

57. Distance to be covered = 120 meters. Speed = 10m/s \therefore Time required = $120/10 = 12$ seconds.

58. $20 \times (5/18) \times 18 = 100 \text{ m} = 0.1 \text{ km.}$

59. When the second train leaves Muzaffarpur, the first train would have already traveled 30 km. Now, after 9 AM, the relative speed of the two trains would be 10 kmph (i.e. the rate at which the faster train would catch the slower train).

Since the faster train has to catch up a relative distance of 30 km in order for the trains to meet, it would take $30/10 = 3$ hours to catch up.

Distance from Muzaffarpur = $70 \times 3 = 210$ km

60. Speed of running of the train = 1.25 km/hr.

With stoppage, an effective speed of 60 kmph means that the time of travel per hour would be $60/1.25 = 48$ minutes.

Thus, the train stops for 12 minutes per hour.

61. Upstream speed = 3.2 kmph

Downstream speed = 6 kmph.

Thus, speed of stream = 1.4 kmph.

62. Vijay takes 9 hours to return upstream after going for 6 hours downstream. Solve using options. Option (d) fits as we get
Downstream speed = 18 kmph \therefore distance = $18 \times 6 = 108$ km

Also, upstream speed = 12 kmph \therefore distance = $12 \times 9 = 108$ km

63. Upstream speed = 4.8 kmph

Downstream speed = 7.2 kmph.

$$d/4.8 + d/7.2 = 1$$

Solving we get $d = 2.88$ km.

64. The length of the train would be given by: $36 \times 5/18 \times 8 = 80$ meters.

65. Rate in still water = $(16 + 22)/2 = 19$ kmph

66. The given situations are satisfied with the speed of the boat as 8 kmph and the speed of the stream as 3 kmph. Option (c) is correct.

67. $10/(x - 2) + 10/(x + 2) = 55/60 = 11/12$ hours.

$x = 22$ fits the expression.

68. The speed of the boat in still water is the average of the upstream and downstream speeds. $(x + y)/2$.

69. $(1/4) \times 2pr = 4p$ (Since $r = 8$ cm).

70. The hands would be together once in each hour. However, the 12 noon time would be counted in both 11 to 12 and 12 to 1. Hence, the no. of times = $12 - 1 = 11$.

71. If we consider the clock to be a circle with circumference 60 km, the speed of the Minute hand = 60 kmph, while the speed of the hour hand = 5 kmph. The relative speed = 55 kmph. At 2 PM, the distance between the two would be seen as 10 km. This would get covered in $10/55 = 2/11$ hours. Option (a) is correct.
72. $14/(5 + x) + 9/(5 - x) = 5$
 $x = 2$, fits this equation.
73. Look for the solution by thinking of the factors of 91. It can be seen that $91/13 + 91/7 = 7 + 13 = 20$ hours. This means that the speed of the boat in still water is 10 kmph and the speed of the water flow would be 3 kmph. Option (a) is correct.
74. When Ajay does 600 metres, Vijay does 540 m.
 When Vijay does 500 metres, Anjay does 475 m
 Thus, Ajay : Vijay : Anjay = 600 : 540 : 513.
 Thus, Ajay would beat Anjay by $(87 \times 2/3) = 58$ m in a 400 m race.
75. $30/(15 + x) + 30/(15 - x) = 4$ hrs 30 minutes.
 At $x = 5$, the equation is satisfied.

Level of Difficulty (II)

- By travelling at 10 kmph higher than the original speed, the train is able to make up 16 minutes while traveling 80 km.
 This condition is only satisfied at an initial speed of 50 (and a new speed of 60 kmph).
- Solve this question through options. For instance, if he traveled at 25 kmph, his original speed would have been 24 kmph.
 The time difference can be seen to be 6 minutes in this case:
 $60/24 - 60/25 = 0.1$ hrs = 6 mins. Thus, this is the correct answer.
- In 1 hours 15 minutes an individual will be able to cover 25% more than his speed per hour. The relationship between the original speed and the new speed is best represented as below:
 Original speed $\xrightarrow{25\% \text{ increase}}$ speed per 75 minutes $\xrightarrow{+1 \text{ increase}}$
 New speed.

Thus, to go from the new speed to the original speed the process would be:

New speed $\xrightarrow{-1}$ Speed per 75 minutes $\xrightarrow{20\% \downarrow}$ Original speed.

We need to use this process to check the option. Only the first option satisfies this condition. (at 16 kmph it would take 6 hours while at 12 kmph it would take 8 hours).

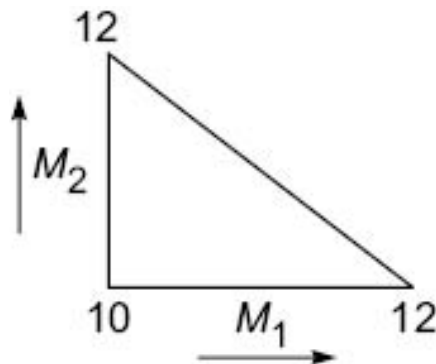
4. The question's structure (and solving) have to be done on the basis of integers. The following equations emerge:

$$\frac{d}{s} - \frac{d}{(s+6)} = 4 \text{ and } \frac{d}{(s-6)} - \frac{d}{(s+6)} = 10$$

Solving these expressions through normal solving methods is close to impossible (at the very least it would take a huge amount of time.) Instead this question has to be solved using the logic that integral difference in ratios in such a situation can only occur in all the three ratios (d/s), $d/(s+6)$ and $d/(s-6)$) are integers.

Hence, d should have three divisors which are 6 units apart from each other.

5. The relative speed is 20 kmph. Also, the pedestrian should take 7:30 hours more than the cyclist. Using option (a) the speeds of the two people are 4km/hr and 16 km/hr respectively. At this speed, the respective times would be 10 hrs and 2:30 hours, giving the required answer.
- 6.



The distance between the motorists will be shown on the hypotenuse. Using the 3,4,5 Pythagoras triplet and the condition that

the two speeds are 6 kmph different from each other, you will get the triplet as: 18,24,30. Hence, the slower motorist travelled at 18 kmph.

7. Since the two motorists meet after an hour, their relative speed is 28 kmph. Use options to check out the values. Since the speed of the faster cyclist is asked for it has to be greater than 14 kmph. Hence only check options > 14 kmph.

8. Since the second ant covers $7/120$ of the distance in 2 hours 30 minutes, we can infer that it covers $8.4/120 = 7\%$ of the distance in 3 hours. Thus, in 3 hours both ants together cover 15% of the distance $\therefore 5\%$ per hour \therefore they will meet in 20 hours.

Also, ratio of speeds = 8 : 7.

So, the second ant would cover 700 ft to the meeting point in 20 hours and its speed would be 35 feet/hr.

9. In this question consider the total distance as 100%. Hence the sum of their speeds will be 75% per hour. Checking option (c)

If the bus took 6 hours, it would cover 16.66% distance per hour and the car would cover 25% distance per hour. (as it takes 2 hours less than the bus.)

This gives an addition of only 41.66%. Hence, the answer is not correct.

Option (b) is the correct answer.

10. The requisite conditions are met on a Pythagoras triplet 6,8,10. Since the racetrack only consists of the legs of the right triangle the length must be $6 + 8 = 14$ km.

11. The sum of speeds would be 0.08 m/s (relative speed in opposite direction). Also if we go by option (b), the speeds will be 0.03 and 0.05 m/s respectively.

At this speed the overlapping would occur every 60 seconds.

12. When Rahim starts, Karim would have covered 40 km. Also, their relative speed is 12 kmph and the distance between the two would get to 0 in $40/12 = 3.33$ hours.

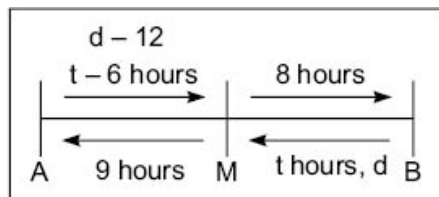
Distance covered = $28 \times 3.33 = 93.33$ km.

13. Solve this question through options.

For option (c), the conditions match since: If he rode for 2 hours (speed = 5 kmph), he would have walked for 6 hours (4 hours more) and his walking speed would be 15 kmph.

If we interchange the times, we get $15 \times 2 = 5 \times 6$.

14. This is a complex trial and error based question and the way you would have to think in this is:

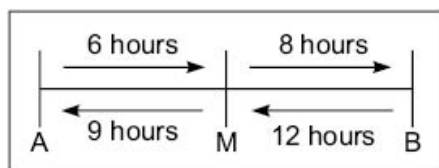


From the figure above, it is clear that A is faster as he takes only $t + 2$ hours while B has taken $t + 9$ hours to complete the journey.

Then, we get: $(t - 6)/9 = 8/t$

Solving for t , we get $t = -6$ (not possible)

Or $t = 12$. Putting this value of t in the figure it changes to:



We also get ratio of speeds = $3 : 2$ (inverse of ratio of times)

The next part of the puzzle is to think of the 12 km less traveled by the first person till the meeting point.

If the speed of the faster person is $3s$, that of the slower person = $2s$.

Further

$$12 \times 2s - 6 \times 3s = 12 \text{ km}$$

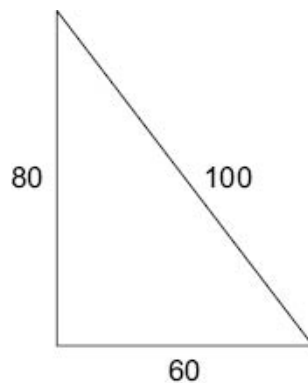
$$s = 2 \text{ kmph.}$$

The speed of the faster tourist is $3 \times 2 = 6 \text{ kmph}$

15. Solve using options. The first option you would check for (given the values in the questions) would be option (b). This would give that the first jogger would run at 3 min per km, while the second jogger would run at 4 min per km. In the new condition, the first jogger would jog for 13 km while the second jogger would jog for 14 km

and their respective times would be 39 mins and 56 minutes. This is consistent with the condition in the question which talks about a difference of 17 minutes in their respective times.

16. Solve this through options as: For option (a)
 $4800/60 - 4800/50 = 16$ minutes
17. The ant would cover $7 \times 8 = 56$ meters in 16 hours.
Further, it would require $7/12$ of the 17th hour to reach the top. Thus
time required = 16 hours 35 minutes
18. If the slower ship took 20 hours (option d) the faster ship would take 12 hours and their respective speeds would be 15 and 25 kmph. This satisfies the basic condition in the question.
19. The movement of the ant in the two cases would be 3, 7, 11, 15, 19, 23 and 1, 9, 17, 25, 33, 41. It can be seen that after 3 seconds the difference is 6mm, after 4 seconds, the difference is 16mm and after 5 seconds the difference is 30 mm. Thus, it is clearly seen that the ant moved for 4 seconds.
20. When the signal happened distance left was 150 km.
 $150/(s) - 150/(s + 15) = 1/2$ hours $\therefore s = 60$.
21. The following figure gives us the movement of the two swimmers:



The faster swimmer must have traveled 80 km in 2 hours and hence his speed is 40 kmph.

22. Since they cover the distance in 80 minutes traveling in opposite directions we infer 100% distance is covered in 80 minutes \therefore 1.25% per minute \therefore 75% per hour.
i.e. their combined distance coverage is 75% per hour.

Since we are asked for the time the faster motorcyclist takes, we can pick up this time from the options.

<i>Options</i>	<i>Time for faster motorcyclist</i>	<i>Faster's % coverage per hour</i>	<i>Slower's % coverage per hour</i>
a	6 hours	16.66	58.33
b	3 hours	33.33	41.66
c	2 hours	50	25
d	4 hours	25	50
e	5 hours	20	55

It is clear that options a, b, d and e are not feasible as it is making the faster motorcyclist slower.

Thus option (c) has to be correct.

Note: You can use the values in option (c) to check the other condition in problem and see that it works.

23. Since the two horses meet after 200 minutes, they cover 0.5% of the distance per minute (combined) or 30% per hour. This condition is satisfied only if you the slower rider takes 10 hours (thereby covering 10% per hour) and the faster rider takes 5 hours (thereby covering 20% per hour).

24. Solve through options the equation: $350/s - 350/(3 + 5) = 2.33$ hours.

$$\text{Æ } s = 25.$$

25. Solve this question through options. The total travel time should be 5 hours 25 minutes.

$$\text{or } 5(5/12) \text{ hours} = 65/12 \text{ hours}$$

$$d/36 + d/14 = 65/12 \text{ Æ } d = 54.6 \text{ km.}$$

Thus, option (d) none of these is correct.

26–28. You can make the following table to chart out the motions of the three.

Hour	Ram	Shyam	Mohan
1	10	30	3.33

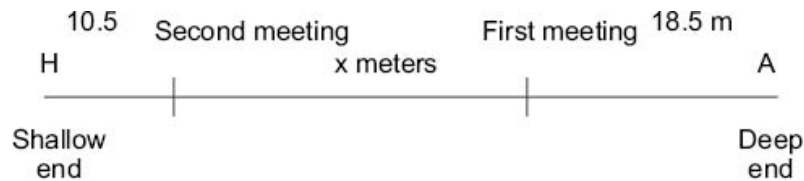
2	20	33.33	6.66
3	60	36.66	10
4	81.66	40	20
5	85	50	30
6	88.33	60	40
	90(6.5)	70(7)	70(7)
		80(8)	100(8)

26. It is evident that Ram would overtake Shyam between 2 and 3. At x , Shyam is ahead by 13.33 km.
Relative speed between 2 – 3 = 36.66 kmph.
Time required = $13.33/36.66$ of the hour
= $4/11$ of the hour
= 2 : 22. (approx)
27. Mohan would overtake Shyam after 70 miles.
28. Ram would cover 90 miles in 3 hours 45 minutes.
Mohan would cover 90 miles in 7 hours 40 minutes.
Time difference = 3 hours 55 minutes.
29. Mohan at 8 pm (each of the others would reach later).
30. Ram would reach at 9:30 p.m., while Shyam would reach at 10:00 p.m.
31. $25/s - 25/(s + 10) = 1/2$
 $S = 50$ km/hr.
32. The respective times are 224 seconds and 364 seconds. They will meet at the starting point in the LCM of these times i.e. 224×13 . Hence, Ram Singh will cover the circle 13 times.
33. The wife drives for 12 minutes less than her driving on normal days. Thus, she would have saved 6 minutes each way. Hence, Ravi would have walked for 30 minutes (since his speed is $1/5^{\text{th}}$ of the car's speed).

In effect, Ravi spends 24 minutes extra on the walking (rather than if he had traveled the same distance by car).

Thus, if Ravi had got the car at the station only, he would have saved 24 minutes more and reached at 5 : 36.

34. The following figure represents the travel of the two:



Once, you can visualize this figure, try to extract the value of x by taking the length as given in the options. For option (a) length of pool is 55.5 meters, the ratio of speeds of Ajay to Hemant on the basis of the first meeting = $18.5/37$. The ratio of speeds on the basis of the second meeting = Ajay's travel to Hemant's travel = $47.5/63.5$. The two ratios are not the same- which they should have been as both these ratios represent the speed ratio between Ajay and Hemant.

For option (b), length of pool is 45 meters, the ratio of speeds of Ajay to Hemant on the basis of the first meeting = $18.5/26.5$. The ratio of speeds on the basis of the second meeting = Ajay's travel to Hemant's travel = $37/53$. The two ratios are the same- which they should have been as both these ratios represent the speed ratio between Ajay and Hemant. Hence, this is the correct answer.

35. The distances covered in percentage would be, $10\% + 6.66\% + 8.33\% + 16.66\% + 5.833\% + 31.666 + 2.0833 = 81.25\%$
 $(22.5/18.75) \times 100 = 120 \text{ km}$
36. If you start at 12 noon, you would reach at 4:30 PM. You would be able to meet the train which left Mumbai at 8 AM, 9 AM, 10 AM, 11 AM, 12 Noon, 1 PM, 2 PM, 3 PM and 4 PM – a total of 9 trains.
37. The total time = time in the first part of the journey + time for the second part of the journey = $k/y + (x - k)/z$. Option (a) is correct.
38. If we assume the speed of the sound as 330 m/s, we can see that the distance traveled by the sound in 45 seconds is the distance traveled by the train in 11 minutes.

$$330 \times 45 = 660 \times s \Rightarrow s = 22.5 \text{ m/s} = 81 \text{ kmph}$$

39–40. In 9 hours, (7 pm to 4 pm) the Kalinga Express would cover 540 kms.

Remaining distance = 260 kms

Relative speed = 150 kmph.

Time required = $260/150 = 1.733$ hours

= 104 minutes.

39. $1.733 \times 90 = 156$ km.

40. 4 A.M. + 1 hr 44 minutes = 5 : 44 A.M.

41. The total distance the bird would travel would be dependent on the time that the cars crash with each other. Also, the speed of the bird is the same as the relative speed of the cars. Hence, the answer to question 41 will be 12 km.

42. The bird would travel at 120 kmph for $4 + 4/3 + 4/9$ minutes. i.e 5.77 minutes. Hence, the answer is $(5.77/60) \times 120 = 11.55$ km.

43. The bird would be able to theoretically reach the bonnet of the second car an infinite number of times.

44. Initial distance = 25 dog leaps.

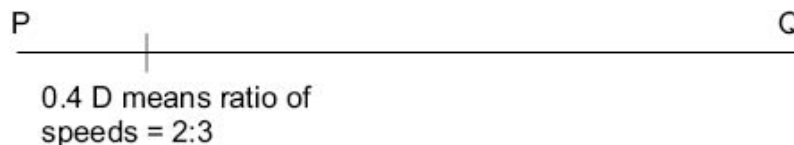
Per minute A dog makes 5 dog leaps

Per minute A Cat makes 6 cat leaps = 3 dog leaps.

Relative speed = 2 dog leaps/minutes.

An initial distance of 25 dog leaps would get covered in 12.5 minutes.

45. Refer to the following figure which helps us understand that the ratio of speeds of A to B would be 2:3.



The 4th meeting would occur after a combined movement of $D + 6D = 7D$. $2/5^{\text{th}}$ of this distance would be covered by A and $3/5^{\text{th}}$ of this distance would be the distance covered by B. Thus, distance covered

by A would be $\frac{2}{5}^{\text{th}}$ of $7D$ --: distance covered by A = $2.8D$ – which means that the 4^{th} meeting occurs at a distance of $0.8D$ from P.

46. In 36 hours, there would be a gap of 8 minutes. The two watches would show the same time when the gap would be exactly 12 hours or 720 minutes.

The no. of 36 hour time frames required to create this gap = $720/8 = 90$.

Total time = $90 \times 36 = 3240$ hours. Since this is divisible by 24, the watches would show 12 noon.

47. Solve through options. At 18 kmph the motorboat would take exactly 6 hours.
48. Check through options. Option (d) will give us 14 kmph and 9 kmph as the down stream and up stream speeds. This would mean that the total travel time would be 1.5 hours and 2.33 hours down stream and up stream respectively.
49. At 2:15 PM the distance between the two trains would be 550 km as the train from Hazipur to Muzaffarpur would already have traveled for 40 minutes. After that they would take $550/110 = 5$ hours to meet. Thus, the train from Muzaffarpur would have traveled 250 kms before meeting. Option (c) is correct.
50. The dog loses $\frac{1}{3}^{\text{rd}}$ of his normal time from the meeting point. (Thus normal time = $35 \times 3 = 105$ minutes)

If the meeting occurred 24 km further, the dog loses 25 minutes.

This means that the normal time for the new distance would be 75 minutes. Thus, normally the dog would cover this distance of 24 km in 30 minutes. Thus, normal speed = 48 km/hr.

EXERCISE ON APPLICATIONS OF TIME, SPEED AND DISTANCE

1. At the ancient Athens Olympic games, in a duel between two runners, Porthus and Morpheus, they were made to start running in opposite direction from diametrically opposite ends of a circular race track of length (circumference) 2 kms. The first time they met was after 24 minutes. If the distance between them exactly ' n ' minutes after they start is equal to a quarter of the length of the track, which of the following is a possible value of ' n '?
(a) 124 (b) 184
(c) 160 (d) 204
2. Aman and Biman started a walkathon around a circular track starting from the same point on the track in opposite directions. They met for the first after time ' t '. Had they walked in the same direction with their speeds intact, they would have met after a time ' $7t$ '. It was also observed that Aman was slower than Biman, and Aman's speed was measured at 12 kmph. Find the speed of Biman.
(a) 4 m/s (b) 5 m/s
(c) 6 m/s (d) None of these
3. Abhishek and Aiswarya start from two opposite ends of a tunnel AB, which is 182 meters in length. Abhishek starts from A and Aiswarya starts from B. After they meet, they continue moving in their respective directions, till one of them reaches his end point and immediately reverses direction and starts walking back towards the other end. The ratio of their speeds is 7:6. At what distance (in metres) from A will they meet when Abhishek is in his 8th round?
(a) 105 (b) 130
(c) 125 (d) They would not meet.

4. For the above question, at what distance (in metres) from A will they meet when Abhishek is in his 12th round?
- (a) 126 (b) 118
(c) 91 (d) They would not meet.
5. Two runners Porthus and Zeus, are running around a circular track at different speeds such that they meet after regular time intervals. The length of the track (circumference) is 1600 meters. If they run in opposite directions, they meet at eight different points while if they run in the same direction it is observed that they meet at 2 distinct points on the circular track. If they meet at intervals of 1.33 minutes when they run in the same direction, how much time does the faster runner (Porthus) take to complete one round?
- (a) 80 secs (b) 128 secs
(c) 120 secs (d) None of these
6. At the Vijayantkhand Mini Stadium there are two circular race tracks— A with radii 40m and B 80 m respectively such that they touch each other at a point X. The coach Vijay Sir has a particular ritual with his best athletes Mridul and Odeon. Mridul runs at a speed of $80p$ m/min on Race Track A and Odeon runs at a speed of $40p$ m/min along the Race Track B. Both of them start from the point X and run multiple rounds. If Mridul gives Odeon a start of 4 mins exactly before he starts running himself, after how much time (in minutes) will the straight line distance between the two be exactly 240 m?
- (a) 6 (b) 10
(c) 12.5 (d) Never
7. Bolt and Milkha, start running around a race track simultaneously. Bolt runs at a speed of ' s ' kmph, while Milkha runs at a speed of ' m ' kmph. They meet for the first time when Bolt is in his third round. Which of the following can be the value of $x : y$?
- (a) 11 : 6 (b) 11 : 5
(c) 17 : 8 (d) 9 : 4

8. Amar, Abhijit and Arun start running on a circular race track (from the same point). Amar and Abhijit run in a clockwise fashion while Arun runs anticlockwise. When Amar and Arun meet for the first time, Arun is at a distance which is equal to a quarter of the circumference of the circular race track. It is also known that Amar runs faster than Arun. The ratio of speeds of Amar, Arun and Abhijit cannot be...?
(a) 5 : 1 : 2 (b) 3 : 1 : 1
(c) 4 : 2 : 1 (d) 3 : 2 : 1
9. At what time between 6 and 7 o'clock is the minute hand of a clock 4 minutes ahead of the hour hand?
(a) $34 \frac{1}{11}$ minutes past 6
(b) $36 \frac{5}{11}$ minutes past 6
(c) $37 \frac{1}{11}$ minutes past 6
(d) None of these
10. The minute hand of a clock overtakes the hour hand at intervals of 66 minutes of the correct time. How much time does the clock gain or lose in 4 hours?
(a) $1 \frac{119}{121}$ minutes (b) $1 \frac{114}{121}$ minutes
(c) 2 minutes (d) None of these
11. Robin Varkey's watch always runs faster than the actual time – and gains time uniformly. He sets the watch to be 10 minutes behind time at 12 noon on a Sunday. He observes that the watch is 5 minutes 48 seconds faster the following Sunday at 12 noon. At what exact time would the watch be correct?

(a) $\frac{26}{79}$ hours past 10 PM on Thursday

(b) $\frac{13}{79}$ hours past 8 PM on Thursday

(c) $\frac{26}{79}$ hours past 6 PM on Thursday

(d) None of these

- 12.** Prawin Tiwari sets his clock right at 10 AM on Monday morning. However, being a defective piece (the clock), it loses 32 minutes every day. He has to get up on Friday at exactly 2 AM to catch his flight to Lebuana. At what time on Friday morning should he set the alarm on his watch in order for the watch to ring at exactly 2 AM?

(a) 3 AM

(b) 4 AM

(c) 5 AM

(d) None of these

- 13.** At what time, in minutes, between 4 o'clock and 5 o'clock, would both the hands of a clock coincide with each other?

(a) $22\frac{1}{11}$

(b) $21\frac{9}{11}$

(c) $22\frac{4}{11}$

(d) $21\frac{7}{11}$

- 14.** At what time between 8 PM to 9 PM will the hands of a clock be in the same straight line pointing away from each other?

(a) $10\frac{8}{11}$ minutes past 8

(b) $10\frac{10}{11}$ minutes past 8

(c) $10\frac{3}{11}$ minutes past 8

(d) $9\frac{10}{11}$ minutes past 8

15. A watch which gains 5 seconds in 3 minutes was set right at 7 am. In the afternoon of the same day, when it indicated quarter past 4 o'clock, the true time is:

(a) $59\frac{7}{12}$ min. past 3

(b) 4 p.m

(c) $58\frac{7}{11}$ min. past 3

(d) $2\frac{3}{11}$ min. past 4

16. In a 2000 m race between Portheus and Cassius, Portheus gives Cassius a head start of a minute but still beats him by 200 m. When, he increases the head start to 80 seconds, the race ends in a dead heat. Find the speed of Portheus.

(a) 25 m/s

(b) 18 m/s

(c) 13.33 m/s

(d) 16.66 m/s

17. How many right angles would be formed between the minute and the hour hand of a watch in a day?

(a) 48

(b) 46

(c) 45

(d) 44

18. How many times between 2 PM and 4 PM does the minutes hand coincide with the seconds hand?

(a) 118

(b) 119

(c) 120

(d) 121

19. A man enters his house at some time between 6 to 7 PM. When he leaves his house sometime between 7 to 8, he observes that the minute hand and the hour hand have interchanged positions. At what exact time did the man enter the house?

(A) $38\frac{82}{121}$ minutes past 6

(b) $37 \frac{42}{121}$ minutes past 6

(c) $37 \frac{82}{121}$ minutes past 6

(d) $37 \frac{62}{121}$ minutes past 6

20. How many straight lines would be formed between the minute and the hour hand of a watch in a day?

(a) 48

(b) 46

(c) 45

(d) 44

21. Two friends started simultaneously from Lucknow towards Kanpur in the same direction along a straight road. The faster friend Raveesh was on a bike while Prakash was in an auto. The ratio of their speeds was 1 : 5 respectively. Two hours later, Raveesh parked his bike and started running back towards Prakash's auto. His speed dropped by 80% as a result of this. They meet at a point which is 15 km from Kanpur. What was the speed of the auto?

(a) 2 km/hr

(b) 2.5 km/hr

(c) 3 km/hr

(d) None of these.

22. Two brothers came to know about their sister's wedding at the last minute. The wedding was to be held at a location which was 800 kms away from Mumbai where both of them lived. The elder brother Kanhaiya came to know about the wedding at 6 PM and left immediately in his car. His younger brother Ramaiyya came to know about the wedding at 9:30 PM and left in his car immediately at a speed which was 15 kmph higher than the speed of his elder brother. At 4:30 AM it was found that the two cars were 70 km apart. If the cars had travelled continuously without taking any rest, find the speed (in km/hr) of car A.

(a) 40

(b) 50

(c) 60

(d) Cannot be determined

23. Ranatunga once challenged Bolt to a race. The distance of the race was set at 2 km. They start at the same time and the ratio of their speeds is seen to be 4:1 (obviously Bolt would be faster). After some time passes, Bolt realises that he is far ahead and calculates that even if he stops for a snack and a nap for 'n' minutes, he would still reach his destination and beat Ranatunga by 13 minutes. Hence, he plans to take a break of 'n' minutes. Ranatunga keeps walking during this whole time. However, when Bolt wakes up, he realises that he has stopped for a total of (n+15) minutes. He redoubles his efforts by increasing his speed to double his original speed. The race eventually ended in a dead heat. If it is known that Bolt overstayed his stop by $\frac{6n}{5}$ mins, how long did Ranatunga take to complete the race?
- (a) 32 mins (b) 34 mins
(c) 25 mins (d) None of these
24. A and B run a 300 m race where the initial speed of B is double the speed of A. After some time, going on these speeds, A realising that he would be losing the race redoubled his effort and increased his speed to four times his initial speed. As a result, they reached the end point at the same time and the race resulted in a dead heat. What was the distance traveled by B, when A quadrupled his speed?
- (a) 100 m (b) 200 m
(c) 150 m (d) None of these
25. Amit and Bimal start running around a circular track of circumference 4200 metres. Their respective speeds are 15m/s and 3 m/s. Their 14th meeting occurs at point P and their 22nd meeting occurs at the point Q. Find the longer distance (along the circumference) between Points P and Q.
- (a) 2800 (b) 1400
(c) 3500 (d) 3150
26. In a 2 km race, Ravi beats Sandeep by 45 seconds and Sandeep beats Tarun by a further 75 seconds. In the same race, Ravi beats

Tarun by 400 m. Find the time in which Ravi can run the race (in seconds).

(a) 240

(b) 300

(c) 360

(d) 480

ANSWER KEY

1. (d)

2. (d)

3. (d)

4. (a)

5. (b)

6. (d)

7. (a)

8. (d)

9. (c)

10. (a)

11. (a)

12. (b)

13. (b)

14. (b)

15. (b)

16. (d)

17. (d)

18. (d)

19. (a)

20. (c)

21. (b)

22. (b)

23. (b)

24. (b)

25. (a)

26. (d)

Solutions

1. They would first meet after 24 minutes (after covering 50% of the distance represented by the circumference of the circle). The next time they would meet would be at 72 minutes, then 120 minutes, then 168 minutes, 216 minutes and so on.

Every time they meet they would be together and after the meeting point they continue running in opposite directions till they meet again. Between two meeting points, the distance between them would be 25% of the length of the circle's circumference in two cases: first when they are going away from each other after meeting (this would occur at a time of 12 minutes after the meeting point) and second when they are approaching each other before their next meeting (this would occur at a time of 12 minutes before the next meeting point).

The meeting times 24, 72, 120, 168, 216, 264 etc, the table would represent the times at which the distance would be 25% of the circumference:

$(24 - 12 = 12)$; $(24 + 12 = 36)$; $(72 - 12 = 60)$;

$(72 + 12 = 84)$; $(120 - 12 = 108)$; $(120 + 12 = 132)$;

$$(168 - 12 = 156); (168 + 12 = 180);$$

$$(216 - 12 = 204).$$

Only Option (d) is possible and hence is the correct answer.

2. Let the speed of Biman be b kmph. The value of b should be such that. be x .

$b = 16 \text{ kmph} = 16 \times 5 \div 18 = 80 \div 18 \text{ m/s} = 4.44 \text{ m/s}$. Option (d) is the correct answer.

3. When Abhishek would complete 7 rounds, Aiswarya would have completed: $7 \times 6 \div 7 = 6$ rounds.

This means that both of them would be at the point B at this time. Since Abhishek is faster than Aiswarya, during his eighth round there would be no meeting with Aiswarya. Hence, Option (d) is correct.

4. When Abhishek would complete 11 rounds, Aiswarya would have completed: $11 \times 6 \div 7$ rounds = $9 \frac{3}{7}$ rounds.

This means that Aiswarya would be at a distance of $3/7$ from A, while Abhishek would be at B at this point of time. The distance between them would be $4/7$ of the total distance between A and B. Aiswarya would further cover a distance of $4/7 \times 6/13$ in order to meet Abhishek. Thus the total distance from A is $(3/7 + 24/91) \times 182 = 63 \times 182 \div 91 = 126$ meters from A and 56 meters from B. Option (a) is correct.

5. Let the ratio of speeds be $P:Z$ (where $P > Z$).

Since they meet at 8 distinct points on the circle when they move in opposite directions, it automatically means that the sum of $P+Z = 8$. (I would like to encourage you to discover this piece of logic through trial and error.)

Similar logic gives us that $P-Z = 2$ (since they meet at two distinct points when travelling in the same direction).

Using these two equations, we can determine that if $P = 5$, $Z = 3$. Let the speeds of P be $5x$ and Z be $3x$ (in m/s). Then we have: $1600/8x =$

80 secs $\therefore x = 2.5$ and hence the speeds are $P = 12.5$ m/s and $Z = 7.5$ m/s.

P would take $1600 \div 12.5 = 128$ seconds to complete one round.

Option (b) would be the correct answer.

6. Since the radii of the circles are 40m and 80m respectively, the circumference would be 80π and 160π meters respectively. Since Odeon's speed is 40π m/min, he would take 4 minutes to cover a round. This also means that when Mridul starts running, they would both be at point X, since Odeon would have covered 1 round exactly in 4 minutes. Also, for the straight line distance to be 240 m they should be at the diametrically opposite ends from the point X (of their respective circles). Mridul reaches the diametrically opposite end (from X) of his circle for the first time in 30 seconds and after that he would reach the same point every 1 minute at 1:30, 2:30 and so on. Odeon on the other hand would reach the diametrically opposite end at 2 minutes, 6 minutes, 10 minutes and so on. They would never be exactly 240 m apart. Option (d) is correct.
7. Check using the options. You can see that only in the case of Option (a) do they meet when Bolt is in his third round. For all other options, Bolt would cross Milkha when Bolt is in his second round.
8. Checking the options, it can be seen that the condition of diametrically opposite is satisfied in each of the first three options. It is only in Option (d) that it is not satisfied. Hence, Option (d) is correct.
9. At 6 o'clock, the minute hand is 30 minutes behind the hour hand. From this position, we need to reach a position, where the minute hand is 4 minutes ahead of the hour hand. For this to occur, the minute hand has to gain $(30 + 4) = 34$ minute spaces on the hour hand. In one hour, the minute hand moves 60 minutes while the hour hand moves 5 minute spaces on the clock. Hence, the minute hand gains 55 minutes on the hour hand in an hour.

Hence, to gain, 34 minutes, the minute hand would take

$$\left(\frac{60}{55} \times 34 \right) = 37 \frac{1}{11} \text{ min.}$$

The required answer would be $37\frac{1}{11}$ minutes past 6. Option (c) is correct.

- 10.** Assume the clock to be a circular race track of 60 kms with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 kms more than Mr. Hour every hour.

This means that they would be together (meaning Mr. Minute would overtake Mr. Hour) every $\left(\frac{60}{55} \times 60\right)$ min. = $65\frac{5}{11}$ minutes. If they meet at longer time intervals than this, it means that the clock is slow. If the time intervals are shorter it would mean that the clock is fast.

In this problem they are together after 66 minutes. Thus, the clock loses time.

$$\text{Loss in 66 minutes} = \left(66 - 65\frac{5}{11}\right) = \frac{6}{11} \text{ minutes.}$$

$$\text{Using unitary method we get loss in 4 hours} = \left(\frac{6}{11} \times \frac{60 \times 4}{66}\right) \text{ min.} = 1\frac{119}{121} \text{ minutes.}$$

- 11.** In one week the time elapsed is exactly 168 hours. Robin's watch gains 15 minutes 48 seconds in 168 hours. In other words it gains $\left(10 + 5\frac{4}{5}\right)$ min. or $\frac{79}{5}$ minutes in 168 hrs.

To be showing the exact time, the watch should have gained exactly 10 minutes.

Using Unitary method it can be seen that 10 minutes would be gained by the watch in: $\left(168 \times \frac{5}{79} \times 10\right)$ hrs. = $106\frac{26}{79}$ hours.

\ Watch is correct at $\frac{26}{79}$ hours past 10 PM on Thursday. Option (a) is the correct answer.

- 12.** Time from 10 AM on Monday to 2 AM on Friday = 88 hours.
Now 23 hrs 28 minutes of this clock = 24 hours of correct clock.

$$\backslash \frac{352}{15} \text{ hrs of this clock} = 24 \text{ hours of correct clock}$$

$$88 \text{ hrs of this clock} = \left(24 \times \frac{15}{352} \times 88 \right) \text{ hrs of correct clock.}$$

= 90 hrs of correct clock. This means that at 2 AM on Friday his clock would show 4 AM. Hence, if he needs to wake up at 2 AM, he should set his clock's alarm at 4 AM.

Hence, Option (b) is the correct answer.

- 13.** Assume the clock to be a circular race track of 60 kms with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 kms more than Mr. Hour every hour.

At 4 o'clock, the minute hand is 20 kms behind the hour hand.

It would hence, need to gain 20 kms to coincide with the hour hand.

In 60 minutes, it gains 55 kms.

In t minutes, it gains 20 kms.

$$= \left(\frac{60}{55} \times 20 \right) \text{ min.} = 21 \frac{9}{11} \text{ minutes.}$$

- 14.** Thinking as in the previous question, we can think that at 8 PM the minute hand is 40 kms behind the hour hand. For it to become 30 kms behind the hour hand, we would need it to cover 10 kms over the hour hand.

In 60 minutes, it gains 55 kms.

In t minutes, it gains 10 kms.

$$= \left(\frac{60}{55} \times 10 \right) \text{ min.} = 10 \frac{10}{11} \text{ minutes.}$$

Option (b) is correct.

15. Time from 7 am to 4:15 pm = 9 hrs 15min = $\frac{37}{4}$ hrs

3 min 5 sec of this clock = 3 min of the correct clock.

fi $\frac{37}{720}$ hrs of this clock = $\frac{1}{20}$ hrs of the clock.

fi $\frac{37}{4}$ hrs of this clock = $\left(\frac{1}{20} \times \frac{720}{37} \times \frac{37}{4}\right)$ hrs of the correct clock
= 9 hrs of the correct clock

The correct time is 9 hrs after 7 AM i.e. 4 PM.

16. Since Cassius is able to get a dead heat when he gets a head start of 80 seconds, it means that he would cover 200 meters in 20 seconds. Hence, his speed is 10m/s.

Let the time taken by Portheus to finish the race be t seconds. Then tracking the movement of Cassius we get:

$$t \times 10 + 60 \times 10 = 2000 - 200.$$

So $t = 120$ seconds.

Hence, the speed of Portheus would be = $2000/120 = 250/15 = 50/3 = 16.666$ m/s. Option (d) is correct.

17. There are 2 right angles that are formed every hour between the hands of a watch. Hence, in 24 hours, we would expect 48 right angles. However, between 2 to 4 AM and 2 to 4 PM the number of right angles formed is only 3, because the right angle formed at 3 O'Clock (both AM and PM) is the second right angle for the hour between 2 O'Clock and 3 O'Clock. It is also the first right angle between 3 O'Clock and 4 O'Clock. This makes the clock lose two of its 48 expected right angles. Similarly, two right angles are lost when the clock passes through 8 O'Clock to 10 O'Clock. Hence, there would be a total of 44 right angles formed. Option (d) is correct.
18. In two hours, the minute hand completes 2 rounds around the circumference of the clock's dial. In the same time, the seconds hand covers 120 rounds. If we count 2 PM coincidence as the first

one, the 4 pm coincidence would be the last one. There would be a total of 121 coincidences in 2 hours. Option (d) is correct.

- 19.** Assume the clock to be a circular race track of 60 kms with each minute denoting 1 km. Also imagine two runners Mr. Minute and Mr. Hour running on this track. Normally, in a correct clock, Mr. Minute would cover 55 kms more than Mr. Hour every hour. For the conditions given in the problem, when the man enters the house, the time would be somewhere between 6:35 to 6:40 while when he leaves the time would be somewhere between 7:30 to 7:35.

Let, the distance between the two be equal to x kms. When the hands interchange positions, the hour hand would have traveled x kms and the minute hand would have traveled $(60 - x)$ kms.

Using unitary method we get:

When the minute hand travels 60 kms, the hour hand travels 5 kms.

When the minute hand travels ' $60 - x$ ' kms, the hour hand travels ' x ' kms.

$$60x = 300 - 5x \Rightarrow x = \frac{300}{55} = 5\frac{5}{11} \text{ minutes.}$$

This means that when he comes home, the minute hand is $5\frac{5}{11}$ minutes ahead of the hour hand.

In order to find the exact time at which this happens between 6 to 7, we know that at 6, the minute hand is 30 kms behind the hour hand.

For the minute hand to move $5\frac{5}{11}$ minutes ahead of the hour hand

we would need the minute hand to cover $35\frac{5}{11}$ kms.

In 60 minutes, the minute hand covers 55 kms.

In t minutes, the minute hand covers $35\frac{5}{11}$ minutes.

$$= 60 \times 35 \frac{5}{11} \div 55 = \frac{12}{11} \times \frac{390}{11} \text{ minutes} = 4680 \div 121 = 38 \frac{82}{121}$$

minutes.

He comes home at $38 \frac{82}{121}$ minutes past 6.

- 20.** There are 2 times that the hands of a watch form straight lines every hour. Hence, in 24 hours, we would expect 48 straight lines. However, between 11 to 1 and between 5 to 7 we would 'lose' one straight line as the 12 o'clock straight line and the 6 o'clock straight lines are double counted. Hence, the number of straight lines = $48 - 1$ (for 5 AM to 7 AM) $- 1$ (for 11 AM to 1 PM) $- 1$ (for 5 PM to 7 PM). Hence, there would be a total of 45 straight lines formed in a day. Option (c) is correct.
- 21.** Solve this through options. Option (b) matches the conditions of the problem and is hence the correct answer.

The thought process for this goes as follows:

If the auto's speed is 2.5, the bike's speed would be 12.5. Naturally 2 hours later, Raveesh would be at 25 kms. while Prakash would be at 5 kms. A distance of 20 kms. When Raveesh starts back his speed would be 2.5 kmph and hence the total speed at which they would approach each other would be 5 kmph. They would meet 6 hours after starting – and in this time Prakash would have covered 15 km and hence they would meet at 15 km from Kanpur. (This last bit would not match for the other options.)

For example if we check Option (a):

The thought process for this goes as follows:

If the auto's speed is 2, the bike's speed would be 10. Naturally 2 hours later, Raveesh would be at 20 kms while Prakash would be at 4 kms. A distance of 16 kms. When Raveesh starts back his speed would be 2 kmph and hence the total speed at which they would approach each other would be 4 kmph. They would meet 6 hours after starting – and in this time Prakash would have covered 12 km

and hence they would meet at 12 km from Kanpur which does not match the information in the problem.

22. Solve using options. For option (b), at 4:30 AM the elder brother has travelled for 10:30 hours and hence must have covered 525 kms. The younger brother has traveled only for 7 hours and at a speed of 65 kmph, the distance traveled would be 455 km. This would mean that the distance between them would be 70 km (as given). Hence, this option works correctly. The other options do not work and can be tested in a similar way. For instance for option (a), 40 kmph does not work because $10.5 \times 40 - 7 \times 55 \neq 70$.

Similarly, Option (c) can be rejected because $10.5 \times 60 - 7 \times 75 \neq 70$

23. Since Bolt outstretched his time by $6n/5$ mins and this is also equal to 15 mins. Solving we get: $n = 12.5$ mins.

Let their original speeds be '4s' and 's' kmph respectively.

Had Bolt not overstretched his nap, he would have beaten Ranatunga by 13 min.

$$\frac{2000}{4s} + 12.5 + 13 = \frac{2000}{s} \text{ if } s = 1000/17$$

Hence, the time taken by Ranatunga to complete the race = $2000 \times 17 \div 1000 = 34$ minutes.

Hence, Option (b) is correct.

24. The distance traveled by B in the initial phase of the race would be double the distance traveled by A during the same time. Likewise, in the second phase of the race, the distance traveled by A would be double the distance traveled by B. Also the total distance traveled by A and B would be 300 m. The only value which creates this symmetrical situation is if the initial phase is such that B travels 200 m and A travels 100 m. Hence, Option (b) is correct.

25. Imagine the circle to be a clock with 12 divisions on the circumference- each division equal to a distance of $4200 \div 12 = 350$ metres. (Imagine these are representing 1 o'Clock to 12 o'Clock for ease of understanding). Since they travel at a ratio of speed as 5:1,

imagine Amit travels clockwise and Bimal travels anti clockwise. Their first meeting would occur at the point representing 10 o’Clock, the next at 8 o’clock, then 6 o’clock and so on. It can be seen that the 14th meeting would occur at 8 o’Clock and the 22nd meeting at 4 o’Clock. The longer distance between them would be equal to 8 markings on the clock. This distance would be $8 \times 350 = 2800$ metres. Option (a) is correct.

- 26.** Ravi beats Tarun by 120 seconds or 400 meters. Hence, Tarun’s speed is $400 \div 2 = 200$ m/minute. Also, when Ravi does 2000 meters, Tarun does 1600 meters – which he would do in 8 minutes. Thus Ravi takes 8 minutes = 480 seconds to complete the race. Option (d) is correct



BLOCK REVIEW TESTS

Review Test 1

1. A man earns $x\%$ on the first ₹ 5,000 of his investment and $y\%$ on the rest of his investment. If he earns ₹ 1250 from ₹ 7,000 and ₹ 1750 from ₹ 9,000 invested, find the value of x .
(a) 20% (b) 15%
(c) 25% (d) None of these
2. The price of a television set drops by 30% while the sales of the set goes up by 50%. What is the percentage change in the total revenue from the sales of the set?
(a) -4% (b) -2%
(c) +5% (d) +2%
3. A person who has a certain amount with him goes to the market. He can buy 100 oranges or 80 mangoes. He retains 20% of the amount for petrol expenses and buys 40 mangoes and of the balance, he purchases oranges. The number of oranges he can purchase is:
(a) 30 (b) 40
(c) 15 (d) 20
4. A cloth merchant cheats his supplier and his customer to the tune of 20% while buying and selling cloth respectively. He professes to sell at the cost price but also offers a discount of 20% on cash payment, what is his overall profit percentage?
(a) 20% (b) 25%
(c) 40% (d) 15%
5. I sold two horses for ₹ 50,000 each, one at the loss of 20% and the other at the profit of 20%. What is the percentage of loss (-) or

profit (+) that resulted from the transaction?

- (a) (+) 20 (b) (−) 4
(c) (+) 4 (d) (−) 20

6. The cost of a diamond varies directly as the square of its weight. A diamond fell and broke into four pieces whose weights were in the ratio 1:2:3:4. As a result the merchant had a loss of ₹700000. Find the original price of the diamond.

- (a) ₹ 14 lacs (b) ₹ 20 lacs
(c) ₹ 10 lacs (d) ₹ 25 lacs

7. Two oranges, three bananas and four apples cost ₹ 25. Three oranges, two bananas and one apple cost ₹ 20. I brought 3 oranges, 3 bananas and 3 apples. How much did I pay ?

- (a) ₹ 22.5 (b) ₹ 27
(c) ₹ 30 (d) Cannot be determined

8. From each of two given numbers, half the smaller number is subtracted. Of the resulting numbers the larger one is five times as large as the smaller one. What is the ratio of the two numbers?

- (a) 2: 1 (b) 3: 1
(c) 3: 2 (d) None of these

Directions for Questions 9 and 10: Answer these questions based on the following information.

A watch dealer incurs an expense of ₹150 for producing every watch. He also incurs an additional expenditure of ₹ 30,000, which is independent of the number of watches produced. If he is able to sell a watch during the season, he sells it for ₹ 250. If he fails to do so, he has to sell each watch for ₹ 100.

9. If he is able to sell only 1,000 out of 1,500 watches he has made in the season, then he has made a profit of:

- (a) ₹90,000 (b) ₹75,000
(c) ₹45,000 (d) ₹60, 000

10. If he produces 2000 watches, what is the number of watches that he must sell during the season (to the nearest 100) in order to break-even, given that he is able to sell all the watches produced?
- (a) 700 (b) 800
(c) 900 (d) 1,000
11. A stockist wants to make some profit by selling oil. He contemplates about various methods. Which of the following would maximise his profit?
- I. Sell oil at 20% profit.
II. Use 800 g of weight instead of 1 kg
III. Mix 20% impurities in oil and selling it at cost price.
IV. Increase the price by 10% and reduce weights by 10%.
- (a) I or III (b) II
(c) II and IV (d) Profits are same
12. A dealer offers a cash discount of 20% and still makes a profit of 20%, when he further allows 160 articles when the customer buys 120. How much percent above the cost price were his wares listed?
- (a) 100% (b) 80%
(c) 75% (d) $66\frac{2}{3}\%$
13. A man buys spirit at ₹ 600 per litre, adds water to it and then sells it at ₹ 750 per litre. What is the ratio of the spirit's weight to the weight of the water if his profit in the deal is 37.5%?
- (a) 9:1 (b) 10:1
(c) 11:1 (d) None of these

Directions for Questions 14 to 16: Answer these questions based on the following information.

Aamir, on his death bed, keeps half his property for his wife and divides the rest equally among his three sons: Bimar, Cumar and Danger. Some years

later, Bimar dies, leaving half his property to his widow and half to his brothers, Cumar and Danger together, sharing equally. When Cumar makes his will, he keeps half his property for his widow and the rest he bequeaths to his younger brother Danger. When Danger dies some years later, he keeps half his property for his widow and the remaining for his mother. The mother now has ₹15,75,0000

14. What was the worth of the total property?

(a) ₹3 crore	(b) ₹0.8 crore
(c) ₹1.8 crore	(d) ₹2.4 crore
15. What was Cumar's original share ?

(a) ₹40 lakh	(b) ₹120 lakh
(c) ₹60 lakh	(d) ₹50 lakh
16. What was the ratio of the property owned by the widows of the three sons, in the end?

(a) 7:9:13	(b) 8:10:17
(c) 5:7:9	(d) 9:12:13
17. At a bookstore, "MODERN BOOK STORE" is flashed using neon lights. The words are individually flashed at long intervals of $2\frac{1}{2}$, $4\frac{1}{4}$, $5\frac{1}{8}$ seconds respectively, and each word is put off after a second. The least time after which the full name of the bookstore can be read again, is:

(a) 49.5 seconds	(b) 73.5 seconds
(c) 1744.5 seconds	(d) 855 seconds
18. A train approaches a tunnel AB. Inside the tunnel a cat is located at a point that is $\frac{2}{5}$ th the distance AB measured from the entrance A. When the train whistles, the cat runs. If the cat moves to the entrance of the tunnel, A, the train catches the cat exactly at the entrance. If the cat moves to the exit B, the train catches the cat at exactly the exit. The speed of the train is greater than the speed of the cat by what order?

19. Six technicians working at the same rate complete the work of one server in 2.5 hrs. If one of them starts at 11:00 a.m. and one additional technician per hour is added beginning at 5:00 p.m., at what time the server will be complete?
- (a) 6:40 p.m., (b) 7 p.m.
(c) 7:20 p.m. (d) 8:00 p.m.

A thief, after committing the burglary, started fleeing at 12 noon, at a speed of 60 km/hr. He was then chased by a policeman X. X started the chase, 15 min after the thief had started, at a speed of 65 km/hr.

20. At what time did X catch the thief?
- (a) 3.30p.m. (b) 3 p.m.
(c) 3.15 p.m. (d) None of these
21. If another policeman had started the same chase along with X, but at a speed of 60 km/hr, then how far behind was he when X caught the thief?
- (a) 18.75 km (b) 15 km
(c) 21 km (d) 37.5km
22. Two typists undertake to do a job. The second typist begins working one hour after the first. Three hours after the first typist has begun working, there is still $\frac{9}{20}$ of the work to be done. When the assignment is completed, it turns out that each typist has done half the work. How many hours would it take each one to do the whole job individually?
- (a) 12 hr and 8 hr (b) 8 hr and 5.6 hr
(c) 10 hr and 8hr (d) 5 hr and 4 hr

23. A man can walk up a moving 'up' escalator in 30 s. The same man can walk down this moving 'up' escalator in 90s. Assume that his walking speed is same upwards and downwards. How much time will he take to walk up the escalator, when it is not moving?
- (a) 30s (b) 45s
(c) 60s (d) 90s

Directions for Questions 24 and 26: Answer the questions based on the following information.

Boston is 4 hr ahead of Frankfurt and 2 hrs behind India. X leaves Frankfurt at 6 p.m. on Friday and reaches Boston the next day. After waiting there for 2 hrs, he leaves exactly at noon and reaches India at 1 a.m. On his return journey, he takes the same route as before, but halts at Boston for 1 hr less than his previous halt there. He then proceeds to Frankfurt.

24. If his journey, including stoppage, is covered at an average speed of 180 mph, what is the distance between Frankfurt and India?
- (a) 3,600 miles (b) 4,500 miles
(c) 5580 miles (d) Data insufficient
25. If X had started the return journey from India at 2.55 a.m. on the same day that he reached there, after how much time would he reach Frankfurt?
- (a) 24 hrs (b) 25 hrs
(c) 26 hrs (d) Data insufficient
26. What is X's average speed for the entire journey (to and fro)?
- (a) 176 mph (b) 180 mph
(c) 165 mph (d) Data insufficient

Review Test 2

1. A car after traveling 18 km from a point A developed some problem in the engine and the speed became $\frac{4}{5}$ th of its original speed. As a result, the car reached point B 45 minutes late. If the engine had developed the same problem after travelling 30 km from A, then it would have reached B only 36 minutes late. The original speed of the car (in km per hour) and the distance between the points A and B (in km) are
(a) 25,130 (b) 30,150
(c) 20,190 (d) None of these
2. A, B and C individually can finish a work in 6,8 and 15 hours respectively. They started the work together and after completing the work got ₹94.60. when they divide the money among themselves. A, B and C will get respectively (in ₹)
(a) 44,33,17.60 (b) 43,27,24.60
(c) 45,30,19.60 (d) 42,28,24.60
3. Two trains are traveling in opposite direction at uniform speed 60 and 50 km per hour respectively. They take 5 seconds to cross each other. If the two trains had traveled in the same direction, then a passenger sitting in the faster moving train would have overtaken the other train in 18 seconds. The length of the trains in metres are
(a) 112, 78.40 (b) 97.78, 55
(c) 102.78, 50 (d) 102.78, 55
4. Assume that an equal number of people are born on each day. Find approximately the percentage of the people whose birthday will fall on 29th February.
(a) 0.374 (b) 0.5732
(c) 0.0684 (d) None of these.
5. A sum of money compounded annually becomes ₹625 in two years and ₹675 in three years. The rate of interest per annum is

- (a) 7% (b) 8%
(c) 6% (d) 5%

6. Every day Asha's husband meets her at the city railway station at 6:00 p.m. and drives her to their residence. One day she left early from the office and reached the railway station at 5:00 p.m. She started walking towards her home, met her husband coming from their residence on the way and they reached home 10 minutes earlier than the usual time. For how long did she walk?

- (a) 1 hour (b) 50 minutes
(c) $\frac{1}{2}$ hour (d) 55 minutes

7. Three machines, A, B and C can be used to produce a product. Machine A will take 60 hours to produce a million units. Machine B is twice as fast as Machine A. Machine C will take the same amount of time to produce a million units as A and B running together. How much time will be required to produce a million units if all the three machines are used simultaneously?

- (a) 12 hours (b) 10 hours
(c) 8 hours (d) 6 hours

8. Mr. and Mrs. Shah travel from City A to City B and break journey at City C in between. Somewhere between City A and City C, Mrs. Shah asks "How far have we travelled?" Mr. Shah replies, "Half as far as the distance from here to city C". Somewhere between City C and City B, exactly 200 km from the point where she asked the first question, Mrs. Shah asks "How far do we have to go?" Mr. Shah replies "Half as far as the distance from City C to here." The distance between Cities A and B in km. is

- (a) 200 (b) 100
(c) 400 (d) 300

9. A shop sells ball point pens and refills. It used to sell refills for 50 paise each, but there were hardly any takers. When he reduced the price, the remaining refills were sold out enabling the shopkeeper to realize ` 35.89. How many refills were sold at the reduced price?

- (a) 37 (b) 71
(c) 89 (d) 97

10. Anand and Bharat can cut 5 kg of wood in 20 min, Bharat and Chandra can cut 5 kg of wood in 40 min. Chandra and Anand can cut 5 kg. of wood in 30 min. How much time Chandra will take to cut 5 kg of wood alone?

- (a) 120 minutes (b) 48 minutes
(c) 240 minutes (d) $(240/7)$ minutes

11. If 200 soldiers eat 10 tons of food in 200 days, how much will 20 soldiers eat in 20 days?(1ton = 1000 kgs)

- (a) 1 ton (b) 10 kg
(c) 100 kg (d) 50 kg

12. A servant is paid ` 100 plus one shirt for a full year of work. He works for 6 months and gets ` 30 plus the shirt. What is the cost of the shirt? (in Rupees)?

- (a) 20 (b) 30
(c) 40 (d) 50

13. A train without stopping travels at 60 km per hour and with stoppages at 40 km per hour. What is the time taken for stoppages on a route of 300 km?

- (a) 11 hours (b) 22 hours
(c) 5 hours (d) 2.5 hours

14. A contractor receives a certain sum every week for paying wages. His own capital together with the weekly sum enables him to pay 45 men for 52 weeks. If he had 60 men and the same wages his capital and weekly sum would suffice for 13 weeks, how many men can be maintained for 26 weeks?

- (a) 60 (b) 52
(c) 50 (d) 65

15. A supply of water lasts for 150 days if 12 gallons leak off every day, but only for 100 days if 15 gallons leak off daily. What is the total quantity of water in the supply?
- (a) 900 (b) 1125
(c) 3350 (d) 1250
16. If a dealer were to diminish the selling price of his wares by 10% he would double his sale making the same profit as before. In what ratio would his profit diminish if he were to increase his selling price by 10% and thereby halve his sale?
- (a) 2:1.5 (b) 5:4
(c) 1:1.5 (d) 9:7
17. A can is full of paint. Out of this 5 litres are removed and a thinning liquid substituted. The process is repeated. Now the ratio of paint to thinner is 49:15. What is the full capacity of the can?
- (a) 20 litres (b) 60 litres
(c) 40 litres (d) 50 litres

Directions for Questions 18 to 20: Use the following information.

Kachua Bhaiya started to move from point B towards point A exactly an hour after Jiggly Pup started from A in the opposite direction. Kachua Bhaiyas's speed was twice that of Jiggly Pup. When Jiggly Pup had covered one-sixth of the distance between the points A and B, Kachua Bhaiya had also covered the same distance.

18. The point where the two would meet is
- (a) Closer to A
(b) Exactly between A and B
(c) Closer to B
(d) P and Q will not meet at all
19. How many hours would Jiggly Pup take to reach B?
- (a) 2 (b) 5

(c) 6 (d) 12

20. How many more hours would Jiggly Pup (compared to Kachua Bhaiya) take to complete his journey?

(a) 4 (b) 5

(c) 6 (d) 7

21. A group of workers was put on a publishing job. From the second day onwards one worker was withdrawn each day. The job was finished when the last worker was withdrawn. Had no worker been withdrawn at any stage, the group would have finished the job in two-thirds the time. How many workers were there in the group?

(a) 2 (b) 3

(c) 5 (d) 10

22. A ship leaves on a long voyage. When it is 18 miles from the shore, a seaplane, whose speed is ten times that of the ship, is sent to deliver mail. How far from the shore does the seaplane catch up with the ship?

(a) 24 miles (b) 25 miles

(c) 22 miles (d) 20 miles

23. One man can do as a woman can do in 2 days. A child does one-third the work in a day as a woman. If an estate-owner hires 39 pairs of hands, men, women and children in the ratio 6:5:2 and pays them in all ₹1113 at the end of days work, what must the daily wages of a child be, if the wages are proportional to the amount of work done?

(a) ₹14 (b) ₹5

(c) ₹20 (d) ₹7

24. A water tank has three taps A, B and C. A fills four buckets in 24 mins, B fills 8 buckets in 1 hour and C fills 2 buckets in 20 minutes. If all the taps are opened together a full tank is emptied in 2 hours. If a bucket can hold 5 litres of water, what is the capacity of the tank?

(a) 120 litres (b) 240 litres

(c) 180 litres

(d) 60 litres

25. A man buys spirit at `60 per litre, adds water to it and then sells it at `75 per litre. What is the ratio of spirit to water if his profit in the deal is 37.5%?

(a) 9:1

(b) 10:1

(c) 11:1

(d) None of these

OceanofPDF.com

Review Test 3

1. There is a leak in the bottom of a tank. This leak can empty a full tank in 8 hours. When the tank is full, a tap is opened into the tank which admits 6 litres per hour and the tank is now emptied in 12 hours. What is the capacity of the tank?
(a) 28.8 litres (b) 36 litres
(c) 144 litres (d) cannot be determined
2. The winning relay team in a high school sports competition clocked 48 minutes for a distance of 13.2 km. Its runners A, B, C and D maintained speeds of 15 kmph, 16, 17 kmph and 18 kmph respectively. What is the ratio of the time taken by B to that taken by D?
(a) 5:16 (b) 5:17
(c) 9:8 (d) 8:9
3. Three bells chime at intervals of 18, 24 and 32 minutes respectively. At a certain time they begin to chime together. What length of time will elapse before they chime together again?
(a) 2 hours 24 minutes (b) 4 hours 48 minutes
(c) 1 hours 36 minutes (d) 5 hours
4. In a race of 200 meters run, Ashish beats Sunil by 20 metres and Nalin by 40 metres. If Sunil and Nalin are running a race of 100 metres with exactly the same speeds as before, then by how many metres will Sunil beat Nalin?
(a) 11.11 metres (b) 10 metres
(c) 12 metres (d) 25 metres
5. A man invests ₹3000 at a rate of 5% per annum. How much more should he invest at a rate of 8%, so that he can earn a total of 6% per annum?
(a) ₹1200 (b) ₹1300

(c) $t \approx 1500$

(d) $t \approx 2000$

Use the following data for questions 6 to 9: Helitabh and Ruk Ruk are running along a circular course of radius 14 km in opposite directions such that when they meet they reverse their directions as well as they interchange their speeds i.e. after they meet Helitabh will run at the speed of Ruk Ruk and vice-versa. However, this interchange occurs only when they meet outside the starting point. They do not interchange directions or speeds when they meet at the starting point. Initially, the speed of Helitabh is thrice the speed of Ruk Ruk. Assume that they start from M_0 and they first meet at M_1 , then at M_2 , next M_3 , and finally at M_4 .

6. What is the shortest distance between M_1 and M_2 ?
(a) 22 km. (b) $14\sqrt{2}$ km
(c) 14 km (d) 28 km
7. What is the shortest distance between M_1 and M_3 along the course?
(a) 44 km (b) $28\sqrt{2}$ km
(c) $44\sqrt{2}$ km (d) 28 km
8. Which is the point that coincides with M_0 ?
(a) M_1 (b) M_2
(c) M_3 (d) M_4
9. What is the distance travelled by Helitabh when they meet at M_3 ?
(a) 154 km. (b) 132 km
(c) 198 km (d) 176 km

Directions for Questions 10 to 12: A certain race is made up of three stretches A, B and C, each 4 km long, and to be covered by a certain mode of transport. The following table gives these modes of transport for the stretches, and the minimum and maximum possible speeds (in kmph) over

these stretches. The speed over a particular stretch is assumed to be constant. The previous record for the race is ten minutes.

Stretch	Mode of transport	Min. Speed	Max Speed
A	Car	80	120
B	Motor-cycle	60	100
C	Bicycle	20	40

10. Anshuman travels at minimum speed by car over A and completes stretch B at the fastest possible speed. At what speed should he cover stretch C in order to break the previous record?
 - (a) Max. speed for C
 - (b) Min. speed for C
 - (c) This is not possible
 - (d) None of these
11. Mr. Hare completes the first stretch at the minimum speed and takes the same time for stretch B. He takes 50% more time than the previous record to complete the race. What is Mr. Hare's speed for the stretch C?
 - (a) 21.8 kmph
 - (b) 26.66 kmph
 - (c) 34.2 kmph
 - (d) None of these
12. Mr. Tortoise completes the race at an average speed of 40 kmph. His average speed for the first two stretches is 4 times that for the last stretch. Find his speed over stretch C.
 - (a) 30 kmph
 - (b) 24 kmph
 - (c) 20 kmph
 - (d) This is not possible
13. After allowing a discount of 11.11% a trader still makes a gain of 20%. At what percent above the cost price does he mark his goods?
 - (a) 28.56%
 - (b) 35%
 - (c) 22.22%
 - (d) None of these

14. A dealer buys oil at ₹100, ₹80 and ₹60 per liter. He mixes them in the ratio 5:6:7 by weight and sells them at a profit of 50%. At what price does he sell oil?
- (a) ₹80/liter (b) ₹116.666/ liter
(c) ₹95/liter (d) None of these
15. An express train travelling at 80 kmph overtakes a goods train twice as long and going at 40 kmph on a parallel track, in 54 seconds. How long will the express train take to cross a station 400 m long?
- (a) 36 sec (b) 45 sec
(c) 27 sec (d) none of these
16. A man earns $x\%$ on the first 2000 rupees and $y\%$ on the rest of his income. If he earns ₹700 from ₹4000 and ₹900 from ₹5000 of income. Find x .
- (a) 20 (b) 15
(c) 25 (d) None of these
17. In the famous Harrods museum, the value of each of a set of gold coins varies as the square of its diameter, if its thickness remains constant and it varies as the thickness, if the diameter remains constant. If the diameters of the two coins are in the ratio 4:3, what should the ratio of their thickness be if the value of the first is 4 times that of the second?
- (a) 16:9 (b) 9:4
(c) 9:16 (d) 4:9

A thief after committing a burglary, started fleeing at 12:00 noon at the speed of 60 kmph. He was then chased by a policeman X. X started the chase 15 minutes after the thief had started at a speed of 65 kmph.

18. At what time did X catch the thief?
- (a) 3:30 p.m. (b) 3:00p.m.
(c) 3:15 p.m. (d) None of these

19. If another policeman has started the same chase along with X, but at a speed of 60 kmph, then how far behind was he when X caught the thief?
- (a) 18.75 km (b) 15 km
(c) 21 km (d) 47.5 km
20. A and B walk from X to Y, a distance of 27 km at 5 kmph and 7 kmph respectively. B reaches Y and immediately turns back meeting A at Z. What is the distance from Y to Z?
- (a) 2 km (b) 4.5 km
(c) 3 km (d) 7 km
21. A motorist leaves the post office to go to the airport to collect mail. The plane arrives early, and the mail is sent on a horse-cart. After half an hour, the motorist meets the horse-cart, collects the mail and returns to the post office, thus saving 20 minutes. How many minutes early did the plane arrive?
- (a) 20 (b) 25
(c) 30 (c) 40
22. In his book on Leonardo da Vinci, Sigmund Freud, after a detailed psychoanalysis concluded that Goethe could complete the masterpiece in nine days as he could channelize overly but was more possessed as a result of which he could generate 50% more efficiency than Goethe. The number of days it takes Leonardo da Vinci to do the same piece of work that Goethe completes in nine days is:
- (a) 4 (1/2) days (b) 6 days
(c) 13 (1/2) days (d) None of these
23. The North South Express is a pair of trains between the cities Jammu & Chennai. A train leaves Jammu for Chennai exactly at 12 noon every day of the week. Similarly, there is a train that leaves from Chennai to Jammu on every day of the week at exactly 12 noon. The time required by a train to cover the distance between

Chennai & Jammu is exactly 7 days and 1 minute. Find the number of trains from Chennai to Jammu which a train from Jammu to Chennai will encounter in completing its journey. (Assume all trains run exactly on time).

- (a) 7
- (b) 8
- (c) 14
- (d) 15

24. For the question above, the minimum number of rakes that the Indian Railways will have to devote for running this daily service will be:

- (a) 16
- (b) 32
- (c) 30
- (d) None of these

25. There are two candles each of the same initial length. The first candle can burn for 24 hours, while the second candle can burn for 16 hours. Both of them are lit at the same time. After sometime, it was found that one of the candles was twice as long as the second. For how long had the candle been burning?

- (a) 6 hours
- (b) 8 hours
- (c) 10 hours
- (d) 12 hours

Review Test 4

1. The menu at a local café at Mumbai reads as under:

Item	Price (`)
Samosa and Coffee	– ac
Parathe	– bc
Sweet Dish, Samosa and Coffee	– bd
Samosa, Coffee and Parathe	– ca
Parathe, Sweet Dish, Samosa and Coffee	– db

In the price list, each of the entry in the right hand column stands for a two digit number and each of the different letter stands for a different digit. What is the price of the sweet dish?

- (a) t` 6 (b) t` 11
(c) t` 41 (d) t` 22

2. Two trains, a passenger train and a freight train, are running in the same direction on parallel railway tracks. The passenger train takes three times as long to pass the freight train as when they are going in opposite directions.

If the trains run at uniform speeds with goods train running at a maximum speed of 25 km/h, what is the speed of passenger train (p) in km/h?

- (a) $p = 50$ (b) $p \leq 50$ ($p > 0$)
(c) $0 \leq p \leq 50$ (d) $20 \leq p \leq 50$

3. Rambilas, a rice merchant does not think much of ethical practice and neither does he think too much about his reputation; his only aim is to earn as much profit as possible. Which of the following would serve his purpose best?

I. Fixing selling price one-eighth above the cost price.

- II. Mix stones (available for free) 12.5% by weight and fixing selling price at cost price
- III. Use an 8.75 kg weight for 10 kg weight and selling at cost price
- IV. Selling $15/16^{\text{th}}$ only, by cheating, of the weight kept on balance and fixing the selling price 6.25% above cost price.
- (a) I (b) I and II
- (c) IV (d) II and III

Directions for Questions 4 to 6: A motorboat race is held in the Suvarnarekha river in Jharkhand. The race is held over 3 stretches namely M , N and O . The maximum speed allowed in the stretch M is 80 km/hr and the maximum speeds allowed in stretches N and O are 65 km/hr and 30 km/hr respectively. The minimum speeds allowed over the 3 stretches are 50 km/hr, 40 km/hr and 15 km/hr respectively. Each of the stretches is 4 km in length and speed over a stretch is assumed constant. Current record for the race is 12 min. 30 sec.

4. Shoaib completes the first stretch at minimum speed but is able to maintain the same speed in the second stretch also. If he takes 60% more time than the current record, then speed of Shoalb over stretch O is approximately:
(a) 23 km/hr (b) 17 km/hr
(c) 28.8 km/hr (d) 32 km/hr
5. Amitabh covers stretch M at minimum speed but completes the next stretch at maximum permissible speed. What should be Amithabh's speed in the stretch O if he now aims at breaking the current record?
(a) 30 km/hr (b) Indeterminate
(c) Breaking Record is not possible
(d) 40 km/hr
6. Steven Miles completes the race at an average speed 30 km/hr. If his average speed over stretches M and N is 300% more than his speed over stretch O , what is his speed over stretch O ?

- (a) 24 km/hr (b) 27 km/hr
(c) 18 km/hr (d) 15 km/hr

7. Ali along with his friend embarked on a boat journey. While making all his preparations for the journey, he checked with the boat manufacturer's data and was glad to learn that the boat was really dependable as it could float even if it was upto 75% full of water (with more water it could sink). Unfortunately, the boat developed a hole during his journey—the hole filling up water @ 2 liter per minute. The boat was also equipped with a drainage pump which could empty a boatful of water in 32 hrs. If Ali figures that they have a maximum of 12 hrs to reach a safe place (before they sink), what is the capacity of the boat?

- (a) 1280 liter (b) 1480 liter
(c) 1600 liter (d) 1056 liter

8. The number of votes not cast for Pappu's party increased by $33\frac{1}{3}\%$ over those not cast for it in the previous polls in the Farrukhabad city constituency where the only other candidate belongs/belonged to the Jhussu Party. If a total of 4,50,000 people voted each time and Pappu's Party loses by a majority one-third times as large as that by which it had won in the last polls, How many people voted for Pappu's Party in the current polls?

- (a) 150000 (b) 210000
(c) 240000 (d) 180000

Directions for Questions 9 and 10: On the planet of Krypton (yes the same one from where Superman originated) A small scale businessman owns an ancillary unit that manufactures 6 types of tools namely *A, B, C, D, E* and *F*. These tools for their manufacturing require work on machine *X* and machine *Y* in that order. The time taken on these machines to manufacture one unit of a tool is as follows:

Tool	A	B	C	D	E	F
-------------	----------	----------	----------	----------	----------	----------

Time (hrs)	Machine X	6	24	10	4	18	22
	Machine Y	16	20	18	12	6	2

Presently, the businessman has received orders to manufacture one unit of each of the tools. There is no constraint to work on the machines and these machines can be run non-stop.

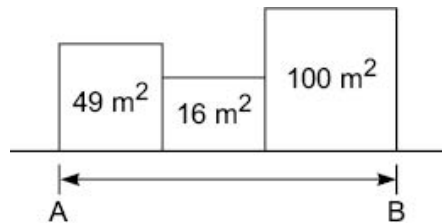
9. For a particular order from Earth, the tools are to be manufactured in the sequence FEBCAD, what is the minimum time taken to execute the order?
 - (a) 158 hrs
 - (b) 110 hrs
 - (c) 130 hrs
 - (d) 120 hrs
10. If a revolutionary technology is imported from the earth, the time required for working on each tool is reduced to half it's current time on both machines. With this technology in place, what is the shortest possible time in which the above order can be executed?
 - (a) 65 hrs
 - (b) 51 hrs
 - (c) 55 hrs
 - (d) None of these
11. A man can climb up a greased pole 30 ft high in 15 seconds (where 10 seconds is used for climbing up and 5 seconds when he is slipping down). If grease causes a downward slip of 2 ft a second, the time taken by the man to climb a non greased pole would be:
 - (a) 8 seconds
 - (b) 10 seconds
 - (c) 7.5 seconds
 - (d) 9 seconds
12. A state's GDP during 2011-12 grew by a healthy 6.3%. During the same period service sector growth was 7.0%: average growth for agricultural, manufacturing, and service sector (excluding ITES and IT) was 5.8%. If weightage given to agricultural sector is 25%, to manufacturing sector 42%, and to service sector as a whole 33% (IT sector 13% and ITES 9%), then what is the approximate growth rate for service sector (excluding ITES and IT)?
 - (a) 6.4%

- (b) 5.9%
- (c) 5.0%
- (d) 5.8% to 7.0% (depending on weightage)

13. The village of Hara Kiri has two-thirds of its male population married to 90% of its women population. Each of such man is married to exactly two of such women. What is the minimum possible 4 digit population of the village (Children are not counted as part of the population unless they are married)?

- (a) 1005
- (b) 1026
- (c) 1080
- (d) Cannot be determined/None of these

14.



The figure contains three squares with areas of 100 m^2 , 49 m^2 , and 16 m^2 lying side by side. Rahim wishes to reduce the length AB to 19 m by reducing area of only one of the squares without altering its shape, what is the maximum reduction (in %) in the area of that square?

- (a) (Approx) 33%
- (b) 50%
- (c) (Approx) 66%
- (d) 75%

15. Tingal and Sagar practice in the local Gomati Nagar stadium daily. One day, they started running around the circular track simultaneously from the same point in opposite directions. Thereafter they met a total of ten times when the practice session was terminated. If they meet at a point diametrically opposite to the starting point when they meet for the second time, what could be ratio of their speed?

- (a) 1 : 1 (b) 2 : 1
(c) 1 : 3 (d) Data insufficient

16. The Sinhadgad Express and the Gomati Express consisting of 41 and 42 carriages respectively are traveling @ 36 kmph in opposite directions. The carriage length (including inter-carriage lengths averaged over number of carriages) averages 10 m and is half the engine length. If the trains cross each other on parallel tracks, in how much time will they complete the crossing?
(a) 1 min 20 sec (b) 42 seconds
(c) 38 seconds (d) 40 seconds
17. The selling price and the cost price of an article which is being sold at a profit have increased by $r\%$ YOY for a period of 3 years. Which of the following statements summarizes the effect of the inflationary pressure?
(a) The profitability of the article has increased at the same rate $r\%$ every year for the 3-year period.
(b) The profit has increased YOY at the same rate of $r\%$ while the profitability has remained constant.
(c) The profit has increased YOY at the same rate $r\%$ but profitability has increased at a rate which is less than the rate of increase of profits.
(d) The profit has increased YOY at the same rate of $r\%$, while the profitability has decreased over the 3 year period.
18. The Hosur Computer Company gets a large supply order for assembled computers of two different configurations A and B from the Karnataka government. The supply order for A-type computers being double that of the B-type. A team of hardware experts was assigned the task which worked on A-type computers. For the second day, the team was split into two equal groups: the first continued work on A-type computers and completed the work order by day end. The second group, however could not complete work order for B-type computers on the second day and this work order

could only be completed by employing two experts for the whole of the third day. What was the strength of the team if it is known that a B-type computer takes 20% less time to assemble than A-type?

- (a) 5
- (b) 20
- (c) 16
- (d) 24

19. In a learning experiment at Stanford University it was found that the square of the inverse of learning time varies directly as the age of a rat in weeks, while the inverse of learning time and complexity index of the maze are directly related. If the age of the rat in the second trial of the experiment is 40% more than in the first trial and the learning time is 16.67% less, then find change in complexity index of the maze

- (a) Increase of 10%
- (b) Increase of 5%
- (c) Increase of 1%
- (d) Decrease of 5%

20. Ramu is standing at an intersection where two roads intersect at right angles. He observes through his binoculars that two cars start moving towards the intersection at the same time along these two roads, one of them is moving at a speed of 13.333 m/sec and starts at a point 40 km from the intersection. The second car is moving at 10 m/sec and starts at a point 50 km from the intersection. In how many minutes from the start will the distance between the two be minimum?

- (a) 83 min
- (b) 62 min
- (c) 50 min
- (d) (1) or (3)

Review Test 5

Directions for Questions 1 and 2: Refer to data below: In a motorcycle race, three motorcycles started out. The first motorcycle was 15 km/h faster than the second, while the third was 3 km/h slower than the second. The second motorcycle driven by Ayrton Senna arrived at the finish 12 min after the first motorcycle and 3 minutes before the third one. There were no stops on route.

1. What is the length of the race?
(a) 150 km (b) 72 km
(c) 75 km (d) 90 km
2. What is the speed of the slowest motor cycle?
(a) 75 km/h (b) 90 km/h
(c) 72 km/h (d) 64 km/h
3. Naman Sweets, a sweet shop in down town Allahabad, manufactures Rossagullas for export. They are currently experimenting with an ideal sugar syrup concentration for their new product. Originally, the sugar in the syrup is $33\frac{1}{3}$ % by weight. The syrup is heated till 25% of the water in it evaporates. The resultant solution is mixed with a 40% sugar syrup in the ratio 5 : 3. The sugar syrup so obtained is again heated to evaporate $33\frac{1}{3}$ % of water in it. Find the strength of this solution assuming the solution never saturates.
(a) 50%
(b) slightly more than 90%
(c) slightly more than 75%
(d) 35%

4. Two sets of boys are playing a match of catching. It is decided that once the ball falls on the ground from the hands of a side it would get the other side as many points as the number of meters the ball travels before coming to rest and the play won't resume until that happens. It is also known that height of a fall is exactly 150% of that of the bounce for the kind of balls to be used for the match. In the first instance Raghav's team dropped the ball a height of 45 m. How many points does Shaurya's team gain?

(a) 90 (b) 135
(c) 225 (d) None of these

5. Akhilesh was experimenting with time measurement using a pair of sandglasses. The following pairs of sand glasses are available (sand glass of one pair cannot be combined with sand glass of another pair)

A – 9 min and 12 min

B – 4 min and 7 min

C – 6 min and 7 min

In how many ways can he choose his pair of sand glasses in order to be able to measure exactly 15 minutes?

(a) 3 (b) 2
(c) 1 (d) None

6. In a 4000 meter race around a circular track (in the stadium at IIM Bangalore) having a circumference of 1000 meters, the fastest runner and the slowest runner reach the same point at the end of the 5th minute, for the first time after the start of the race. All the runners have the same starting point and each runner maintains a uniform speed throughout the race. If the slowest runner runs at half the speed of the fastest runner, what is the time taken by the slowest runner to finish the race?

(a) 40 min. (b) 30 min.
(c) 20 min. (d) 15 min.

Directions for Questions 7 and 8: Answer these questions based on the following information:

Prabhjeet made a trip from Hyderabad to Bengaluru to attend an interview. He had been traveling at a speed which would have ensured that he reaches the interview on time. He had a flat tyre on the way and it took 100 min. to mend it. He arrived 15 min. late for the interview. The distance between Bengaluru and Hyderabad is 260 km.

7. If the speed after the flat tyre was 20% more than the original speed, find the normal time taken by Prabhjeet to reach the destination from the site of the accident.
(a) 8 hr. 30 min. (b) 1 hr. 45 min.
(c) 6 hr. (d) 8 hr. 30 min.
8. If the normal time taken to reach Bengaluru after the start was 10 hr. at what distance from Bengaluru did the flat tyre occur? (Use data of Question 7)
(a) 39 km. (b) 221 km.
(c) 169 km. (d) Can't be determined
9. Steven fell in love with Ankita who lived 630 miles away. He decided to propose his beloved and invited her to travel to his place and offered to meet her en route and bring her home. Steven is able to cover 4 miles per hour to Ankita's 3 miles per hour. How far will each have travelled upon meeting?
(a) Steven = 270 miles; Ankita = 360 miles
(b) Steven = 360 miles; Ankita = 270 miles
(c) Steven = 400 miles; Ankita = 230 miles
(d) Steven = 450 miles; Ankita = 180 miles
10. The evergreen shrubs at Ramesh's nursery are planted in rows on a square plot of land measuring 2,401 sq. ft. The shrubs are planted in such a manner that the centers of the shrubs are 7 ft. apart and the outer shrubs are planted along the edges of the plot, with a shrub at each corner. Ramesh spent \$1792 to cover all the costs necessary for

raising this crop of the evergreen shrubs. If Ramesh succeeds in selling each shrub for \$63, his profit will be what percentage of his total cost?

- (a) 100%
- (b) 50%
- (c) 125%
- (d) 150%

11. Chashmish is repaid a loan that he had given to Mucchad such that each year the amount he gets is $\frac{1}{20}$ lesser than what he got in the previous year. Mucchad being a sly person, decides to give Chashmish ` 2500 as a lump sum and not pay anything later. Who gains from this agreement and what is the breakeven value, if the initial installment is ` 100? (Consider no time value of money.)

- (a) Chashmish, ` 2000
- (b) Mucchad, ` 3000
- (c) Chashmish, ` 100
- (d) Mucchad, ` 10000

12. NTPC Gas power plant in Dibyapur can produce upto 120 MW of power every month. The cost of the power is partly fixed and partly varying. The cost is ` 250 million, when 80 MW are produced and it is ` 300 million, when 100 MW is produced. On the other hand, the part of selling price per unit goes on decreasing linearly as more power is consumed. The selling rate per unit is ` 3.30 at 80 MW sell and it is ` 3.20, when 100 MW power is sold. What will be the profit or loss when it produces 110 MW of power and sells it all?

- (a) Profit, ` 26.5 million
- (b) Profit, ` 21.5 million
- (c) Loss, ` 26.5 million
- (d) Loss, ` 21.5 million

13. Divyansh Awasthi buys some apples and Chikoos from the market at a rate such that a Chikoo is two times costlier than an apple and he sells them such that a Chikoo is sold at thrice the cost price of an

apple. By selling the apple at twice its cost price, he makes 150% profit. Find the proportion of Chikoos to the apples.

- (a) 1 : 6 (b) 3 : 4
(c) 1 : 2 (d) Cannot be determined

14. Arundhati bets a certain portion of her total money on betting. On a particular day, when she won, the betting rate was 12 : 1 (i.e. if you bet 1 rupee you stand to gain 12 rupees if you win the bet) and her total money became 8 times the initial total money. What is the proportion of her initial total money to the money she put on bet?

- (a) 3 : 2 (b) 7 : 5
(c) 8 : 5 (d) None of these

15. On 26th July, Mumbai was flooded. Rainshield enterprises is in the business of manufacturing umbrellas and raincoats. An umbrella can shield 2 people while a raincoat can shield 1 person. People under an umbrella can walk at $\frac{1}{3}$ rd the speed of a person wearing a raincoat. The cost of an umbrella and cost of the raincoat are in the ratio 2 : 5. Points A and B are 100 m apart and it takes 20 minutes for a person wearing a raincoat to travel the distance. At the maximum how many people will be transported today from A to B, if only ₹ 1000 is available for transporting 20 people? Cost of traveling time is ₹ 2 per min. per head (Assume cost of a raincoat to be ₹ 100.)

- (a) 6 (b) 7
(c) 4 (d) None of these

16. A manufacturing job was wrongly estimated to be completed in 10 days by x machines. By deploying 3 extra machines, the job was completed in 12 days. If only one additional machine was used, how many days more than that estimated would it have taken to complete the job?

- (a) $\frac{2x-18}{x+3}$ (b) $\frac{2x+13}{x+1}$

(c) $\frac{2x + 26}{x + 1}$

(d) Cannot be determined

17. A tank in Gauri Apartments is full of water and is fitted with pumps of equal capacity. Besides it is also fitted with a certain number of inlet pipes which are always kept open. When the tank is full, 10 pumps of equal capacity empty the tank in 12 hrs., while 15 pumps of the same capacity empty the tank in 6 hrs. In how much time would 25 pumps of the same capacity empty the tank, if the tank is initially full? (All the pipes pouring water into the tank are always open)

(a) 3 hrs.

(b) $2\frac{1}{2}$ hrs.

(c) 4 hrs.

(d) $3\frac{1}{2}$ hrs.

18. A group of 4 people—Raghav, Golu, Shaurya and Arjit, arrive in a car to a friend's house. The group was forced to park around the corner due to lack of parking space. It was raining heavily and the group had only one umbrella. They decided to share it. Two persons would go at a time to the friends house and one of them would come back with the umbrella. The process would be repeated unless all four people reach the friends house. If Raghav, Golu, Shaurya and Arjit take 1, 2, 5 and 10 minutes respectively at their fastest speed to go to the friend's house, what is the minimum time required for all of them to reach the friend's house? (A faster person slows down to accompany a slower one)

(a) 15 mins

(b) 17 mins

(c) 22 mins

(d) 19 mins.

19. At a shooting competition, Rathore and Bindra had x bullets between them. Bindra fired ' a ' bullets per min. while Rathore fired ' b ' bullets per min. After time ' t ', both of them had the same number of bullets. What is the initial number of bullets with Rathore?

(a) $x - \frac{a+b}{2}$

(b) $x + \frac{t(a-b)}{2}$

(c) $\frac{x - t(a-b)}{2}$

(d) None of these

ANSWER KEY

Review Test 1

- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 2. (c) | 3. (a) | 4. (a) |
| 5. (b) | 6. (c) | 7. (b) | 8. (b) |
| 9. (c) | 10. (c) | 11. (b) | 12. (a) |
| 13. (b) | 14. (d) | 15. (a) | 16. (b) |
| 17. (b) | 18. (c) | 19. (d) | 20. (c) |
| 21. (b) | 22. (c) | 23. (b) | 24. (b) |
| 25. (a) | 26. (a) | | |

Review Test 2

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

Review Test 3

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

Review Test 4

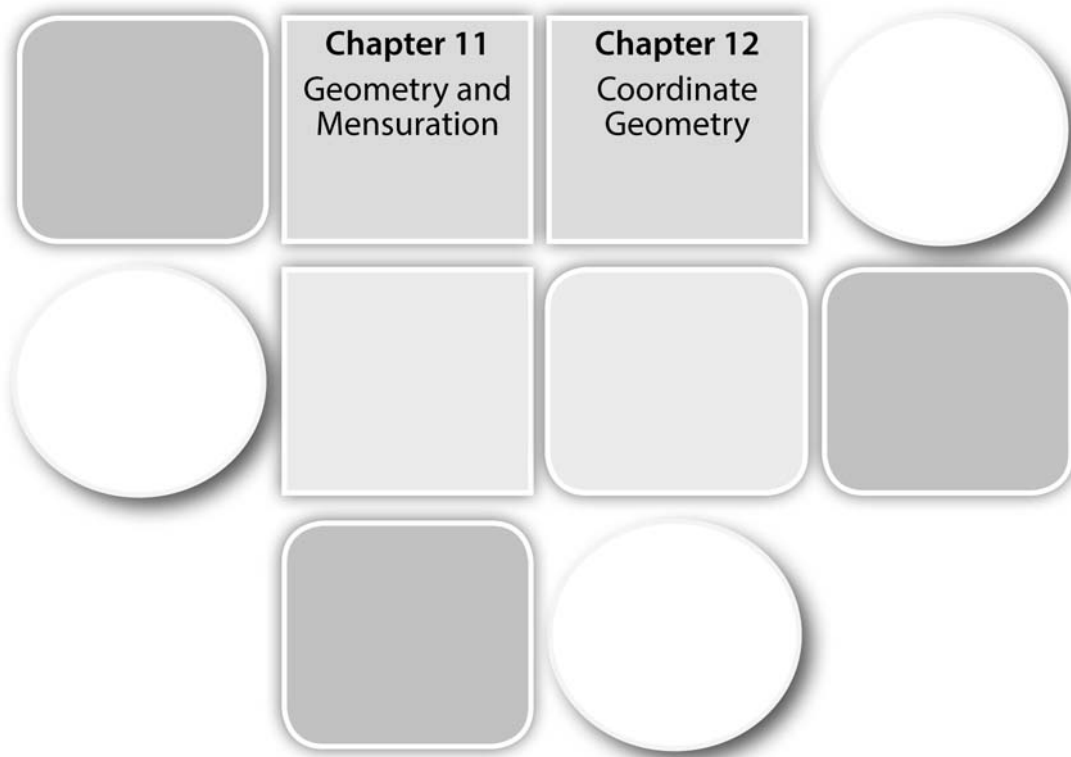
- | | | | |
|---------|---------|---------|---------|
| 1. (b) | 2. (b) | 3. (d) | 4. (a) |
| 5. (c) | 6. (d) | 7. (a) | 8. (b) |
| 9. (c) | 10. (a) | 11. (c) | 12. (c) |
| 13. (a) | 14. (d) | 15. (c) | 16. (c) |
| 17. (b) | 18. (b) | 19. (b) | 20. (b) |

Review Test 5

- | | | | |
|---------|---------|---------|---------|
| 1. (d) | 2. (c) | 3. (a) | 4. (c) |
| 5. (a) | 6. (c) | 7. (a) | 8. (b) |
| 9. (b) | 10. (c) | 11. (a) | 12. (b) |
| 13. (c) | 14. (a) | 15. (b) | 16. (a) |
| 17. (a) | 18. (d) | 19. (d) | |

BLOCK IV

Geometry





...BACK TO SCHOOL

The word GEOMETRY is derived from two words—GEO meaning earth and METRY meaning measurement. Hence, it is quite evident that geometry as a mathematical science developed mainly due to the human need of measuring land masses and distances. The major developments in the fields of Geometry and Mensuration are mainly credited to the ancient Egyptian and Greek civilisations. (In fact, this is one of the reasons why all formulae and theorems primarily carry Greek names.)

Key Geometrical Concepts

Point: The point should be visualised as a singular dot. In physical terms, a point can be defined as a single dot that can be created on a plain paper by a very sharp pencil. It could also be visualised as a singular prick on a piece of paper by a very sharp nail or pin.

Line: Mathematically, lines are defined as a group of points which are straight one after another. All lines are supposed to extend infinitely in two directions.

Segment of a Line

If a part of a line is cut out, we get a segment of a line.

Physically, the closest representations of a segment of a line would be a tight thread or the straight crease of a piece of paper.

Plane: The surface of a smooth wall or a table top is the closest representation of a portion of a plane.

Some Geometrical Properties

1. Lines Between Points: Let us take two distinct points in a plane. You can easily verify that an infinite number of lines can be drawn in the plane passing through any one of these two points. However, if you wanted to draw a line which passes through both the points, you will be able to draw only one line. This is an important result in Geometry.

Property: Given any two distinct points in a plane, there exists one and only one line containing both the points. Alternately, we can state that two distinct points in a plane determine a unique line.

2. Collinearity of Points: Collinear or non-collinear points are only defined in the context of 3 or more points.

Consider the situation of three points. There can only be two cases with respect to three points:

1. All the points lie on the same line. (Here, the points are said to be collinear).
2. All the three points do not lie on the same line (In this case the points are said to be non-collinear).

Note: It is quite evident that we would discuss collinear or non-collinear points only if the number of points is more than two. Obviously, if there are only two points they would always lie on one line.

3. Points in common between distinct lines: In the case of distinct lines, there can only be two cases:

- (A) There is one point in common: In such a case, the common point is called as the point of intersection, and the two lines are called as intersecting lines.
- (B) There is no point in common: In such a case, the two lines are non-intersecting and are also called as parallel lines.

The property can thus be stated as:

Property: Two distinct lines in a plane cannot have more than one point in common.