



## Preface

1. Vedic Mathematics and Calculation Techniques

2. Percentage

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Explanations

Dear Student,

The journey to achieve success has begun. The CL Educate team brings to you an offering, which incorporates **theme based learning** that revolves around different concepts with **diverse applications**. The outcome is an enriching learning experience.

Our integrated thematic methodology is driven by latest research, undertaken to enhance learning. Numerous practice exercises and tests have been incorporated to reinforce the conviction in one's ability. Our teaching experience coupled with extensive research has lent credence to our conviction that learning is at its best when concept based understanding and applications go hand in hand.

To enhance your learning and assimilation of relevant concepts, our attempt has been to identify the basic concepts (or themes) that are required to solve different questions in MBA entrance examinations. Our class exercises integrate the different types of questions requiring application of these concepts. Each set of concepts along with relevant question types therefore, forms a module. At the end of each module we expect the student to:

- 1) Clearly understand a concept through its repeated application in different question types.
- 2) Quickly and effectively apply the relevant concept to different question types in a time-bound examination scenario.
- 3) Develop long-lasting skills by imbibing each concept that is clearly covered through a module.

Armed with the latest tools for success, along with your diligence and positive attitude, you have begun your march towards success. Have faith in yourself!

The woods are lovely, dark and deep,

But I have promises to keep,

And **miles to go before I sleep**,

And **miles to go before I sleep**

**(Robert Frost)**

## How to use this book

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## How to use this book

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1. Before you enter the class read the topics that are to be covered beforehand. This will help you immensely in understanding the concepts when they are taught in the class.
2. After each class, once again go through the relevant topics very carefully, in order to understand the concepts and relate them to what was taught in the class.
3. Do not directly jump to the practice problems but go through the solved examples first as they will enhance your problem solving skills and help in further clarifying concepts.
4. After you are through with the fundamentals and the solved examples, move on to the unsolved problems given at the end of the book and the practice exercises.
5. Start with the Level - I problems as they are easier. Move to the Level - II problems, if and only if you have completely understood the concept used in every problem in Level - I. Similarly, move to the Level - III problems after you have completed all the problems in Level - II.

## Vedic Mathematics and Calculation Techniques

1

### Introduction

A lot of students consider Mathematics as a very difficult subject. Some students encounter difficulty with basic arithmetic operations, while some feel it difficult to approximate the fractional figures. Learning Mathematics is an unpleasant experience to some students mainly because it involves mental exercise.

In the Vedic system 'difficult' problems or huge sums can often be solved immediately by the Vedic method. These striking and beautiful methods are just a part of a complete system of mathematics which is highly systematic. Vedic Mathematics manifests the coherent and unified structure of mathematics and the methods are complementary, direct and easy. The simplicity of Vedic Mathematics means that calculations can be carried out mentally (though the methods can also be written down). Furthermore, you can invent your own methods; they are not limited to the one 'correct' method. This leads to more creative, interested and intelligent you.

But the real beauty and effectiveness of Vedic Mathematics cannot be fully appreciated without actually practising the system. One can then see that it is perhaps the most refined and efficient mathematical system possible.

### Learning Objectives

By the end of the chapter, you should be able to

- approximate any calculative figure under the sun without pen/pencil or a calculator.
- practically and actively apply concepts in QA/LRDI questions as well as your day-to-day life.

- Essentials to calculate faster
- Multiplication
- Division
- Comparing ratios
- Approximation Techniques
- Strategies to tackle DI sets

After this chapter, no student should feel that calculation is a very tedious task. Every student should feel capable of identifying the correct alternative without the feeling the need of long winded calculations. In a nutshell, the student should not feel handicapped just because a calculator is not at his disposal.

### Multiplication through Base Method

This method is applicable only when the numbers are close to a base like 10, 100, 1000 or so on. In this method we take a base that is close to both the numbers. Let's start with simple example:

**Base = 100**

**$105 \times 107$**

Base = 100, Surplus = 5 and 7

$$\begin{array}{r} 105 \quad | +5 \\ \times 107 \quad | +7 \\ \hline (105+7) \text{ or } | 35 \Rightarrow 112 | 35 = 11235 \\ (107+5) \end{array}$$

The result of the above problem will be found in two parts.

(i) Right part (after slash)  $\Rightarrow$  is the product of the surplus.

Since base = 100 and surplus are 5 and 7, so product would be  $5 \times 7$  i.e. 35.

(ii) Left part (before slash)  $\Rightarrow$  It can be either number plus surplus of the other multiplicand. Hence left part would be either  $(105 + 7)$  or  $(107 + 5) = 112$  (both will always be the same) i.e. 112.

Hence the result of the multiplication would be 11235

### **112 × 113**

Base = 100, Surplus = 12 and 13

$$\begin{array}{r}
 112 \quad |+12 \\
 \times 113 \quad |+13 \\
 \hline
 (112+13) \text{ or } |156 \Rightarrow 125 | 56 \\
 (113+12) \\
 = 12656
 \end{array}$$

Note: Number of digits allowed on the right hand side of the slash would be equal to number of zero's in the base.

Here it is  $12 \times 13 = 156$ . But it can have only two digits. Thus 1 will be carried over to the left part and right part will be only 56. Left part will be either  $112 + 13 + 1$  (1 for the carry over) or

$113 + 12 + 1$  i.e. 126. Hence the result will be 12656.

For  $102 \times 104$ , the answer will be 10608. Please note that the right part will be 08 and not simply 8.

### **92 × 97**

Base = 100, Deficit =  $92 - 100 = -8$

$$\begin{array}{r}
 92 \quad |-8 \\
 \times 97 \quad |-3 \\
 \hline
 (92-3) \text{ or } |+24 \Rightarrow 89 | 24 \Rightarrow 8924 \\
 (97-8)
 \end{array}$$

### **96 × 108**

Base = 100, Deficit =  $96 - 100 = -4$ ,

Surplus =  $108 - 100 = 8$

$$\begin{array}{r}
 96 \quad |-4 \\
 \times 108 \quad |+8 \\
 \hline
 (108-4) \text{ or } |-32 \\
 \Rightarrow 104 |-32 \Rightarrow 103 | 100 - 32 \Rightarrow 103 | 68 = 10368 (96+8)
 \end{array}$$

Right part will now be  $(-4) \times 8$  i.e.  $-32$ . To take care of the negative we will borrow 1 from the left part, which is equivalent to borrowing 100 (because we are borrowing from the hundred digits of the answer). Thus this part will be  $100 - 32 = 68$ .

### **Base Not equal to hundred**

### **209 × 211**

Base = 200

$$\begin{array}{r}
 209 \quad |+9 \\
 211 \quad |+11 \\
 \hline
 \text{Base } (209+11) \text{ or } |9 \times 11 \\
 \Rightarrow 2 \times (220) | 99 \Rightarrow 440 | 99 = 44099
 \end{array}$$

**When Numbers are of the form of 34 × 36, 71 × 79, 112 × 118 ...**

Conditions:

(a) Sum of the unit digit is 10 and

(b) Rest of the digits are similar

$$\begin{array}{r}
 34 \mid 4 \\
 \times 36 \mid 6 \\
 \hline
 3(3+1) \mid 4 \times 6 \Rightarrow 12 \mid 24 \Rightarrow 1224
 \end{array}$$

Similarly  $112 \times 118$  would be  $11(11+1) \mid 8 \times 2 = 13216$

**When Numbers are of the form of  $35 \times 45, 55 \times 65, 75 \times 85, 115 \times 125 \dots$**

Conditions :

(a) Unit digit is 5 and

(b) Rest of the digits are consecutive numbers.

It includes the following two steps

(a) Right part  $\Rightarrow$  it would always be 75

(b) Left part  $\Rightarrow$  Subtract one from the square of larger number

$$75 \times 85 = (8^2 - 1) \mid 75 = 63 \mid 75 = 6375$$

$$115 \times 125 = (12^2 - 1) \mid 75 = 143 \mid 75 = 14375$$

### **General Multiplication**

Base method does not work when numbers to be multiplied are far apart.

This method is applicable for any two numbers to be multiplied and used when none of the above discussed condition matches. It is also known as Criss – Cross method.

$$\begin{array}{r}
 7 \quad 6 \\
 \times 4 \quad 2 \\
 \hline
 \end{array}$$

Step 1: Multiply unit place digits. Therefore  $6 \times 2 = 12$ . Here put 2 at the unit place of the answer and 1 is carried over

$$\begin{array}{r}
 7 \quad 6 \\
 \times 4 \quad 2 \\
 \hline
 12
 \end{array}$$

Step 2: Now cross-multiply and add this as shown in the figure.

$$\begin{array}{r}
 7 \quad 6 \\
 \times 4 \quad 2 \\
 \hline
 \end{array}$$

Here as the result is 38 but place 8 and 3 as carried over.

$$\begin{array}{r}
 7 \quad 6 \\
 \times 4 \quad 2 \\
 \hline
 38 \quad 12
 \end{array}$$

Step 3: Multiply the tenth place column to each other i.e.  $7 \times 4 = 28$

$$\begin{array}{r}
 7 \quad 6 \\
 \times 4 \quad 2 \\
 \hline
 28 \quad 38 \quad 12 \Rightarrow 3192
 \end{array}$$

**Note:** In each multiplication you can only have one digit result. Once you get a two-digit result, the tenth place digit will get carried over.

Lets take one more example to strengthen our understanding

$$\begin{array}{r}
 & 5 & 2 \\
 & \times 3 & 7 \\
 \hline
 5 & 3 & 5 & 7 & + 3 & 2 & | 2 & \times 7 \\
 15 & | & 41 & | & 14
 \end{array}$$

Thus answer is 1924

**243 × 658**

Step 1:  $8 \times 3 = 24$

$$\text{Step 2: } \begin{array}{r}
 & 4 & 3 \\
 & \times & \diagdown \\
 5 & & 8
 \end{array} = 4 \times 8 + 5 \times 3 = 32 + 15 = 47$$

$$\text{Step 3: } \begin{array}{r}
 & 2 & 4 & 3 \\
 & \times & \diagdown & \diagup \\
 6 & 5 & 8
 \end{array} = 2 \times 8 + 6 \times 3 + 4 \times 5 = 16 + 18 + 20 = 54$$

$$\text{Step 4: } \begin{array}{r}
 & 2 & 4 \\
 & \times & \diagup \\
 6 & 5
 \end{array} = 2 \times 5 + 4 \times 6 = 10 + 24 = 34$$

Step 5:  $2 \times 6 = 12$

Now the answer is 12|34|54|47|24 = 159894

Though here we have first done each step and then at end written the answer, each step has to be done to keep getting each digit of the answer (starting from the units place simultaneously)

**Note:** In the method place 0 if all column are not filled with digits. E.g.,  $723 \times 34$  is nothing but  $723 \times 034$  and follow the above mentioned steps.

## Squaring

### When Number is close to $10^n$

With Base as  $10^n$ , find the surplus or deficit (x)

Answer is again in two parts  $(B + 2x) | x^2$

Right hand part will consist of n digits. Add leading zeros or carry forward the extra to satisfy this condition

$$108^2 = (100 + 2 \times 8) | 8^2 = 116 | 64 = 11664$$

$$112^2 = (100 + 2 \times 12) | 12^2 = 124 | 44 = 12544$$

$$102^2 = (100 + 2 \times 2) | 2^2 = 104 | 04 = 10404$$

$$93^2 = (100 - 2 \times 7) | (-7)^2 = 86 | 49 \Rightarrow 8649$$

$$1006^2 = (1000 + 2 \times 6) | 6^2 = 1012 | 036 = 1012036$$

### When Number is close to 50

With Base as 50 find the surplus or deficit (x)

Answer is again in two parts  $(25 + x) | x^2$

Right hand part will consist of 2 digits. Add leading zeros or carry forward the extra to satisfy this condition

$$63^2 = (25 + 13) | 13^2 = 38 | 169 = 3969$$

$$38^2 = (25 - 12) | (-12)^2 = 13 | 144 = 1444$$

### Numbers ending with 5

If a number is in the form of n5, the square of it is  $n(n + 1) | 25$

$$\text{E.g. } 45^2 = 4 \times 5 | 25 = 2025$$

$$135^2 = 13 \times 14 | 25 = 18225$$

## Cubing

We can find the cube of any number close to a power of 10 say  $10^n$

With base  $= 10^n$  find the surplus or the deficit ( $x$ )

The answer will be obtained in three parts :  $B + 3x | 3 \times x^2 | x^3$

The right two parts will have  $n$  digits.

So either put in leading zeroes or carry forward the extra digits.

$$104^3$$

Base  $B = 100$  and surplus  $= x = 4$

$$(100 + 3 \times 4) | 3 \times 4^2 | 4^3 = 112 | 48 | 64 = 1124864$$

$$109^3$$

Base  $B = 100$  and  $x = 9$

$$(100 + 3 \times 9) | 3 \times 9^2 | 9^3 = 127 | 243 | 729 = 1295029$$

$$98^3$$

Base  $B = 100$  and deficit  $x = -2$

$$(100 - 3 \times 2) | 3 \times (-2)^2 | (-2)^3 = 94 | 12 | -8 = 94 | 11 | 100 - 8 = 941192$$

## Essentials to calculate faster

A high school student can score better than graduate students, in a DI test. The prime reason for this is that calculations do not daunt him. He is used to calculate, using a

pencil and hence is very fast at it. Most of graduate students have got so accustomed to calculating with the help of calculators that when a calculator is not available, the calculation part is usually left out, rationalizing that as it is answers are incidental, what is more important is the method to solve. From today, this has to be avoided like a plague and one should ensure that all calculations that come one's way has to be done without the use of a calculator. All the methods that follow cannot be mastered as long as we use a calculator. So the first essential to calculate fast enough is to throw away calculators.

Next, one would have to learn the following by heart :

Tables \_ upto 30 X 30

Reciprocals \_ Upto 30

Squares \_ upto 30

Cubes \_ upto 20

Square roots \_ upto 15

Cube roots \_ upto 15

Does it seem an onerous task? A task that will take ages and hazaar efforts to accomplish? Consider the case of tables \_ the one which usually will take the most amount of time. The amount of work involved is not as high as it seems. If one knows  $8 \times 9$  is 72, it is common sense that  $16 \times 9$  will be twice this i.e. 144 (since 16 is two times 8). Thus tables of 16 is already known if one knows tables of 8. Similarly tables of 18 is known if tables of 9 is known. Carrying this logic forward, one would be required to learn only tables of 13, 17, 19, 23 and 29. All other tables one can easily derive by doubling or trebling already known tables. Now does it seem that demanding?

## Reciprocal Percentage Equivalent:

Tables can take care of multiplications encountered. But if one has to develop speed in division, where the real tediousness lies, reciprocal percentage equivalent are an absolute must. Also reciprocal percentage equivalent is going to help you a lot in QA also.

The following may help you in memorizing the reciprocal equivalents.

If reciprocal of 2 is 50%, that of 4 will be half of 50% i.e. 25%. Similarly, reciprocal of 8 be half of 25% i.e. 12.5% and that of 16 will be 6.25%.

Reciprocal of 3 is 33.33%. Thus reciprocal of 6 and 9 will 16.66% and 11.11% respectively.

Reciprocal of 9 is 11.11 and reciprocal of 11 is 09.090909. Reciprocal of 9 is composed of 11s and reciprocal of 11 is composed of 09s.

Reciprocal of 20 is 5%. Reciprocal of 21 is 4.76% and of 19 is 5.26%. Thus we can easily remember reciprocals of 19, 20, 21 as 5.25%, 5, 4.75% i.e. 0.25% more and less than 5%

Similarly, reciprocal of 25 is 4%. Reciprocal of 24 is 4.16% and of 26 is 3.84%. Thus we can easily remember reciprocals of 24, 25, 26 as 4.15%, 4, 3.85% i.e. 0.15% more and less than 4%

Reciprocal of 29 is 3.45% (i.e. 345 in order) and reciprocal of 23 is 4.35% (same digits but order is different)

Reciprocal of 22 is half of 09.0909% i.e 4.545454% i.e consists of 45s

Reciprocal of 18 is half of 11.1111 i.e. 5.55555% i.e. consists of only 5s

Thus the work may seem to be a huge task, but if one uses a smart approach, it is hardly anything.

If any calculation has 9 in the denominator, the decimal part will be only 1111... or 2222 ... or 3333... or 4444 ... e.g.  $\frac{84}{9}$  will be 9.3333... can be found out in a jiffy

One can also calculate any fraction of the type  $\frac{(n-1)}{n}$  ( $n \leq 30$ ) within a second if one knows the reciprocal percentage equivalent. E.g.  $\frac{11}{12}$  will be nothing but  $1 - \frac{1}{12}$  i.e. the complement of 0.08333 which is 0.91666. Similarly if I know  $\frac{1}{23}$  is 0.0435,  $\frac{22}{23}$  will be 0.9565.

**Other Fraction Percentage Equivalents:** Knowing the reciprocal percentage equivalents is just a qualifying criteria, to gain a competitive advantage one needs to go beyond. One also needs to remember tables of  $\frac{1}{8}$  (or of 12.5) and  $\frac{1}{12}$  (or of 8.33). is 12.5%, is 25%,  $\frac{3}{8}$  is 37.5%, ....is 62.5%... is 87.5% Lets say one has to find 37.5% of 128. This will be nothing but  $\frac{3}{8} * 128$  which is 48. And percentages like 37.5% and 62.5% are used very regularly.

Also tables of  $\frac{1}{12}$  will help one find percentages like 83.33%, which is nothing but  $\frac{5}{6}$  th.

## Multiplication

Most multiplications can be easily solved by the process of factorization. Factorisation is a process which would go a long way in reducing the calculations. Factorisation in its basic sense has been used by many of us e.g. if we want to find 17 X 21 we would do 17 X 20 + 17 i.e. 357. We have factorised 21 as 20 + 1

Lets see how we can use this for even more tougher problems.

Lets say we want to find 14.25% of 3267. 10% of 3267 will be 326.7 . 1% of 3267 will be 32.67 and thus 4% would be 128 + 2.68 i.e. 130.6 Thus 14% will be 326.7 + 130.6 i.e.

457.3 . If one wants an even more accurate answer, since 1% is 32.6, 0.25% will be  $\frac{1}{4}$  th of 32.6 i.e 8.15 .

Thus, 14.25% of 3267 will be 465.4 . The best part of this method is that one has the liberty of deciding how accurate an answer one requires. Thus if alternatives are wide apart one may stop the process in between.

Knowing reciprocal percentage equivalent, one can even think of an even better factorization as 14.28% - 0.03% and since 14.28% is nothing but  $\frac{1}{7}$ , the answer can directly be found by dividing 3267 by 7 i.e. 466.7

## Division

Factorisation can also be used in division.

If one has to find  $\frac{1465}{320}$  .....

$$\frac{1465}{320} = \frac{1280 + 185}{320} = 4 + \frac{(160 + 25)}{320} = 4.5 + \frac{25}{320}$$

So the answer will be slightly more than 4.5

Another example,  $\frac{4835}{7280} = ?$

- a. 59.6% b. 63.8% c. 66.4% d. 71.4%

Just focus on denominator. 10% of denominator would be 728. Thus the answer will be definitely less than 70% (since  $7 \times 10\%$  will be more than 4900) and also answer will be more than 60% (since  $6 \times 10\%$  will be around 4360).  $\frac{2}{3}$  rd of 7280 will be 4860. Since the

numerator is less than 4860, the answer choice has to be less than rd or 66.66% and hence c is the obvious choice.

Remember almost all calculations can be reduced if one knows the milestones in the number systems that can be converted to fractions. For example in the above example if one had to choose between the first two options, all one had to find is 60% of denominator and compare it with the numerator. Thus one would know whether the answer is less than 60 or more than 60. Thus here 60% is chosen as a milestone. 62.5, 66.66 all of these can be used as milestones as finding,  $\frac{2}{3}$  of denominator are easier.

For making use of approximations, one must make sure that he treats the alternatives as also a part of the questions. Thus one must consciously use the process of elimination immediately after finishing reading the questions, this will force the person to have a look at the alternatives.

## Comparing ratios

**Approach 1 :** In a proper fraction  $\frac{a}{b} < \frac{a+x}{b+x}$  where x is positive. For an improper fraction, the inequality sign changes.

Which is greater  $\frac{456}{788}$ ,  $\frac{508}{835}$

Using this just find by what magnitude does the numerator increase and then proceed as follows ...

Considering  $\frac{456}{788}$ ,  $\frac{508}{835}$ , the numerator increase by 52.

Thus  $\frac{456}{788} < \frac{456+52}{788+52}$  i.e.  $\frac{508}{840}$  and thus first fraction will be lower than second fraction since in the second fraction, the denominator is even lower than 840, making it even higher.

This approach does not work always (what if the denominator would have been greater than 840?)

**Approach 2:** Find by what percentage does the numerator increase and check if denominator increases by higher or lower percentage. Which is greater  $\frac{456}{788}$ ,  $\frac{235}{390}$ ?

Consider,  $\frac{456}{788}$ ,  $\frac{235}{390}$ . In second ratio we see the numerator is just marginally higher than half the numerator of first ratio. Half of the denominator is 394.

Thus denominator of second fraction is lower than half the denominator of first ratio. Thus obviously the second ratio has to be higher as the numerator is more than half and at same time denominator is less than half.

**Approach 3:** In this we knowingly add an error and then compare.

Which is greater  $\frac{235}{390}$ ,  $\frac{1112}{2089}$ ?

If we consider the denominators as 400 and 2000 respectively, we have increased the denominator of the first and decreased the denominator of second. With these changes, the ratios boil down to 0.5875 and 0.556. The first ratio will be higher than 0.5875 and second ratio will be lower than 0.556.

Thus  $\frac{235}{390} > \frac{1112}{2089}$ . Using this approach you can always compare two ratios provided the approximation of denominators or for that matter of numerators is in opposite directions.

We have used different approaches to elucidate the different methods. You can use any method. Don't try to waste time deciding which approach is most suitable. Use whichever approach strikes first. Most importantly, while comparing ratios, don't immediately start calculating. First get an approximate idea (even to the tune of  $\pm 5\%$ ) and you will see that this approximation itself can give you the answer!

## Approximation

While approximating, ideally approximate the higher number. Consider  $288 \times 3890$ .

If we approximate 288 to 300 we are adding an error of  $12 \times 3890 = 93046680$ .

However if we approximate 3890 to 4000, we will be adding an error of  $110 \times 288 = 31680$ . Thus a lower percentage error is added when the higher number is approximated, even if the absolute error is higher (the percentage error introduced matters and not the absolute error introduced)

Similarly if we have to evaluate  $\frac{1868}{2575}$ . Approximate the denominator as 2500 (rather than 2600, why add to our calculations) and we get the approximated answer as 0.7472 (division by 25 is multiplication by 4). The actual answer has to be less than this approximation. Thus a golden rule while approximating is to identify if the actual answer will be higher or lower than the approximated answer. For this ensure that you approximate either the numerator or the denominator and not both or else we may not be able to tell which side does the actual answer lie.

To get the correct answer through approximation, we can also calculate the percentage error in the approximation. We have decreased the denominator by 3%. Thus the approximated answer that we get is going to be higher by slightly more than 3%. 0.75 reduced by 3% will give 0.725. Thus the answer will be very very close to 0.725.

## Vedic Mathematics Exercise

1.  $115 \times 0.92$  2.  $132^2$  3.  $987^2$  4.  $0.992^3$  5.  $512 \times 496$

6.  $112^3$  7.  $1024 \times 1012$  8.  $1.21 \times 1.14$  9.  $1.14^3$  10.  $89 \times 95$

11.  $65^2$  12.  $1016 \times 1006$  13.  $123 \times 112$  14.  $321 \times 52$  15.  $105^2$

16.  $635 \times 502$  17.  $79 \times 71$  18.  $889 \times 898$  19.  $123 \times 89$  20.  $128 \times 672$

**Learning Outcomes :**

Vedic Maths is an excellent exercise to discipline the mind to do a series of additions and multiplications of single digit numbers mentally. Any multiplication can be done by Vedic Maths through the general rule of multiplication. The general rule of multiplication also provides the answer directly without the need of writing the intermediate steps or calculations. Thus it can save a lot of time since calculating orally is much faster than writing.

And if numbers are favourable, the base method can provide the answers in a jiffy. Also using Vedic Maths one can find the squares of any number from 1 to 130 within 4 seconds if one is aware of squares from 1 to 30. The process of finding the cubes of numbers close to 100 is also very handy in compound interest.

However, anything that is new can become a regular habit only when it is practised consciously. Thus, one has to live with the discomfort of trying something new, but only for a week at maximum.

The fear of calculations is more because of our inertia rather than any real difficulty in calculations. To excel at calculation, all it requires is to invest couple of weeks studying the essentials to calculate faster viz. tables, reciprocal equivalents, squares, etc. Once these are memorised, one needs to avail each opportunity to calculate orally.

Another point to keep in mind is to avoid using the pencils immediately and end up with long winded calculations. Before applying pencil to paper, orally get to a close range of the answer. While doing so use answer choices and approximation techniques effectively.

**Assignment:**

Use every opportunity to do mental calculations :

1. Next time when you go to fill in petrol, orally calculate the exact amount of petrol available for Rs. 100.

2. Calculate the current and the required run-rate before it is displayed on the screen while watching a cricket match.
3. On your shopping visit, calculate the total spendings before the counter person does it.
4. While reading newspaper, take any financial data and calculate the growth rate between two figures.

# Percentage

2

## Learning Objectives

1. Concept of percent and of base
2. Change of base
3. Successive percentage changes
4. Indexing
5. Simple Interest & Compound Interest
6. Profit and Loss
7. Marked Price and Discount percentage
8. Faulty Balances
9. Stocks and Shares

## Concept of Percent

Percent in the simplest sense means per cent i.e. per hundred. Thus, the expression 15% simply means  $\frac{15}{100} = 0.15$

Thus, to convert any percent to a number, divide it by 100

E.g. 4% = 0.04 and 40% = 0.4 and 400% = 4

Similarly, to write any number in the percent form, multiply it with 100 and append a % symbol.

E.g. 2 = 200%, 0.2 = 20%, 0.02 = 2% and 0.002 = 0.2%

## Fractions, Ratios and Percentage

As seen above, x % is nothing but a fraction with numerator x and denominator 100. Identifying certain percentages in the reduced form of the fractions can be very useful.

E.g. whenever we have to calculate 20%, we can calculate  $\frac{20}{100} = \frac{1}{5}$  th.

Similarly the ratio  $\frac{3}{5}$  can be expressed as  $\frac{60}{100}$  i.e. 60%

$$\frac{1}{2} = 50\% \quad \frac{1}{3} = 33.33\% \quad \frac{1}{4} = 25\%$$

$$\frac{1}{5} = 20\% \quad \frac{1}{6} = 16.66\% \quad \frac{1}{8} = 12.5\%$$

$$\frac{1}{9} = 11.11\% \quad \frac{1}{11} = 9.09\% \quad \frac{1}{12} = 8.33\%$$

$$\frac{1}{15} = 6.66\% \quad \frac{1}{16} = 6.25\% \quad \frac{1}{20} = 5\%$$

$$\frac{2}{3} = 66.66\% \quad \frac{3}{4} = 75\% \quad \frac{5}{6} = 83.33\%$$

$$\frac{3}{8} = 37.5\% \quad \frac{5}{8} = 62.5\% \quad \frac{7}{8} = 87.5\%$$

As we will see in further chapters, ratios are nothing but fractions. Thus there is a strong link between fractions, ratios and percentages. E.g. in a mixture of 20 ltrs of milk and 30 ltrs of water, the ratio of milk and water is 2 : 3. This can be converted to fraction of milk in the solution as 2 : 5 or  $\frac{2}{5}$  th. As seen is nothing but  $\frac{2}{5} \times 100 = 40\%$ .

## Concept of base:

If it is said that India won 40% of the matches she played, neither does it mean that India won 40 matches nor does it mean that India won 0.4 matches. All that it means is that HAD India played 100 matches, she would have won 40 matches.

Pay close attention to the usage "40% of the matches she played". The number of matches India played is the base and to calculate the number of matches won, we have to find 40% of this base. Thus if India had played a total of 25 matches, she would have won 40% of 25  
 $= \frac{40}{100} \times 25 = 10$  matches.

Alternately, if we know that in a class of 60, only 40 students passed, then the percentage (per 100) of student passing is  $\frac{40}{60} \times 100 = 66.66\%$ . Simply stated this is unitary method i.e. out of 60 students 40 passed. Had there been 100 students appearing, how many would have passed? In this case the base is the number of students taking the exam.

One more example, if a number, let's say 80, increases by 20%, the final number is not really  $80 + 20\%$  i.e.  $80 + 0.2$ . The 20% is again a percentage of a base, in this case of the number itself. Thus the final number is  $80 + 20\% \text{ of } 80 = 80 + \frac{1}{5} \text{th of } 80 = 80 + 16 = 96$ .



*A = 0.004% of 25,000 and B = 25,000% of 0.004 i.e. A is a very small percentage of a very large number and B is a very large percentage of a very small number. Which is greater A or B?*

**Example 1:** A's income is 70% of B's. B's income is 50% of C's. If C's income is Rs. 1,00,000, what is A's income?

**Solution:** B's income =  $\left(\frac{50}{100}\right) \times \text{Rs.} 100000 = \text{Rs.} 50,000$

$$\text{A's income} = \left(\frac{70}{100}\right) \times \text{Rs.} 50000 = \text{Rs.} 35,000$$

#### Alternative Method:

$$\text{B's income} = \frac{50}{100} \text{ of C's income}$$

$$\text{A's income} = \frac{70}{100} \text{ of B's income} = \frac{70}{100} \text{ of C's income}$$

$$\text{A's income} = \frac{35}{100} \times 100000 = \text{Rs.} 35,000 .$$

**Example 2:** In a basket of fruits, 60% are mangoes and remaining 40% are apples. 25% of the apples are green and the rest 75% are red. Of the mangoes, 80% are red and the rest of the mangoes are green. What percentage of the green fruits are mangoes?

**Solution:** Please pay attention very carefully to the base of the percentages given. For 60% and 40%, the base is the total number of fruits. 25% and 75% are percentages of apples whereas 80% and 20% are percentages of mangoes. And in the question asked, the base has to be the total number of green fruits!

If total number of fruits is 100, 60 are mangoes and 40 are apples.

$$\text{Green Apples} = 25\% \text{ of } 40 = 10$$

$$\text{Green Mangoes} = 20\% \text{ of } 60 = 12$$

Total number of green fruits =  $10 + 12 = 22$  of which 12 are mangoes.

$$\text{Thus required percentage} = \frac{12}{22} = \frac{6}{11} = 54.54\%$$

**Example 3:** In an exam, a student scored 50% of the maximum marks and yet failed by 12 marks. If he had scored 10% more than what he scored, he would have just managed to

get the pass percentage. What are the maximum marks of the paper?

**Solution:** If the maximum marks of the paper is M, the student scored  $0.5M$ . If he had scored 10% more (this 10% is a percent of the marks obtained), he would have scored  $0.5M + 10\%$  of  $0.5M$  i.e.  $0.55M$ . Further we have  $0.55M - 0.5M = 12$

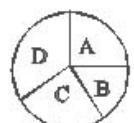
$$\Rightarrow M = 240.$$

Alternately, one could have even avoided equations. 10% of the marks scored is equal to 12 marks. Thus marks scored is 120 and this is 50% of the maximum marks, suggesting that maximum marks is 240.



*Percentages in pie-charts:*

*Pie charts are just a diagrammatic representation of percentage share of various heads.*



In the pie-chart shown, A accounts for  $\frac{1}{4}$ th of the entire pie. Thus the entire pie is 100% and A accounts of 25%. The actual size of the pie (radius of circle) is immaterial.

**Example 4:** If the milk to water ratio in a mixture is 2 : 3, what is the milk percentage in the mixture?

**Solution:** Milk constitutes of the mixture, which is equivalent to  $\frac{2}{5} \times 100 = 40\%$ .

**Example 5:** If three-fourth of students in the class have cars and half of the car owners own a Mercedes, what fraction of the class has a Mercedes? Express the answer in

percentage term.

**Solution:** The fraction of the class owning Mercedes is  $\frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$ .

If the same were to be expressed in percentage terms, it could be worded as:

75% of the class owned a car and 50% of them owned a Mercedes.

So the percentage of students owning a Mercedes = 50% of 75% of the class

$$= \left( \frac{50}{100} \right) \times \left( \frac{75}{100} \right) \times 100 = 37.5\%.$$

Or directly from the fraction, we get the percentage of students owning a Mercedes is  $\frac{3}{8} \times 100 = 37.5\%$ .

**Example 6:** Mira's expenditure and savings are in the ratio 3 : 2. Her income increases by 10%. Her expenditure increases by 12%. By what percentage does her savings increase?

**Solution:**

**Method 1:** Let Mira's expenditure be  $3x$  and the savings be  $2x$ . Hence, her income =  $5x$ .

Her new expenditure and income after the increase are  $3.36x$  and  $5.5x$  respectively.

Hence, her new savings =  $(5.5x - 3.36x) = 2.14x$ .

$$\text{So increase in the savings} = \left( \frac{0.14x}{2x} \right) \times 100 = 7\%.$$

**Method 2:** Let the expenditure and savings be

Rs. 300 and Rs. 200 respectively. So the income is Rs. 500, which increases to Rs. 550. Similarly, the expenditure increases to Rs. 336. So the new savings is equal to 214, which

is 7% more than Rs. 200. This method helps in verbalizing your calculations. The principle is same as the earlier method.

### Percent of a percent

$$20\% \text{ of } 30\% \text{ will be nothing but } \frac{20}{100} \times \frac{30}{100} = 0.06 = 6\%$$

#### Example 7:

What is 20% of 30% of 40%?

#### Solution:

$$\text{The value is } \left( \frac{20}{100} \right) \times \left( \frac{30}{100} \right) \times 40\% = 2.4\%.$$

You may encounter the following types of questions in the examination

| Types of questions  | Examples  | Approach to the question   |
|---|---|--|
| 1. Convert x percentage into fraction.  | Express 12% as a fraction.  | $x\% = \frac{x}{100} = \frac{12}{100} = \frac{3}{25}$  |
| 2. Convert fraction or decimal into percentage.   | Express $\frac{5}{11}$ as percentage.   | Multiply the fraction by 100.<br>$= \frac{5}{11} \times 100 = 45.45\%$   |
| 3. If A's income is x% of B's income and B's income is given, then find A's income.   | A's income is 40% of B's income. If B's income is Rs. 10,000, what is A's income?   | $A = \frac{x}{100} \times P$<br>$= \frac{40}{100} \times 10000 = \text{Rs. } 4,000$  |
| 4. If A's income is r% more than B's income, then by how much % is B's income less than A's income?                         | X's income is 25% more than Y's. By how much % is Y's income less than X's income?  | Difference = $\frac{r}{100+r} \times 100$<br>$= \frac{25}{125} \times 100 = 20\%$  |
| 5. If A's income is r% less than B's income, then by how much % is B's income more than A's income?                         | X's income is 40% less than Y's. By how much % is Y's income more than X's income?  | Difference = $\frac{r}{100-r} \times 100$<br>$= \frac{40}{60} \times 100 = 66.67\%$  |
| 6. If the price of a commodity increases by r%, find the % decrease in the consumption given that expenditure remains same. | If the price of potato is increased by 20%, by how much should the consumption be decreased so as to maintain the same expenditure? | Expenditure<br>= Price $\times$ Consumption<br>Decrease = $\frac{r}{100+r} \times 100$<br>$= \frac{20}{120} \times 100 = \frac{50}{3} = 16.67\%$ |

**Example 8:** In a market survey, 20% opted for product B. The remaining individuals were uncertain. If the difference between those who opted for product B and those who were uncertain was 720, then how many individuals were covered in the survey?

**Solution:** Clearly, 80% were uncertain. 80% of x - 20% of x = 720 Or 60% of x = 720

$$\text{or } \frac{60}{100}x = 720 \text{ or } x = \frac{720 \times 100}{60} = 1200$$

**Example 9:** Of the total amount received by Kiran, 20% was spent on purchases and 5% of the remaining on transportation. If he is left with Rs. 1520, the initial amount was

**Solution:** Let 100 be the initial amount with Kiran. 20% is spent on purchases. Hence, we are left with 80%. Five percent of 80% is 4%. Hence, the remaining is 76%. We are given that the remaining is 1520. Here, 76% corresponds to 1520 and hence, 100% corresponds to  $\frac{100 \times 1520}{76} = 2000$ .

## Concept of Multiplying Factor

Consider the following calculation that is done when 40 has to be increased by 20%.

$$\text{Increased Value} = 40 + 20\% \text{ of } 40 = 40 + \frac{20}{100} \times 40 = 40 + 8 = 48$$

One could also re-arrange and approach it in the following manner.

$$\text{Increased Value} = 40 + 20\% \text{ of } 40 = 40(1 + 20\%) = 40(1 + .2) = 40 \times 1.2 = 48$$

1.2 can be called the Multiplying Factor (MF) corresponding to 20% and can simplify a lot of calculations as will be seen later. So understand the concept of Multiplying Factor (MF) very well.

The Multiplying Factor (MF) corresponding to  $x\%$  increase is nothing but  $1 + \frac{x}{100}$  for an  $x\%$  decrease.

Thus MF corresponding to 40% increase will be 1.4 and corresponding to 4% increase will be 1.04. Similarly the MF corresponding to 20% decrease will be 0.8 and will be 0.98 for 2% decrease.

MF can also be used in Data Interpretation to a huge extent. Since ratio of 48 to 36 is  $\frac{4}{3} = 1.3333$ , we can say that 48 is 33.33% more than 36.



*MF > 1 implies an increase and MF < 1 implies a decrease. A more than 100% increase would give a multiplying factor greater than 2 (e.g. a 100% increase o MF of 2, 400% increase o MF of 5). A more than 100% decrease would translate to what MF? A negative MF? !!!*

(Hint : More than 100% decrease !!!)



*Multiplying factor comes in handy wherever percentages are present. Thus make sure your understanding of multiplying factor is thorough.*

*Initial value × MF = Final value*

*Initial value can be cost price, principal kept in bank, sales in year x, value of asset in year x and corresponding final value will be selling price, amount, sales in subsequent year and value of asset in subsequent year respectively.*

## Change of base

The basic problem of this type can be understood with the following example :

If salary of A is 20% more than salary of B, then the salary of B is how much percent less than the salary of A?

In the data given "salary of A is 20% more than salary of B", the comparison (the base) is with the salary of B, whereas in the question "...percent less than the salary of A", the comparison (the base) is with salary of A.

Also another point to note is that the difference between the salaries will be same. Thus what the problem boils down to is that in the data the difference is given as a percentage of salary of B and the question asks one to calculate the difference as a percentage of A's salary.

If B's salary is 100, A's salary will be 120. Thus salary of B is 20 less than A's salary and is  $\frac{20}{120} = \frac{1}{6} = 16.66\%$  less than that of A.

Thus, if A is r% more/less than B, B is  $\frac{100r}{100 \pm r}\%$  less/more than A.

Rather than assuming B's salary as 100, we could have assumed it to be 5 (the reciprocal percentage equivalent of 20%) and then A's salary would be 20% i.e.  $\frac{1}{5}$ th of 5 = 1 more i.e. 6 and the required answer will be  $\frac{1}{6} = 16.66\%$ .

Thus the answer can be orally calculated by remembering the triplet 5, 1, 6 starting with 5 as  $20\% = \frac{1}{5}$ .

What if the question was "If salary of A is 20% less than salary of B, then the salary of B is how much percent more than the salary of A"?

It would just mean repeating the triplet 5, 1, 4 in your mind and answer would be  $\frac{1}{4} = 25\%$



*Change of base is another concept used widely and helps in saving a lot of calculation time.*

For same distance if speed increases by 10%, would time taken decrease by 10%? No, Ratio of new speed to original speed =  $\frac{11}{10}$  and hence ratio of new time to original time =  $\frac{10}{11}$  i.e. a 9.09% decrease.

In fact in any relation of type  $A \times B = \text{constant}$ , if A changes by  $\pm x\%$ , B will change by  $\frac{100x}{100 \pm x}\%$



$\frac{100x}{100 \pm x}\%$  is also the answer to what percentage change will offset  $\pm x\%$  change i.e. will get the value back to the original magnitude.

**Example 10:** If A is 37.5% more than B, by what percent is B less than A?

**Solution:** Using the formula  $\frac{100r}{100 \pm r}\%$ ,

we arrive at the answer as  $\frac{37.5}{137.5} \times 100\%$  which is going to be difficult to calculate.

Thus it is advisable that the fraction equivalent of 37.5% be used.  $37.5\% = \frac{3}{8}$  and thus if B is 8, A is 37.5% of 8 i.e.  $\frac{3}{8}$  of 8 i.e. 3 more.

Thus A is 11 and required answer is  $\frac{3}{11} = 27.2727\%$ .

Calculating is very easy if one remembers that  $\frac{1}{11}$  is 9.0909%

The whole problem can be solved by just identifying the triplet 8, 3, 11.

The above concept is used in a variety of problems as follows:

**Example 11:** If prices decrease by 25%, by what percentage can consumption increase without affecting the expenditure?

**Solution:** This question is also exactly similar to the above question and the answer can be got from  $\frac{25}{100 - 25} = \frac{1}{3} = 33.33\%$

However a better process could be - if price decreases from 4 to 3 (a 25% decrease), consumption can increase from 3 to 4 i.e. an increase of 33.33%.

This problem can be made tougher as follows :

**Example 12:** Since prices of mangoes decreased by 25%, I can purchase 4 mangoes more for Rs. 60. What is the original price of one mango?

**Solution:** The equation for this would be  $\frac{60}{0.75x} - \frac{60}{x} = 4$  where x is the original price of one mango.

However the problem can be solved orally as follows : As seen in the earlier problem, because price decreased by 25%, I can purchase  $1/3^{\text{rd}}$  mangoes more for same amount. But actually I could purchase 4 mangoes more and this should be equal to  $1/3^{\text{rd}}$  the number I could purchase earlier. Thus, earlier I could purchase 12 mangoes for Rs. 60 and price of each mango would be Rs. 5.

Alternately, since prices decreased by 25%, had I purchased the same number of mangoes as earlier, I would have saved 25% of 60, i.e. Rs. 15. This means that in Rs. 15 I can get 4 mangoes at new rate.

$$\therefore \text{New rate} = \frac{15}{4} \quad \text{Old rate} = \frac{15}{4} \times \frac{4}{3} = \text{Rs. } 5$$

**Example 13:** If the area of the circle is increased by 21%, then what is the percentage increased in the circumference of the circle?

**Solution:** Let r and  $r'$  be the old and new radii of the circle.

$$\text{Then, } \pi r'^2 - \pi r^2 = \frac{21}{100} \times \pi r^2$$

$$\Rightarrow r'^2 = \frac{121}{100} \times r^2 \Rightarrow r' = 1.1r$$

$$\begin{aligned} \text{Increase in the circumference of the circle} \\ &= \frac{2\pi r' - 2\pi r}{2\pi r} \times 100 = \frac{r' - r}{r} \times 100 = \frac{1.1r - r}{r} \times 100 = 10\%. \end{aligned}$$

**Example 14:** If speed increases by 33.33%, what is the percent reduction in time taken to travel the same distance?

**Solution:** Speed becomes  $4/3^{\text{rd}}$  and thus time will become  $3/4^{\text{th}}$  i.e. a reduction of 25%.



Which one of the following would you prefer?

In first year, an increase of a% in your salary and then in second year a decrease of b%; OR

In first year a decrease of b% in your salary and in second year an increase of a%

## Successive percentage changes

If in the first year, A's salary increases by 10% and in second year, the salary increases by 20% again, would the net increase over the two years be  $10 + 20 = 30\%$ ? Not really.

If A's salary was 100 at start, after 1<sup>st</sup> year it would be 110. In second year

it would be  $110 \times 1.2 = 132$ . Thus the net increase is 32 i.e. 32% and not 30%

The computation of final salary can also be done with multiplying factor as

Final Salary = (Initial salary  $\times 1.1$ )  $\times 1.2$  = Initial salary  $\times 1.32$

i.e. the final salary is 32% more than the initial salary.

The 10% increase and 20% increase in above problem are called successive increases as the second percentage increase is effected on the new base i.e. on the value after the first increase and not on the initial value.

Let's consider the above calculation with two successive percentage increases of a% and b%.

$$\text{Net MF} = \left(1 + \frac{a}{100}\right) \left(1 + \frac{b}{100}\right) = \left(1 + \frac{a}{100} + \frac{b}{100} + \frac{ab}{10000}\right) = \left(1 + \frac{a+b+\frac{ab}{100}}{100}\right)$$

i.e. the net percentage increase is  $a+b+\frac{ab}{100}$ %.

Two successive percentage changes of a% and b% is an effective change of  $\left(a+b+\frac{ab}{100}\right)\%$ .

Thus for two successive percentage changes (the process also works for two successive decreases or one increase and one decrease, though with correct signs), we have two approaches :

- either we multiply the two corresponding

Multiplying Factors to get the net

Multiplying factor or

- we use the formula  $a+b+\frac{ab}{100}$  with a and b the changes in percentages Wherever one can use  $a+b+\frac{ab}{100}$ , one can use MFs and vice versa. It is advisable to get used to both these

methods as for different situations, one might be less time consuming than the other.

This same concept also applies in any relation of the type  $P = A \times B$ .

If A and B change by a% and b% respectively, then the net percentage change in P is  $\left(a+b+\frac{ab}{100}\right)\%$ . E.g. in a rectangle, if the length increases by 10% and the breadth decreases by 5%, the net percentage change in area will be  $10 - 5 - \frac{10 \times 5}{100} = 4.5\%$ .

Few relations of this type are

- Area = Length  $\times$  Breadth
- Total Sales in rupees = Sales in volume  $\times$  Rupees per unit
- Total Sales = Market Share  $\times$  Total Market Sales

The last two relations will be of immense use in Data Interpretation.



Could you calculate an expression for overall percentage increase for three successive increases of a%, b% and c%? (Not needed for CAT)



50 successive discounts of 2%, 4%, 6%, 8% ... would mean a net discount of \_\_\_\_%.



A shopkeeper offers you a flat discount of 20% or alternately you can choose two successive discounts of a% and b% (of your choice) such that  $a\% + b\% = 20\%$ . What

should you take - the flat discount or the two successive discount? If successive, what values of  $a$  and  $b$  would you choose?

If the above case was that of a raise given to you by your employer, would you opt for a flat raise of 20% or two successive raise of  $a\%$  and  $b\%$  such that  $a\% + b\% = 20\%$ . What values of  $a$  and  $b$  would you choose?

**Example 15:** If the price of petrol increases successively by 20% and then by 10%, what is the net change in percentage terms?

**Solution:** 32%

[Hint: Apply the  $a + b + \frac{ab}{100}$  formula.]

**Example 16:** The length and the breadth of a rectangle are 10 cm and 5 cm respectively. The length is increased by 10% and the breadth is increased by 5%. What is the new area of the rectangle?

**Solution:**

**Method 1:** New length =  $10 \times \frac{11}{10} = 11$  cm. The new breadth =  $5 \times \frac{105}{100} = 5 \times \frac{21}{20} = 5.25$  cm.

The final area =  $11 \times 5.25 = 57.75$  sq. cm.

**Method 2 :** A more elegant method would be the  $a + b + \frac{ab}{100}$  method.

A simultaneous increase in the length and the breadth is equivalent to an increase in the length first and subsequently the breadth or vice versa. So the increase in the area happens in two stages, an increase of  $a\%$  first and a subsequent increase of  $b\%$ . Applying the  $(a + b) + \frac{ab}{100}$  formula, the net increase is 15.5%. So the original area, i.e. 50 sq. cm increases by 15.5% and hence becomes 57.75 sq. cm.

**Example 17:** The number of cars sold by Maruti increased by 25% in the year 1999 and then decreased by 10% next year. Find the total number of cars sold by Maruti in the year 2000, if in the year 1998 it sold 2 lakh cars?

**Solution:** Sales in the year 2000 =  $2 \times \frac{5}{4} \times \frac{9}{10} = 2.25$  lakh.

**Example 18:** If the price of potatoes increased first by 20% and subsequently by 40%, what is the final price per kilogram, if the original price was Rs. 25 per kilogram?

**Solution:** Using the fraction method, we get the final price as  $25 \times \left(\frac{6}{5}\right) \times \left(\frac{7}{5}\right) = \text{Rs. } 42$

**Example 19:** The radius of a circle has increased by 20%. By what percentage does

- the circumference increase?
- the area increase?

**Solution:**

a. Circumference of a circle =  $2\pi r$ . Since  $r$  increases by 20%, the circumference also increases by 20%.

b. Area of a circle =  $\pi r^2$ .

Since  $r^2 = r \times r$  as  $r$  increases by 20%,  $r^2$  increases by  $20 + 20 + \frac{(20 \times 20)}{100} = 44\%$ .

#### Application of percentages :

Percentages find a lot of use in real life situations, few of them are

- Indexing
- Simple Interest and Compound Interest

## c. Profit Loss and Discount

Data Interpretation is mostly about percentages.

**Example 20:** The number of seats in an auditorium is increased by 25%. The price on a ticket is also increased by 12%. What is the effect on the revenue collected?

**Solution:** Let the initial number of seats be 100 and price per ticket be Re. 1

Then, Revenue = number of seats × price per ticket Increased number of seats

$$= \frac{125}{100} \times 100 = 125$$

$$\text{Increased price of a ticket} = \frac{112}{100} \times 1 = \text{Rs. } 1.12$$

$$\text{Increased revenue} = 125 \times 1.12 = \text{Rs. } 140$$

$$\text{Percentage increase in revenue} = \left( \frac{140 - 100}{100} \right) \times 100 = 40\%$$

**Short cut:**

$$\text{Using \% increase} = a + b + \frac{ab}{100}$$

$$\therefore \text{Percentage increase in revenue} = 25 + 12 + \frac{25 \times 12}{100} = 25 + 12 + 3 = 40\%.$$

**Example 21:** The length of a rectangle is increased by 10%. What will be the percentage decrease in its breadth so as to have the same area?

**Solution:** Let length and breadth of the rectangle be l and b respectively.

$$\text{Area} = lb \text{ Increased length and breadth} = l' \text{ and } b'; \text{Area} = l'b' \quad l' = \frac{110}{100}l \quad b' = \frac{11}{10}b$$

$$\Rightarrow \frac{11}{10}lb' = lb \Rightarrow b' = \frac{10}{11}b$$

$$\text{decrease in breadth} = b - b' = b - \frac{10}{11}b = \frac{1}{11}b$$

$$\text{Percentage decrease in breadth} = \frac{b}{11b} \times 100 = \frac{100}{11} = 9\frac{1}{11}\%$$

**Short cut:**

$$\text{Applying percent change} = a + b + \frac{ab}{100}$$

$$\text{Let decrease in breadth be } x\%, \text{ then } 0 = 10 - x - \frac{10 \times x}{100} \Rightarrow \frac{11x}{10} = 10$$

$$\Rightarrow x = \frac{100}{11} = 9\frac{1}{11}\%$$

**Example 22:** If the side of a square is increased by 25%, then its area is increased by how many percent?

**Solution:** Let the side be 10 cm. Then the area will be  $100 \text{ cm}^2$ .

$$\text{New side} = 125\% \text{ of } 10 = 12.5 \text{ cm}; \text{Area} = (12.5)^2 = 156.25$$

$$\therefore \text{Percentage increase in area} = 56.25\%$$

**Short cut :**

If x is the percentage increase in the side of a square, then increase in area is given by

$$x + x + \frac{x \times x}{100} = 2x + \frac{x^2}{100} = 25 + 25 + \frac{25 \times 25}{100} = 56.25\%$$

**Indexing**

As managers, one would come across a lot of "Index" e.g. consumer price index, SENSEX, etc.

Indexes are just "relative" values and not the exact values. Let's say the sales of a company are 400, 450, 550, 600, 800 in five successive years from 2000 to 2004. If one is to form an Index of sales, any one year (usually the first) is assumed as base year and the sales for this year are considered as 100 (i.e. 100%). The index values corresponding to sales of all other years are then calculated with respect to this 100 in base year. Since 400 corresponds to 100, 450 will correspond to  $\frac{450}{400} \times 100 = 112.5$  and 550 will correspond to  $\frac{550}{400} \times 100 = 137.5$ . The Index values for 2000 to 2004 will be 100, 112.5, 137.5, 150, 200 respectively.

One should notice that the percentage change in the Index values, exactly replicates the percentage change in the underlying values, i.e. sales in this case.



### *History of Sensex*

Though the BSE is more than 128 years old, it came up with the index Sensitive Index (SENSEX) only in 1986. The base year of the SENSEX is 1978-79 and base value is 100. This means that if one had invested Rs. 100 in a SENSEX base fund in 1978-79 it would have amounted to Rs. 17,000 (current SENSEX Level), i.e. 16,900% increase.

More on calculation of Sensex (though quite technical) at

[www.bseindia.com/about/abindices/bse30.asp](http://www.bseindia.com/about/abindices/bse30.asp)

**Example 23:** The price of rice per kilogram was Rs. 18 in the base year 1990. What is the price in 2001, if the index is 250?

**Solution:** An index of 250 implies that the new price is 150% more than the price in the base year, or the new price is 2.5 times the original price.

Hence, the new price =  $2.5 \times 18 = \text{Rs. } 45$ .

**Example 24:** The indexed values of the cost price of X for 1991, 1992 and 1993 are 125, 150 and 200. If the base year is 1990, find

- the ratio of the cost prices in 1992 and 1993.
- the cost price in 1991 if the cost price increases by Rs. 100 in 1993 compared to 1992.

**Solution:**

a. If the cost price in 1990 is Rs. x, then cost price in 1993 = 2x, cost price in 1992 = 1.5x.

∴ Ratio of the cost prices

$$= \frac{1.5x}{2x} = \frac{3}{4} \text{ or } 3 : 4 .$$

b. Just as in case (a): If the cost price in 1990 is x,

then the cost price in 1993 is 2x,

The cost price in 1992 is 1.5x,

The cost price in 1991 is 1.25x.

Since  $2x - 1.5x = \text{Rs. } 100$ ,

$x = \text{Rs. } 200$ . So  $1.25x = \text{Rs. } 250$ .

**Example 25:** 5% of income of A is equal to 15% of income of B and 10% of income of B is equal to 20% of income of C. If income of C is Rs. 2,000, then total income of A, B, and C is

**Solution:**  $\frac{5}{100}A = \frac{15}{100}B$  and  $\frac{10}{100}B = \frac{20}{100}C$

$$\therefore A = 3B \text{ and } B = 2C = 2 \times 2000 = 4000$$

$$\therefore A = 3 \times 4000 = 12000$$

$$A + B + C = (12000 + 4000 + 2000) = 18000$$

**Example 26:** Arvind spends 75% of his income. His income is increased by 20% and he increases his expenditure by 10%. His savings are increased by how many percent?

**Solution:** Let the income be 100. Expenditure = 75 and savings = 25.

$$\text{New income} = 120$$

$$\text{New expenditure} = \left( \frac{110}{100} \times 75 \right) = \frac{165}{2};$$

$$\text{New savings} = \left( 120 - \frac{165}{2} \right) = \frac{75}{2}$$

$$\text{Increase in savings} = \left( \frac{75}{2} - 25 \right) = \frac{25}{2};$$

$$\text{Percentage increase} = \left( \frac{25}{2} \times \frac{1}{25} \times 100 \right) = 50\%$$

**Example 27:** Two numbers are respectively 19% and 70% more than a third number. What percentage is the first number out of the second?

**Solution:** Let the third number be 100.

Then, the first number is  $100 + 19 = 119$  and the second number is 170.

$\therefore$  The first is  $\frac{119}{170} \times 100 = 70\%$  of the second.

### Short cut:

First number is  $\left( \frac{100+19}{100+70} \right) \times 100 = 70\%$  of the second.

**Example 28:** Salaries of A, B and C are in the ratio 1 : 2 : 3. Salary of B and C together is Rs. 6,000. By what percent is salary of C more than that of A?

**Solution:** Let  $A = x$ ;  $B = 2x$  and  $C = 3x$

$$\text{Then, } 2x + 3x = 6000 \Rightarrow x = 1200$$

$$\therefore A = 1200 \text{ and } C = 3600$$

$$\text{Required excess} = \left( \frac{2400}{1200} \times 100 \right) = 200\%$$

### Alternative method:

If salary of A =  $x$ , then salary of C =  $3x$ , hence, salary of C is  $2x$  more than A. So, C is  $\frac{2x}{x} \times 100 = 200\%$  more than A.

**Example 29:** A cricket team won 40% of the total number of matches it played during a year. If it lost 50% of the matches played and 20 matches were drawn, the total number of matches played by the team during the year was

**Solution:**  $40\% \text{ of } x + 50\% \text{ of } x + 20 = x$ , where  $x$  = Total number of matches

$$\Rightarrow \frac{40}{100}x + \frac{50}{100}x \Rightarrow x + 20 = x \text{ or } x = 200$$

## Simple Interest & Compound Interest

Whenever we keep any amount in bank, we are paid interest. The interest is usually specified as, say, 5% per annum. The 5% p.a. means that if Rs. 100 is the money invested,

one would receive 5% of this i.e. Rs. 5 every year. Thus the amount of Interest received depends on the principal that is invested and also the number of years that the money is invested for.

Basically we can say that our money invested grows at 5% every year. Thus this concept of Interest can be applicable in a host of situations wherever growth (or for that matter decline) is present and is not limited to just banks or monetary parameters. In any context we define the following terms as

**Principal :** Denoted by P, is the value at the outset.

**Amount :** Denoted by A, is the final value of the principal after the applicable growth.

**Rate of interest :** Denoted by r, is the percentage growth of the principal for any single time period.

**Interest :** Denoted by I, is the amount by which a principal increases.

**Time period :** Denoted by t or n, is the time interval after which any growth/interest is calculated.

There are two ways that the interest can be calculated viz. Simple Interest or Compound Interest.

In Simple Interest, the Interest, in any time period, is calculated as a percentage of the initial amount invested. Thus in Simple Interest the Interest in any year is always a constant i.e.  $r\%$  of P. In absolute terms, the principal grows by a constant amount (or rate).

In Compound Interest, the Interest, in any time period, is calculated as a percentage of the amount outstanding at the start of the time period and not the initial investment. The amount outstanding at the start of any time period will be equal to the initial amount invested plus the interest earned so far. Thus the interest earned in earlier time periods

gets added to the initial investment and this new sum is considered to be reinvested and interest is calculated on this new amount.

The following table captures the above information when Rs. 1000 is kept at 10%.

| For the year | Simple interest |     |        | Compound interest |     |        |
|--------------|-----------------|-----|--------|-------------------|-----|--------|
|              | Principal       | SI  | Amount | Principal         | CI  | Amount |
| 1            | 1000            | 100 | 1100   | 1000              | 100 | 1100   |
| 2            | 1000            | 100 | 1200   | 1100              | 110 | 1210   |
| 3            | 1000            | 100 | 1300   | 1210              | 121 | 1331   |

Please also understand the following observations from the table. These will be of great use in our understanding the difference between SI and CI.

- (1) The simple interest earned every year was constant and equal to Rs. 100, which is 10% of the principal.
- (2) The principal in the case of SI is always the same at the beginning of every year.
- (3) The principal for CI was increasing constantly. The interest earned each year was added on to the principal at the end of that year and the resultant was the principal for the next year.
- (4) The increase in the interest amount earned each year on account of CI was equal to 10% of the interest earned in the previous year.



*The entire theory of simple and compound interest is not limited to just banks. It is also applicable to a depreciating assets and loans. Straight line depreciation is case of simple interest whereas Written down depreciation is case of compound interest.*

### Simple Interest

The Simple Interest is given by  $S.I. = \frac{P \times r \times n}{100}$

One can also break this formula as

$$S.I. = \frac{P \times r}{100} + \frac{P \times r}{100} + \frac{P \times r}{100} + \dots \text{ n times i.e.}$$

Total S.I. in  $n$  years = Interest in 1 year  $\times$  number of years, which we are already aware of from the table.

Another understanding from the equation is

$S.I. = P \times \frac{r \times n}{100}$  =  $m\%$  of  $P$  i.e. if rate of interest is 5% and principal is invested for 6 years, the total S.I. will be 30% of the principal invested.

Please note that the formula gives the Simple Interest and to calculate the final amount one must add it to the principal.

$$\text{Amount} = P + \frac{P \times r \times n}{100} = P \left(1 + \frac{r \times n}{100}\right)$$



If principal is same

$S.I. @ 12\% \text{ for } 5 \text{ years} = S.I. @ 6\% \text{ for } 10 \text{ years} = S.I. @ 5\% \text{ for } 12 \text{ years} = S.I. @ 2.5\% \text{ for } 24 \text{ years ...etc. i.e. any way such that } r\% \times n = 60\%$

Also SI @ 37.5% can also be considered as collective result of SI at the rate of 30% and 5% and 2.5% or any way such that the sum is 37.5%

Another handy understanding is the direct proportion between SI and  $P$ ,  $r$  or  $n$ . Thus if principle halves, rate doubles and number of years becomes thrice, the SI will become

$$\frac{1}{2} \times 2 \times 3 \text{ i.e. thrice.}$$

## Compound Interest

Let us consider principal  $P$  kept at compound interest of  $r\%$  p.a., the interest earned in the first year will be  $r\%$  of  $P$  as  $P$  is the amount at the start of the year. Thus interest in the first year is  $P \times \frac{r}{100}$ . For the second year, we have to first calculate the amount outstanding i.e. the principal plus all interest earned so far.

Thus amount outstanding at start of 2<sup>nd</sup> year will be  $P + P \times \frac{r}{100} = P \left(1 + \frac{r}{100}\right)$ . Interest for second year will be calculated as  $r\%$  of this amount and using the same result, the amount at end of second year (or start of 3<sup>rd</sup> year) will be (using Principal as  $P \left(1 + \frac{r}{100}\right)$ )

$$\text{Amount after 2 years} = P \left(1 + \frac{r}{100}\right) \left(1 + \frac{r}{100}\right) = P \left(1 + \frac{r}{100}\right)^2$$

$$\text{Similarly amount after 3 years} = P \left(1 + \frac{r}{100}\right)^3 \text{ and so on.}$$

If  $P$  is the principal kept at CI @  $r\%$  p.a., amount after  $n$  years will be  $P \left(1 + \frac{r}{100}\right)^n$

Please note that this formula is for Amount and if one needs to calculate the Compound Interest, one must deduct the Principal amount from this.

Another important understanding worth noticing is that this formula is nothing but that of a successive increase of  $r\%$ . Thus Compound Interest is nothing but a case of successive percentage increases!



Unless otherwise stated in case of banks assume SI and in case of population growth, appreciating or depreciating assets assume CI.



The number of years taken for an amount to double at CI @ r% p.a. is  $\frac{72}{r(\text{is in \%})}$  years.

This is an empirical formula and gives an approximate answer. An even more accurate answer is  $\frac{69}{r(\text{is in \%})} + 0.35$ . The exact answer will be greater than these approximations.

The error in the answer increases drastically if  $r < 5\%$

**Example 30:** If  $r = 10\%$ ,  $n = 4$  years, what is the simple interest charged on a loan of Rs. 2,000?

$$\text{Solution: } SI = \frac{P \times n \times r}{100} = \frac{2000 \times 4 \times 10}{100} = \text{Rs. 800}$$

Alternately, for 4 years the interest payable would be equal to  $10 \times 4 = 40\%$  of the principal, i.e. 40% of 2000, which is Rs. 800.

**Example 31:** In the above problem, if the case was one of compound interest, what is the CI?

**Solution:** The amount at the end of 4 years, when interest is compounded annually, is

$$= P \left(1 + \frac{r}{100}\right)^n$$

$$\text{So } A = 2000 \left(1 + \frac{10}{100}\right)^4 = 2000 \times (1.1)^4 = 2000 \times (1.4641) = \text{Rs. 2928.2}$$

So compound interest payable = Rs. 2928.2 - Rs. 2000 = Rs. 928.2

**Example 32:** The company policy states that for a short-term loan on simple interest for 2 years, the rate of interest is 20%. A new recruit did not know it and he negotiated with a very tough customer for a 18% loan. What is the percentage of reduction in the earnings?

**Solution:**

**Method 1:** For a lender, the income earned is equal to the interest on the loan disbursed.

There was a loss of 2% on the principal every year. For 2 years, the earnings foregone = 4% of principal. The total earnings should have been 40% of the principal.

$$\text{So the percentage reduction in earnings} = \frac{4}{40} \times 100 = 10\%.$$

**Method 2:** It can be directly inferred that because of the negotiation, the company lost out on 10% of the interest charged each year. So for the whole period of 2 years, the same percentage reduction would be incurred on the total earnings. (Since every year the receivables are 10% lesser.)

**Example 33:** If Mr Kuber had lent \$10 million at an interest rate of 40% p.a. to a less preferred customer Mr Narada, after how many years would the principal double itself if compounded half-yearly?

$$\text{Solution: } 20 = 10 \left(1 + \frac{40}{200}\right)^{2n}$$

$n$  is the number of years.

This reduces to finding  $n$  when  $(1.2)^{2n} = 2$ .

Now we need to use a bit of approximation here. This is where your speed of calculation can come in handy.

$$(1.2)^2 = 1.44$$

$$(1.2)^4 = (1.44)^2$$

Estimating  $(1.44)^2$  gives us the idea that it must lie between  $(1.4)^2 = 1.96$  and  $(1.5)^2 = 2.25$ .

A linear interpolation will tell us that it must be somewhere in the middle, i.e. around 2.10.

$$\text{So } (1.2)^4 \approx 2.1$$

Hence, the principal would double in slightly less than 2 years.

**Example 34:** A certain strain of epidemic bacteria made its appearance in Swarg Lok sending all the medical into a frenzy. It reproduces itself at the rate of 10% every 5 min. In how much time will the number double itself?

**Solution:** We have  $2P = P \left(1 + \frac{10}{100}\right)^n$

$$2 = (1.1)^n, n \text{ lies between 7 and 8 time periods.}$$

Since each period = 5 min, time taken is between 35 and 40 min. You could linearly interpolate between the two, which would be approximately 36.36 min.

**Example 35:** What is the net present value of a piece of property which would be valued at Rs. 2 lakh at the end of 2 years? [Annual rate of increase = 5%]

**Solution:** Future value = Present value  $\left(1 + \frac{r}{100}\right)^n = 2$  lakh.

Hence, present value = Rs. 1.81 lakh.

**Example 36:** After Mr Kuber introduced the new norms for lending, the turnover of Kuber and Daughters went up from \$100 million to \$300 million in just 3 years. What is the compound growth rate of the company?

**Solution:**  $A = P \left(1 + \frac{r}{100}\right)^n$

$$300 = 100 \left(1 + \frac{r}{100}\right)^3 \text{ or } \left(1 + \frac{r}{100}\right)^3 = 3$$

So r is approximately equal to 44%.

**Example 37:** If above question had asked Simple Annual Growth Rate the calculation would have been  $200 = \frac{100 \times r \times 3}{100} \Rightarrow r = 66.66\%$



Lots of student worry about the calculation involved in C.I. In CAT or other exams, the questions of C.I. involving tedious calculation never appeared. Problems are usually based just on the understanding of C.I.

#### Interest on Interest :

Recollect that in case of CI the CI earned keeps increasing year after year. Why does this happen? By now it should be clear that this is because the interests of previous years get added to the principal and thus this interest also starts earning interest. Consider the following as the situation after n years of keeping a principal in a bank at CI @ r% p.a.

| Year  | Principal at start of year | Interest earned in the year   | Amount at end of year           |
|-------|----------------------------|---|---------------------------------|
| n - 1 |                            |   | X                               |
| n     | X                          | $Y = r\% \text{ of } X$   | $X + Y$                         |
| n + 1 | $X + Y$                    | $r\% \text{ of } (X + Y)$<br>$= r\% \text{ of } X + r\% \text{ of } Y$<br>$= Y + r\% \text{ of } Y$ | $X + Y + Y + r\% \text{ of } Y$ |

Thus we observe that in year n, CI earned is Rs. Y and in year n + 1, CI earned is Y + r% of Y. Thus we see that in any two successive years, the interest earned in latter year is higher

by an amount equal to the interest on previous year's Interest.

Also note that the difference in the amounts of two successive years is  $Y + r\% \text{ of } Y$  which is nothing but the interest on the amount at the end of the earlier year. And this also has to be the case because in CI each year can be considered as a fresh beginning, with the amount at end of earlier year being re-invested as principal in the latter year and thus the interest earned will be on this amount. And amount at end of latter year will be higher than the amount at end of earlier year by this interest.

Next consider an amount kept at SI and a similar amount kept at CI for the first two years.

| Year      | Simple Interest         |           | Compound Interest                                      |
|-----------|-------------------------|-----------|--|
| Principal | Interest                | Principal | Interest   |
| 1 P       | $I = r\% \text{ of } P$ | P         | $I = r\% \text{ of } P$                                |
| 2 P       | $I = r\% \text{ of } P$ | $P + I$   | $r\% \text{ of } (P + I)$<br>$= I + r\% \text{ of } I$ |
| Total     | $2I$                    |           | $2I + r\% \text{ of } I$                               |

Thus for same amount kept at same rate, but one at SI and other at CI, in the first two years, the amount kept at CI would earn an extra interest equal to interest of first year's interest!

$$\text{Also, } \frac{\text{Total SI of first 2 yrs}}{\text{Total CI of first 2 yrs}} = \frac{2}{2 + r\%}$$



In the first three years if SI earned is  $3I$ , CI earned is  $3I + 3rI + r^2I$ . Here  $r$  is in ratio. Verify this to get a firm understanding of the concept of interest on interest.

From the table, it should be evident that ratio of CI earned in a particular year to the CI earned in previous year is  $\left(1 + \frac{r}{100}\right)$  i.e. the multiplying factor corresponding to rate of interest.

Thus CI earned in successive years is a geometric progression with common ratio  $\left(1 + \frac{r}{100}\right)!!!$

**Example 38:** If an amount is kept at SI, it earns an interest of Rs. 600 in first two years but when kept at CI, it earns an interest of Rs. 660 in the same period. Find the rate of interest and the Principal.

**Solution:** The Rs. 60 earned extra is the Interest on the first year's Interest. And as we know that in SI, interest earned in all the years is a constant, we can infer that the interest earned in first year is Rs. 300. Thus rate of interest is

$$\frac{60}{300} \times 100 = 20\%$$

At 20%, Interest of first year is Rs. 300. Thus the principal is  $\frac{300 \times 100}{20} = \text{Rs. 1500}$

**Example 39:** An amount kept at CI, earns an interest of Rs. 600 in the 7<sup>th</sup> year and an interest of Rs. 660 in the 8<sup>th</sup> year. Find the rate of interest.

**Solution:** The interest is higher in the 8<sup>th</sup> year by Rs. 60 and this amount should be equal to the interest on the 7<sup>th</sup> year's interest i.e. Rs. 600. Thus the rate of interest = 10%

**Example 40:** Two customers borrowed the same amount of money, one on a compounded interest and the other on a simple interest. If after 2 years, the interest payable by one was Rs. 200 and by the other was Rs. 220. What was the principal lent to each of them?

**Solution:** The extra Rs. 20 payable by the first person is the interest on the interest of the first year, which is Rs. 100. So the rate of interest = 20%.

The interest payable at the end of the first year = Rs. 100, which is 20% of the principal.

Hence, principal = Rs. 500.

**Example 41:** A customer, Lord Venkateswara, took a loan of \$10 million from Mr Kuber. In the second year of the loan period, the interest that accrued to Mr Kuber was \$0.1 million more than that in the first year. (Assume CI)

- At what rate of interest did Kuber lend to Lord Venkateswara?
- When will the principal double itself (approximately)?

**Solution:**

a. The difference in the compound interest earned in the second year and the first year is equivalent to  $r\%$  of the interest earned in the first year, i.e.  $\frac{Pr}{100}$ . Hence, the total

$$\text{difference} = \left(\frac{r}{100}\right) \left(\frac{Pr}{100}\right) = \frac{Pr^2}{10000} = 0.1.$$

Hence,  $r = 10\%$ .

b. If  $r = 10\%$ , the principal would double itself if  $A = 2P$ ,

$$\text{i.e. } P \left(1 + \frac{r}{100}\right)^n = 2P$$

or  $(1.1)^n = 2 \Rightarrow n = 8$  years (approximately).

In fact, the principal doubles after 7 years and before 8 years.

**Example 42:** What shall be the simple interest to be paid on a principal of Rs. 14,000 borrowed at a rate of 15% for a period of 3 years and 6 months?

$$\text{Solution: S.I.} = \frac{P \times R \times T}{100}$$

$$P = 14,000, R = 15 \text{ and } T = 3.5$$

$$\text{So, S.I.} = \frac{(14000 \times 15 \times 3.5)}{100} = \text{Rs. 7,350}$$

**Example 43:** At what simple rate of interest shall a sum of money double itself in 4 years?

**Solution:** Important point to be noted is that the amount received by the lender is double the amount given, which means Interest = Principal

So, if  $x$  is the Principal, then  $x$  is the Simple Interest.

$$\text{Or, } x = \frac{(x \times R \times 4)}{100} \text{ Or, } R = \frac{100}{4} = 25\%$$

**Example 44:** If a certain sum amounts to Rs. 108 in 2 years, Rs. 112 in 3 years, find the principal and rate of interest (simple).

**Solution:** Amount after 2 years = Rs. 108. Amount after 3 years = 112.

In S.I., interest amount remains the same for every year.

Therefore, interest for 1 year = Rs. 4.

Hence, principal =  $108 - 2(4) = 100$ .

$$\text{Rate of interest} = \frac{4 \times 100}{100 \times 1} = 4\%$$

**Example 45:** For how many years should Rs. 600 be invested at 10% p.a. in S.I., in order to earn the same interest as earned by investing Rs. 800 at 12% p.a. for 5 years in S.I.?

$$\text{Solution: Interest required} = \text{Rs. } \left(\frac{800 \times 12 \times 5}{100}\right) = \text{Rs. 480}$$

$$\text{Time} = \left( \frac{100 \times 480}{600 \times 10} \right) = 8 \text{ years}$$

**Example 46:** Prabhat took a certain amount as a loan from a bank at the rate of 8% p.a. S.I. and gave the same amount to Ashish as a loan at the rate of 12% p.a. If at the end of 12 years, he made a profit of Rs. 320 in the deal, what was the original amount?

**Solution:** Let the original amount be Rs. x. Then,

$$\frac{x \times 12 \times 12}{100} - \frac{x \times 8 \times 12}{100} = 320 \Rightarrow x = \frac{2000}{3} = \text{Rs. } 666.67$$

**Alternative method:**

Prabhat gave at the rate of 12% and took at the rate of 8%. Here his net profit is  $12 - 8 = 4\%$ .

$$\text{If the original sum} = x, \frac{x \times 12 \times 4}{100} = 320 \text{ and } x = \text{Rs. } 666.67$$

**Example 47:** If a sum of money at simple interest doubles in 6 years, it will become 4 times in

**Solution:** Let sum be x. Then S.I. = x

$$\therefore \text{Rate} = \left( \frac{100 \times x}{x \times 6} \right) \% = \frac{50}{3} \%$$

Now sum is x and S.I. is  $3x$ , Rate =  $\frac{50}{3}\%$ .

$$\therefore \text{Time} = \frac{100 \times 3x}{x \times \frac{50}{3}} = 18 \text{ years}$$

**Alternative method:**

Let principal be P, thus amount is  $2P$  after 6 years.

Interest in 6 years =  $2P - P = P$ .

To become 4 times, interest =  $4P - P = 3P$ .

When interest is P, time taken = 6 years

When interest is  $3P$ , time taken =  $3 \times 6 = 18$  years.

**Example 48:** The rate of interest on a sum of money is 4% p.a. for the first 2 years, 6% p.a. for the next 3 years and 8% p.a. for the period beyond 5 years. If the simple interest accrued by the sum for a total period of 8 years is Rs. 1,280 then what is the sum?

**Solution:** Let the sum be Rs. x. Then,

$$\frac{x \times 4 \times 2}{100} + \frac{x \times 6 \times 3}{100} + \frac{x \times 8 \times 3}{100} = 1280 \text{ or } 50x = 1280 \times 100$$

$$\therefore x = \text{Rs. } 2,560$$

**Example 49:** Vinod Kumar invested Rs. 1,600

for 3 years and Rs. 1,100 for 4 years at the same rate of simple interest. If the total interest from these investments is Rs. 506, find the rate of interest.

$$\text{Solution: } \frac{1600 \times 3 \times R}{100} + \frac{1100 \times 4 \times R}{100} = 506 \text{ or } 92R = 506 \text{ or } R = 5\frac{1}{2}\%$$

**Example 50:** A man invests an amount of Rs. 15,860 in the names of his three sons A, B and C in such a way that they get the same interest after 2, 3 and 4 years respectively at S.I. If the rate of interest is 5%, then the ratio of amounts invested in the name of A, B and C is

**Solution:** Let the amounts invested be x, y, z respectively.

$$\text{Then, } \frac{x \times 2 \times 5}{100} = \frac{y \times 3 \times 5}{100} = \frac{z \times 4 \times 5}{100} = k$$

$$\therefore x = 10k, y = \frac{20k}{3} \text{ and } z = 5k$$

$$\text{So, } x:y:z = 10k : \frac{20k}{3} : 5k = 30 : 20 : 15 = 6:4:3$$

**Example 51:** The rates of simple interest in two banks A and B are in the ratio 5 : 4. A person wants to deposit his total savings in two banks in such a way that he receives equal half yearly interest from both. In what ratio, he should deposit his savings in banks A and B?

**Solution:** Let the savings be X and Y and the rates of simple interest be  $5x$  and  $4x$  respectively.

Then,

$$X \times 5x \times \frac{1}{2} \times \frac{1}{100} = Y \times 4x \times \frac{1}{2} \times \frac{1}{100} \text{ or } \frac{X}{Y} = \frac{4}{5}$$

i.e.  $X:Y = 4:5$



*SAGR and CAGR*

If sales increases from  $x$  to  $y$  in  $n$  years, we can calculate the annual growth rate of sales in two ways, either using the simple interest formula or using the compound interest formula. In this case the principal is considered as  $x$  and the amount is considered as  $y$ .

Thus the Simple Annual Growth Rate (SAGR) is found using  $y-x = \frac{x \times r \times n}{100}$  and

Compound Annual Growth Rate (CAGR) is found using

$$P \left(1 + \frac{r}{100}\right)^n \quad y = x \left(1 + \frac{r}{100}\right)^n$$



$$(CI)_2 - (SI)_2 = \frac{Pr^2}{100^2} \text{ for two years}$$

$$(CI)_3 - (SI)_3 = \frac{Pr^3}{100^3} + \frac{3Pr^2}{100^2} \text{ for three years}$$

#### Non-Annual Compounding:

In all above examples of Compound Interest, we have added the Interest back to the principal only at the end of the year and this interest also starts earning interest in succeeding years. The Interest earned in any year does not happen all of a sudden at the end of the year. The interest is earned throughout the year. The interest earned in the first half of the year is lying idle for the second half of the year i.e. it is not earning any interest. If this interest earned in first half of the year is added to the principal at end of half year, it will earn some interest in the second half of the year.

This process of adding interest earned back to the principal every six months is called semi-annual compounding. Compounding can be done with any frequency and need not be just annual or semi-annual. The interest earned every quarter or every month or for that matter every day can be added back to the principal and this new sum can be considered as principal for the next quarter or next month or next day, respectively. The same formula of Compound Interest i.e.  $\text{Amount} = P \left(1 + \frac{r}{100}\right)^n$

can also be used for any compounding – annual, semi-annual, quarterly, monthly, etc. The only thing to take care is that in the formula 'r' refers to the rate of interest per period (year if annual compounding, 6 months if semi-annual compounding or 1 month if

monthly compounding) and 'n' refers to the number of time periods. Thus if it is given that compounding happens every quarter and money is invested at 12% p.a. for 5 years, then 'r' to be used in the formula is  $\frac{12}{4} = 3\%$  per quarter and 'n' will be  $5 \times 4 = 20$  quarters.

It would be obvious that higher the frequency of compounding, the more beneficial it will be for us as consumers keeping money in a bank. If it is not obvious, just follow the table and fortify your understanding.

**Note:** In questions involving population growth or depreciation, unless otherwise stated, it will be a case of Compound Interest. In all other cases, if nothing is mentioned, consider the case to be of Simple Interest.

**Example 52:** Mr Kuber bought a flat in Swarg Lok Apartments for \$1,000. What would the future value of the flat be after 2 years if the value is compounded semi-annually at 22% per annum?

$$\text{Solution: Future value} = \text{Present value} \left(1 + \frac{r}{100}\right)^n = 1000 \left(1 + \frac{11}{100}\right)^4 = \text{Rs. } 1518.07041$$

Here  $r$  = Semi-annual rate of interest  $= \frac{22}{2} = 11\%$ ,  $n$  = Number of time periods  $= 2 \times 2 = 4$ .



If we are keeping money in banks, higher the frequency of compounding, the better it is for us. In case of banks providing loans, higher the frequency of compounding better it is for them. What if the frequency of compounding increases, from daily to hourly; to per minute or even higher frequency, i.e. compounding happens on continuous basis

$$A = \lim_{k \rightarrow \infty} P \left(1 + \frac{r}{100k}\right)^{kn} = Pe^{nr/100}$$

| Types of questions  | Examples  | Approach to the question   |
|---|---|--|
| 1. Given Interest amount for n years at rate r%. What is the principal?   | A certain sum earns a simple interest of Rs. 250 in 4 years at 5% p.a. Find the principal.  | $P = \frac{I}{R \times T} \times 100$<br>$= \frac{250}{4 \times 5} \times 100 = \text{Rs. } 1250$  |
| 2. Which would lead to a higher amount 1. r% simple interest for t time.<br>2. r% compound interest for t time.   | Mr. Sharma wants to choose a investment plan<br>1. 15% for 5 years. (SI)<br>2. 20% for 3 years (CI)<br>Which plan will result in higher amount?                           | Compare<br>1. $15 \times 5 = 75\%$ of interest on investment<br>2. $(1.20)^3 - 1 = 1.728 - 1 = 72.8\%$ of interest on investments. Thus option 1 will result in higher amount.   |
| 3. The C.I in nth year is Rs. X and C.I in (n+1)th year is Rs. Y. What is the rate of interest?   | C.I. earned in 7th year is Rs. 600 and in 8th year is Rs. 660. Find the rate of interest.   | $R = \frac{Y - X}{X} \times 100$<br>$= \frac{60}{600} \times 100 = 10\%$   |
| 4. The total S.I in first two years is Rs. X and total C.I in first two years is Rs. Y. What is the principal and rate of interest, if they are same for S.I and C.I? | Total S.I for first two years is Rs. 600. If same amount was kept at C.I at same rate, total C.I would have been Rs. 660. What is the principal and the rate of interest? | $R = \frac{Y - X}{X/2} \times 100$<br>$= \frac{60}{300} \times 100 = 20\%$<br>Since interest for first years<br>$\frac{SI}{2} = \frac{600}{2} = 300$ and if Principal is P, then<br>$P \times \frac{20}{100} \times 1 = 300$ or $P = 1500$ |

|  |  |   |
|--|--|---|
| 5. A principal amounts to X times in T years at S.I. In how many years will it become Y times? (Assume S.I.) | Amount becomes 3 times in 5 years. In how many years will it become 9 times? | $\text{Years} = \left( \frac{Y-1}{X-1} \right) \times T$<br>$= \left( \frac{9-1}{3-1} \right) \times 5 = 20 \text{ years}$  |
| 6. Same as above but with C.I.   | Same as above but assume C.I.  | $\text{Years} = T \times n \text{ where } n \text{ is given by } X^n = Y$<br>$\text{Years} = 5 \times 2 = 10 \text{ years}$ |

**Example 53:** What shall be the amount for a sum of Rs.1,000 at 10% for 3 years compounded annually?

**Solution:** Amount at the end of year 1 is

$$A_1 = \frac{(P \times R \times T)}{100} + P \frac{1000 \times 10 \times 1}{100} + 1000 = \text{Rs. } 1,100 = \text{Rs. } 1,100$$

This shall be the principal for year 2.

$$A_2 = \frac{(1100 \times 10 \times 1)}{100} + 1100 = \text{Rs. } 1,210$$

$$A_3 = \frac{(1210 \times 10 \times 1)}{100} + 1210 = \text{Rs. } 1,331$$

So amount at the end of 3 years in case of Compound Interest (C.I.) is Rs. 1,331, while in the case of S.I., it shall be Rs. 1,300 (at 10%).

#### Alternative Method:

Amount can also be calculated directly by using the formula.

$$\text{Amount} = P \left( 1 + \frac{R}{100} \right)^n = 1000 \left( 1 + \frac{10}{100} \right)^3 = \text{Rs. } 1,331$$

Where, P = Principal or sum being borrowed

R = Rate of interest

n = Time period for which the amount is borrowed

**Example 54:** Find the C.I. on Rs. 5,000 at 8% p.a. for 2 years, compounding being done annually.

**Solution:** P = Rs. 5000, R = 8% and N = 2 years

$$5000 \left( 1 + \frac{8}{100} \right)^2 = \text{Amount} = \text{Rs. } 5832.$$

$$\text{C.I.} = \text{Amount} - \text{Principal} = \text{Rs. } (5832 - 5000) = \text{Rs. } 832$$

#### Alternative method:

The Compound Interest on the given sum is nothing but two successive increment of 8%,

$$\text{i.e. } 8 + 8 + \frac{8 \times 8}{100} = 16.64\% \quad \left[ \text{using } x + y + \frac{xy}{100} \text{ formula} \right]$$

$$\text{Hence, Compound Interest} = \frac{16.64}{100} \times 5000 = \text{Rs. } 832$$

**Example 55:** Find amount for Rs. 80,000 at 20% per annum, compounded semi-annually for 2 years.

**Solution:** Here n = (2 years) × 2 = 4 periods Similarly, R = 10% per time period

(As interest compounded semi-annually)

$$P = 80000$$

$$A = 80000 \left( 1 + \frac{10}{100} \right)^4 = 80000 \times 1.4641 = \text{Rs. } 11712.8$$

**Example 56:** Find C.I. on Rs. 10,000 at 10% for 9 months compounded quarterly.

**Solution:** n = 3 periods, R = 2.5% per period and P = Rs. 10,000

$$\text{Amount} = 10000 \left(1 + \frac{2.5}{100}\right)^3 = \text{Rs. } 10,769 \text{ (approx.)}$$

$$\text{C.I.} = \text{Amount} - \text{Principal} = 10769 - 10000 = \text{Rs. } 769$$

**Example 57:** The difference between the C.I. and S.I. on a certain amount at 10% per annum for 2 years, compounded annually is Rs. 372. Find the principal.

**Solution:** Let the principal be P.

$$\text{S.I.} = P \times 10 \times \frac{2}{100} = \frac{P}{5} \text{ and C.I.} = \text{Amount} - P = P \left(1 + \frac{10}{100}\right)^2 - P = \frac{21P}{100}$$

$$\text{C.I.} - \text{S.I.} = \text{Rs. } 372$$

$$\frac{21P}{100} - \frac{P}{5} = \text{Rs. } 372$$

$$\therefore P = \text{Rs. } 37,200$$

#### Alternative Method:

You need to understand the fact that for 1st period, S.I. = C.I.

The difference between the values of C.I. and S.I. is because of accumulated interest building on interest which is reinvested. Therefore, for period 2, the difference between C.I. and S.I. is the interest on the interest for period 1.

In the above example, the difference being 372 is the interest generated on interest for period 1 on the principal.

$$\text{Interest for period 1} = \text{Rs. } 372 \times \frac{100}{10} = \text{Rs. } 3,720$$

$$\text{Therefore, Principal} = \text{Rs. } 3720 \times \frac{100}{10} = \text{Rs. } 37,200$$

**Example 58:** Ram invested a particular sum at 12% per annum with Shyam and a similar amount in bank which pays interest at 12% p.a. compounded semi-annually. The difference between the amounts received after 1 year was Rs. 1,800. Find the total sum invested by Ram.

**Solution:** Following the argument in the previous example, we have the difference equal to the interest on the interest paid on the principal for 6 months. (Rate of interest becomes  $\frac{12}{2} = 6\%$ ). Interest paid for first 6 months by the bank =  $\text{Rs. } 1800 \times \frac{100}{6}$  on principal =  $\text{Rs. } 30,000$ .

$$\text{Principal} = \text{Rs. } 30,000 \times \frac{100}{6} = \text{Rs. } 5,00,000.$$

$$\text{Total sum invested} = \text{Rs. } 5,00,000 + \text{Rs. } 5,00,000 = \text{Rs. } 10,00,000.$$

**Example 59:** If the C.I. on a certain sum for 3 years at 20% p.a. is Rs. 728, what is the sum invested?

$$\text{Solution: C.I.} = 728 = P \left(1 + \frac{20}{100}\right)^3 - P$$

$$\Rightarrow P(1.2)^3 - P = 728$$

$$P(1.728 - 1) = 728$$

$$P(0.728) = 728$$

$$P = \text{Rs. } 1000$$

**Note:** When rates are different for different years, say  $r_1$ ,  $r_2$ , and  $r_3$  for different years 1, 2 and 3 respectively, then amount  $A = P$

$$\left(1 + \frac{r_1}{100}\right) \left(1 + \frac{r_2}{100}\right) \left(1 + \frac{r_3}{100}\right)$$

## Profit Loss Discount

### **Cost Price:**

CP of an item is the expenditure incurred to purchase (or to produce).

$$\text{Profit \%} = \frac{\text{Profit}}{\text{CP}} \times 100$$

$$\text{SP} = \text{CP} + \text{P\% of CP} = \text{CP} \left( 1 + \frac{\text{P}}{100} \right)$$

### **Selling Price:**

SP of an item is the revenue realized when the item is sold.

Thus we see that we can again use the concept of Multiplying Factor and we have the relation

$\text{SP} = \text{CP} \times \text{MF}$ . The MF in case of a profit will be greater than 1 and in case of loss will be less than 1.

### **Profit/Loss:**

This is the difference between the selling price and the cost price. If the difference is positive, it is called profit; and if negative, it is called loss.

Given SP and CP, one could also rearrange the expression and get  $\text{MF} = \frac{\text{SP}}{\text{CP}}$  and from the multiplying factor, one can easily deduce the profit or loss percentage. E.g. Given that the  $\text{CP} = 49$  and  $\text{SP} = 56$ , the  $\text{MF} = \frac{56}{49} = \frac{8}{7} = 1.1428$  i.e. a profit percentage of 14.28%.

### **Profit/Loss %:**

This is the profit/loss as a percentage of the CP.

One can obviously also do  $\frac{\text{SP} - \text{CP}}{\text{CP}} \times 100\%$  to calculate profit percentage. However, do understand the method of Multiplying Factor as well.

### **Margin:**

Normally, used in percentage terms only. This is the profit as a percentage of SP.

Converting between profit percentage and margin : 25% profit would mean what margin?

### **Marked Price:**

This is the price of the product as displayed on the label.

This type of problem is exactly similar to that of 'change in base' type of problems seen in percentages. In this case, the CP, Profit and SP can be 100, 25, 125 (or as seen in percentages 4, 1, 5) and the margin will be  $\frac{25}{125} = \frac{1}{5} = 20\%$

### **Discount:**

This is the reduction given on the marked price before selling it to a customer.

If the question was 25% margin is equivalent to what profit percentage?

### **Mark-up:**

This is the increment on the cost price before being sold to a customer.

One has to start by assuming SP as 100 as margin is percentage of SP and not CP and one can consider the CP, profit and SP as 75, 25, 100 (or 3, 1, 4) and profit percentage is one third i.e. 33.33%

Using these terminologies, we can arrive at the following :



In Profit and Loss accounts of companies, the profit stated is always as a percentage of sales. However the term used is "Net profit margin" or "Operating profit margin". For our purpose, profit percentage is always as a percentage of CP and margin is as a percentage of SP.

**Example 60:** A bought a cycle for Rs. 1080 and then sold it to B for a loss of 20%. B spent Rs. 36 on improving the condition of the cycle and then sold it to C for a 20% profit. What amount did C pay for the cycle?

**Solution:** A sold the cycle to B for  $Rs. 1080 \times 0.8 = 864$ . B's 20% profit will be calculated on his total investment  $= 864 + 36 = Rs. 900$ .

Thus C paid  $Rs. 900 \times 1.2 = Rs. 1080$

**Example 61:** A salesman sold one-fourth of his stock at 50% profit and the remaining at 80% profit. Find the net profit % he made on his total stock.

**Solution:** Let's say the salesman invested in stock worth Rs. 100. Stock worth Rs. 25 was sold at a 50% profit and thus he would have received Rs. 37.5. For the remaining stock worth Rs. 75, he would have received  $Rs. 75 \times 1.8 = Rs. 135$ . Thus he receives a total of Rs. 172.5 on an investment of Rs. 100 implying a profit of 72.5%

**Example 62:** Amit bought equal quantities of two varieties of oranges, one variety at a rate of Rs. 200 for 4 kgs and other variety at a rate of Rs. 400 for 10 kgs. He mixed the two varieties and sold them at a rate of Rs. 50 per kg. What is his profit/loss%?

**Solution:** Important point to note here is that Amit purchases equal quantities of both varieties. Let him purchase 1 kg of each variety. Thus, the amount he spent on first variety was Rs. 50 and on second variety was Rs. 40, incurring a total investment of Rs. 90.

However he receives Rs. 100 for 2 kgs at the rate of Rs. 50 per kg. Thus he makes a profit of Rs. 10 and a profit % of  $\frac{10}{90} \times 100 = 11.11\%$

**Example 63:** In the above problem, if Amit would have spent equal amount on both the varieties instead of purchasing equal quantities of the varieties, what would have been his profit percent?

**Solution:** Let Amit spend Rs. 200 on each variety (LCM of 40 and 50, the rates per kg of each variety). Thus he purchases 4 kgs of the first variety and 5 kgs of the second variety. The total amount he receives after selling these 9 kgs is Rs. 450. Thus on an investment of Rs. 400, Amit makes a profit of Rs. 50 i.e.  $\frac{1}{8}$  th of C.P. or 12.5%. Interestingly in this problem, the profit percentage on variety 1 is 0% (as CP = 50 per kg and SP = 50 per kg) and the profit percent on variety 2 is 25% (as CP = 40 per kg and SP = 50 per kg) and the answer 12.5% is the simple average of 0% and 25%. Mull over this.

**Example 64:** Krishnan has 12 eggs with him. He sells x at a profit of 10% and remaining at a loss of 10%. He gains 5% on the whole. What is the value of x?

**Solution:**

**Method 1:** Let each egg costs Rs. 10. Then the overall profit = Rs. 6. If x eggs are sold at a profit of 10%, then  $(12 - x)$  are sold at a loss of 10%. Hence, total revenue  $= x(11) + (12 - x)9 = 2x + 108 = Rs. 126$ .

So  $2x = 18$  and  $x = 9$ .

**Method 2:**  $10x - (12 - x)10 = 12 \times 520 - 120 = 60; x = 180/20 = 9$

**Example 65:** Aditya purchases toffees at Rs. 10 per dozen and sells them at Rs. 12 for every 10 toffees. Find the gain or loss percentage.

**Solution:**

**Method 1:** Cost price = Rs.  $\frac{10}{12}$ .

Selling price = Rs.  $\frac{12}{10}$

$$\frac{SP}{CP} = \frac{144}{100} = 1.44$$

So, profit percentage = 44%.

**Method 2:** Assume that he buys 120 toffees. Aditya spends Rs. 100.

Revenue generated = Rs. 144.

Hence, profit percentage = 44%.

**Example 66:** Anirudh bought 8 lemons for a rupee, but sells only 6 lemons for a rupee. Find his profit percentage.

**Solution:**

**Method 1:** Cost price of 1 lemon =  $\frac{1}{8}$ . Selling price of 1 lemon =  $\frac{1}{6}$ .

$$\frac{SP}{CP} = \frac{8}{6} = 1.3333\dots$$

Hence, profit percentage =  $33\frac{1}{3}\%$ .

**Method 2:** Suppose Anirudh purchases 24 lemons (LCM of 8 and 6). Therefore, cost price of 24 lemons = Rs. 3.

Selling price of 24 lemons = Rs. 4.

Gain = Re 1.

$$\text{Profit percentage} = \times 100 = 33\frac{1}{3}\%.$$

**Example 67:** Paresh sells 40 pencils and gains the selling price of 10 pencils. What is his profit percentage?

**Solution:**

**Method 1:** Selling price of 40 pencils - Cost price of 40 pencils = Selling price of 10 pencils

Selling price of 30 pencils = Cost price of 40 pencils

Let CP of 40 pencils = Re 1.

SP of 30 pencils = Re 1.

$$\text{SP of 40 pencils} = 1 \times \frac{4}{3}.$$

$$\text{Gain percentage} = \frac{\left(\frac{4}{3}-1\right)}{1} \times 100 = 33\frac{1}{3}\%$$

$$\text{Method 2: } \frac{SP}{CP} = \frac{40}{30} = 1.33.$$

Hence, gain percentage =  $33\frac{1}{3}\%$



The cost price increases by  $x\%$ . So the trader also increase the selling price by  $x\%$ .

How will these changes affect the profit percentage of the trader i.e. would he earn a higher or lower profit percentage compared to earlier profit percentage?

What will be the effect on profit earned per item?



*Buy 4, get 1 free.*

*Is the discount being offered 25% or 20%?*

#### Mark-up and Discount:

Usually when one goes for shopping, one can see signage of discount being offered, let's say 20% discount. Does this mean that the shopkeeper will be incurring a loss? Need not be so. Consider the price tag on a shirt is Rs. 500 and discount being offered is 10%. If one were to purchase this shirt, the 10% discount will be calculated on the price tag i.e. Rs. 500 in this case and one would pay the shopkeeper Rs. 450.

The value on the price tag is called as List Price or Marked Price (MP). Important aspect to notice and keep in mind is that the Discount percent is calculated as a percentage of Marked Price.

Now in the above example the SP for the shopkeeper was Rs. 450 where as the MP was Rs. 500. This does not necessarily mean that the shopkeeper has incurred a loss of Rs. 50. To calculate the loss, we need to know the CP incurred by the shopkeeper, which in our usual shopping, we do not know as customers. Let's assume that the shopkeeper had purchased the shirt for Rs. 400. Thus in fact, even after giving a discount of Rs. 50 (or 10%), the shopkeeper has made a profit of Rs. 50 or a profit percentage of  $\frac{50}{400} \times 100 = 12.5\%$ . The shirt that costed the shopkeeper Rs. 400 was marked with a price tag of Rs. 500. This process of tagging an item at higher than the CP is called as 'marking

up' and Mark-up percentage is the percentage by which the MP is higher than the CP i.e.  $\frac{MP - CP}{CP} \times 100\%$ . Please note that the mark-up percentage is a percentage of CP.

Let's now see the entire process:

The shopkeeper incurs a cost of CP and then marks the item up by m% (of CP) and puts a price tag of MP.

$$CP \xrightarrow{m\%} MP$$

Next the customer bargains a discount of d% on the MP and thus arrives at the SP

$$CP \xrightarrow{m\%} MP \xrightarrow{d\%} SP$$

We also know m% is that of CP and d% is that of MP. Thus m% and d% are nothing but successive percentage changes or more specifically percentage increase and percentage decrease. We also know the net percentage change between CP and SP is profit percentage p%.

Thus using the theory studied of successive percentage changes, we can arrive at  $p = m - d - \frac{m \times d}{100}$  where m, d and p are the mark-up, discount and profit percent

And if we remember, wherever we can use this expression, we can also use multiplying factors and thus we will have

$$MF_{\text{profit}} = MF_{\text{mark-up}} \times MF_{\text{discount}}$$

| Types of questions  | Examples   | Approach to the question  |
|---|--|---|
| 1. If A sells to B at a profit of $x\%$ ; B sells to C at a profit of $y\%$ and C pays Rs. P for it, find the cost for A.                         | A sells a cycle to B at a profit of $10\%$ , B sells to C at a profit of $20\%$ . If C pays Rs. 264 for it, how much did A pay for it?                   | C.P. A<br>$= \frac{100+x}{100} \times \frac{100+y}{100} \times P$<br>where x and y are the % profits of A and B, and P is the cost for C.<br>$\therefore \frac{110}{100} \times \frac{120}{100} \times P = 264$<br>$P = \text{Rs. } 200$  |
| 2. If cost price of A articles is equal to the selling price of B articles, find the profit percentage.   | The C.P. of 10 articles is equal to the S.P. of 9 articles. Find the profit percentage.  | C.P. of 10 units = S.P. of 9 units<br>= Rs. 90 (say)<br>?C.P. of 1 unit = 9<br>S.P. of 1 unit = 10<br>?Profit % = $\frac{10-9}{9} \times 100 = 11.11\%$<br><br>Alternatively, on selling 9 items, profit equal to C.P. of 1 item is made<br>?Profit %<br>$\frac{1}{9} \times 100 = 11.11\%$ |
| 3. The cost price of two articles is same. If one is sold at $X\%$ profit and the other at a loss of $X\%$ , find the profit or loss percentage.  | Amit buys 2 cows for Rs. 200 each. He sells one at a profit of $10\%$ and the other at a loss of $10\%$ . Find his profit or loss percentage.            | For same cost price and equal profit and loss percentage, there is no profit or no loss.  |
| 4. The selling price of two articles is same. If one is sold at $X\%$ profit and the other at loss of $X\%$ , find his profit or loss percentage. | Amit sells 2 cows for Rs. 200 each. On one he gets a profit of $10\%$ , while losing $10\%$ on the other. What is his overall profit or loss percentage? | Loss %<br>$\frac{X^2}{100}\% = \frac{10^2}{100} = 1\%$  |

|   |  |  |
|---|--|--|
| 5. If $x\%$ discount on an article is given on cash payment, find the percentage that should be marked above the cost price so as to make a profit of $y\%$ . | A dealer allows a discount of $7\%$ for cash payment. How much percentage above the cost price should he mark his goods to make a profit of $10\%$ . | $\text{S.P.} = \text{MP} \left( \frac{100-x}{100} \right)$<br>$= \text{C.P.} \left( \frac{100+y}{100} \right)$<br>$\therefore \frac{\text{MP}}{\text{C.P.}} = \frac{100+y}{100-x} = \frac{110}{93}$<br>$= 1.182$<br>$= 18.2\%$<br><br>Alternatively, $P = m - d - \frac{md}{100}$<br>$\therefore 10 = m - 7 - 0.07m$<br><br>$\therefore m = \frac{17}{0.93} = 18.28\%$ |
| 6. If a dealer sells goods at cost price but uses faulty weight, find his gain percentage.  | A dishonest dealer professes to sell his goods at cost price, but he uses a weight of 960 g for 1 kg. Find his profit percentage.                    | $\text{Profit \%age} = \frac{x}{T-x} \times 100$<br><br>where x is the error and T is the true value.<br>$\frac{40}{1000-40} \times 100 = 4.16\%$  |



*Revision time: If a shopkeeper marks up items by  $m\%$ , what is the maximum discount that he can offer such that he does not make any loss?*

*(Hint: What percentage decrease will offset a  $x\%$  increase)*

**Example 68:** A single discount equivalent to a series discount of  $20\%$ ,  $10\%$  and  $5\%$  is \_\_\_\_.

**Solution:**  $\text{SP} = \frac{80 \times 90 \times 95}{100 \times 100 \times 100} \times \text{MP} = 0.8 \times 0.9 \times 0.95 \times \text{CP} = 0.684 \times \text{MP}$

$$\text{Equivalent discount} = (1 - 0.684) \times 100 = (0.316) \times 100 = 31.6\%.$$

**Example 69:** An off-season discount of  $x\%$  is being offered at the discount store. An additional 12.5% discount is given if the value of purchase is more than Rs. 500. After the discounts, a person pays Rs. 525 for a jean whose list price is Rs. 750. Find the value of  $x$ .

**Solution:**

$$\text{Method 1: Final selling price} = \text{Rs. } 525 = \text{Rs. } 750 \times \frac{100 - 12.5}{100} \times \frac{100 - x}{100}$$

$$\Rightarrow (100 - x) = \frac{525}{750} \times \frac{100}{87.5} \times 100 = 80.$$

Hence,  $x = 20\%$ .

**Method 2:** We can solve the problem by applying the  $a + b + \frac{ab}{100}$  formula.

The net discount = 30%.

(List price = Rs. 750; selling price = Rs. 525)

$$\text{So } x - 12.5 - \frac{12.5x}{100} = -30. \text{ Solving for } x, \text{ we get } x = -20.$$

**Example 70:** Inspite of giving a discount of 10%, a shopkeeper manages to make a profit of 8%. By what percentage does the shopkeeper mark-up his goods?

**Solution:**

**Method 1:** Using  $MF_{\text{profit}} = MF_{\text{mark-up}} \times MF_{\text{disc}}$ ,  $1.08 = MF_{\text{mark-up}} \times 0.9$

Thus  $MF_{\text{mark-up}} = 1.2$  meaning a mark-up of 20%

$$\text{Alternately using, } p = m - d - \frac{m \times d}{100}$$

$$\begin{aligned} S &= m - 10 - 0.1m \\ \Rightarrow 0.9m &= 18 \Rightarrow m = 20\% \end{aligned}$$

$$\text{Method 2: } MP = \frac{100 + P\%}{100 - D\%} \times CP$$

$$MP = \frac{108}{90} \times CP \Rightarrow \frac{MP}{CP} = 1.2$$

$\therefore$  The shopkeeper marks up his goods by 20%

**Example 71:** A shopkeeper gives 2 items free with every 3 items purchased. In effect, what discount percentage is being offered? [Assume that all the items are identical]

**Solution:** Please realise that the discount is not  $2/3$  or 66.66%. Why?

Discount percent is expressed as a percentage of marked or list price. The list price of the 5 items will be  $5x$  and the selling price will be  $3x$ . Thus discount percent is  $2/5$  or 40%

**Example 72:** A boy buys eggs at 10 for Rs. 1.80 and sells them at 11 for Rs. 2. What is his profit or loss percent?

**Solution:** To avoid fractions, let the number of eggs purchased be

LCM of 10 and 11 = 110

$$C.P. \text{ of } 110 \text{ eggs} = \frac{110 \times 1.80}{10} = \text{Rs. } 19.80$$

$$S.P. \text{ of } 110 \text{ eggs} = \frac{110 \times 2.00}{11} = \text{Rs. } 20.00$$

$$\text{Profit percentage} = \frac{0.20 \times 100}{19.80} = 1.01\%$$

**Example 73:** A woman buys apples at 25 for a rupee and the same number at 40 a rupee. She mixes and sells them at 65 for 2 rupees. What is her gain or loss percentage?

**Solution:** Suppose the woman buys (LCM of 25, 40 and 65) 2600 apples each at 25 apples a rupee and 40 apples a rupee.

Cost at the rate of 25 per rupee = Rs. 104

Cost at the rate of 40 per rupee = Rs. 65

Total cost for 2600 apples = Rs. 169

$$\text{S.P. for 2600 apples} = \frac{5200 \times 2}{65} = 160; \text{Loss percentage} = \frac{(169 - 160) \times 100}{169} = 5.32\%$$

**Example 74:** A man bought 80 kg of rice for Rs. 88 and sold it at a loss of as much money as he received for 20 kg. At what price did he sell it?

**Solution:** C.P. of 80 kg - S.P. of 80 kg = S.P. of 20 kg

S.P. of 100 kg = C.P. of 80 kg = 88

S.P. of 1 kg = 88 paise

He sold it at 88 paise per kg.

**Example 75:** Goods are purchased for Rs. 450 and one-third is sold at a loss of 10%. At what profit percentage should the remainder be sold so as to gain 20% on the whole transaction?

**Solution:** Total cost price of goods = Rs. 450

$$\text{S.P. of total goods} = \frac{120}{100} \times 450 = \text{Rs. } 540$$

$$\text{C.P. of one-third goods} = \frac{450}{3} = 150$$

$$\text{S.P. of one-third goods} = \frac{90}{100} \times 150 = \text{Rs. } 135$$

S.P. of remaining goods = (540 - 135) = Rs. 405

C.P. of remaining(two-third) goods = Rs. 300

$$\text{Hence, profit percentage} = \frac{405 - 300}{300} \times 100 = \frac{105}{300} \times 100 = 35\%$$

**Alternative method:**

Applying weighted average, in one-third of quantity there is a loss of 10% (or a profit of -10%) and the balance two-third gives a profit of x%.

$$\text{Hence, overall profit is given by } \frac{1}{3} (-10\%) + \frac{2}{3} x = 20,$$

thus x = 35%.

**Example 76:** A reduction of 10% in the price of sugar enables a man to buy 25 kg more for

Rs. 225. What is the original price of sugar (per kg)?

**Solution:** Let original price be x.

$$\text{Original quantity} = \frac{225}{x} \quad \text{New price} = 0.9x$$

$$\text{New quantity.} = \frac{225}{0.9x} \quad \text{Equating} = \frac{225}{0.9x} - \frac{225}{x} = 25 \Rightarrow x = \text{Rs. } 1$$

**Example 77:** A man sells an article at a profit of 25%. If he had bought it at 20% less and sold it for Rs. 10.50 less, he would have gained 30%. Find the C.P. of the article.

**Solution:** Let C.P. = Rs. x ; S.P. = .25x

New C.P. = 0.8x ; New S.P. = 1.25x - 10.50

But new S.P. = 130% of new C.P. = 1.3 x 0.8x

Therefore,  $1.3 \times 0.8x = 1.25x - 10.50 \Rightarrow x = \text{Rs. } 50.$

**Example 78:** A vendor bought bananas at 6 for 5 rupees and sold at 4 for 3 rupees. Find his gain or loss percentage.

**Solution:** Let number of bananas be 12 (LCM of 6 and 4)

$$\text{Cost Price} = \frac{12}{6} \times 5 = \text{Rs. } 10$$

$$\text{Selling Price} = \frac{12}{4} \times 3 = \text{Rs. } 9$$

$$\text{Loss percentage} = \frac{1}{10} \times 100 = 10\%$$

**Example 79:** If a commission of 10% is given on the marked price of an article, the gain is 25%. Find the gain percentage, if the commission is increased to 20%.

**Solution:** Let marked price = Rs. 100 Commission = Rs. 10

$$\text{S.P.} = \text{Rs. } 90$$

$$\text{C.P.} = \frac{90}{120} \times 100 = \text{Rs. } 75$$

$$\text{New commission} = \text{Rs. } 20$$

$$\text{New S.P.} = \text{Rs. } 80.$$

$$\text{Gain percentage} = \frac{80 - 75}{75} \times 100 = 11.1\%$$

**Example 80:** Peanuts are sold at 60 per rupee. If the vendor decides to hike the S.P. by 20%, how many peanuts can be bought per rupee?

**Solution:** S.P. of 1 peanut = Re.  $\frac{1}{60}$ ; New S.P. =  $\frac{1.2}{60} = \text{Re. } \frac{1}{50}$

Therefore, 50 peanuts can be bought per rupee.

**Example 81:** Sumit buys 9 books for Rs. 100 but sells 8 for Rs. 100. What is the net percentage of profit?

**Solution:** S.P. of 8 books = Rs. 100

$$\therefore \text{S.P. of 1 book} = \frac{100}{8} = \text{Rs. } 12.50$$

$$\therefore \text{S.P. of 9 books} = 12.50 \times 9 = \text{Rs. } 112.50$$

$$\therefore \text{Profit percentage} = 12.5\%$$

**Alternative method:**

$$\text{C.P. of 9 books} = \text{S.P. of 8 books}$$

$$\text{C.P. of 8 books} + \text{C.P. of 1 book} = \text{S.P. of 8 books}$$

$$\text{C.P. of 1 book} = \text{S.P. of 8 books} - \text{C.P. of 8 books}$$

$$\text{Profit} = \text{C.P. of 1 book}$$

$$\text{Profit percentage} = \frac{\text{C.P. of 1 book}}{\text{C.P. of 8 books}} \times 100 = 12.5\%$$

**Example 82:** If by selling an article for Rs. 100, a man gains Rs. 15, then find his profit percentage.

**Solution:** S.P. = Rs. 100, gain = Rs. 15. So, C.P. = S.P. - Gain

$$\therefore \text{Gain percentage} = \left( \frac{15}{85} \times 100 \right) \% = 17\frac{11}{17}\%$$

**Example 83:** A grain dealer cheats to the extent of 10% while buying as well as selling by using false weights. His total profit percentage is

**Solution:** Here grain dealer gains 10% while buying as well as selling which is equivalent to two successive gains of 10%. Hence total gain =  $10 + 10 + \frac{10 \times 10}{100} = 21\%$

**Example 84:** A person earns 15% on an investment but loses 10% on another investment. If the ratio of the two investments be 3 : 5, what is the gain or loss on the two investments taken together?

**Solution:** Let the investments be  $3x$  and  $5x$ .

Then, the total investment =  $8x$

$$\text{Total receipt} = (115\% \text{ of } 3x + 90\% \text{ of } 5x) = (3.45x + 4.5x) = 7.95x$$

$$\therefore \text{Loss} = \left( \frac{0.05x}{8x} \times 100 \right)\% = 0.625\%$$

**Example 85:** Vivek purchased 120 tables at a price of Rs. 110 per table. He sold 30 tables at a profit of Rs. 12 per table and 75 tables at a profit of Rs. 14 per table. The remaining tables were sold at a loss of Rs. 7 per table. What is the average profit per table?

**Solution:** Total C.P. = Rs.  $(120 \times 110)$  = Rs. 13,200

$$\text{Total S.P.} = (30 \times 110 + 30 \times 12) + (75 \times 110 + 75 \times 14) + (15 \times 110 - 15 \times 7) = \text{Rs. } 14,505$$

$$\text{Average profit} = \text{Rs. } \left( \frac{14505 - 13200}{120} \right) = \text{Rs. } \frac{1305}{120} = \text{Rs. } 10.88$$

**Alternative method:**

$$\text{Total profit} = (30 \times 12) + (75 \times 14) - (15 \times 7) = 1305$$

$$\text{Hence, average profit} = \frac{1305}{120} = \text{Rs. } 10.88.$$

### Faulty Balances:

Consider a shrewd shopkeeper who sells wheat by weight and he professes and also actually sells wheat at the same rate at which he purchase wheat. Before you start wondering would he not be an idiot rather than shrewd, just think for a moment how can the shopkeeper make a profit inspite of selling at the same rate as the rate of purchase? By cheating on the weights i.e. using a weight which is actually lesser than the reading on it.

Consider an example: A shopkeeper sells oranges at the same rate at which he purchases them. However he uses a 1 kg weight that actually weighs just 900 gms.

Let's say you as a customer ask for 1 kg of oranges. He would weigh the oranges with the faulty weight and would actually give you just 900 gms. His cost price will be just for the 900 gms that he is actually giving away. However since the weight is a 1 kg weight he will charge you for 1000 gms. If the selling rate, equal to the purchase rate is Rs.  $x/\text{gm}$ , CP will be  $900x$  and SP will be  $1000x$  and thus profit percentage will be  $\frac{100x}{900x} = \frac{1}{9} = 11.11\%$ .

An even more unscrupulous shopkeeper, not only uses a 0.5 kg weight that weighs 0.4 kg but also marks up his selling rate by 10% over the purchase rate. What will be his net profit percentage?

The shopkeeper actually sells 400 grams but charges for 500 grams. His CP is 400x, considering purchase price of  $x$  Rs/gm. His SP will be  $500 \times 1.1x$ . Thus  $\frac{SP}{CP} = \frac{55}{40} = 1.375$  i.e. a net profit percentage of 37.5%

In the above problem, one could also have calculated the profit percentage solely arising from the faulty weight as  $\frac{100}{400} = 25\%$  and then used  $a+b+\frac{ab}{100}$  with  $a = 25\%$  and  $b = 10\%$

to get  $25 + 10 + \frac{250}{100} = 37.5\%$ . In all problems of this type, one can follow this approach of calculating the profit percentage on volume and that on price separately and then apply the expression of successive percentages changes.

The Multiplying Factor because of cheating on volume =  $\frac{\text{Amount charged for (Reading)}}{\text{Actual Sold}}$

This approach is not limited to only problems with faulty weights, but in any problem where the amount sold and that charged for is different. E.g. a milkman mixes 20% water to milk and sells the mixture at same rate as his CP of milk. What is his profit percentage?

Consider he buys 100 litres of milk at rate of Rs. 1 per litre. Thus his CP = Rs. 100. However he sells 120 litres at the same rate and pockets Rs. 120. Thus his profit percentage is 20% (same as the percentage of adulteration!).

The above problem could also be considered as that of faulty balance with balance reading 120 for every 100 and shopkeeper selling at CP.

Another example of this application: The Morning Stores offers 2 soaps free with every 3 soaps bought. However they mark-up the price of the soap by 40%. What is the profit or loss percentage when a customer asks for 3 soaps but takes away 5 soaps including the free ones?

Let's say each soap costs Rs. x for the store. Thus CP = 5x. However SP =  $3 \times 1.4x = 4.2x$ , because the store will be charging for just 3 soaps at the rate of 1.4x. Thus the store incurs a loss of  $0.8x$  on a CP of  $5x$  whenever a customer takes away 5 soaps i.e. a loss percentage of 16%

Again the problem could be looked as balance reading 3 for 5 and mark-up of 40%. Thus loss on volume is  $\frac{2}{5} = 40\%$  and profit on price is 40%, thus an overall loss of

$$40 - 40 - \frac{40 \times 40}{100} = -16\%$$



*Due to faulty weights, a shopkeeper makes a profit of 10%. Does this mean the customer makes loss of 10%? If no, how much loss does the customer make?*

**Example 86:** A weighing balance shows 900 g for 1 kg. What is the net profit percentage if the trader marks up his cost price by 20%?

**Solution:** Initially there is a loss of 10% because of defect in weighing balance. As there is a mark-up of 20%, net profit =  $-10 + 20 - \frac{10 \times 20}{100} = 8\%$ .

Therefore, there is a net profit of 8%.

**Example 87:** A trader has a weighing balance that shows 1,200 g for a kilogram. He further marks up his CP by 10%. Find the net profit percentage.

**Solution:** Due to defect in weighing balance initially there is a profit of 20%.

Now there is a mark-up of 10% in CP.

$$\text{Therefore, net profit} = 10 + 20 + \frac{10 \times 20}{100} = 32\% \text{ profit.}$$

**Example 88:** In winters, the meter scale of a cloth merchant shrinks by 10% of its actual length. If the meter scale in its regular condition was rigged to measure 10% more than it is supposed to, what is the profit/loss percent the cloth merchant makes in winter, if he sells goods at the rate at which he purchase?

**Solution:** A meter scale is supposed to measure 100 cm. After rigging, the meter scale would be measuring 110cm. In winters, the scale shrinks by 10% and thus would measure just  $110 \times 0.9$

= 99 cm. Thus the cloth merchant would charge for 100cm (as the scale would still read 100 cm) but actually sell just 99 cm. Thus he would make a profit of  $\frac{1}{99} \times 100 = 1.0101\%$

(If you have not realised that the shopkeeper was an idiot, the question is being read mechanically and you are not thinking while reading. Why would a shopkeeper rig his scale to measure more than the reading!)



*A fruit-seller rigs his pan-balance such that the pan in which he keeps the fruits weighs 10% more than the pan in which he keeps the weight. If he sells at the rate at which he purchases the fruits, find the profit/loss percent he makes.*

*In the above problem, you as a intelligent customer asks him to keep the fruits in the other pan (compared to what he usually does) and the weights in the other pan. Now what profit/loss percent does the shopkeeper make?*

### Stocks and Shares

Stocks or shares are instruments by which investors own a part of the company that issues them.

There are a few terms that one has to know when attempting these questions.

#### 1. Par Value:

The par value of the stock or share is the value at which the company accounts for them. For example, if the par value of a share is Rs. 10, then the company would value it at Rs.10 irrespective of the price at which it sells in the market.

#### 2. Market Value:

It is the price at which the stocks/shares are traded in the market.

#### 3. Dividend:

The company pays out a certain part of its profit to the investors in the form of dividend. Dividend is normally in percentage terms. If a company announces a 4% dividend on a

share whose par value is 100, then the investor gets Rs. 4 for every share he owns.

4. When we say 5% stock at 97, we mean a stock whose face value was Rs. 100, the market price of that Rs. 100 stock is Rs. 97 now and the annual dividend on this stock is 5% of the face value.

**Example 89:** The par value of a share is Rs.100, the market price of which is Rs. 250. Ketan invested Rs. 25,000 on these shares. What is his income if the company announces a dividend of 30%?

**Solution:** The number of shares bought =  $\frac{25000}{250} = 100$

For every share that Ketan owns he gets 30% of Rs. 100 as the dividend.

Hence, the total income =  $30 \times 100 = \text{Rs. } 3000$

Hence, his return on investment =  $\frac{3000}{25000} \times 100 = 12\%$

#### Learning Outcomes :

Fill in the blanks with an expression using the variables given in each question and any mathematical operator.

1. If A is r% less than B, B is \_\_\_\_\_ % more than A

2. If X increases successively by a% and b%, the total increase in X is \_\_\_\_\_

3. The Price level was A in 1972 and this year is taken as the base for the Price Index. If the Price Index in 2002 is 412, the Price level in 2002 is \_\_\_\_\_

4. If CI in year n was Rs. A and CI in year n+1 was Rs. A + x, the Rate of Interest p.a. is \_\_\_\_\_

share whose par value is 100, then the investor gets Rs. 4 for every share he owns.

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Fill in the blanks with an expression using the variables given in each question and any mathematical operator.

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4. If CI in year n was Rs. A and CI in year n+1 was Rs. A + x, the Rate of Interest p.a. is \_\_\_\_\_

5. If total SI in first two years is Rs. A and total CI in first two years is Rs. A + x, rate of interest and principal remaining same, then the rate of interest is \_\_\_\_\_

6. A principal when kept at SI @ r% p.a. earns Rs. A in 2 years and when kept at CI @ r% p.a. earns Rs. B in 2 years. The ratio  $\frac{A}{B}$ , in terms of r, is \_\_\_\_\_

7. The relationship between mark-up % (m), discount % (d) and profit % (p) is

a.  $p =$

$$\text{b. } \left(1 + \frac{m}{100}\right) = \left(1 + \frac{d}{100}\right) \left(1 - \frac{d}{100}\right)$$

8. A faulty weight reading r but weighing a leads to a profit % of \_\_\_\_\_

9. Two items are sold, one at profit of x% and other at loss of x%. What is the overall profit % if

a. The CP of both items is same :

b. The SP of both items is same :

10. A profit percentage of x% is equal to a margin of \_\_\_\_\_ %.

## Practice Exercises

3

### Introduction

There are 7 practice exercises out of which 4 are of level-1 and 3 are of level 2 apart from Non MCQ Questions to Strengthen your fundamental. While solving the exercises make sure that each and every concept is understood properly.

### Problems for Practice (Non MCQ)

#### Level 1

1. 20% of the population in a town are females. If there are 72,000 males, how many females are there? There are no eunuchs in the town.

2. In class IX, there were 20% absentees. If 40 students turned up, what is the total strength of the class?

3. Madhu's income is Rs. 12,000 per month. She pays 20% tax on monthly income above Rs. 2,000 and she spends 30% of the remaining income. How much does she save annually?

4. X spent 15% of his pocket money on food and 20% of the remaining on a new shirt. If he was left with Rs. 1,360, how much did the new shirt cost X?

5. A mixture contains sand and gravel in the ratio 1 : 4. The sand has 20% impurity. If total mixture weighs 10 kg, how much impurity is there? (Consider that gravel has no impurity.)

6. P's income has increased by 10% over last year and will be 20% higher next year. If his last year's income is Rs. 7,000 per month, what will it be the next year?

7. A class has girls and boys in the ratio 4 : 5. Among the girls, the ratio of Mathematics to Physics students is 3 : 1. What percentage of the class comprises girls studying Mathematics?

8. A shopkeeper gives two successive discounts of 8% and 12%. What is the overall discount?

9. The manufacturer of a product Z first increased the price by 5% and then decreased it by 8%. What was the overall percentage change in price?

10. A factory sells its product to the distributor at 10% profit, who then sells it to the retailer at 8% profit. If the retailer pays Rs. 2,376 for the product, what is the factory cost?

11. The population of a city is estimated to be at 4,32,000 after 2 years. If the population growth is 20% per annum, what is the current population?

12. A man bought a car for Rs. 75,000. He paid Rs. 25,000 cash down and the rest at the end of 2 years at 12% SI. What is the incremental amount paid?

13. Tom borrowed a certain amount of money at a certain rate of SI. After 5 years, he had to pay back twice the amount that he had borrowed. What was the rate of interest?

14. A principal of Rs. 6,000 amounts to Rs. 7,560 at the end of 2 years. How much will Rs. 8,000 amount to at the same rate? (Assume SI)

15. Tony needed to invest Rs. 20,000. He had two options: invest in (a) Bank A at the rate of 12% SI for 3 years and (b) Bank B at the rate of 10% CI for 3 years. Which is the better option and by how much?

16. A certain sum of money gives Rs. 500 at 5% simple interest for 1 year. What is the compound interest at the same rate at the end of 2 years?

17. The CI for a certain sum at 5% interest for 2 years is Rs. 220.5. Find the SI for the same sum at the same rate and for the same period.

- 18.** A certain sum of money invested at 12% per annum, compounded quarterly, amounts to Rs. 1,125.5 in 1 year. What is the sum?
- 19.** A sum of money doubles itself in 4 years at a certain rate of CI. What is the rate of interest?
- 20.** The difference in CI and SI for 2 years on a certain sum at 5% rate of interest is Rs. 200. What is the sum?
- 21.** The price of a product of a company increases by 20% and the turnover increases by 12%. What is the percentage change in the quantity sold?
- 22.** Even after a discount of 10% on the marked price, a trader managed to gain 25%. What is the marked price as a percentage of the cost price?
- 23.** Mr Moron calculates his profit percentage as a percentage of selling price. He sells an item for Rs. 150 and calculates his profit percentage to be 20%. What is the true profit percentage?
- 24.** By bargaining, Lalitaji manages to get a discount of 20% on vegetables and thus, saves Rs. 30. What is the amount that she finally paid?
- 25.** The selling price and the cost price of an article differ by Rs. 240. If the profit percentage is 20, what is the selling price?
- 26.** If a man reduces the selling price of a fan from Rs. 400 to Rs. 380, his loss increases from  $x\%$  to  $(x + 4)\%$ . What is the cost price of the fan?
- 27.** Santosh gains 20% by selling 10 toffees for a rupee. How many did he buy for a rupee?
- 28.** Amitabh bought bidis at 6 for a rupee. How many for a rupee must he sell to gain 20%?
- 29.** A person sold an item at a loss of 20%. Another person sold the same item at a profit of 10%. If both of them sold the item for Rs. 13,200, find the difference in the prices at which they purchased it.
- 30.** What profit percentage is made by selling an article at a certain price if by selling it at half that price there would be a loss of 10%?
- 31.** The cost of 9 articles is equal to the selling price of 11 articles. Find the loss percentage.
- 32.** A cloth merchant claims to sell his material at cost price but uses a scale which reads 1 m for 95 cm. Find his gain percentage.
- 33.** Andrew buys mangoes at Rs. 200 per hundred. At what price would he sell a gross in order to make a profit of 20%, in spite of a 20% decay (here one gross = 12 dozens)?
- 34.** A grocer purchased 80 kg of rice at Rs. 13.50 per kilogram and mixed it with 120 kg of rice at Rs. 16 per kilogram. At what rate per kilogram should he sell the mixture to gain 16%?
- 35.** A person bought a share (par value = Rs. 50) at the rate of Rs. 150 from the market. If it yields a dividend of 20%, what is his effective return on investment?

### Level 2

- 36.** Madhu invested Rs. 50,000 in a fixed deposit at 10% CI for 2 years. At the end of 2 years, she put the money in another deposit at 12% SI for 3 years. What was the final value of the initial investment?
- 37.** What is the present value of a stock valued at Rs. 3,380 after 2 years?  
(Rate of interest = 30% per annum) (Assume CI)
- 38.** P borrowed Rs. 5,000 at a rate of 12% for 3 years compounded quarterly. What is the amount he will have to pay back finally?

- 39.** The population of a strain of bacteria X increases at the rate of 20% every 10 min. In how much time will it double itself?
- 40.** The CI on a certain sum of money for 2 years is Rs. 2,200 and that for 3 years is Rs. 3,640. What is the rate of interest?
- 41.** If the investment in the stock markets increases by the same percentage as the stock index, find the compounded rate of growth of Sharad Mehta who invested Rs. 10 crore in 1992, for 3 years, 1992-1995. The stock index in 1992 was 3,000 and the index in 1995 was 4,000.
- 42.** The cost of a fan increases in the first year by 10%, in the second year by 20% and finally by 25% during the subsequent year. If the present cost of fan is Rs. 2,000, find the cost of the fan at the end of the third year.
- 43.** The price of a house increases by 25% after 10 years, reduces by 25% during the subsequent 10 years. If the present cost is Rs. 10 lakh, what will be its cost after 20 years?
- 44.** Find out the present value of a car, if after 2 years due to two successive increases of 20% and 25% respectively, the price becomes Rs. 75,000.
- 45.** When the selling price of a watch is Rs. 130, the loss percentage is 25%. What is the loss or gain percentage if selling price is increased to Rs. 182?
- 46.** A company sells its goods to a wholesaler making a profit of 15%. The wholesaler, in turn, sells it to the retailer making a profit of 8%. A customer buys the goods from the retailer for Rs. 350 and the retailer gains 5%. What is the cost incurred by the company to produce the good?
- 47.** Mr Sharma offers successive discounts of 5% and 15% whereas Mr Varma offers successive discount of 8% and 12%. If the final selling prices are same in either case, what is the ratio of their marked prices?
- 48.** Mr Absentmindz instead of marking up the cost price by 10%, discounted the cost price by 10% and prepared the price tag of a shirt. A discount of 5% is applicable to the list price. Because of the mistake, the company earned Rs. 19 less per shirt. What is the cost price of the shirt?
- 49.** A reduction of 20% in the price of sugar enables a customer to obtain 2.5 kg more for Rs. 160. Find the original price per kilogram.
- 50.** A dealer sold an article at a loss of  $2\frac{1}{2}\%$ . If he had sold it for Rs. 100 more, he would have gained 7%. To gain  $12\frac{1}{2}\%$ , in how much rupees should he sell it?
- 51.** Profit earned by selling an article for Rs. 1,060 is 20% more than the loss incurred by selling the article for Rs. 950. At what price should the article be sold to earn 20% profit?
- 52.** A person sold his watch for Rs. 75 and got a profit percentage equal to the cost price. Find the cost price of the watch?
- 53.** By selling 5 dozen of mangoes for Rs. 20, it was found that a trader makes a 10% profit. What is the selling price if the profit is 20%?
- 54.** A reduction of 20% in the price of eggs would enable a man to obtain 56 more for Rs. 10. What is the original price per dozen of eggs?
- 55.** A man bought certain goods, of which he sold at a profit of  $21\frac{3}{5}\%$  of which he sold at a profit of 20% and the rest at a profit of 25%. What was his overall profit percentage?
- 56.** A trader increases the selling price by 20% because of which his profit percentage increases from 10% to 15%. What is the percentage increase in the cost price?
- 57.** The cost price of an article increases by Rs. 100. The selling price increases by 10%. If the new profit decreases from 15% to 10%, what is the original cost price?

**58.** Ganguram Doodhwallah had the compulsive habit of adulterating milk with water. One day he mixed water to an extent of 20% of the milk content. He was not satisfied. So he increased the volume by 10% by adding more water to it. If pure milk costs him Rs. 10 per litre, what is the profit percentage he now makes if he sells the final milk solution at Rs. 10 per litre?

**59.** One merchant correctly calculates his profit percentage on the cost price; another wrongly calculates it on the selling price. Find the difference in actual profits if both claim to make 30% profit, and their revenue is Rs. 3,900?

**60.** Ram and Lakshman went for shopping to buy a gift for Sita on her swayamvar anniversary. Ram went to deer shop. He wanted to buy her a spotted deer. The shopkeeper gave Ram a discount of 20% on the list price. Ram, who was carrying Rs. 1,000 with him, had just the right amount of money to pay the shopkeeper. Had Ram gone to the next shop, Ravan and Co., who offers a discount of only 12%, what is the amount that Ram would have fallen short of?

**61.** A man buys 25 chairs for Rs. 375 and sells them at a profit equal to the selling price of 5 chairs. What is the selling price of one chair?

**62.** An honest milkman mixes 20% by volume of Bisleri to his milk and then sells the whole at the cost price of milk. If Bisleri costs 20% of the cost price of milk, what is the net profit percentage?

**63.** A cloth merchant sells cloth at a mark-up of 10% for every metre of cloth. What will be his profit in summer if the metre scale expands 10%?

**64.** If the cloth merchant in the earlier question 63, uses a metre scale that measures 90 cm for every metre, what is the net profit or loss percentage in summers?

**65.** A trader finds that the net profit he has made, in spite of his spring balance reading 10% less than the actual weight, is 20%. What is the mark-up on the cost price?

**66.** Par values of two kinds of shares were Rs. 10 and Rs. 20 respectively. The market values are Rs. 150 and Rs. 200 respectively. Find the ratio in which the shares have to be purchased such that the profit from selling the shares in the market value is the same.

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

**68.** Once I had been to a post-office to buy stamps of five rupees, two rupees and one rupee. I paid the clerk Rs. 20, and since he did not have change, he gave me three more stamps of one rupee. If the number of stamps of each type that I had ordered initially was more than one, what was the total number of stamps that I bought?

### Level 3

**69.** The ratio of the par value of 2 shares X and Y is 2 : 1. Their market prices is in the ratio 3 : 1. If a person invests in them in the ratio 4 : 1, what is the ratio of the incomes if the dividends (in percentage terms) are in the ratio 5 : 1?

**Direction for questions 70 to 72:** The questions are based on following information.

Ghosh Babu took voluntary retirement in Dec 1991 and received a certain amount of money as retirement benefits. On Jan 1, 1992, he invested the entire amount in shares. At the end of the month, he sold all his shares and realised 25 per cent profit. On Feb 1, he reinvested the entire amount in shares which he sold at the end of the month at a loss of 20 per cent. Again, he invested the entire amount on March 1 in a new company. At the end of the month, he sold the new company to a friend and realised a profit of 20 per cent in the process. He invested the entire amount in shares on Apr 1, which he sold at the end of the month for Rs. 1,08,000 incurring a loss of 10 per cent.

**70.** What is the amount of retirement benefits received by Ghosh Babu?

**71.** The percentage profit received by Ghosh Babu between January 1 and April 30 is

72. The amount of loss incurred by Ghosh Babu based on his operations in April 1992 is

73. The auto fare in Ahmedabad has the following formula based upon the meter reading. The meter reading is rounded up to the next higher multiple of 4. For instance, if the meter reading is 37 paise, it is rounded up to 40 paise. The resultant is multiplied by 12. The final result is rounded up to the nearest multiple of 25 paise. If 53 paise is the meter reading, then what will be the actual fare?

**Direction for questions 74 and 75:** The questions are based on the following information.

TV Links Inc. manufactures televisions. The cost of raw material accounts for 50 per cent of the selling price, while labour cost is 15 per cent of the selling price and selling expenses account for 10 per cent of the selling price. The other overheads like rent, electricity, interest, etc., work out to 40 per cent of the raw material cost.

Due to changes in duty and tax structure proposed in the budget, the raw material cost increased by 10 per cent after the budget. Other increases after the budget were labour cost by 20 per cent and selling expenses by 50 per cent. Because of severe competition, the company could increase the price of TVs by only 10 per cent. The managing director of TV Links Inc. noted that the decrease in profit per television after the budget was Rs. 600.

74. What is the pre-budget price of TVs sold by TV Links Inc.?

75. If 75 per cent of the selling expenses were dealer margins, what was the amount spent per TV on dealer margin after budget?

### Practice Exercise 1 - Level 1

1. What is the  $18\frac{3}{4}\%$  of 2000?

- a. 300 b. 400 c. 390 d. 375 e. 420

2. What percent of 48 is 26?

a. 54.16% b. 184.6% c. 56.33% d. 57.16% e. 5.5%

3. What is  $33\frac{1}{3}\%$  of 972?

- a. 332 b. 411 c. 348 d. 342 e. 324

4. What percent of 60 is 37?

- a. 60% b. 61.66% c. 65.66% d. 75% e. 70%

5. The population of a town increases from 6500 to 7475. What is the percentage increase?

- a. 10% b. 12% c. 15% d. 20% e. 17%

6. What is 90% of 90% of 100?

- a. 80 b. 100 c. 90 d. 81 e. 8100

7. 50 min is what percent of an hour?

- a. 83.33% b. 50% c. 90% d. 87.66% e. 93.33%

8. If A's income is 25% more than B's, then B's income is what percent of A's income?

- a. 75% b. 80% c. 90% d. 100% e. 125%

9. In an examination passing percentage is 40. A obtained 72 out of 200. By what percent did he fail?

- a. 8% b. 5% c. 4% d. 16% e. 6%

10. A 50 L mixture of milk and water has 35% water. What is the quantity of milk in it?

- a. 27.5 L b. 15 L c. 31.5 L d. 32.5 L e. 37.5 L

**11.** If A is increased by 10%, A<sup>2</sup> is increased by

- a. 20% b. 21% c. 100% d. 19% e. 18%

**12.** A is what percent of  $\left(\frac{9}{15}\right)$  A?

- a. 60% b. 100% c. 133% d. 160% e. 166.67%

**13.** If the length and breadth of a rectangle are decreased by 10%, then by what percent does the area decrease?

- a. 19% b. 25% c. 10% d. 20% e. 21%

**14.** What is 30% of 55% of 100?

- a. 25 b. 16.5 c. 85 d. 11.5 e. 17.5%

**15.** Which one of the following is the largest?

- a. 66% b.  $\frac{3}{5}$  c. 0.65 d.  $\frac{16}{25}$  e.  $\frac{7}{11}$

**16.** In a town, there are 2500 men and 2500 women. If men increased by 20% and women decreased by 20%, women as a percent of men now is

- a. 60% b. 66.67% c. 80% d. 83.33% e. 50%

**17.** If the numerator of a fraction is increased by 25% and denominator decreased by 20%, the new value is  $\frac{5}{4}$ . What was the original fraction?



- a.  $\frac{3}{5}$  b.  $\frac{5}{4}$  c.  $\frac{7}{8}$  d.  $\frac{3}{7}$  e.  $\frac{4}{5}$

**18.** A 'laddoo' is made of 70% flour, 20% sugar and the rest is 'ghee'. What is the quantity of 'ghee' in two kg laddoos?

- a. 200 gm b. 2 kg c. 100 gm d. 400 gm e. 320 gm

**19.** Raman's salary was decreased by 50% and subsequently increased by 50%. He has a loss of



- a. 0% b. 25% c. 0.25% d. 2.5% e. 10%

**20.** The population of a town increases 20% annually. What is the population after 2 years, if present population is 2500?

- a. 3250 b. 3500 c. 3600 d. 3700 e. 4000

**21.** If 37% of a number is 990.86, what will be approximately 19% of that number?



- a. 600 b. 500 c. 450 d. 700 e. 400

**22.** I bought 20 kg of mango, out of which 16 kg were fine and rest were rotten. What is my percentage of loss, if I bought them for Rs. 30 per kilogram?



a. 33% b. 40% c. 15% d. 10% e. 20%

**23.** Y is a% of X. If X is 120% of Y, then find a?

a. 83.33% b. 80% c. 75% d. 86.66% e. 96%

**24.** The price of rice increased from Rs.15 by 15% and then reduced by 30 paise. What was the net increase?

a. 10% b. 12% c. 13% d. 28% e. 15%

**25.** If 20% of a number exceeds 16% of the same number by 16, then what is the number?



a. 4 b. 40 c. 4000 d. 400 e.  $4 \times 10^3$

**26.** In order to increase sales, price of a product was decreased by 20%. The total revenue is increased by 28%. What is the percentage increase in number of units sold?



a. 48% b. 50% c. 40% d. 83% e. 60%

**27.** If 28% of a number is less than 43% of the same number by 75. What is 30% of that number?

a. 120 b. 105 c. 180 d. 150 e. 100

**28.** In an examination, it is required to get 45% marks to pass. A student got 138 marks and failed by 15% of the total marks. What were the maximum marks?

a. 400 b. 450 c. 460 d. 500 e. 425

**29.** Design requirement demands that an angle should be  $37\frac{1}{2}^\circ$ . Upon construction, the same angle was found to be only  $36^\circ$ , as built. The error percent is

a.  $1\frac{1}{2}$  b. 3 c. 4 d.  $4\frac{1}{6}$  e. 28

**30.** An increase of Rs. 60 in the monthly salary of Madan made it 50% of the monthly salary of Kamal. What is Madan's present monthly salary?

a. Rs. 180 b. Rs. 200 c. Rs. 300 d. Rs. 120 e. Cannot be determined

### Practice Exercise 2 - Level 1

**1.** The salaries of A and B together amount to Rs. 2,000. A spends 95% of his salary and B spends 85% of his salary. If their savings are the same, then what is A's salary?



a. Rs. 1,500 b. Rs. 1,250 c. Rs. 750 d. Rs. 1,600 e. Cannot be determined

**2.** In an examination, A got 10% marks less than B, B got 25% marks more than C and C got 20% less than D. If A got 360 marks out of 500, the percentage of marks obtained by D was

a. 70 b. 75 c. 85 d. 80 e. 82

3. In an examination, 80% of the students passed in English. 85% in Mathematics and 75% in both English and Mathematics. If 40 students failed in both the subjects, the total number of students is

- a. 200
- b. 400
- c. 600
- d. 800
- e. 160

4. p is six times as large as q. The percent that q is less than p, is

- a. 83.33
- b. 16.66
- c. 90
- d. 60
- e. 40

5. In an election involving two candidates, 68 votes were declared invalid. The winning candidate got 52% of the valid votes and won by 98 votes. The total number of votes polled was



- a. 2500
- b. 2450
- c. 2382
- d. 2518
- e. 2392

6. The price of oil is increased by 25%. If the expenditure is not allowed to increase, the ratio between the reduction in consumption and the regular consumption is



- a. 1:3
- b. 1:4
- c. 1:5
- d. 1:6
- e. 4:1

7. The current birth rate per thousand is 32, whereas corresponding death rate is 11 per thousand. The net growth rate in terms of population increase in percent is

- a. 0.021%
- b. 0.0021%
- c. 21%
- d. 2.1%
- e. 6.25%

8. The length of a rectangle is increased by 60%. By what percent would the width have to be decreased to maintain the same area?

- a. 30%
- b. 60%
- c. 75%
- d. 37.5%
- e. 15%

9. In a class of 300 students, the number of boys is twice that of girls. If 50% of boys and 48% of girls appear in examination, how many students did not appear?

- a. 152
- b. 160
- c. 16
- d. 144
- e. 154

10. If 1 L of water is added to 5 litres of a 20% solution of sugar in water, what is the strength of the solution now?



- a. 12.66%
- b. 10%
- c. 8.33%
- d. 16.66%
- e. 6.33%

11. Al Pacino invested 40% of his money in shares, 20% of rest in property and lost 25% of the remaining in a casino. What percent of the original sum he was left with?

- a. 15%
- b. 40%
- c. 42%
- d. 36%
- e. 38%

**Directions for questions 12 to 14:** Answer the questions on the basis of the following information.

In an election, there were only 2 candidates. The losing candidate received 66 % of the votes the winner got. The votes polled in favour of the loser were 60 less than that of the winner.

- 12. How many votes did the loser get?

- a. 200 b. 150 c. 120 d. 100 e. 260

**13.** How many votes were cast in total?

- a. 200 b. 300 c. 400 d. 500 e. 580

**14.** What percent of the total votes did the winner get?

- a. 60 b. 50 c. 80 d. 66.66 e. 55.1

**15.** A shopkeeper made 10% profit if the S.P. of the product is Rs. 121. What would be the percentage loss / profit, if the S.P. is reduced by Rs. 11?

- a. Loss of 10% b. Gain of 5% c. Loss of 5%

- d. No profit, no loss e. Gain of 10%

**16.** A merchant makes a profit of 8% even after giving a 10% discount. What will be the profit if he sells at marked price?

- a. 10% b. 18% c. 26% d. 20% e. None of these

**17.** Avinash spends 30% of his income on petrol,  $\frac{1}{4}$  th of the remaining on house rent and the balance on food. If he spends Rs. 300 on petrol, then what is the expenditure on house rent?

- a. Rs. 525 b. Rs. 1,000 c. Rs. 675 d. Rs. 175 e. Rs. 700

**18.** If  $x\%$  of  $a$  is the same as  $y\%$  of  $b$ , then  $z\%$  of  $b$  is



- a.  $\frac{yz}{x}\%$  of  $a$  b.  $\frac{xy}{z}\%$  of  $a$  c.  $\frac{x}{zy}\%$  of  $a$  d.  $\frac{xz}{y}\%$  of  $a$  e.  $\frac{y}{zx}\%$  of  $a$

**19.** The price of sugar is increased by 20%. As a result, a family decreases its consumption by 25%. The expenditure of the family on sugar will be decreased by



- a. 10% b. 5% c. 14% d. 15% e. 7.8%

**20.** A man's basic pay for a 40-hour week is Rs. 20. Overtime is paid for at 25% above the basic rate. In a certain week, he worked overtime and his total wage was Rs. 25. He, therefore, worked for



- a. 45 hrs b. 48 hrs c. 47 hrs d. 50 hrs e. 41 hrs

**21.** A sum of Rs. 3,500 is lent for 5 years at 5% p.a. The S.I. and amount respectively are

- a. Rs. 785, Rs. 4,375 b. Rs. 875, Rs. 3,675 c. Rs. 500, Rs. 4,375  
d. Rs. 875, Rs. 4,375 e. Rs. 500, Rs. 3,675

**22.** In what time, a sum of money will triple itself at S.I. 20% p.a.?

- a. 5 years b. 10 years c. 15 years d. 20 years e. 12.5 years

**23.** What will be the C.I. on Rs. 1,000 for 3 yrs at 10% p.a.?

a. Rs. 331 b. Rs. 330 c. Rs. 300 d. Rs. 361 e. Rs. 321

24. If C.I. for a certain sum for 2 years at 2% p.a. be Rs. 1,010, what is the principal?



a. Rs. 20,000 b. Rs. 25,000 c. Rs. 25,250 d. Rs. 27,500 e. Rs. 33,225

25. At what rate per cent, the interest on Rs. 1,125 will be Rs. 225 in 4 years?

a. 4% b. 5% c.  $6\frac{2}{3}\%$  d.  $8\frac{1}{3}\%$  e. Cannot be determined

26. In what time will Rs. 36 become Rs. 45 at 6.25% p.a. simple interest?

a. 2 years b. 3 years c. 4 years d. 8 years e. 10 years

27. The simple interest on Rs. 400 for 8 months at 5 paise per rupee per month is



a. Rs. 120 b. Rs. 160 c. Rs. 200 d. Rs. 400 e. 1600 paise

28. If Re. 1 becomes Rs. 10 in 50 years at simple interest, the rate percent per annum is

a. 15% b. 18% c. 20% d. 24% e. 16.5%

29. The difference between the interests received from two different banks on Rs. 500 for 2 years is Rs. 2.50. Find the difference between their rates. (Assume S.I.)

a. 1% b. 2.5% c. 0.25% d. 0.5% e. 5%

30. Find the difference between S.I. and C.I. on Rs. 700 at the rate of 10% for 3 yrs?



a. Rs. 20.90 b. Rs. 21.00 c. Rs. 21.70 d. Rs. 24.00 e. Rs. 11.70

### Practice Exercise 3 - Level 1

1. S.I. on a sum of money is one fourth of principal. The number of years is equal to the rate of interest. Find the rate of interest.

a. 2.5% b. 7.5% c. 6% d. 5% e. 0.5%

2. What is the sum which when lent at 5% S.I. for 2 years would yield Rs.. 154?

a. Rs. 1,450 b. Rs. 1,540 c. Rs. 1,650 d. Rs. 1,480 e. Rs. 1,560

3. I owe you Rs. 1,500 to be payable 4 years from now. What is the equivalent cash payment that I can make now (S.I. prevailing being 6.25% p.a.)?



a. Rs. 1,000 b. Rs. 800 c. Rs. 1,400 d. Rs. 1,200 e. Rs.  $666\frac{2}{3}$

4. I buy a watch for Rs. 400 and sell it for Rs. 460 at a credit of 8 months. What is my gain percent considering interest rate to be 15% p.a.?

- a. 4.54%
- b. 6.66%
- c. 7.5%
- d. 8%
- e. 5%

5. If I lend Rs. 5,000 for 3 years in two schemes

I. 11% S.I.

II. 10% C.I.,

Which scheme is more profitable and by what amount?

- a. (I); Rs. 150
- b. (I); Rs. 50
- c. (II); Rs. 5
- d. (II); Rs. 50
- e. (II); Rs. 5.50

6. A sum was put at simple interest at a certain rate for 2 years. Had it been put at 3% higher rate, it would have fetched Rs. 72 more. The sum is



- a. Rs. 1,200
- b. Rs. 1,500
- c. Rs. 1,600
- d. Rs. 1,800
- e. Rs. 1,650

7. If a sum of money doubles itself in 8 years at simple interest, the rate percent per annum is

- a. 11.5%
- b. 12.5%
- c. 12%
- d. 12%
- e. 25%

8. A man lends Rs. 10,000 in four parts and gets 8% on Rs. 2,000, 7.5% on Rs. 4,000 and 8.5 % on Rs. 1,400. What percent must he get for the remainder, if his average annual interest is 8.13%?

- a. 9%
- b. 9.25%
- c. 10.5%
- d. 7%
- e. 8.5%

9. If the difference between the compound interest compounded half-yearly and the simple interest on a sum at 10% per annum for one year is Rs. 25, the sum is



- a. Rs. 9,000
- b. Rs. 9,500
- c. Rs. 10,000
- d. Rs. 10,500
- e. Rs. 12,000

10. A man borrowed Rs. 800 at 10% per annum simple interest and immediately lent the whole sum at 10 % per annum compound interest. How much does he gain at the end of 2 years?



- a. Rs. 6
- b. Rs. 8
- c. Rs. 10
- d. Rs. 12
- e. Rs. 14

11. A sum of money amounts to Rs. 4,624 in 2 years and to Rs. 4,913 in 3 years at compound interest. The sum is



- a. Rs. 4,096
- b. Rs. 4,260
- c. Rs. 4,335
- d. Rs. 4,360
- e. Rs. 4,210

12. A sum of Rs. 12,000 deposited at compound interest becomes double after 5 years. After 20 years it will become

- a. Rs. 1,20,000 b. Rs. 1,92,000 c. Rs. 1,24,000 d. Rs. 96,000 e. Rs. 1,60,000

**13.** The least number of complete years in which a sum of money put out at 20% compound interest will be more than doubled is

- a. 3 b. 7 c. 5 d. 4 e. 6

**14.** A tree increases annually by one eighth of its height. By how much will it increase after 2 years, if it stands today 64 cm high?

- a. 72 cm b. 74 cm c. 75 cm d. 81 cm e. 80 cm

**15.** At what rate of compound interest per annum will a sum of Rs. 1,200 become Rs. 1,348.32 in 2 years?

- a. 7% b. 6% c. 7.5% d. 6.5% e. 5.5%

**16.** A sum of money invested at compound interest amounts to Rs. 800 in 3 years and Rs. 840 in 4 years. What is the rate of interest p.a.?

- a. 2% b. 4% c. 5% d. 10% e. 6%

**17.** The simple interest on a sum of money for 3 years is Rs. 360 and the compound interest on the sum at the same rate for 2 years is Rs. 270. The interest rate per annum is



- a. 25% b. 50% c. 60% d. 80% e. 20%

**18.** A man lent Rs. 400 and Rs. 600 for 3 years at the same rate at simple interest and received only Rs. 90 as interest. What was the rate percent per annum?

- a. 1% b. 2% c. 4% d. 3% e. 5%

**19.** If C.I. for a certain sum at 3% for 2 years is Rs. 203, what would be the S.I.?

- a. Rs. 210 b. Rs. 185 c. Rs. 190 d. Rs. 200 e. Rs. 197

**20.** A sum of Rs. 1,550 was partly lent at 5% and 8% p.a. simple interest. The total interest received after 3 years was Rs. 300. The ratio of the money lent at 5% to that lent at 8% is



- a. 8 : 5 b. 5 : 8 c. 31 : 6 d. 16 : 15 e. 15 : 16

**21.** A man invested one third of his capital at 7%, one fourth at 8% and the remainder at 10% simple interest respectively. If his annual income from interest earned is Rs. 561, then the capital is



- a. Rs. 5,400 b. Rs. 6,000 c. Rs. 6,600 d. Rs. 7,200 e. Rs. 5,600

**22.** Rs. 2,189 is divided into three parts and invested such that their amounts after 1, 2 and 3 years respectively are equal. The rate of simple interest is 4% p.a. in all cases. Find the smallest part.

- a. Rs. 703 b. Rs. 389 c. Rs. 756 d. Rs. 398 e. Rs. 596

**23.** If the simple interest on a sum of money for 3 years at 5% per annum is Rs. 1,200, then the compound interest for the same period at the same rate is



- a. Rs. 1,260 b. Rs. 1,216 c. Rs. 1,264 d. Rs. 1,261 e. Rs. 1,254

**24.** The simple interest on Rs. 1,820 from March 9, 1994 to May 21, 1994 at 7.5% rate will be

- a. Rs. 29 b. Rs. 28.80 c. Rs. 27.30 d. Rs. 22.50 e. Rs. 28.50

**25.** Cost of 3 balls = Cost of 2 pads. Cost of 3 pads = Cost of 2 gloves. Cost of 3 gloves = Cost of 2 bats. If the bat costs Rs. 54, what is the cost of the ball?

- a. Rs.12 b. Rs.14 c. Rs.16 d. Rs. 18 e. Rs. 20

**26.** If books bought at prices ranging from Rs. 200 to Rs. 350, are sold at prices ranging from Rs. 300 to Rs. 425, then what can be the maximum possible profit?

- a. Rs. 300 b. Rs. 400 c. Rs. 600 d. Rs. 800 e. Cannot be determined.

**27.** The cost price of 20 articles is the same as the selling price of 15 articles. The profit percentage is

- a. 25 b. 30 c. 35 d. 33.33 e. Cannot be determined

**28.** If the selling price of an article is  $\frac{4}{3}$  times its cost price, then the profit percent is

- a.  $33\frac{1}{3}\%$  b.  $25\frac{1}{4}\%$  c.  $20\frac{1}{2}\%$  d.  $20\frac{1}{3}\%$  e. 25

**29.** A dealer who professes to sell his goods at cost price uses a 900 gm weight for a kg. His gain percentage is

- a. 9 b. 10 c. 11 d. 11.11 e. No gain, but loss

### **Practice Exercise 4 - Level 1**

**1.** A dealer professes to sell his goods at cost price, but he uses a false weight and gains  $6\frac{18}{47}\%$ . For a kg he uses a weight of



- a. 953 gm b. 960 gm c. 940 gm d. 947 gm e. 936 gm

**2.** A man sells 2 cows for Rs. 4,000 each, neither gaining nor losing in the deal. If he sells one cow at a gain of 25%, then the other cow must have sold at a loss of

- a. 16.66% b. 18.22% c. 25% d. 30% e. 20%

**3.** Two horses were sold for Rs. 12,000 each, one at a loss of 20% and the other at a gain of 20%. The entire transaction resulted in

- a. No loss, no gain b. Loss of Rs. 1,000 c. Gain of Rs. 1,000  
d. Gain of Rs. 2,000 e. Loss of 666.67

**4.** Successive discounts of 30%, 20% and 10% are equivalent to a single discount of

- a. 50% b. 40% c. 39.4% d. 49.6% e. 60%

5. The difference between the discounts of 40% on Rs. 500 and two successive discounts of 36% and 4 % on the same price is

- a. Nil b. Rs. 2 c. Rs. 7.20 d. Rs. 1.93 e. Rs. 12.8

6. At what percentage above the cost price must an article be marked so as to gain 33% after allowing a discount of 5%?



- a. 30% b. 38% c. 40% d. 43% e. 48%

7. A trader allows two successive discounts of 20% and 10%. If he sells the article for Rs.108, then the marked price of the article is

- a. Rs. 150 b. Rs. 148 c. Rs. 142 d. Rs. 140 e. Rs. 154

8. A merchant gives a discount of 10% on the cost price of the tea, but uses a weight of 900 gm per kg. Find his net profit / loss percentage.

- a. No profit, no loss b. 2.05% loss c. 4.67% profit
- d. 3.33% loss e. 1.11% profit

9. If the cost price of 12 books is the same as the selling price of 16 books, the loss percentage is



- a. 15% b. 25% c. 20% d. 30% e. Cannot be determined

10. A man loses the selling price of 4 apples on selling 36 apples. His loss percentage is



- a. 12.5% b. 11.11% c. 10% d. 9% e. None of these

11. By selling a table, Aditya earned a profit equal to one fourth of the price for which he bought it. If he sold it for Rs. 375, what was the cost price?

- a. Rs. 281.25 b. Rs. 281.75 c. Rs. 300 d. Rs. 312.50 e. Rs. 350

12. A man bought a number of bananas at 3 for a rupee and an equal number at 2 for a rupee. At what price per dozen should he sell them to make a profit of 20%?

- a. Rs. 4 b. Rs. 5 c. Rs. 8 d. Rs. 6 e. Rs. 5.76

13. A man buys oranges at Rs. 5 a dozen and an equal number at Rs. 2 a dozen. He sells them at Rs. 5.50 a dozen and makes a profit of Rs. 50. How many oranges (in dozens) did he buy?

- a. 25 b. 40 c. 50 d. 60 e. 20

14. A tea merchant blends two varieties of tea costing Rs. 18 per kg and Rs. 20 per kg in the ratio of 5 : 3. If he sells the blended variety at Rs. 21 per kg, what is his gain percentage?

- a. 10 b. 22 c. 19 d. 12 e. 14

15. By selling toffees at 20 for a rupee, a man loses 4%. To gain 20%, for a rupee he must sell



- a. 16 toffees b. 14 toffees c. 12 toffees d. 8 toffees e. 10 toffees

**16.** A man gains 10% by selling an article for a certain price. If he sells it at double the price, the profit is

- a. 20% b. 120% c. 100% d. 140% e. 220%

**17.** 'A' bought a cycle and spent Rs. 110 on its repairs. He then sold it to 'B' at a profit of 20%. 'B' sold it to 'C' at a loss of 10%. 'C' sold it at a profit of 10% for Rs. 1,188. How much did 'A' buy it for?

- a. Rs. 850 b. Rs. 870 c. Rs. 930 d. Rs. 890 e. Rs. 1,000

**18.** A vendor has 24 kg of apples. He sells part of these at a 20% gain and the balance at 5% loss. If on the whole he earns a profit of 10%, the part of apples sold at a loss is



- a. 6 kg b. 4.6 kg c. 9.6 kg d. 11.4 kg e. 14.4 kg

**19.** The cost price of an article is 40% of the selling price. The percent that the selling price is of cost price is

- a. 250% b. 240% c. 60% d. 40% e. None of these

**20.** By selling an article, there is a loss of 2.5%. By selling it at Rs. 6 more, there is a gain of 5%. Find the cost price of the article.



- a. Rs. 78 b. Rs. 81 c. Rs. 82 d. Rs. 80 e. Rs. 84

**21.** Profit after selling goods for Rs. 425 is the same as the loss after selling it at Rs. 355. What is its cost price?



- a. Rs. 390 b. Rs. 385 c. Rs. 395 d. Rs. 400 e. Rs. 380

**22.** The profit earned by selling a table for Rs. 900 is double the loss incurred when it is sold for Rs. 450. At what price should it be sold to make a 25% profit?

- a. Rs. 600 b. Rs. 650 c. Rs. 800 d. Rs. 750 e. Rs. 700

**23.** A merchant intends to offer a discount of 10% but would like to maintain the current selling prices. By what percentage should he increase the list price?

- a. 10% b. 9.09% c. 11.11% d. 12.5% e. 10.10%

**24.** A trader buys 78 kg of wheat for Rs. 492. He sells 40% of this at a loss of 20%. What should be the percentage mark up on the remaining so as to gain an overall 25%?



- a. 40% b. 55% c. 28% d. 45% e. 50%

**25.** By selling 25 L of milk at Rs. 50 per litre, a merchant earns a profit equivalent to the cost price of 5 L. Find the profit percentage.

- a. 15% b. 25% c. 20% d. 18% e. Cannot be determined

**26.** A man bought 100 kg of rice for Rs. 1,100 and sold it at a loss of as much money as he received for 20 kg rice. At what unit price did he sell the rice?

- a. Rs. 9 b. Rs. 10.50 c. Rs. 10 d. Rs. 9.16 e. Rs. 8.50

**27.** Ram purchased 35 kg rice at Rs. 9.50 per kilogram and another 30 kg at Rs. 10.50 per kilogram and mixed them. At what price (per kilogram) should he sell the mixture to gain 35%?

- a. Rs. 12 b. Rs. 12.50 c. Rs. 13 d. Rs. 13.50 e. Rs. 14

**28.** Oil costs Rs. 100 per kilogram. After adulterating it with another oil that costs Rs. 50 per kilogram, Ram sells the mixture at Rs. 96 per kilogram, making a profit of 20%. In what ratio does he mix the dearer and cheaper oil?

- a. 1 : 2 b. 3 : 2 c. 3 : 1 d. 1 : 3 e. 2 : 3

**29.** The C.P. of an article is Rs. x and its S.P. is Rs. y. The C.P. is increased by 20% but the S.P. remains constant. For a weight of 12 kgs how much the trader should weigh so that he is having the same percentage profit?

- a. 15 kg b. 10 kg c. 8 kg d. 14.4 kg e. 9 kg

**30.** By selling 20 kgs of mangoes the profit is equal to C.P. of 5 kgs of mangoes. Find the profit percentage?

- a. 20% b. 15% c. 25% d. 40% e. Cannot be determined

### **Practice Exercise 5 - Level 1**

**1.** Amit takes a loan from a bank at 18% CI for 2 years. At the end of the period, he pays back Rs. 6,962. What was the loan amount?



- a. Rs. 4,000 b. Rs. 6,000 c. Rs. 5,000 d. Rs. 4,500 e. None of these

**2.** Which of the following assures the best return for a sum of Rs. 25,000?

- (I) 2 years at 18% SI

- (II) 3 years at 10% SI

- (III) 2 years at 20% CI

- a. I b. II c. III

- d. Both (I) and (III) are equally good

- e. Both (II) and (III) are equally good

**3.** Madhu took a loan of Rs. 20,000 at 5% SI for 2 years and invested it at 4% CI for the same period. What is her gain/loss in the transaction?

- a. Rs. 368 gain b. Rs. 423 gain c. Rs. 368 loss d. Rs. 423 loss e. Rs. 386 loss

4. A principal of Rs. 3,000 amounts to Rs. 3,360 in 2 years when compounded at a certain rate of interest. How much will the same principal amount to if it was compounded semi-annually?

- a. Rs. 3,370.80
- b. Rs. 3,720
- c. Rs. 3,400
- d. Rs. 3,263.43
- e. None of these

5. In approximately how many years will a certain sum of money triple itself at 22% simple interest?

- a. 10 years
- b. 11 years
- c. 9 years
- d. 12 years
- e. 8 years

6. At a certain rate of compound interest, Rs. 15,320 becomes Rs. 30,640 in 6 years. What is the rate of interest?



- a. 12%
- b. 13%
- c. 14%
- d. 15%
- e. 11%

7. The population of a town grows at the rate of 20% every 5 years. In how many years will it double itself? (approximately)

- a. 12 years
- b. 15 years
- c. 16 years
- d. 20 years
- e. 22 years

8. A strain of bacteria reproduces at the rate of 25% every 12 min. In how much time will it triple itself?



- a. 96 min
- b. 60 min
- c. 48 min
- d. 40 min
- e. 72 min

9. The amounts on a certain principal for 3 years and for 4 years at a certain rate of CI are Rs. 18,250.50 and Rs. 20,988.10. What is the rate of interest?

- a. 10%
- b. 12%
- c. 13%
- d. 15%
- e. 17%

10. The CI on a certain principal in second year is Rs. 420 and that in third year is Rs. 462. What is the rate of interest?

- a. 8%
- b. 10%
- c. 12%
- d. 15%
- e. 20%

11. What is the net present value of a stock valued at Rs. 54,880 after 3 years? (Rate of interest = 40% per annum and interest is compounded annually)

- a. Rs. 20,000
- b. Rs. 30,000
- c. Rs. 40,000
- d. Rs. 50,000
- e. Rs. 15,000

12. The value of an estate is estimated to be Rs. 324.48 lakh after 2 years. If the rate of growth of value is 4% per annum, what is its present value?

- a. Rs. 200 lakh
- b. Rs. 250 lakh
- c. Rs. 300 lakh
- d. Rs. 350 lakh
- e. None of these

13. Sachin spends  $\frac{1}{4}$  th of his leisure hours on reading and  $\frac{2}{3}$  rd of the remaining watching the television. If he spends 2 hr on watching the television, what is his total leisure time?

- a. 4 hr
- b. 5 hr
- c. 6 hr
- d. 8 hr
- e. 10 hr

14. In a recent survey of 800 socialites, it was found that 3% of them attended one party a week on an average. Of the other 97% it was found that half attended an average of two parties a week and the other half did not attend any party. How many party attendance is recorded on an average per week?

- a. 400
- b. 800
- c. 600
- d. 500
- e. 700

15. An alloy contains tin, aluminum and copper in the ratio  $\frac{1}{2} : \frac{1}{3} : \frac{1}{5}$ . What is the approximate percentage of aluminum in the alloy?

- a. 20%
- b. 30%
- c. 32%
- d. 36%
- e. 48%

16. The price of a book includes 10% printing cost, 20% paper cost and another 15% labour cost. If other costs add-up to Rs. 110, what is the total price of the book?

- a. Rs. 200
- b. Rs. 250
- c. Rs. 300
- d. Rs. 400
- e. Rs. 500

17. A's salary increased by 12% over last year and has become Rs. 6,720. What will next year's salary be if it increases by 20% over last year's salary?

- a. Rs. 8,000
- b. Rs. 8,064
- c. Rs. 7,500
- d. Rs. 7,200
- e. Rs. 8,200

18. A shopkeeper sells product at 12% discount on his marked price. He has to pay a 10% tax. If he gives a discount of Rs. 36. How much money is he left with after tax?

- a. Rs. 234.30
- b. Rs. 233.70
- c. Rs. 237.60
- d. Rs. 239.40
- e. Rs. 227.70

19. A fruit vendor gives two successive discounts of 10% and 14%. What is the overall discount given?

- a. 22.4%
- b. 22.6%
- c. 23.4%
- d. 23.6%
- e. 21.6%

20. A manufacturer adds 10% to the cost while selling it to the retailers, who in turn adds 15% to his cost while selling it to the customer. If the customer pays Rs. 5,060 for the product, what is the manufacturing cost?

- a. Rs. 4,000
- b. Rs. 5,000
- c. Rs. 4,500
- d. Rs. 5,200
- e. Rs. 4,200

21. A man sells two items such that the cost price of one is equal to the selling price of the second, and the selling price of the first is equal to the cost price of the second. Which of the following is true?



a. He makes a profit

b. He makes a loss

c. He makes neither profit nor loss

d. He makes a profit equal to cost price of 1st item

e. He makes a loss of equal to cost price of 2nd item.

22. A quantity of 30 ml of 20% alcohol is mixed with 20 ml of 25% alcohol. What is the strength of alcohol in the mixture?

- a. 20%
- b. 25%
- c. 22%
- d. 22.5%
- e. 20.5%

23. An alloy contains tin and copper in the ratio 4 : 5. If tin has 20% impurity and copper 58%, what is the average impurity percentage?



- a. 20%
- b. 41.1%
- c. 35%
- d. 38%
- e. 43.1%

24. I purchase some eggs for Rs. 100. 20% of the eggs break in transit. What profit percentage should I make on the remaining to get an overall 10% profit?



- a. 20% b. 27.5% c. 30% d. 37.5% e. 39.5%

**25.** A merchant buys Rs. 20,000 worth of goods. In the transit 40% of the goods got damaged. He is forced to sell them at a 10% loss. What profit percentage should he make on the rest of the items to make an overall profit of 20%?

- a. 25% b. 30% c. 35% d. 40% e. 45%

### Practice Exercise 6 - Level 1

**1.** What strength of 20 ml alcohol should be added to 10 ml of 50% alcohol to get an average strength of 20% alcohol?



- a. 0.5% b. 5% c. 50% d. 5.5% e. 0.05%

**2.** A 20% hike in bus fare resulted in a 10% fall in the passenger traffic. Still the daily collection at the bus depot increased by Rs. 150. The daily collection at the depot after the fare hike is



- a. Rs. 1,600 b. Rs. 1,750 c. Rs. 2,025 d. Rs. 1,875 e. Rs. 2,250

**3.** 30% of the students in a class wear spectacles. 10% of the students who wear spectacles, wear gold-rimmed spectacles. If the class has 200 students, how many wear gold rimmed spectacles?

- a. 6 b. 7 c. 8 d. 3 e. None of these

**4.** In a village, 18% of the population are children and 10% of children are female. If the number of female children is 90, what is the population?

- a. 500 b. 5,000 c. 600 d. 6,000 e. 5,500

**5.** A market leader wants to make profit by selling rice. He tried different methods to get higher profit. Find out which among the following methods should he use to maximise his profit.

I : Increase the price by 5% and reduce the weight by 5%

II : Mix impurities to the extent of 10% of the weight of rice

III : Use a weight of 900 g in stead of 1 kg

IV : Sell rice at 10% profit

- a. I or III b. II or III c. II or IV d. II, III and IV e. None of these

**6.** A dishonest seller uses a weight of 800 g in place of 1 kg and adds 20% impurities in sugar. What would be his profit percentage if he claims to be selling at cost price?



a. 50% b. 40% c. 45.5% d. 36% e. None of these

7. A sum of money amounts to Rs. 1,180 and Rs. 1,300 in 3 years and 5 years respectively at a simple interest per annum. The money invested is

a. Rs. 90 b. Rs. 950 c. Rs. 1,000 d. Rs. 1,050 e. Rs. 925

8. If the cost price of 6 articles is the same as the selling price of 5 articles, the profit will be



a. 25% b.  $22\frac{1}{2}\%$  c. 20% d.  $18\frac{3}{4}\%$  e. 21%

9. One kilogram tea and 1 kg sugar together cost Rs. 95. If the price of tea falls by 10% and that of sugar rises by 20%, the price of 1 kg each combined comes to Rs. 90. The original price of tea per kilogram is



a. Rs. 72 b. Rs. 55 c. Rs. 60 d. Rs. 80 e. Rs. 75

10. A showroom owner sells a leather jacket for Rs. x and claims to make a 10% profit. He plans to have a stall in the trade fair and mark the same jacket at Rs. 2x. At the stall, he allows a 20% discount. What will be the percentage profit he makes at the trade fair?

a. 80% b. 60% c. 76% d. 70% e. None of these

11. Madhu got married 6 years ago. Today her age is 125% times her age at the time of marriage. Her son's age is one-tenth of her age. Her son's age is

a. 3 years b. 2.5 years c. 2 years d. 4 years e. 3.5 years

12. A building worth Rs. 13,31,000 is constructed on land worth Rs. 7,29,000. After how many years will the value of both be same if land appreciates at 10% and building depreciates at 10% per annum?

a. 1.5 years b. 3 years c. 2 years d. 2.5 years e. 4 years

13. In a village the current birth rate per thousand is 55 whereas corresponding death rate is

34 per thousand. The net growth rate in terms of population increase will be

a. 0.021% b. 0.0021% c. 21% d. 2.1% e. 0.21%

14. The population of a town was 8,000. In one year, the female population increased by 8% and the male population increased by 10%, but the total increased by only 9%. What is the number of males in the town now?



a. 4,400 b. 4,000 c. 5,000 d. 6,000 e. 4,500

15. A sum of money doubles itself at compound interest in 15 years. In how many years will it become eight times?

a. 30 years b. 45 years c. 50 years d. 60 years e. 40 years

**16.** CI on a sum for 2 years at 4% per annum is Rs. 102. The SI on the same sum for the same period at the same rate will be

- a. Rs. 99 b. Rs. 101 c. Rs. 100 d. Rs. 93 e. Rs. 95

**17.** If CP of 36 books is equal to SP of 30 books, then the gain percentage is

(You have to assume that all the books cost same.)

- a. 20% b.  $16\frac{4}{6}\%$  c. 16% d.  $8\frac{2}{6}\%$  e. 15%

**18.** A trader bought 10 kg oranges for Rs. 405, of which 1 kg was found rotten. If he wishes to make a profit of 10%, at what rate per kilogram should he sell the remaining oranges?

- a. Rs. 44.55 b. Rs. 48.66 c. Rs. 51.25 d. Rs. 45.65 e. None of these

**19.** A man buys 6 dozen eggs for Rs. 10.80, and 12 eggs are found rotten and the rest are sold at 5 eggs per rupee. Find his percentage gain or loss.



- a.  $11\frac{1}{9}\%$  gain b.  $11\frac{1}{9}\%$  loss c.  $9\frac{1}{11}\%$  gain d.  $9\frac{1}{11}\%$  loss e. None of these

**20.** A bank lent Rs. 4,000 to a person A at a certain rate of simple interest and Rs. 5,000 to B at  $\frac{1}{2}\%$  more than that of A. After 2 years the bank received Rs. 860 as interest from A and B. Find the rate of interest per annum at which the amount was lent to B.

- a. 5% b. 4.5% c. 5.5% d. 4% e. 6%

**21.** A businessman marked the price of his goods 30% more than his CP. He then sells  $\frac{1}{4}$  of his stock at a discount of 15%, and half of the stock at the marked price, and the rest at a discount of 30%. Find his gain percentage.



- a. 16.5% b.  $15\frac{3}{8}\%$  c. 14.20% d. 13.37% e.  $15\frac{2}{8}\%$

**22.** If an article is sold at 8% profit in stead of 8% loss, it would have brought Rs. 12 more. Find out the cost price of the article.

- a. Rs. 75 b. Rs. 72 c. Rs. 60 d. Rs. 70 e. Rs. 65

**23.** The simple interest on a sum of money is  $\frac{4}{9}$  of the principal, and the number of years is equal to the rate of interest per annum. Find out the rate of interest per annum.

- a. 5% b. 6% c.  $6\frac{2}{3}\%$  d. 7% e.  $7\frac{1}{3}\%$

**24.** A shopkeeper bought some pencils at 2 for Re 1, and an equal number at 3 for Rs. 2. He sold the entire lot at 5 for Rs. 3. Find out his gain or loss percentage.

- a.  $2\frac{6}{7}\%$  loss b.  $3\frac{6}{7}\%$  gain c.  $2\frac{6}{7}\%$  gain d.  $3\frac{6}{7}\%$  loss e. None of these

**25.** A shopkeeper has certain number of eggs of which 5% are found to be broken. He sells 93% of the remainder and still has 266 eggs left. How many eggs did he originally have?

a. 3,800 b. 4,000 c. 4,200 d. 3,500 e. None of these

**26.** A shopkeeper bought 80 kg rice for Rs. 384 and was obliged to sell it at a loss of as much money as he received for 16 kg. Find his selling price per kilogram.

a. Rs. 6 b. Rs. 8 c. Rs. 4 d. Rs. 3 e. Rs. 5

**27.** A quantity of tea is sold at Rs. 5.75 per kilogram. The total gain by selling the tea at this rate is Rs. 60. Find the quantity of tea being sold if a profit of 15% is made on the deal.

a. 80 kg b. 60 kg c. 90 kg d. 105 kg e. 82 kg

**28.** The simple interest on a sum of money will be of the principal after a certain number of years. If the interest is Rs. 360 at the end of the second year, what would be the rate of interest per annum?

a. 5% b. 8% c. 6% d. 7% e. Data inadequate

**29.** If a commission of 20% is given on retail price, the profit is 60%. Find the profit percentage when the commission is increased by 5% of the retail price.

a. 66.66% b. 50% c. 36% d. 63% e. 55%

**30.** By selling an article at Rs. 540, a profit of 12.5% is made. In order to double the profit, at what price should the article be sold?

a. Rs. 460 b. Rs. 680 c. Rs. 480 d. Rs. 600 e. Rs. 650

**31.** The population of a village is 8,400. Of this four-sevenths are males, and they are to marry women of their own village. If 65% of the males are married, then find the percentage of unmarried females among females. Females of this village are also supposed to marry men of their own village.

a. 92% b. 6% c. 5.7% d. 15.29% e. None of these

**32.** If a selling price of Rs. 24 results in a 20% discount off the list price, the selling price that would result in a 30% discount off the list price is

a. Rs. 9 b. Rs. 27 c. Rs. 14 d. Rs. 21 e. Rs. 18

### **Practice Exercise 7 - Level 1**

**1.** If the difference between compound interest and simple interest on a certain sum of money for 3 years at 5% per annum is Rs. 122, what will be the principal?

a. Rs. 16,000 b. Rs. 18,000 c. Rs. 20,000 d. Rs. 14,886 e. Rs. 15,500

**2.** Sheila purchases 20 kg apples at Rs. 15/kg and another 10 kg apples at Rs. 20/kg. What is the average cost per kilogram?

a. Rs. 15.33/kg b. Rs. 16.67/kg c. Rs. 17.27/kg d. Rs. 18/kg e. Rs. 16/kg

**3.** If Pawan is making a profit of 25% on his selling price, what is his actual profit percentage?

a. 25% b. 30% c. 35% d. 32% e. None of these

**4.** Suvakar was very much excited about an offer from Reebok that read 'Buy things worth Rs. 2,000 and get things worth Rs. 1,000 absolutely free!'. How much discount was there in the offer?

a. 50% b. 40% c.  $33\frac{1}{3}\%$  d. 35% e. None of these

**5.** If  $a^2\%$  of b is equal to  $b^3\%$  of c, and  $c^4\%$  of a is equal to  $b\%$  of b, then the relation between a and b is

a.  $a = b$  b.  $a = b^2$  c.  $a^9 = b^{10}$  d.  $a = b^{10}$  e.  $a^2 = b^3$

**6.** Ram owes Shyam Rs. 10. Shyam owes Ghanshyam Rs. 15 and Ghanshyam owes Ram Rs. 8. Which of these transactions would settle all the dues?

- a. Ram gives Rs. 2 to Shyam and Rs. 5 to Ghanshyam
- b. Shyam gives Rs. 2 to Ram and Rs. 7 to Ghanshyam
- c. Ram pays Rs. 2 to Shyam and Shyam pays Rs. 7 to Ghanshyam
- d. Ram pays Rs. 5 to Ghanshyam and Ghanshyam pays Rs. 2 to Shyam
- e. None of these

**7.** Three years ago a friend offered me a used typewriter for Rs. 1,024. A year later he offered me the same for Rs. 640 and last year he wanted Rs. 400 and now he is willing to sell it to me for Rs. 250. But I have decided to buy it when he reduces the price next time. If he is constantly reducing its price, at what price will he offer the typewriter to me next?

- a. Rs. 150.45 b. Rs. 156.25 c. Rs. 211.25 d. Rs. 206.75 e. Rs. 202.25

**8.** I sold two watches for Rs. 300 each, one at 10% loss and another at 10% profit. What is the loss percentage (-) or the profit percentage (+) that resulted from the transaction?

- a. (+)10% b. (-)1% c. (+)1% d. (-)10% e. None of these

**9.** The value of a share of P-type and the value of a share of Q-type each increased by 16%. If the value of P-type increased by 16 paise and the value of Q-type increased by Rs 1.68, what is the difference between the value of Q-type and the value of P-type before the increase?

- a. Rs. 8 b. Rs. 9.50 c. Rs. 10 d. Rs. 10.50 e. Rs. 9.25

**10.** If CP of 23 books is equal to SP of 30 books, then the gain or loss is

(You have to assume that all the books cost same.)



- a.  $23\frac{1}{3}\%$  gain b.  $30\frac{10}{23}\%$  loss c.  $23\frac{1}{3}\%$  loss d.  $33\frac{1}{3}\%$  loss e. None of these

**11.** Mr Kamal Dutta invests Rs. 1,546 in a bank at a certain rate of CI per annum. At the end of 8 years, he finds that his money has doubled. What approximately is the rate of interest the bank paid him?



- a. 12% b. 15% c. 10% d. 18% e. 16%

**12.** A merchant buys 200 kg rice at Rs. 7.25 per kilogram and 400 kg at Rs. 5.75 per kilogram. He mixes and sells one-third of the mixture at Rs. 6 per kilogram. At what price per kilogram should he sell the remaining mixture so that he may earn a profit of 20% on the whole?

- a. Rs. 8 b. Rs. 8.25 c. Rs. 6 d. Rs. 9.25 e. Rs. 6.25

**13.** In a town the population grows at a simple rate of 10% in a decade and compounds from decade to decade. Find the population at the beginning of the 1970s if the population at the beginning of the 1990s is 3,63,000 people.

- a. 30,000 b. 3,00,000 c. 30,00,000 d. 3,15,000 e. 2,75,000

**14.** A man purchases 2 watches for Rs. 560. He sells one at 15% profit and the other at 10% loss. He neither gains nor loses. Thus, the cost prices of 2 watches are



a. Rs. 260 and Rs. 300 b. Rs. 210 and Rs. 350 c. Rs. 224 and Rs. 336

d. Rs. 560 and Rs. 560 e. Rs. 224 and Rs. 350

**15.** A merchant claims a loss of 4% on coffee, but uses weight equal to 840 g instead of 1 kg. The merchant actually makes a



a.  $11\frac{1}{7}\%$  gain b.  $14\frac{2}{7}\%$  gain c. 4% loss d. 4% gain e. 2% loss

**16.** A charity solicited P persons over phone who agreed to an average pledge of Rs. R each. Q of these people who had pledged an average of Rs. S each never sent the pledged money. Which of the following expressions represents the percentage of pledged money that the charity actually received?

a.  $100 \left( \frac{PR}{QS} \right)$  b.  $100 \left( \frac{QS}{PR} \right)$  c.  $100 - 100 \left( \frac{QS}{PR} \right)$

d.  $100 PR - 100 \left( \frac{QS}{PR} \right)$  e.  $100 PR + 100 \left( \frac{PR}{QS} \right)$

**17.** The rate of increase in prices in a particular country is 1,000% per annum compoundedly. What will be the cost in 2001 of a product which costs 5 units of currency in 1999?

a. 20 units b. 726 units c. 605 units d. 5,000 units e. 1024 units

**18.** The total number of candidates who appeared for an examination at the centres P, Q, R, S and T are 164, 61, 53, 82 and 73 respectively. The total number of candidates who passed were 83, 31, 27, 41 and 37 respectively. Which centre can claim the highest percentage of candidates passed?



a. P b. Q c. R d. S e. T

**19.** Two lumps of gold, silver and copper together weigh 20 kg. One lump contains 75% gold and 31.25 g silver per kilogram. Another lump contains 85% gold and 30 g silver per kilogram. The total quantity of silver in two lumps is 617.5 g. If two lumps are melted to form one, the percentage of gold in it will be



a. 75% b. 87% c. 15.6% d. 78% e. 60%

**20.** Howard Conster bought walnuts at 5 for Re 1 and pineapples at 4 for Re 1. He spent a total of Rs. 19.50. He sells both at 20 for Rs. 5 and as a result gains Rs. 3. How many walnuts did Howard buy?

a. 50 b. 45 c. 60 d. 80 e. 55

**21.** The profit in running a bus is directly proportional to the distance when the number of passengers is constant, and directly proportional to the number of passengers in excess

of a certain fixed number when the distance is constant. The profit is Rs. 80 when 30 passengers are carried over a distance of 40 km, and Rs. 180 when 35 passengers are carried over 60 km. The minimum number of passengers to be carried, so that there is no loss, is

- a. 19 b. 18 c. 20 d. 25 e. 21

**22.** A light blinks such that it is on for 1.5 secs and off for 1 sec. If its is switched on at 06 : 43 : 20 am and switched off at 11: 21 : 13 pm, on the same day, then in what position is the light when switched off ?

- a. about to switch on b. on c. about to switch off  
d. off e. None of these

**Direction for questions 23 to 26:** Answer the questions based on the following information.

An aquarium contains 100 kg of water, including 3 per cent in the form of carbon dioxide ( $\text{CO}_2$ ) and 7 per cent in the form of oxygen ( $\text{O}_2$ ). The plants in the aquarium consume  $\text{CO}_2$  at the rate of 100 gram per hour during photosynthesis, but if the weight of  $\text{CO}_2$  is less than 1 per cent of the total weight of water the process of photosynthesis stops. In such a case, the plants start to consume  $\text{O}_2$  at the rate of 50 grams per hour during the process of respiration. In photosynthesis, 70 per cents of  $\text{CO}_2$  intake is released in the form of  $\text{O}_2$ ; and in respiration, 120 per cent of  $\text{O}_2$  is released in the form of  $\text{CO}_2$ .

There are eight fishes in the aquarium which consume  $\text{O}_2$  at the rate of 10 gram per hour per fish and release  $\text{CO}_2$  at the rate of 11.25 gram per hour per fish. The fishes will die if the weight of  $\text{O}_2$  is less than 2 per cent of total weight of water, or if  $\text{CO}_2$  is more than 10 per cent of total weight.

The water can be refreshed any time. In the process, 2 kg of  $\text{O}_2$  and  $1/2$  kg of  $\text{CO}_2$  are artificially inserted in the water.

**23.** For how long can the fishes survive without any refreshment ?

- a. 700 hours b. 500 hours c. 600 hours d. 800 hours e. 1000 hours

**24.** Assume that at some point of time, the level of  $\text{O}_2$  is 9.5 per cent and that of  $\text{CO}_2$  is 0.5 per cent. How long will it take for  $\text{CO}_2$  level to come to 1 per cent ?

- a. 2 hours 10 minutes b. 3 hours 5 minutes c. 3 hours 15 minutes  
d. 3 hours 45 minutes e. 3 hours 20 minutes

**25.** If in the original aquarium, 4 more fishes are introduced and 10 per cent more plants are added, then for how long can the fishes survive ?

- a. 642 hrs b. 714 hrs c. 806 hrs d. 680 hours e. 840 hours

**26.** What is the maximum possible number of fishes that can be introduced so that all of them remain alive for atleast 100 hr when a refreshment is planned ?

- a. 3 b. 4 c. 5 d. 6 e. 7

**Direction for questions 27 to 31:** Answer the questions based on the following information.

A farmer has 100 hectares of land with him which he uses to earn his living. There are two agricultural seasons – from June to October, and December to March. He sows the seeds in the first week of the season and harvests the crops in the last week.

In the first season, he grows rice on 80 per cent of his land and vegetables on the rest. Rice requires a supply of 100 litres of water per hectare per day for 100 days. In addition, every hectare of rice requires 15 kg of urea for the season. At the end of the season, every hectare produces 1,000 kg of rice, but 12 per cent of this is not fit for consumption. The wastage can be reduced by half if he sprays insecticides on the entire land which will cost Rs. 1,500 for the season. The vegetables require only 20 per cent of water and 30 per cent

of urea as compared to rice. But they yield 1,600 kg per hectare, irrespective of whether insecticides have been sprayed or not.

In the second season, he produces wheat on 70 per cent of his land and vegetables on the rest. The wheat requires as much water and urea as the vegetables, but yields only 900 kg per hectare. It is advisable to spray insecticide in this season as wheat is prone to diseases which can destroy the entire crop.

In normal conditions, the following are the prices prevailing in the market.

Rice \_ Rs. 8/kg

Wheat \_ Rs. 6/kg

Vegetables \_ Rs. 11/kg

Urea \_ Rs. 50/kg

Water \_ Re 1 for 100 litres

**27.** What is the difference between the profits from the first and the second season?

- a. Rs. 800
- b. Rs. 760
- c. Rs. 900
- d. Rs. 720
- e. Rs. 880

**28.** What percentage of his profits does he get from vegetables?

- a. 47
- b. 49
- c. 52
- d. 55
- e. 58

**29.** If insecticide is not available in a June-Oct. season, how much does he lose because of that?

- a. Rs. 76,800
- b. Rs. 38,400
- c. Rs. 54,200
- d. Rs. 75,300
- e. Rs. 36,900

**30.** If profit percentage is defined as the profit obtained divided by the sale value of crop, which of the following is the least profitable?

- a. Rice
- b. Wheat
- c. Vegetable

- d. Rice and Wheat put together
- e. Wheat and Vegetable put together

**31.** If the farmer decides to sell his land and invest the money in a deposit yielding eight percent per annum, how much is the minimum amount that he will be willing to settle for, so that his income from the deposit is equal to the profit from the land?

- a. Rs. 22,000,000
- b. Rs. 17,000,000
- c. Rs. 2,500,000

- d. Rs. 24,000,000
- e. Rs. 18,000,000

## Answer Key

### Problems for Practice (Non MCQ)

**1.** 18000 **2.** 50 **3.** Rs. 84000

**4.** Rs. 340 **5.** 400 gm **6.** Rs. 9240

**7.** 33.33% **8.** 19.04% **9.** -3.4%

**10.** Rs. 2000 **11.** 3,00,000 **12.** Rs. 12000

**13.** 20% **14.** 10,080 **15.** a, Rs. 580

**16.** Rs. 1025 **17.** Rs. 215.12 **18.** Rs. 1000

**19.** 20% **20.** Rs. 80000 **21.** -6.67%

**22.** 138.88% **23.** 25% **24.** Rs. 120

**25.** Rs. 1440 **26.** Rs. 500 **27.** 12

**28.** 5 **29.** Rs. 4500 **30.** 80%

**31.** 18.18% **32.** 5.26% **33.** Rs. 432

**34.** Rs. 17.4 **35.**  $\frac{20}{3}\%$  **36.** Rs. 82280

**37.** Rs. 2000 **38.** Rs. 7128.5 **39.** 40 min

**40.** 20% **41.** 10% **42.** Rs. 3300

**43.** Rs. 9,37,500 **44.** Rs. 50000 **45.** 5%

**46.** Rs. 268.3 **47.** 1.0026 **48.** Rs. 100

**49.** Rs. 16 **50.** Rs. 1184.2 **51.** Rs. 1200

**52.** Rs. 50 **53.** Rs. 21.81 **54.** Rs. 0.535

**55.** 20.66% **56.** 14.78% **57.** Rs. 666.66

**58.** 32% **59.** Rs. 270 **60.** Rs. 100

**61.** Rs. 18.75 **62.** 15.38% **63.** 0%

**64.** 11.11% **65.** 33.33% **66.**  $\frac{9}{7}$

**67.** 20 **68.** 10 **69.** 40 : 3

**70.** Rs. 1,00,000 **71.** 8.00% **72.** Rs. 12,000

**73.** Rs. 6.75 **74.** Rs. 20,000 **75.** Rs. 2,250

### Practice Exercise 1 – Level 1

|    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |
|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|
| 1  | d | 2  | a | 3  | e | 4  | b | 5  | c | 6  | d | 7  | a | 8  | b | 9  | c | 10 | d |
| 11 | b | 12 | e | 13 | a | 14 | b | 15 | a | 16 | b | 17 | e | 18 | a | 19 | b | 20 | c |
| 21 | b | 22 | e | 23 | a | 24 | c | 25 | d | 26 | e | 27 | d | 28 | c | 29 | c | 30 | e |

### Practice Exercise 2 – Level 1

|    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |    |   |
|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|----|---|
| 1  | a | 2  | d | 3  | b | 4  | a | 5  | d | 6  | c | 7  | d | 8  | d | 9  | a | 10 | d |
| 11 | d | 12 | c | 13 | b | 14 | a | 15 | d | 16 | d | 17 | d | 18 | d | 19 | a | 20 | b |
| 21 | d | 22 | b | 23 | a | 24 | b | 25 | e | 26 | c | 27 | b | 28 | b | 29 | c | 30 | c |

### Practice Exercise 3 – Level 1

**43:** Rs. 9,37,500 **44:** Rs. 50000 **45:** 5%

**46.** Rs. 268.3 **47.** 1.0026 **48.** Rs. 100

**49.** Rs. 16 **50.** Rs. 1184.2 **51.** Rs. 1200

**52.** Rs. 50 **53.** Rs. 21.81 **54.** Rs. 0.535

**55-20.66% 56-14.78% 57- Rs. 666.66**

58 33% 50 Rs 370 60 Rs 100

61 Rs. 18.75 63 15.28% 63 0%

**64.** 11.11% **65.** 33.33% **66.**  $\frac{9}{7}$

67, 20 68, 10 69, 49; 3

**70.** Rs. 1,00,000 **71.** 8.00% **72.** Rs. 12,000

73. Rs. 6,75,74. Rs. 30,000 75. Rs. 3,350

### Practice Exercise 1 Level 1

|           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| <b>1</b>  | d | <b>2</b>  | a | <b>3</b>  | e | <b>4</b>  | b | <b>5</b>  | c | <b>6</b>  | d | <b>7</b>  | a | <b>8</b>  | b | <b>9</b>  | c | <b>10</b> | d |
| <b>11</b> | b | <b>12</b> | e | <b>13</b> | a | <b>14</b> | b | <b>15</b> | a | <b>16</b> | b | <b>17</b> | e | <b>18</b> | a | <b>19</b> | b | <b>20</b> | c |
| <b>21</b> | b | <b>22</b> | e | <b>23</b> | a | <b>24</b> | c | <b>25</b> | d | <b>26</b> | e | <b>27</b> | d | <b>28</b> | c | <b>29</b> | c | <b>30</b> | e |

### Practice Exercise 2 Level 1

|           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| <b>1</b>  | a | <b>2</b>  | d | <b>3</b>  | b | <b>4</b>  | a | <b>5</b>  | d | <b>6</b>  | c | <b>7</b>  | d | <b>8</b>  | d | <b>9</b>  | a | <b>10</b> | d |
| <b>11</b> | d | <b>12</b> | c | <b>13</b> | b | <b>14</b> | a | <b>15</b> | d | <b>16</b> | d | <b>17</b> | d | <b>18</b> | d | <b>19</b> | a | <b>20</b> | b |
| <b>21</b> | d | <b>22</b> | b | <b>23</b> | a | <b>24</b> | b | <b>25</b> | e | <b>26</b> | c | <b>27</b> | b | <b>28</b> | b | <b>29</b> | c | <b>30</b> | c |

### Practice Exercise 3 Level 1

|           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| <b>1</b>  | d | <b>2</b>  | b | <b>3</b>  | d | <b>4</b>  | a | <b>5</b>  | c | <b>6</b>  | a | <b>7</b>  | b | <b>8</b>  | a | <b>9</b>  | c | <b>10</b> | b |
| <b>11</b> | a | <b>12</b> | b | <b>13</b> | d | <b>14</b> | d | <b>15</b> | b | <b>16</b> | c | <b>17</b> | a | <b>18</b> | d | <b>19</b> | d | <b>20</b> | d |
| <b>21</b> | c | <b>22</b> | a | <b>23</b> | d | <b>24</b> | c | <b>25</b> | c | <b>26</b> | e | <b>27</b> | d | <b>28</b> | a | <b>29</b> | d |           |   |

**Practice Exercise 4 – Level 1**

|           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |           |   |
|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|-----------|---|
| <b>1</b>  | c | <b>2</b>  | a | <b>3</b>  | b | <b>4</b>  | d | <b>5</b>  | c | <b>6</b>  | c | <b>7</b>  | a | <b>8</b>  | a | <b>9</b>  | b | <b>10</b> | c |
| <b>11</b> | c | <b>12</b> | d | <b>13</b> | a | <b>14</b> | d | <b>15</b> | a | <b>16</b> | b | <b>17</b> | d | <b>18</b> | c | <b>19</b> | a | <b>20</b> | d |
| <b>21</b> | a | <b>22</b> | d | <b>23</b> | c | <b>24</b> | b | <b>25</b> | c | <b>26</b> | d | <b>27</b> | d | <b>28</b> | b | <b>29</b> | b | <b>30</b> | c |

### Practice Exercise 5 Level 2

### Practice Exercise 6 Level 2

### Practice Exercise 7 Level 2

## Explanations: Fundamentals of Percentage

### Problems For Practice (Non MCQ)

1. Let  $x$  be the total population.

$$\therefore 0.8x = 72000 \text{ (number of men)}$$

$$x = 90,000$$

$$\therefore \text{Number of women} = 0.2x = 0.2(90,000) = 18,000$$

2. If 20% are absent, it means 80% are present.

$$\therefore 0.8x = 40; x = 50$$

3. Madhu's income = Rs. 12,000 p.m.

She pays 20% tax on Rs. 10,000 = Rs. 2,000

She is now left with Rs.  $(12,000 - 2,000) = \text{Rs. } 10,000$

She spends 30% of it, i.e. Rs. 3,000

She saves, Rs. 7,000 p.m. and therefore  $7,000 \times 12$  annually.

So annual savings = Rs. 84,000

4. Let his income be  $y$ .

After spending 15%, he is left with = 0.85%

$$\text{Now } 0.8 \times 0.85y = 1360 = y = \text{Rs. } 2,000$$

$$\therefore \text{Cost of new shirt} = 0.2 \times 0.85 \times 2000 = \text{Rs. } 340$$

5. Ratio of sand to gravel = 1 : 4

Total mix = 10 kg

$$\therefore \text{Sand} = \frac{1}{5} \times 10 = 2 \text{ kg}$$

20% of sand is impure.

$$\text{So impurity} = \frac{20}{100} \times 2000 \text{ g} = 400 \text{ g}$$

6. An increase of 10% and 20% = A net increase of 32%. Using  $\left[ a+b+\frac{ab}{100} \right]$

$$1.32 \times \text{Last year's income} = \text{Next year's income}$$

$$\therefore \text{Next year's income} = 1.32 \times 7000 = \text{Rs. } 9,240$$

7. Ratio of girls to boys = 4 : 5

Among the girls, ratio of mathematics to physics = 3 : 1

$$\text{Therefore, girls studying mathematics} = \frac{3}{4} \times \frac{4}{9} = \frac{3}{9} = 33.33\%$$

8. Two successive discounts of 8% and 12%

$$= a+b+\frac{ab}{100} = -8-12+\frac{(-8)(-12)}{100} = -19.04\% \quad [\text{Note: } -\text{ve sign implies a discount.}]$$

$$9. \text{Net increase/decrease is given by } a+b+\frac{ab}{100} \Rightarrow 5-8-\frac{5 \times 8}{100} = -3.4\%$$

Therefore, there is a decrease of 3.4% in the price.

10. Let  $x$  be the factory cost.

Then  $1.1 \times 1.08x = 2376$

$$x = 2000 \text{ or } a+b+\frac{ab}{100} = 10+8+\frac{80}{100} = 18.8\%$$

So  $1.188x = 2376$

$x = \text{Rs. } 2,000$

11. Let the present population be  $P$ .

Then  $P(1.2)^2 = 4,32,000$

$$\therefore P = 3,00,000$$

12. Incremental amount paid is the interest on

$$(75000 - 25000) = \text{Rs. } 50,000$$

$$\therefore SI = \frac{50,000 \times 2 \times 12}{100} = \text{Rs. } 12,000.$$

13.  $SI = \text{Same as principal } (A = SI + P = 2P)$

$$P = \frac{P \times 5 \times r}{100} \Rightarrow r = 20\%$$

$$14. SI = A - P = 7560 - 6000 = 1560$$

$$SI = \frac{P \times r \times t}{100} \Rightarrow \frac{6000 \times r \times 2}{100} = 1560$$

$$r = 13\%$$

So Rs. 8,000 will amount to

$$8000 + \frac{8000 \times 13 \times 2}{100} = \text{Rs. } 10,080$$

$$15. a. \frac{20000 \times 12 \times 3}{100} = \text{Rs. } 7,200$$

$$b. [20,000(1.1)^3 - 20,000] = \text{Rs. } 6,620$$

Therefore, option (a) is better than option (b) by Rs. 580.

$$16. 500 = SI$$

$$SI = \frac{P \times r \times t}{100}$$

$$\therefore 500 = \frac{P \times 5 \times 1}{100}$$

$$P = 10,000$$

Now

$$CI = P [(1.05)^2 - 1] = 10000 [(1.05)^2 - 1] = \text{Rs. } 1,025$$

$$17. 220.5 = P [(1.05)^2 - 1]$$

$$P = 2151.2$$

$$SI = \frac{2151.2 \times 5 \times 2}{100} = \text{Rs. } 215.12.$$

$$18. P(1.03)^4 = 1125.5$$

$$P = \text{Rs. } 1,000$$

$$19. A = P \left(1 + \frac{r}{100}\right)^n$$

$$2P = P \left(1 + \frac{r}{100}\right)^n \Rightarrow r = 20\% \text{ (approximately)} \quad [Q. (1.2)^4 = (1.2^2)^2 = (1.44)^2 \approx 2]$$

$$20. CI \text{ for 2 years} = [(1.05)^2 - 1]P$$

$$\text{SI for 2 years} = \frac{P \times 5 \times 2}{100}$$

$$\therefore [(1.05)^2 - 1] P - \frac{P \times 5 \times 2}{100} = 200$$

$$\therefore P = \text{Rs. 80,000}$$

**Alternative method:**

$$(CI)_2 - (SI)_2 = \frac{PR^2}{100^2}$$

$$\frac{P \times 5 \times 5}{100 \times 100} = 200$$

$$P = \text{Rs. 80000}$$

$$21. \text{ Turnover (T)} = \text{Price (P)} \times \text{Number of students}$$

$$\text{New turnover} = 1.12T; \text{ New price} = 1.2P$$

$$\therefore \text{Number of customers} = \frac{1.12P}{1.2T} = 0.933 \text{ (approximately)}$$

$$\text{So change in customers} = 1 - 0.933 = 0.667 \text{ (approximately)}$$

Decrease in number of customers = 6.67%.

$$22. MP = \frac{100 + P\%}{100 - D\%} \times CP$$

$$\text{If } CP = 100, MP = \frac{125}{90} \times CP = \text{Rs. 138.88} \text{ (approximately)}$$

Hence, the marked price is 138.88% of the cost price.

$$23. \text{ Profit} = 20\% \text{ of } 150 = \text{Rs. 30}$$

$$\Rightarrow CP = \text{Rs. 120.}$$

$$\text{Actual profit} = \frac{30}{120} \times 100 = 25\%$$

$$24. 20\% \text{ of MP} = \text{Rs. 30} \Rightarrow MP = \text{Rs. 150}$$

$$\Rightarrow SP = 80\% \text{ of MP} = \text{Rs. 120}$$

$$25. 20\% \text{ of CP} = \text{Rs. 240}$$

$$\Rightarrow 120\% \text{ of CP} = 6 \times 240 = \text{Rs. 1,440}$$

26. If L is the initial loss, it becomes 1.2 L when the selling price is reduced by Rs. 20. Hence, the net loss originally = Rs. 100. Since the selling price is Rs. 400, CP = Rs. 500

**Alternative method:**

$$4\% \text{ of CP} = 20$$

$$CP = \text{Rs. 500}$$

$$27. SP \text{ of 1 toffee} = 10 \text{ paise}$$

$$CP \text{ of 1 toffee} = \frac{10 \text{ paise}}{1.2}$$

$$\Rightarrow \text{For 100 paise, the number of toffees he bought} \left( \frac{100 \text{ paise}}{\frac{10 \text{ paise}}{1.2}} \right) = 12$$

$$28. CP = \frac{100}{6}, SP = \frac{100}{6} \times 1.2 = 20 \text{ paise}$$

$\Rightarrow$  He must sell 5 for a rupee.

$$29. \text{ For the first person, cost price} = \frac{13200}{0.8} = \text{Rs. 16,500}$$

$$\text{For the second person cost price} = \frac{13200}{1.1} = \text{Rs. 12,000}$$

Hence, the difference in the prices at which they purchased it = Rs. 4,500

$$SI = \frac{60500 \times 12 \times 3}{100} = \text{Rs. } 21,780$$

30. Let SP be x. Now by selling it at  $\frac{x}{2}$ , loss = 10%

$$\Rightarrow CP = \frac{x}{2} \times \frac{100}{90} = 0.555x$$

$$= \text{Profit percentage} = \frac{x - 0.555x}{0.555x} \times 100 = 80\%$$

31. For every 11 articles sold, the loss in terms of the number of items = 2

$$\text{Hence, loss percentage} = \frac{2}{11} \times 100 = 18.18\% \text{ (approximately)}$$

$$32. \text{Gain percentage} = \frac{\text{Error}}{\text{True value} - \text{Error}} \times 100 = \frac{5}{95} \times 100 = 5.26\%$$

33. CP of one mango = Rs. 2

For 20% profit, 80 (remaining) mangoes should be sold at Rs. 240 = Rs. 3 per mango

Cost of 1 gross =  $144 \times 3 = \text{Rs. } 432$

$$34. \text{Cost price of 1 kg of mixture} = \frac{80 \times 13.5 + 120 \times 16}{200} = \text{Rs. } 15$$

$$SP = 1.16 \times 15 = \text{Rs. } 17.4$$

35. Had he bought at the par value, then return on investment = 20%

Since he bought at three times par value, return on investment =  $\left(\frac{20}{3}\right)\%$

$$36. A = 50,000(1.1)^2 = \text{Rs. } 60,500$$

Now after 2 more years,

$\therefore$  Total amount = Rs. 82,280

37. Let P be the present value.

$$\text{So } P(1.3)^2 = 3380$$

$$P = \text{Rs. } 2,000$$

38. As the amount is compounded quarterly, interest would be 3% per quarter.

Number of intervals would be  $3 \times 4 = 12$

$$A = 5000 (1.03)^{12} = \text{Rs. } 7,128.5$$

39. Let P be the population of bacteria.

$$2P = P \left(1 + \frac{20}{100}\right)^n \Rightarrow n = 4$$

So number of intervals are 4.

Duration of interval is 10 min.

Total time taken =  $10 \times 4 = 40$  min

40. Since CI for 2 years = Rs. 2,200

$$\text{So } P \left[ \left(1 + \frac{r}{100}\right)^2 - 1 \right] = 2200 \dots (i)$$

Since CI for 3 years = Rs. 3,640

$$\text{So } P \left[ \left( 1 + \frac{r}{100} \right)^3 - 1 \right] = 3640 \dots (\text{ii})$$

$$\frac{(\text{i})}{(\text{ii})} \Rightarrow \frac{\left( 1 + \frac{r}{100} \right)^2 - 1}{\left( 1 + \frac{r}{100} \right)^3 - 1} = \frac{2200}{3640}$$

$$\text{Let } \left( 1 + \frac{r}{100} \right) = x$$

$$\therefore \frac{x^2 - 1}{x^3 - 1} = \frac{2200}{3640} \Rightarrow \frac{x+1}{x^2 + x + 1} = \frac{55}{91}$$

$$\therefore 91x + 91 = 55x^2 + 55x + 55$$

$$= 55x^2 - 36x - 36 = 0$$

$$55x^2 - 66x + 30x - 36 = 0$$

$$(11x + 6)(5x - 6) = 0$$

$$\Rightarrow x = \frac{-6}{11}, \frac{6}{5}$$

As x cannot be negative, so  $x = \frac{6}{5}$

$$\therefore 1 + \frac{r}{100} = 1 + \frac{1}{5}$$

$$\therefore \frac{r}{100} = \frac{1}{5}$$

$$\therefore r = 20\%$$

41. Sharad Mehta's investment in 3 years would  $10 \left( 1 + \frac{g}{100} \right)^3$  crore.

Where g is the average compounded growth rate.

The growth in the stock index = 33.33%.

Hence, the investment must have grown to  
 $10 \times 1.3333$ .

$$\text{Hence, } 10 \left( 1 + \frac{g}{100} \right)^3 = 10 \times 1.3333$$

To find g, we need to use an approximation.

We know that  $(1.1)^3 = 1.331$

$$\text{Hence, } \left( 1 + \frac{g}{100} \right) \approx 1.1$$

So g is approximately equal to 10%.

42. There are three successive increments of 10%, 20% and 25%. Successive increases of 10% and 20% give net increase of  $10 + 20 + \frac{10 \times 20}{100} = 32\%$ .

Further an increase of 25% gives a net increase of

$$25 + 32 + \frac{25 \times 32}{100} = 65\%$$

So initially if the cost of fan was Rs. 2,000 and as there is a net increase of 65% by the end of third year. So its cost at that time will be  $= 2000 \times 1.65 = \text{Rs. } 3,300$

43. Percentage decrease in cost of house after 20 years =  $25 - 25 - \frac{25 \times 25}{100} = 6.25\%$   
decrease.

After 20 years cost will be = 10 lakh - 6.25% of 10 lakh =  $100000 - 62500 = \text{Rs. } 9,37,500$

44. ∵ Net increase of 20% of 25% =  $20 + 25 + \frac{20 \times 25}{100} = 50\%$

$$= SP = \left( \frac{112.5}{100} \right) \times 1052.63 = \text{Rs. } 1,184.21 \text{ (approximately)}$$

If present value is P, so  $1.5 P = 75000$

$$P = \frac{75000}{1.5} = \text{Rs. } 50,000$$

45. CP =  $\frac{100}{75} \times 130 = \frac{4}{3} \times 130 = \frac{520}{3} = \text{Rs. } 173.3$  (approximately)

Profit per cent on new SP =  $\left( \frac{\text{Profit}}{\text{CP}} \right) \times 100 = \frac{182 - 173.33}{173.33} \times 100 = 5\%$

46.  $x \times 1.15 \times 1.08 \times 1.05 = 350 \Rightarrow x = \text{Rs. } 268.3$  (approximately)

47. If x and y be the marked prices, then

$$x \times 0.95 \times 0.85 = y \times 0.92 \times 0.88$$

$$\Rightarrow \frac{x}{y} = 1.0026$$

48. If CP = Rs. 100, then MP = Rs. 110 and after a 5% discount = SP = Rs. 104.5

If MP = Rs. 90, SP =  $0.95 \times 90 = \text{Rs. } 85.5$

Difference =  $104.5 - 85.5 = \text{Rs. } 19$

Hence, cost price = Rs. 100.

49.  $P \times Q = 0.8P \times (Q + 2.5) = 160 \Rightarrow P = 16$

50.  $7 + 2.5 = 9.5$ , 9.5% of CP = Rs. 100

$$= CP = \frac{100}{9.5} \times 100 = \text{Rs. } 1,052.63 \text{ (approximately)}$$

51. If CP = x, then

$$(1060 - x) = 1.2(x - 950)$$

$$= 5(1060 - x) = 6(x - 950)$$

$$5300 - 5x = 6x - 5700$$

$$\Rightarrow 11x = 11000$$

$$\Rightarrow x = 1000$$

For 20% profit, SP = Rs. 1,200

52. Let CP be x, then profit = x%.

$$\text{We have } x \left( 1 + \frac{x}{100} \right) = 75 \Rightarrow x = 50$$

∴ CP is Rs. 50

$$53. CP = 20 \times \frac{100}{110}$$

$$SP = 20 \times \frac{100}{110} \times \frac{120}{100} = 21.81 \text{ (approximately)}$$

54. Let P be the original price per egg and Q be the quantity bought for Rs. 10. Then

$$10 = P \times Q = 0.8P \times (Q + 56)$$

$$\Rightarrow \frac{Q + 56}{Q} = \frac{1}{0.8} = 0.8Q + 56 \times 0.8 = Q$$

$$= 56 \times 0.8 = 0.2Q \Rightarrow Q = 56 \times 4 = 224$$

Now  $10 = P \times 224 \Rightarrow$  Price for  $12 = \frac{10}{224} \times 12 = \text{Rs. } 0.535$

55. The average profit percentage = Net profit percentage  $= \frac{\frac{21 \times \frac{1}{3} + 20 \times \frac{3}{5} + 25 \times \left[1 - \frac{1}{3} - \frac{3}{5}\right]}{1}}{1}$

$$= 7 + 12 + 1.66 = 20.66\%$$

56. If the earlier CP = 100, earlier SP = 110, now SP =  $110 \times 1.2 = 132$

$$\text{New CP} = \left(\frac{100}{115}\right) \times 132 = \text{Rs. } 114.78 \text{ (approximately)}$$

$$\Rightarrow \text{Percentage increase in CP} = 14.78\% \text{ (approximately)}$$

57. If original CP =  $x$ , original SP =  $1.15x$ , now SP =  $1.15x \times 1.1$

$$\text{Now CP} = \frac{100}{110} \times 1.15x \times 1.1 = 1.15x$$

We have increase in CP =  $1.15x - x = 100$

$$\Rightarrow 0.15x = 100$$

$$\Rightarrow x = \text{Rs. } 666.66 \text{ (approximately)}$$

58. Assume Ganguram had 10 L of pure milk. It is worth Rs. 100. In the first stage, he increased the volume by adding 20% of 10 L, i.e. 2 L of water. So the milk solution became 12 L. In the second stage, he increased this volume by 10%. So the final milk solution had a total volume of  $1.1 \times 12 = 13.2$  L.

If Ganguram sells 13.2 L of milk solution at Rs. 10 per litre, his revenue is Rs. 132.

Cost = Rs. 100. Hence, he makes a 32% profit.

### Alternative method:

Two successive changes of 20% and 10% is equal to net change of  $= 20 + 10 + \frac{20 \times 10}{100} = 32\%$

This is the final profit percentage he makes as he sells the milk at the cost price.

59. In the first case, the CP =  $\frac{100}{130} \times 3900 = \text{Rs. } 3,000$

$$\Rightarrow \text{Profit} = \text{Rs. } 900$$

In the second case, margin = 30%

$$= \frac{\text{Profit}}{\text{SP}} \times 100 = 30\%$$

$$= \frac{\text{Profit}}{3900} \times 100 = 30 \Rightarrow \text{Profit} = \text{Rs. } 1,170$$

Difference in profits = Rs. 270

60. 80% of MP = Rs. 1,000. 1% = Rs. 12.5

At the other shop, he would have fallen short by 8% of the marked price  $= 8 \times 12.5 = \text{Rs. } 100$ .

61. SP of 25 chairs = CP of 25 chairs + Profit on 25 chairs

$$= \text{SP of 25 chairs} = \text{Rs. } 375 + \text{SP of 5 chairs}$$

$$= \text{SP of 20 chairs} = \text{Rs. } 375$$

$$= \text{SP of 1 chair} = \frac{375}{20} = \text{Rs. } 18.75$$

62. If he sells 6 L at the rate of Rs. 5 per litre, then milk = 5 L, Bisleri = 1 L

$$\Rightarrow \text{CP} = 5 \times 5 + 1 \times 1 = \text{Rs. } 26$$

$$\text{SP} = 6 \times 5 = \text{Rs. } 30$$

$$\text{Profit} = \frac{4}{26} \times 100 = 15.38\%$$

63. Suppose the CP for 1 m = Re. 1

Now he sells 1.1 m for Rs. 1.1

$\Rightarrow$  No profit no loss.

64. In summers he sells 99 cm and charges for 100 cm When he sells 99 cm, he charges Rs. 1.1

$\Rightarrow$  When sells 100 cm, he must be charging

$$\frac{100}{99} \times 1.1 = \text{Rs. } 1.111 \text{ (approximately)}$$

$\Rightarrow 11.11\%$  profit (approximately)

65. Suppose the cost of one unit is Re. 1.

Then on charging for 0.9 units (even if the actual weight is 1 unit), he must be earning a revenue of Rs. 1.2.

Hence, the mark-up = 33.33% (approximately).

66. If the shares are bought in the ratio x and y, then net profits on each is  $140x$  and  $180y$ .

$$\text{So if profits are same, } 140x = 180y \text{ or } \frac{x}{y} = \frac{18}{14} = \frac{9}{7}$$

67. Let us assume that he has Rs. 100. In this he can buy 50 oranges or 40 mangoes. In other words the price of an orange is Rs. 2 and that of a mango is Rs. 2.50. Now if he

decides to keep 10% of his money for taxi fares, he would be left with Rs. 90. Now if he buys 20 mangoes, he would spend Rs. 50 and will be left with Rs. 40, in which he can buy 20 oranges.

68. Since, I paid Rs. 20 and because of lack of change, the clerk gave me 3 rupees worth of stamps, it can be concluded that the total value of the stamps that I wanted to buy = Rs. 17. Since, I ordered initially a minimum of 2 stamps of each denominations, if I buy exactly 2 stamps each my total value is  $2(5 + 2 + 1) = \text{Rs. } 16$ . The only way in which I make it Rs. 17 is buying 1 more stamp of Re. 1. Hence, the total number of stamps that I ordered =  $(2 + 2 + 3) = 7$ . In addition the clerk gave me 3 more. Hence, the total number of stamps that I bought =  $(7 + 3) = 10$  (viz., 2 of Rs. 5, 2 of Rs. 2 and 6 of Re. 1).

69. Ratio of investments = 4 : 1

Ratio of market price = 3 : 1

Hence, ratio of the number of shares bought =  $\frac{4}{3} : 1$  or 4 : 3

Ratio of dividends in monetary value =  $2 \times 5 : 1 \times 1 = 10 : 1$

Hence, the ratio of incomes = 40 : 3

#### For questions 70 to 72:

Let the received amount be Rs. x. According to the information, we have the following equations.

When 25% profit is realised, we have  $x + \frac{1}{4}x = y$

When 20% loss is incurred, we have  $y - \frac{1}{5}y = z$

When 20% profit is incurred, we have  $z + \frac{1}{5}z = w$

When 10% loss is incurred, we have  $w - \frac{1}{10}w = 108000$

$$W = 120000$$

Thus,  $z = 100000$ ,  $y = 125000$

and  $x = 100000$

73. Meter Reading = 53 paise

Next higher multiple of 4 = 56 paise

$$56 \times 12 = 672 \text{ paise}$$

672 paise rounded up to nearest multiple of 25 paise = Rs. 6.75

74. Let pre-budget price of TV be Rs. 100.

$$\text{Decrease in profit} = (100 - 95) - (110 - 108) = 3$$

When decrease in profit = 3, pre-budget price = 100

So, when decrease in profit = 3, pre-budget price  $600 = 100/3 \times 600 = \text{Rs. } 20,000$ .

75. Post-budget price = Rs. 22,000

$$\text{Post-budget selling expenses} = \frac{22000}{110} \times 15 = 3000$$

$$\therefore \text{Dealer's margin} = \frac{3000 \times 75}{100} = \text{Rs. } 2,250.$$

### Practice Exercise 1 – Level 1

$$1. d 18\frac{3}{4}\% \text{ of } 2000 = \frac{75}{4} \times \frac{2000}{100} = 375$$

**Alternative method:**

$$18\% \text{ of } 2000 + \frac{3}{4}\% \text{ of } 2000 = 375$$

$$2. a \frac{26}{48} = \frac{13}{24} \times 100 = 54.16\%$$

$$3. e 33\frac{1}{3}\% \text{ of } 972 = \frac{1}{3} \times 972 = 324$$

$$4. b \frac{37}{60} \times 100 = 61.66\%$$

$$5. c \text{ Percentage increase} = \frac{\text{Final Value} - \text{Initial Value}}{\text{Initial Value}} \times 100 = \frac{7475 - 6500}{6500} = \frac{975}{6500} \times 100 = 15\%$$

$$6. d 90\% \text{ of } 90\% \text{ of } 100 = 90\% \text{ of } 90 = 81$$

$$7. a 1 \text{ hour} = 60 \text{ min}$$

$$\therefore \frac{50}{60} \times 100 = 83.33\%$$

$$8. b A's \text{ income} = 1.25 \text{ of } B's \text{ income}$$

$$B's \text{ income} = \frac{1}{1.25} \text{ of } A's \text{ income.} = 80\% \text{ of } A's \text{ income.}$$

$$9. c 40\% \text{ of } 200 = 80$$

He obtained 72, i.e. he failed by 8 marks.

$$\text{Percentage by which he failed} = \frac{8}{200} = 4\%$$

$$10. d \text{ In } 50 \text{ L, } 35\% \text{ is water i.e. } \frac{35}{100} \times 50 = 17.5 \text{ L.}$$

So, quantity of milk =  $50 - 17.5 = 32.5 \text{ L.}$

$$11. b \text{ If } A \text{ is increased by } 10\%, \text{ i.e. } A_1 = 1.1A$$

$$\therefore A_1^2 = (1.1)^2 A = 1.21A^2$$

$\therefore$  A increases by 21%

12. e A is  $\left(\frac{15}{9}\right) \times 100\%$  of  $\left(\frac{9A}{15}\right)$  i.e. 166%

13. a Length becomes 0.9L

Breadth become 0.9B

$$\text{Area} = 0.9L \times 0.9B = 0.81LB$$

$\therefore$  Area decreases by 19%

14. b 30% of 55% of 100 = 30% of 55 = 16.5

15. a (a) 66%, (b)  $\frac{3}{5} = 60\%$  (c) 0.65 = 65%, (d)  $\frac{16}{25} = 64\%$  (e)  $\frac{7}{11} = 63.63\%$

16. b After 20% increase,

$$\text{Men} = 2500 \times 1.2 = 3000$$

After 20% decrease

$$\text{Women} = 2500 \times 0.8 = 2000$$

So, women as a percentage of men =  $\frac{2000}{3000} = 66.67\%$

17. e Let the original fraction =  $\frac{x}{y}$

$$\therefore \frac{x+25\% \text{ of } x}{y-20\% \text{ of } y} = \frac{5}{4}, \frac{1.25x}{0.8y} = \frac{5}{4} = \frac{x}{y} - \frac{4}{5}$$

18. a In 1 kg pack, ghee is 10%, i.e. 100 g

So, in 2 kg, ghee will be 200 g

19. b Let original salary = Rs. 100

$$\text{Now final salary} = 150\% \text{ of } (50\% \text{ of } 100) = \left(\frac{150}{100} \times \frac{50}{100} \times 100\right) = \text{Rs. } 75$$

Decrease = 25%

20. c 20% increase for 2 consecutive years =  $20 + 20 + \frac{400}{100} \{a + b + \frac{ab}{100}\} = 44\%$

New population after 2 years =  $2500 \times 1.44 = 3600$ .

**Short cut:**

$$\text{Population after 2 years} = 2500(1.2)^2$$

21. b Let 37% of x = 990.86. Then,

$$\frac{37}{100} \times x = 990.86$$

$$\text{or, } x = \frac{990.86 \times 100}{37} = \frac{99086}{37} = 2678.$$

$$\text{Now, } 19\% \text{ of } 2678 = \frac{19}{100} \times 2678 = 508.82$$

or, 500 approx.

**Alternative method:**

$$\text{Since } 37\% \text{ of a number} = 990.86 \text{ then, } 18.5\% \text{ of a number} = \frac{990.86}{2} = 495.43$$

Hence, 19% of a number would be near to 500, only one option (b) is close.

22. e Loss percentage =  $\frac{4}{20} = \frac{1}{5} = 20\%$

23. a If  $X = 120\%$  of  $Y$ , then  $Y = \frac{100}{120}$  of  $X = 83.33\%$  of  $X$ .

$$\therefore \text{Percentage error} = \left( \frac{3}{2} \times \frac{2}{75} \times 100 \right) - 4\% = 4\%$$

24. c Price of rice after 15% increase =  $1.15 \times 15 = \text{Rs. } 17.25$

After 30 paise reduction, price = Rs 16.95

$$\text{Net increase} = \frac{16.95 - 15}{15} \times 100 = 13\%$$

#### Alternative method:

Since 30 paise is equivalent to 2% of Rs. 15. Hence, net increase would be close to  $(15 - 2) = 13\%$

25. d Let the number be  $n$ , then 20% of  $n - 16\%$  of  $n = 16$

$$0.2n - 0.16n = 16 \text{ or } 0.04n = 16 \Rightarrow n = 400$$

26. e Since sales = Quantity  $\times$  Price [or  $S = Q \times P$ ]

$$1.28S = Q \times 0.8P \text{ or } Q = \frac{1.28S}{0.8P} = \frac{1.6S}{P}$$

Hence, no. of units sold increased by 60%.

27. d If a number is  $N$ , then  $(43 - 28)\% \text{ of } N = 75$

$15\% \text{ of } N = 75$ . Hence,  $30\% \text{ of } N = 150$ .

28. c A student failed by 15%, i.e. he has got only 30%.

So, 30% of total marks = 138

$$\therefore \text{Total marks} = \frac{1380}{3} = 460$$

$$29. \text{c Error} = \left( 37\frac{1}{2}^\circ - 36^\circ \right) = 1\frac{1}{2}^\circ$$

30. e  $M + 60 = 50\% \text{ of } K$ . Clearly,  $M$  cannot be determined.

#### Practice Exercise 2 – Level 1

1. a Let A's salary =  $x$ . Then, B's =  $(2000 - x)$

$$5\% \text{ of } A = 15\% \text{ of } B, \text{ i.e. } \frac{5}{100}x = \frac{15}{100}(2000 - x) \text{ or } x = 1500$$

$$2. \text{d } A = \frac{90}{100}B, B = \frac{125}{100}C \text{ and } C = \frac{80}{100}D$$

$$B = \frac{10}{9}A, C = \frac{4}{5}B \text{ and } D = \frac{5}{4}C$$

$$B = \frac{10}{9} \times 360 = 400, C = \frac{4}{5} \times 400 = 320 \text{ and } D = \frac{5}{4} \times 320 = 400$$

$$\text{Percentage of } D = \left( \frac{400}{500} \times 100 \right)\% = 80\%$$

3. b Let the total number of students be  $x$ .

Number passed in one or both is given by

$$n(A \cup B) = n(A) + n(B) - n(A \cap B) = 80\% \text{ of } x + 85\% \text{ of } x - 75\% \text{ of } x$$

$$= \left( \frac{80}{100}x + \frac{85}{100}x - \frac{75}{100}x \right) = \frac{90}{100}x = \frac{9x}{10}$$

$$\text{Failed in both} = \left( x - \frac{9x}{10} \right) = \frac{x}{10}$$

$$\frac{x}{10} = 40 \text{ or } x = 400$$

4. a  $p = 6q$ . So,  $q$  is less than  $p$  by  $5q$ .

Note that q has been compared with p.

$$\text{Required percentage} = \left( \frac{5q}{p} \times 100 \right) \% = \left( \frac{5q}{6q} \times 100 \right) \% = 83\frac{1}{3}\%$$

5. d Let the valid votes be x.

Then, 52% of x - 48% of x = 98 = 4% of x = 98.

$$\therefore \frac{4}{100}x = 98 \text{ or } x = 98 \times 25 = 2450.$$

$$\therefore \text{Total votes polled} = (2450 + 68) = 2518.$$

6. c Let original consumption be 1 unit costing Rs. 100.

New cost = Rs. 125.

$$\text{New consumption} = \left( \frac{1}{125} \times 100 \right) - \frac{4}{5} \text{ unit}$$

$$\frac{\text{Reduction in consumption}}{\text{Original consumption}} = \frac{\left(1 - \frac{4}{5}\right)}{1} = \frac{1}{5}, \text{ i.e. } 1 : 5$$

$$7. d \text{ Net growth on } 1000 = (32 - 11) = 21$$

$$\text{Net growth on } 100 = \left( \frac{21}{1000} \times 100 \right) = 2.1\%$$

8. d Let length = l and breadth = b

Area =  $l \times b$ , if new dimensions of breadth =  $b_1$ , then

$$A \Rightarrow l \times b = 1.6 \times b_1 \text{ or } b_1 = \frac{b}{1.6} \text{ or, } b_1 = 0.625b$$

Hence, breadth would decrease by  $b - 0.625b = 0.375b$  or 37.5%

9. a In a class of 300 students, Boys = 200, Girls = 100

50% Boys = 100, 48% Girls = 48

Total students who appeared = 148.

152 did not appear.

10. d 20% solution of sugar means  $\frac{1}{5}$ th of sugar

In 5 L of solution, 1 L is sugar and 4 L is water.

After adding 1 L of water, Percentage of sugar =  $\frac{1}{6} = 16.67\%$

11. d Suppose he had Rs. 100. He invested Rs. 40 in shares. Out of remaining Rs. 60, he invested

Rs. 12 in property. Out of the remaining Rs. 48, he lost Rs. 12 at a casino. He was left with Rs. 36, i.e. 36%.

12. c Let the winner get 'x' votes.

$\therefore$  The loser got  $(x - 60)$  or  $\frac{2}{3}x$  votes.

$$\therefore \frac{2x}{3} = (x - 60)$$

$\therefore x = 180$ , i.e. the winner got 180 votes and the loser got 120 votes.

$$13. b 180 + 120 = 300$$

$$14. a \frac{180}{300} = \frac{6}{10} = \frac{3}{5} = 60\%$$

15. d If S.P. = 121, P = 10%

$$C.P. = \frac{121 \times 100}{110} = 110$$

If S.P. is reduced by 11

$$\text{New S.P.} = 121 - 11 = 110$$

Hence, no profit no loss.

16. d After giving a discount of 10%, the merchant makes a profit of 8%.

$$S.P. = M.P. - 10\% \text{ of M.P.}$$

$$S.P. = 0.9 \text{ M.P.}$$

$$\text{Also } S.P. = 1.08 \text{ C.P.} = 0.9 \text{ M.P.}$$

$$\text{So, } \frac{M.P.}{C.P.} = 1.2, \text{ i.e., M.P. is 20\% more than C.P.}$$

17. d 30% on petrol = Rs. 300.

Hence, total sum = Rs. 1,000

$$\frac{1}{4}\text{th of the remaining } 70\% = \frac{1}{4}\text{th of } 700 = 175$$

$$18. d \quad \begin{aligned} x\% \text{ of } a &= y\% \text{ of } b \Rightarrow \frac{x}{100}a = \frac{y}{100}b \\ \Rightarrow b &= \left(\frac{x}{100} \times \frac{100}{y}\right)a = \left(\frac{x}{y}\right)a \end{aligned}$$

$$z\% \text{ of } b = \left(z\% \text{ of } \frac{x}{y}\right)a = \left(\frac{xz}{y \times 100}\right)a = \left(\frac{xz}{y}\right)\% \text{ of } a$$

19. a Let original consumption = 100 units and original price = Rs. 100/unit

$$\text{Original expenditure} = \text{Rs. } (100 \times 100) = \text{Rs. } 10,000$$

$$\text{New expenditure} = \text{Rs. } (120 \times 75) = \text{Rs. } 9,000$$

$$\text{Decrease in expenditure} = \left(\frac{1000}{10000} \times 100\right)\% = 10\%$$

$$20. b \text{ Basic rate} = \text{Rs. } \frac{20}{40} \text{ per hr} = 50\text{p per hr}$$

$$\text{Overtime rate} = 1.25 \times 50\text{p} = 62.5\text{p per hr.} = \text{Rs. } \frac{5}{8} \text{ per hr.}$$

Let overtime hour = x

$$\text{Then, } \frac{5}{8}x = 5 \Rightarrow x = \frac{5 \times 8}{5} = 8 \text{ hr}$$

So, he worked for (40 + 8) hr = 48 hr

$$21. d \text{ Interest} = \frac{3500 \times 5 \times 5}{100} = \text{Rs. } 875$$

$$\text{Amount} = P + I = 3500 + 875 = \text{Rs. } 4375$$

$$22. b \text{ } 2P = \frac{P \times 20 \times t}{100}, t = 10 \text{ years}$$

$$23. a \text{ C.I.} = P \left[1 + \frac{r}{100}\right]^3 - P = 1000 [1.1]^3 - 1000 = 1331 - 1000 = 331$$

$$24. b \text{ C.I.} = 1010 = P \left(1 + \frac{2}{100}\right)^2 - P$$

$$1010 = P[(1.02)^2 - 1] = 0.0404 P$$

Or, P = Rs. 25,000

25. e Nothing is said about C.I. or S.I.

$$26. c T = \frac{9 \times 100 \times 4}{36 \times 25} = 4 \text{ years}$$

27. b  $\frac{400 \times 8 \times 5}{100} = \text{Rs. } 160$

28. b  $r = \frac{9 \times 100}{1 \times 50} = 18\%$

29. c  $\frac{500 \times R_1 \times 2}{100} - \frac{500 \times R_2 \times 2}{100} = 2.50 \text{ or } 1000 (R_1 - R_2) = 250$

$$R_1 - R_2 = \frac{250}{1000} = \frac{1}{4} = 0.25\%$$

30. c C.I. for 3 years =  $700 \left[ 1 + \frac{10}{100} \right]^3 - 700 = 231.7$

S.I. for 3 years =  $\frac{700 \times 10 \times 3}{100} = 210$

$\therefore \text{C.I.}_3 - \text{S.I.}_3 = 21.7$

### Practice Exercise 3 – Level 1

1. d S.I. =  $\frac{P}{4}$

$$\therefore \frac{P}{4} = \frac{P \times r \times t}{100}$$

Also  $r = t$ ,  $\therefore r^2 = \frac{100}{4}$ ,  $r = \frac{10}{2} = 5\%$

2. b  $154 = \frac{P \times 5 \times 2}{100}$  or  $P = \text{Rs. } 1540$

3. d  $\frac{1500}{1 + \frac{6.25 \times 4}{100}} = 1200$

4. a After 8 month worth of Rs. 400 @ 15% would be  $(400 + \frac{2}{3} \times 15 \times \frac{400}{100}) = \text{Rs. } 440$ , but he sold at Rs. 460, i.e. a profit of Rs. 20 on Rs. 440.

Hence, gain percentage =  $\frac{20}{440} \times 100 = 4.54\%$

5. c (I)  $\text{S.I.} = \frac{5000 \times 3 \times 11}{100} = \text{Rs. } 1650$

(II) C.I. =  $5000 \left( 1 + \frac{10}{100} \right)^3 - 5000 = \text{Rs. } 1,655$

### Short cut:

Effective rate at S.I. and C.I. = 33 % and 33.1% respectively.

6. a Let the sum be Rs. x and original rate be R%. Then,

$$\frac{x \times (R+3) \times 2}{100} - \frac{x \times R \times 2}{100} = 72 \text{ or } 2Rx + 6x - 2Rx = 7200 \text{ or } x = 1200$$

### Alternative method:

If principal in P, the difference of Rs. 72 is equivalent to 3% for 2 years, i.e.  $(3\% \times 2)P = 72$

$$= \frac{72}{6} \times 100 = \text{Rs. } 1200$$

7. b Let sum = x. Then, S.I. = x

$$\text{Rate} = \left( \frac{100 \times x}{x \times 8} \right)\% = 12\frac{1}{2}\%$$

8. a  $\left( \frac{2000 \times 8 \times 1}{100} \right) + \left( 4000 \times \frac{15}{2} \times \frac{1}{100} \right) + \left( 1400 \times \frac{17}{2} \times \frac{1}{100} \right)$

$$+ 2600 \times R \times \frac{1}{100} = \frac{813}{10000} \times 10000$$

Or,  $160 + 300 + 119 + 26R = 813$  or  $R = 9$

9. c Let the sum be x. Then,

$$\text{C. I.} = x \left(1 + \frac{5}{100}\right)^2 - x = \left(\frac{44x}{400} - x\right) = \frac{41x}{400}$$

$$\text{S. I.} = \frac{x \times 10 \times 1}{100} = \frac{x}{10}$$

$$(\text{C.I.}) - (\text{S.I.}) = \frac{41x}{400} - \frac{x}{10} = \frac{x}{400}$$

$$\therefore \frac{x}{400} = 25 \text{ or } x = 10000$$

$$10. \text{ b C.I.} = \text{Rs.} \left[ 800 \times \left(1 + \frac{10}{100}\right)^2 - 800 \right] = \text{Rs.} 168$$

$$\text{S.I.} = \text{Rs.} \left( \frac{800 \times 10 \times 2}{100} \right) = \text{Rs.} 160$$

$$\text{Gain} = (\text{C. I.}) - (\text{S.I.}) = \text{Rs.} (168 - 160) = \text{Rs.} 8$$

$$11. \text{ a Interest on Rs.} 4624 \text{ for 1 year} = 4913 - 4624 = 289$$

$$\therefore \text{Rate} = \frac{289}{4624} = \frac{25}{4} \%$$

$$\text{Now, if principal amount is } x \left(1 + \frac{25}{4 \times 100}\right)^2 = 4624 \text{ or } x \times \frac{17}{16} \times \frac{17}{16} = 4624$$

$$\therefore x = \left(4624 \times \frac{16}{17} \times \frac{16}{17}\right) = \text{Rs.} 4096$$

$$12. \text{ b } 12000 \times \left(1 + \frac{R}{100}\right)^5 = 24000 \Rightarrow \left(1 + \frac{R}{100}\right)^5 = 2$$

$$\therefore \left[\left(1 + \frac{R}{100}\right)^5\right]^4 = 2^4 = 16 \text{ or } \left(1 + \frac{R}{100}\right)^{20} = 16$$

$$\text{Or, } P \left(1 + \frac{R}{100}\right)^{20} = 16P$$

$$\text{Or, } 12000 \left(1 + \frac{R}{100}\right)^{20} = 16 \times 12000 = 192000$$

$$13. \text{ d } P \left(1 + \frac{20}{100}\right)^n > 2P \Rightarrow (1.2)^n > 2$$

Here, pick up the value of n and check the condition, it follows for n = 4.

$$14. \text{ d Increase percentage} = \left(\frac{1}{8} \times 100\right)\% = 12\frac{1}{2}\%$$

$$\text{Height after 2 years} = \left[ 64 \times \left(1 + \frac{25}{2 \times 100}\right)^2 \right] \text{ cm} = \left(64 \times \frac{9}{8} \times \frac{9}{8}\right) \text{ cm} = 81 \text{ cm}$$

$$15. \text{ b } 1200 \times \left(1 + \frac{R}{100}\right)^2 = 1348.32 \text{ or } \left(1 + \frac{R}{100}\right)^2 = \frac{134832}{12000} = \frac{11236}{10000}$$

$$\therefore \left(1 + \frac{R}{100}\right)^2 = \left(\frac{106}{100}\right)^2 \text{ or } 1 + \frac{R}{100} \text{ or } R = 6\%$$

$$16. \text{ c Interest on Rs.} 800 \text{ for 1 year} = \text{Rs.} (840 - 800) = \text{Rs.} 40$$

$$\therefore \text{Rate} = \left(\frac{100 \times 40}{800 \times 1}\right)\% = 5\%$$

$$17. \text{ a S.I. For 1st year} = \frac{360}{3} = 120 = \text{C.I. for 1st year}$$

$$\text{C.I. for 2 years} = 270 = 120 + \text{C.I. for 2nd year}$$

$$\text{C.I. for 2nd year} 270 - 120 = 150$$

$$\text{Difference between CI and SI in 2nd year} = 150 - 120 = 30.$$

$$\text{Hence, rate of interest} = \frac{30}{120} \times 100 = 25\%$$

$$18. \text{ d } \frac{400 \times 3 \times r}{100} + \frac{600 \times 3 \times r}{100} = 90$$

$30r = 90$

$r = 3\%$

19. d C.I. =  $203 = P \left(1 + \frac{3}{100}\right)^2 - P$

$203 = P[(1.03)^2 - 1]$

or  $P = \frac{203}{0.069} = \text{Rs. } 3,333$

S.I. =  $\frac{P \times R \times T}{100} = \frac{3333 \times 3 \times 2}{100} = \text{Rs. } 200$

**Short cut:**

S.I. must be less than C.I.

20. d Let the sum at 5% be Rs. x. Then,

$$\frac{x \times 5 \times 3}{100} + \frac{(1550 - x) \times 8 \times 3}{100} = 300 \text{ or } x = 800$$

$$\frac{\text{Money at } 5\%}{\text{Money at } 8\%} = \frac{800}{(1550 - 800)} = \frac{800}{750} = \frac{16}{15}$$

21. c Let total capital be x, then,

$$\left(\frac{x}{3} \times \frac{7}{100} \times 1\right) + \left(\frac{x}{4} \times \frac{8}{100} \times 1\right) + \left(\frac{5x}{12} \times \frac{10}{100} \times 1\right) = 561$$

$$\text{Or, } \frac{7x}{300} + \frac{x}{50} + \frac{x}{24} = 561$$

$$\text{Or, } x = \left(\frac{561 \times 600}{51}\right) = \text{Rs. } 6,600$$

22. a Let these parts be x, y and z.

Assume x be the largest and z be the smallest part. Hence, by the simple interest formula,  
 $(1.04)x = (1.08)y = (1.12)z$  and  $x + y + z = 2189$

Solving the above equation,  $z = 703$

23. d Sum =  $\text{Rs. } \left(\frac{100 \times 1200}{3 \times 5}\right) = \text{Rs. } 8,000$

$$\text{Amount} = \text{Rs. } \left[8000 \times \left(1 + \frac{5}{100}\right)^3\right] = \text{Rs. } \left(8000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20}\right) = \text{Rs. } 9,261$$

$\therefore \text{C.I.} = \text{Rs. } (9261 - 8000) = \text{Rs. } 1,261$

24. c Number of days in (March + April + May)

$$= 31 + 30 + 21 = 74 \text{ days} = \frac{74}{365} \text{ year} = \text{years (approx.)}$$

$$\therefore \text{Interest} = \text{Rs. } \left(1820 \times \frac{1}{5} \times \frac{7.5}{100}\right) = \text{Rs. } 27.30$$

25. c 3 Balls = 2 Pads, 3 Pads = 2 Gloves

3 Gloves = 2 Bats, Bat =  $\text{Rs. } 54$

$$\text{Glove} = \frac{2}{3} \times 54 = \text{Rs. } 36 \text{ Pad} = \frac{2}{3} \times 36 = \text{Rs. } 24 \text{ Ball} = \frac{2}{3} \times 24 = \text{Rs. } 16$$

26. e Nothing is mentioned about the number of books.

27. d C.P. of 20 articles = S.P. of 15 articles

$$\text{S.P. of 15} = \text{C.P. of 15} + \text{C.P. of 5}$$

S.P. = C.P. + Profit

$$\therefore \text{Profit} = \frac{5}{15} \times 100 = 33.33\%$$

28. a Let C.P. = x, Then,

$$S.P. = \frac{4x}{3} \text{ Gain} = \left( \frac{4x}{3} - x \right) = \frac{x}{3}$$

$$\therefore \text{Gain percentage} = \left( \frac{x}{3} \times \frac{1}{x} \times 100 \right) = 33\frac{1}{3}\%$$

$$29. d \text{ Gain percentage} = \frac{100}{900} \times 100 = 11.11\%$$

#### Practice Exercise 4 – Level 1

1. c If he uses a weight of x gm, then profit percentage =  $\frac{1000-x}{x} \times 100$ , which is equal to

$$6\frac{18}{47}\%$$

Therefore, x = 940 gm

$$2. a S.P._1 = S.P._2 = \text{Rs. } 4,000$$

$$\text{Gain}_1 = 25\%, \text{Loss}_2 = ?$$

$$C.P._1 = 4000 \times \frac{100}{125} = \text{Rs. } 3,200$$

$$\therefore C.P._2 = \text{Rs. } (8000 - 3200) = \text{Rs. } 4,800 \quad (\text{Q Total S.P.} = \text{Total C.P.})$$

$$\text{Therefore, loss percentage} = \frac{800}{4800} \times 100 = 16.66\%$$

3. b When S.P. of two articles is same; one is sold at a loss of x% and other at a gain of x% then there, is always an overall loss, given by  $\frac{x^2}{100}$ % and the absolute loss

$$\text{Rs. } \frac{2x^2}{100^2 - x^2} \times \text{S.P.} = \frac{2 \times 20 \times 20 \times 12000}{10000 - 400} = \text{Rs. } 1000.$$

4. d 30%, 20%, 10% successive discounts.

(Considering 1 and 2) :

$$\text{Discount} = -30 - 20 + \frac{600}{100} = -44\%$$

Considering (1 and 2) and 3 :

$$\text{Discount} = -44 - 10 + \frac{440}{100} = -49.6\%$$

#### Alternative method:

$$0.7 \times 0.8 \times 0.9 = 0.504 = 50.4\%.$$

$$\text{Therefore, } 100 - 50.4 = 49.6\%$$

5. c 36% and 4% successive discounts equal to

$$-36 - 4 + \frac{144}{100} = -38.56\%$$

$$\text{Difference} = 40 - 38.56 = 1.44\%$$

$$\therefore 1.44\% \text{ of } 500 = \text{Rs. } 7.2$$

$$6. c M.P. = C.P. \cdot \frac{(100 + \text{Profit percentage})}{(100 - \text{Discount percentage})}$$

$$M.P. = C.P. \times \frac{133}{95} = 1.4 \text{ C.P.}$$

$\therefore 40\%$  above the C.P.

$$7. a \text{ Net discount} = -20 - 10 + \frac{200}{100} = 28\%$$

$$S.P. = M.P. \cdot \frac{(100 - \text{Discount}\%)}{100}$$

$$108 = M.P. \times \frac{72}{100}, M.P. = \text{Rs. } 150$$

8. a If C.P. of tea is Re. 1 per gram, then he is receiving Rs. 1,000 for something which is worth Rs. 900.

$$S.P. = C.P. \frac{(100 + \text{Gain percentage})}{100}$$

But he gives a discount of 10% on Rs. 1000, i.e. sells at Rs. 900.

$$S.P. = \frac{5}{12} \times \frac{120}{100} = \text{Rs. } \frac{1}{2} \text{ per banana}$$

9. b S.P. of 16 books = C.P. of 12 books

$$\text{Price per dozen} = \frac{1}{2} \times 12 = \text{Rs. } 6$$

S.P. of 16 = C.P. of 16 - C.P. of 4

13. a C.P. of 1 dozen oranges of first quality = Rs. 5

$$\text{Loss} = \frac{4}{16} \times 100 = 25\%$$

C.P. of 1 dozen oranges of second quality = Rs. 2

10. c Loss = S.P. of 4 apples on selling 36 apples

$$\text{Average C.P.} = \frac{5+2}{2} = \text{Rs. } 3.5 \text{ per dozen}$$

$\therefore$  S.P. of 40 = C.P. of 36 = C.P. of 40 - C.P. of 4

$$S.P. = \text{Rs. } 5.50$$

$$\text{Loss} = \frac{4}{40} \times 100 = 10\%$$

Profit per dozen = Rs. 2

11. c  $P = \frac{1}{4}$  of C.P., S.P. = 375

Total profit = Rs. 50

Profit = S.P. - C.P.

$$\therefore \text{Number of dozens} = \frac{50}{2} = 25$$

$$\frac{1}{4} \text{ C.P.} = 375 - \text{C.P. or, } 375 = \left(1 + \frac{1}{4}\right) \text{ C.P.}$$

14. d C.P. of first = Rs. 18 per kilogram

$$\text{C.P.} = 375 \times \frac{4}{5} = \text{Rs. } 300$$

C.P. of second = Rs. 20 per kilogram

12. d C.P. of one banana of first quality = Re.  $\frac{1}{3}$

Suppose he mixes 5 kg of first and 3 kg of second

C.P. of one banana of second quality = Re.  $\frac{1}{2}$

$$\text{Total C.P.} = 18 \times 5 + 20 \times 3 = 90 + 60 = \text{Rs. } 150$$

$$\text{Average C.P.} = \frac{\frac{1}{3} + \frac{1}{2}}{2} - \frac{5}{12}, P = 20\%$$

$$\text{Total S.P.} = 21 \times 8 = \text{Rs. } 168$$

$$\text{Profit} = \frac{18}{150} \times 100 = 18 \times \frac{2}{3} = 12\%$$

15. a Number of toffees =  $\frac{1}{\left(\frac{1}{20}\right)\left(\frac{1.2}{0.95}\right)} = 16$

16. b Let C.P. = 100. Therefore, S.P. = 110

If S.P. = 220, profit percentage = 120%

17. d Let C.P. for A = Rs. x

Total C.P. after repairs = Rs. (x + 110)

$$\text{B's C.P.} = (x + 110) \times 1.2$$

$$\text{C's C.P.} = (x + 110) \times 1.2 \times 0.9$$

$$\text{C's S.P.} = (x + 110) \times 1.2 \times 0.9 \times 1.1 = \text{Rs. } 1,188$$

$$\therefore x + 110 = \frac{1188 \times 1000}{12 \times 9 \times 11}$$

$$x + 110 = 1000$$

$$x = \text{Rs. } 890$$

18. c Let C.P. per kilogram = Re. 1

So, total C.P. of 24 kg = Rs. 24

Let him sell x kg apple at 20% gain and

(24 - x) kg at 5% loss.

$$\text{S.P.}_1 = \frac{120x}{100} = 1.2x \dots (\text{i})$$

$$\text{S.P.}_2 = 0.95(24 - x) = 22.8 - 0.95x \dots (\text{ii})$$

Overall profit = 10% on Rs. 24 = Rs. 2.4

But total S.P. - total C.P. = Rs. 2.4

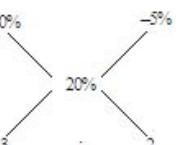
$$[1.2x + 22.8 - 0.95x] - 24 = 2.4$$

Solving for x, x = Rs. 14.4

$\therefore$  Amount sold at loss is 24 - x = 9.6 kg

### Short cut

Using alligation



$$\text{Therefore, } \frac{2}{5} \times 24 = 9.6 \text{ kg}$$

19. a C.P. = 40% of S.P. = 0.4 S.P.

$$\text{S.P.} = \frac{10}{4} \text{ C.P.} \times 100 = 250 \text{ C.P.} = 250\%$$

20. d Profit and loss are calculated on the cost price.

$\therefore$  Difference in percentages = 5 - (-2.5) = 7.5%

7.5% of C.P. = Rs. 6

$$\text{C.P.} = \frac{6 \times 100}{7.5} = \text{Rs. } 80$$

$$21. \text{ a C.P.} = \frac{356 + 425}{2} = 390$$

22. d Let C.P. = Rs. x

$$\text{Profit} = \text{S.P.} - \text{C.P.} = (900 - x)$$

$$\text{Loss} = \text{C.P.} - \text{S.P.} = (x - 450)$$

$$\therefore 900 - x = 2(x - 450)$$

$$900 - x = 2x - 900, \text{ or } 1800 = 3x, x = \text{Rs. } 600 = \text{C.P.}$$

Now, to make a profit of 25%,

$$\text{S.P.} = 600 \times \frac{125}{100} = \text{Rs. } 750$$

23. c Let M.P. = Rs. 100 = S.P. (Initially)

After a discount of 10%, S.P. would be Rs. 90.

But, the shopkeeper wants to maintain the current price, i.e., S.P. = Rs. 100

when S.P. = Rs. 90, M.P. = Rs. 100

$\therefore$  When S.P. = Rs. 100, M.P. =  $\text{Rs. } 100 \times \frac{100}{90} = \text{Rs. } 111.\overline{11}$  or 11.11% increase

$$24. b \text{ C.P. per kg} = \frac{492}{78} = \text{Rs. } 6.3.$$

For an overall gain of 25%, the S.P. of 78 kg =  $492 \times \frac{125}{100} = \text{Rs. } 615$

By selling 40%, i.e. 31.2 kg at a loss of 20%

$$\text{S.P.}_1 = 31.2 \times \left(\frac{492}{78}\right) \times \frac{80}{100} = \text{Rs. } 157.44$$

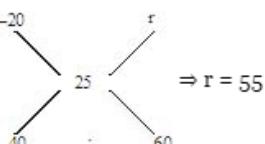
Now, the remaining, i.e.  $78 - 31.2 = 46.8$  kg wheat is to be sold for  $\text{Rs. } 615 - 157.44 = \text{Rs. } 457.56$

$$\text{S.P.}_2 = \frac{457.56}{46.8} = \text{Rs. } 9.77 \text{ per kg}$$

$$\text{Markup} = \frac{9.77 - 6.3}{6.3} = 55\%$$

### Short cut:

Let r% be the % mark up (or profit %). Then, using alligation



25. c Let C.P. per L milk = Rs. x

For 25 L, C.P. = Rs.  $25x$ , S.P. = Rs. 1,250,

$$\text{Profit} = \text{Rs. } 5x = \text{S.P.} - \text{C.P.}$$

$$\text{Or, } 5x = 1250 - 25x \text{ or, } x = \text{Rs. } 41.66/\text{L.}$$

$$\text{Profit percentage} = \frac{50 - 41.66}{41.66} \times 100 = 20\%$$

### Alternative method:

S.P. of 25 L - C.P. of 25 L = C.P. of 5 L = S.P. of 25 L = C.P. of 30 L

$$\frac{\text{S.P.}}{\text{C.P.}} = \frac{30}{25} \Rightarrow 1.2$$

Hence, profit percentage = 20%

26. d Let S.P. of 1 kg rice = Rs. x

$$\text{S.P. of 100 kg rice} = \text{Rs. } 100x$$

C.P. of 100 kg rice = Rs. 1,100

$$\therefore \text{Loss} = \text{Rs. } 20x = \text{C.P.} - \text{S.P.} = 1100 - 100x$$

$$\text{Or, } x = \frac{1100}{120} = \text{Rs. } 9.\overline{16}$$

27. d Total C.P. =  $35 \times 9.5 + 30 \times 10.5$

$$= 332.5 + 315 = \text{Rs. } 647.5 \text{ (For 65 kg rice)}$$

$$\text{S.P.} = \text{C.P.} \cdot \frac{(100 + \text{Gain percentage})}{100}$$

$$\text{S.P.} = \frac{647.5}{65} \times \frac{135}{100} = \text{Rs. } 13.5$$

28. b Let the ratio be  $x : 1$  of Rs. 100 per kg and Rs. 50 per kg oil.

$$\text{Total C.P.} \Rightarrow \text{Rs. } (100x + 50)$$

$$\text{Total S.P.} = \text{Rs. } 96 (x + 1)$$

$$96(x + 1) = (100x + 50) \times \frac{120}{100}$$

$$96 \times 5 (x + 1) = 6 \times 50 (2x + 1)$$

$$8(x + 1) = 5(2x + 1)$$

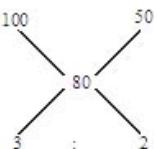
$$8x + 8 = 10x + 5, 2x = 3, x = 3/2$$

Ratio is 3 : 2

### Short cut

$$\text{C.P. of the mixture} = \frac{96}{1.2} = 80$$

### Using alligation



29. b Since the C.P. is increased by 20% ( $\frac{1}{5}$ ).

So to neglect this effect he should give  $12 \times \frac{5}{6} = 10 \text{ kg}$

30. c Let the C.P. of 1 mango = Rs. 1

Total C.P. = 20

Total profit = 5

So profit is  $\frac{5}{20} \times 100 = 25\%$

### Practice Exercise 5 – Level 2

1. c  $A = P \left[ 1 + \frac{r}{100} \right]^n$

$$6962 = P \left[ 1 + \frac{18}{100} \right]^2$$

$$P = \text{Rs. } 5,000$$

### Alternative method:

The other 18% CI for 2 year is nothing but two successive changes of 18%.

$$\text{Net increase } 18 + 18 + \frac{324}{100} = 39.247\% \approx 40\%$$

This means the loan amount  $\times 1.4 = \text{Rs. } 6,962$

$$= \text{Loan amount } \approx \frac{6962}{1.4} \approx \text{Rs. } 5,000$$

$$\text{2. c I. SI} = \frac{25000 \times 18 \times 2}{100} = \text{Rs. } 9,000$$

$$\text{II. SI} = \frac{25000 \times 3 \times 10}{100} = \text{Rs. } 7,500$$

$$\text{III. CI} = 25000 \left[ 1 + \frac{20}{100} \right]^2 - 25000 = \text{Rs. } 11,000$$

So III is the best investment.

#### Alternative method:

We could calculate the returns in percentage terms.

(i) Return =  $2 \times 18\% = 36\%$  (This is simple interest)

(ii) Return =  $3 \times 10\% = 30\%$  (This is simple interest)

(iii) Return<sub>CI</sub> > Return<sub>SI</sub> =  $2 \times 20\% = 40\%$

Now in (iii), the CI return is greater than 40%.

$$\text{3. c SI for 2 years} = \frac{20,000 \times 5 \times 2}{100} = \text{Rs. } 2,000$$

$$\text{CI for 2 years} = 20,000 [(1.04)^2 - 1] = \text{Rs. } 1,632$$

$$\text{So his loss is } \text{Rs. } 2,000 - \text{Rs. } 1,632 = \text{Rs. } 368$$

#### Alternative method:

Total interest he pays =  $2 \times 5\% = 10\%$  of  $\text{Rs. } 20,000$

Total interest he earns =  $4 + 4 + \frac{4 \times 4}{100} = 8.16\%$  of  $\text{Rs. } 20,000$

$\therefore$  Total loss =  $(10 - 8.16) = 1.84\%$  of  $\text{Rs. } 20,000 = \frac{1.84}{100} \times 20000 = \text{Rs. } 368$

$$4. e A = P \left[ 1 + \frac{r}{100} \right]^n$$

$$3360 = 3000 \left( 1 + \frac{r}{100} \right)^2; \text{ i.e.}$$

$$r = 5.8\% \text{ (approximately)}$$

When compounded semi-annually,

$$A = 3000 \left( 1 + \frac{2.9}{100} \right)^4 = \text{Rs. } 3,363$$

$$5. c 2P = \frac{P \times 22 \times T}{100}$$

$$T = 9 \text{ years}$$

#### Alternative method:

If the amount(P) is to be tripled, interest that is to be cashed =  $3P - P = 2P$

Now look at the answer choices.

22% SI in 10 years = 220%. (b) and (d) would be greater than this.

Therefore, correct option is (c), i.e. 9 years.

$$6. a A = P \left[ 1 + \frac{r}{100} \right]^n$$

$$30640 = 15320 \left( 1 + \frac{r}{100} \right)^6$$

$$= \frac{30640}{15320} - \left(1 + \frac{r}{100}\right)^6 = r - 12\% \text{ (approx.)}$$

**Alternative method:**

We see that the amount is double the principal

$$\therefore \text{By the formula } n = \frac{72}{r}$$

$$\text{We get } r = \frac{72}{6} = 12\%$$

7. d Let present population be P.

$$\therefore 2P = P \left(1 + \frac{r}{100}\right)^n$$

$$2P = P \left(1 + \frac{20}{100}\right)^n$$

$$n = 4$$

Number of intervals = 4, where 1 interval = 5 years

Therefore, total time = 20 years

**Alternative method:**

We get the number of intervals by the formula

$$n = \frac{72}{r} = 3.6 \approx 4 \text{ intervals}$$

$$\therefore \text{Number of years} = 4 \times 5 = 20 \text{ years}$$

$$8. b 3P = P \left(1 + \frac{25}{100}\right)^n$$

$$3 = (1.25)^n \Rightarrow n = 5$$

One interval = 12 min

$$\therefore \text{Total time} = 12 \times 5 = 60 \text{ min}$$

$$9. d \text{ Ratio of amounts is } \frac{20988.1}{18250.5} = 115$$

Rate of interest is 15%

**Alternative method:**

$$P + \text{CI of 3 years} = \text{Rs. } 18,250.50 \dots (i)$$

$$P + \text{CI of 4 years} = \text{Rs. } 20,988.10 \dots (ii)$$

Subtracting (ii) from (i), we get

$$\text{CI of 4th year} = \text{Rs. } 20,988.10 - \text{Rs. } 18250.50$$

$$= \text{Rs. } 2,737.60$$

Thus, CI calculated in the 4th year which is

Rs. 1,737.60 is basically the amount of interest on the amount generated after 3 years which is

$$\text{Rs. } 18,250.50$$

$$\therefore r = \frac{2737.60}{18250.50} \times 100 = 15\%$$

$$10. b \text{ Here } \text{Rs. } 462 - \text{Rs. } 420 = \text{Rs. } 42$$

Rs. 42 is the interest on Rs. 420

i.e. 10% of 420

So,  $R = 10\%$

11. a  $54880 = P[1.4]^3$

$P = \text{Rs. } 20,000$

**Alternative method:**

Even if we assume SI, there must be a growth of

$$40\% \times 3 = 120\% \text{ over initial amount.}$$

Now work with answer choices.

If we increase b, c, d by even 100% they would exceed 54880. Thus, option (a) is the answer.

12. c  $324.48 = P[1.04]^2$

$P = \text{Rs. } 300 \text{ lakh}$

**Alternative method:**

Using successive increase concept, net increase in 2 years

$$4\% + 4\% + \frac{16}{100} = 8.16\%$$

Now working with choice, (a) and (b) can be eliminated.

13. a Let  $x$  be total number of hours.

Time spent on reading =  $\frac{x}{4}$

Time left =  $\frac{3x}{4}$

Time spent on watching television =  $\frac{3x}{4} \times \frac{2}{3} = 2x$

Therefore,  $x = 4 \text{ hr}$

14. b Half attending two and half attending none is equivalent to all attending one.

15. c Tin : Aluminium : Copper =  $\frac{1}{2} : \frac{1}{3} : \frac{1}{5} = 15 : 10 : 6$

Percentage of aluminium =  $\frac{10}{15+10+6} \times 100 = 32\%$  (approximately)

16. a  $(10\% + 20\% + 15\%) \text{ of cost} = 45\% \text{ of total cost}$

Therefore,  $55\% \text{ of total cost} = \text{Rs. } 110$

Total cost =  $\text{Rs. } 200$

17. d  $1.12 \times \text{last year's salary} = \text{Rs. } 6,720$

Hence, last year's salary =  $\text{Rs. } 6,000$

Next year salary =  $1.2 \times 6000 = \text{Rs. } 7,200$

18. c  $12\% \text{ of MP} = \text{Rs. } 36$

MP =  $\text{Rs. } 300$

Value after tax deduction =  $0.9 \times 0.88 \times 300 = \text{Rs. } 237.60$

**Alternative method:**

12% discount on MP =  $\text{Rs. } 36$

$\therefore \text{Marked price} = 300$

Price after discount =  $300 - 36 = 264$

Remainder =  $264 \times 0.9$

Option (c) is the answer since the number must end in 6.

$$19. b \text{ Discount} = 10 - 14 + \frac{(-10 \times -14)}{100} = 22.6\%$$

20. a Let cost of manufacture be Rs. x

$\therefore$  Cost to shopkeeper = 1.1x

Selling price =  $1.15 \times 1.1x$

SP = Rs. 5,060

$$\therefore 1.15 \times 1.1x = 5060$$

x = Rs. 4,000

#### Alternative method 1:

$$\text{Total addition to the product} = 10\% + 15\% + \frac{10 \times 15}{100} = 26.5\%$$

$$\therefore \text{Manufacturing cost} \times \left( \frac{100 + 26.5}{100} \right) = \text{Rs } 5,060$$

Manufacturing cost = Rs 4,000

#### Alternative method 2:

There is an increase of 26.5% so that the final price is Rs. 5,060.

It means going from the answer choices you can see that (d) and (b) are very close to Rs. 5,060 indicating very marginal increase. Between answer choices (a) and (c) the latter is ruled out also for the same reason. Hence, the correct answer is (a).

$$21. c \text{ CP}_1 = \text{SP}_2$$

$$\text{CP}_2 = \text{SP}_1$$

$$\text{Hence, total CP} = \text{CP}_1 + \text{CP}_2 = \text{SP}_2 + \text{SP}_1$$

$$\text{Or CP} = \text{SP}$$

So, he makes no profit, no loss.

22. c In a 30 ml 20% is alcohol

So, alcohol = 6 ml

In a 20 ml 25% solution, alcohol = 5 ml

$$\text{Strength of alcohol in the mixture} = \frac{11}{50} \times 100 = 22\%$$

23. b Let tin = 40 g, then copper = 50 g

Impurity in tin = 20% = 8 g

Impurity in copper = 58% = 29 g

$$\text{So, total impurity} = 37 \text{ gm in } 90 \text{ g} = \frac{37}{90} = 41.1\%$$

24. d After breakage, 80% of eggs are left.

Now eggs are worth Rs. 80

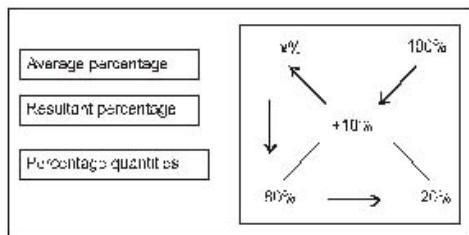
After 10% overall profit, SP = Rs. 110

$$\therefore \text{Profit percentage on the remaining} = \frac{110 - 80}{80} = 37.5\%$$

#### Alternative method: (Alligation)

We have a 100% loss for 20% of eggs and an x% gain for 80% eggs resulting in 10% overall gain.

$$\frac{x-20}{20+10} = \frac{40}{60} = \frac{2}{3} \Rightarrow x = 20 + 20 = 40\%$$



$$\therefore \frac{x-10}{10+100} = \frac{20}{80} = x = 10 + 27.5 = 37.5\%$$

25. d 40% of Rs. 20,000 = Rs. 8,000

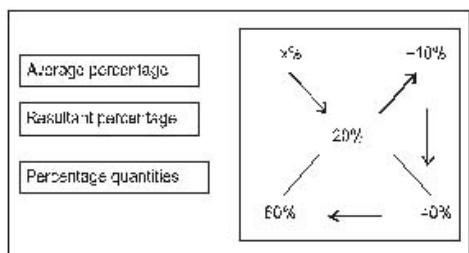
So, SP of goods worth Rs. 8,000 = Rs. 0.9 × 8,000 = Rs. 7,200

For an overall profit of 20%, SP = 1.2 × 20,000 = Rs. 24,000

Now he has to sell goods worth Rs. 12,000 at (24,000 - 7,200) = Rs. 16,800

$$\therefore \text{Profit} = \frac{48.00}{12.000} = 40\%$$

### Alternative method 1: (Alligation)



### Alternative method 2:

We have incurred 10% loss for 40% items and need 20% profit for 100% items.

Let us have x% profit for 60% of items.

$$\begin{aligned} & \Rightarrow -\left(\frac{40}{100}\right) \times 10 + \left(\frac{60}{100} \times x\right) = \left(\frac{100}{100} \times 20\right) \\ & = (0.6)x = 24 \Rightarrow x = 40\% \end{aligned}$$

### Practice Exercise 6 – Level 2

1. b Quantity of final solution = 30 ml

Content of alcohol in final solution = 6 ml

Alcohol content in the second solution = 50% of 10 ml = 5 ml

Therefore, alcohol content in first solution = 1 ml

Strength of alcohol in first solution =  $\frac{1}{20} = 5\%$

2. c Increase in collection =  $20 - 10 - \frac{20 \times 10}{100} = 8\%$

8% of collection = Rs. 150

100% of collection = Rs. 1,875

So new collection = Rs. 1,875 + Rs. 150 = Rs. 2,025

3. a Out of 30% students, 10% have gold-rimmed glasses

= 3% of the total number of students have gold-rimmed glasses

Now, total number of students = 200

3% of 200 = 6

4. b Number of female children = 10% of 18% of population.

Therefore,  $0.1 \times 0.18 \times P = 90$ ;  $P = 5,000$

5. e To find out his maximum profit, find out the profit in each case.

I :  $\frac{100 \times 105}{95} - 110.52$ , i.e. a profit of 10.52%

II :  $\frac{100 \times 110}{100} = 110$ , i.e. a profit of 10%

III :  $\frac{100 \times 1000}{900} = 111.11$ , i.e. a profit of 11.11%

IV : 10% profit

Hence, the best investment is III.

6. a Assume that cost of 1 kg is Re 1.

If the shopkeeper bought sugar at Rs. 800, he would sell this at Rs. 1,000.

Since there is 20% impurities also in this,

sugar whose CP = Rs. 800 is sold at  $1000 + 20\% \text{ of } 1000 = \text{Rs. } 1,200$ .

Hence, profit =  $\frac{400}{800} \times 100 = 50\%$ .

OR

If only the faulty weight were considered, profit would be  $\frac{(1000 - 800)}{800 \times 100} = 25\%$ .

Since 20% impurities is added, it is a successive increase in profit.

Hence, net profit =  $25 + 20 + \frac{25 \times 20}{100} = 50\%$ .

7. c SI for 2 years =  $1300 - 1180 = \text{Rs. } 120$ .

$\therefore \text{SI for 3 years} = 120 \times \frac{3}{2} = \text{Rs. } 180$ .

Hence,  $P = A - \text{SI} = 1180 - 180 = \text{Rs. } 1,000$ .

8. c Let's assume SP of one article is Re 1.

So SP of 6 articles = Rs. 6.

CP of 6 articles = SP of 5 articles = Rs. 5.

Hence, profit =  $6 - 5 = 1$ .

$\therefore \text{Percentage of profit} = \frac{1}{5} \times 100 = 20\%$ .

#### Alternative method 1:

Let the SP be x and CP be y.

$$\therefore 6y = 5x$$

$$\Rightarrow \frac{x}{y} = \frac{\text{SP}}{\text{CP}} = \frac{6}{5} = 120\%$$

$$\therefore \text{Profit} = 20\%$$

#### Alternative method 2:

These types of questions are very common and you should always concentrate on number of items being sold.

Now CP of 6 articles = SP of 5 articles

or articles sold = 5.

CP = 5 CP

Given that SP of 5 articles = 6 CP

$$\therefore \text{Profit} = \frac{\text{C.P.}}{5 \cdot \text{C.P.}} \times 100 = 20\%$$

9. d Let cost of 1 kg of tea be Rs. x and that of sugar be Rs. y.

$$\therefore x + y = 95 \dots (\text{i})$$

$$0.9x + 1.2y = 90 \dots (\text{ii})$$

Solving (i) and (ii), we get  $x = 80$ .

10. c Let the initial SP of the jacket be Rs. 110.

$\therefore$  CP must be Rs. 100.

New SP will be  $110 \times 2 = \text{Rs. } 220$ .

Final SP after a discount of  $20\% = 220 \times (0.8) = 176$ .

$\therefore$  Profit is 76%.

11. a Suppose at the time of marriage, Madhu's age was  $x$  years.

Now her age must be  $(x + 6)$  years.

Now we have  $x + 6 = 1.25x$

$$\Rightarrow x = 24 \text{ or } x + 6 = 30$$

Her son's age is  $\frac{30}{10} = 3$  years.

12. b The clue here lies in 1331000, i.e. the cube of 110.

729000 is also the cube of 90.

Hence, the answer must be 3 years.

#### Alternative method:

Assume that after  $n$  years their values will be equal. Then  $13,31,000 \left(\frac{90}{100}\right)^n = 7,29,00 \left(\frac{110}{100}\right)^n$

$$\Rightarrow \left(\frac{11}{9}\right)^n = \frac{1331}{729} \Rightarrow \left(\frac{11}{9}\right)^n = \left(\frac{11}{9}\right)^3$$

$$\Rightarrow n = 3 \text{ years}$$

13. d The growth of population per thousand per year =  $55 - 34 = 21$ .

Hence, net growth rate =  $\frac{21}{1000} \times 100 = 2.1\%$ .

14. a If  $x$  is the number of males, after the increase:

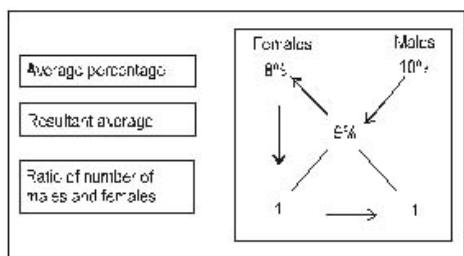
$$\begin{aligned} \text{Males} + \text{Females} &= 1.1x + 1.08(8000 - x) \\ &= (1.09)(8000) \end{aligned}$$

$$0.02x = 8720 - 8640 = 80$$

$$x = 4000$$

$\therefore$  Now the number of males =  $1.1x = 4400$ .

#### Alternative method:



$\therefore$  Ratio of males to females = 1 : 1.

$$\therefore \text{Number of males} = \left( \frac{1}{1+1} \right) \times 8000 \times \frac{110}{100} = 4400.$$

15. b In 15 years the sum doubles itself. In 30 years it will become four times and, therefore, in 45 years it will be eight times itself.

$$16. c P[(1.04)^2 - 1] = 102$$

$$P = 1250$$

$$SI = 1250 \times 4 \times \frac{2}{100} = 100$$

**Note:** Try working with options!

#### Alternative method:

Let the simple interest for one year be  $x$ .

$$\therefore CI \text{ for 2 years} = \left[ x + \left\{ x + \left( \frac{4}{100} \right) \times x \right\} \right] = 2.04x$$

$$\therefore x = \frac{102}{2.04} = 50$$

$$\therefore SI \text{ for 2 years} = 50 \times 2 = \text{Rs. } 100.$$

17. a Let the total investment =  $36 \times 30 = \text{Rs. } 1080$ .

CP of one book = 30. SP of one book = 36.

$$\text{Profit} = \frac{36 - 30}{30} \times 100 = \frac{6}{30} \times 100 = 20\%$$

#### Alternative method:

$$36 \times CP = 30 \times SP$$

$$\Rightarrow \frac{SP}{CP} = \frac{36}{30} = 120\%$$

$$\therefore \text{Profit} = 20\%$$

18. e Cost of 10 kg of oranges =  $\text{Rs. } 405$ .

It is to be noted here that after 1 kg rotten oranges is found, he sells only 9 kg, but the cost to him will remain  $\text{Rs. } 405$ .

For a 10% profit, he should sell the oranges at

$$(1.1 \times 405) = \text{Rs. } 445.5$$

$$\text{So SP of 9 kg} = \text{Rs. } 445.5$$

$$\text{Hence, SP per kg} = \frac{445.5}{9} = \text{Rs. } 49.5$$

19. a 6 dozen eggs cost =  $\text{Rs. } 10.80$

Since one dozen is rotten, he sells only 5 dozen at 5 eggs per rupee.

Hence, SP = Rs. 12

$$\text{His gain} = \frac{(12 - 10.8)}{10.8} \times 100 = 11.11\%$$

20. a The best way to solve such problems is to work with choices.

$$\frac{2[4000x + 5000](x+0.5)}{100} = 860$$

$$2[40x + 50x + 25] = 860$$

Either solve the equation for x, or put in the choices to check out the solution.

$$x = 4.5$$

So B is lent the sum at 5% (catch here is not to pick out A's rate of interest, but B's).

21. b If CP = 100, MP = 130.

$$SP = \frac{1}{4} \times 110.5 + \frac{1}{2} \times 130 + \frac{1}{4} \times 91$$

$$SP = 27.625 + 65 + 22.75 = 115.375$$

Hence, profit = 15.375%.

22. a Let the CP of the article be x.

$$1.08x - 0.92x = 12$$

$$\Rightarrow 0.16x = 12 \Rightarrow x = \frac{12}{0.16} = \text{Rs } 75$$

23. c Assume the rate of interest be x and principle be P.

$$\text{Then } \frac{4}{9}P = \frac{P \times x \times x}{100} \Rightarrow \frac{400}{9} = x^2 \Rightarrow x = \frac{20}{3}$$

Hence, the rate of interest is .

24. c Take LCM of 2, 3, 5, i.e. 30.

So cost of 30 pencils at the rate of 2 per rupee

= Rs. 15 and cost of 30 pencils at the rate of 3 per

Rs. 2 = Rs. 20.

Hence, total cost of 60 pencils = 15 + 20 = 35.

Selling price of 60 pencils at the rate of 5 per Rs. 3 = 36.

Hence, profit percentage =  $\frac{100}{35} = \frac{20}{7}\% = 2\frac{6}{7}\%$ .

#### Alternative method:

The easier way is to assume that he has one pencil of each kind.

$$\frac{SP}{CP} = \frac{\left(\frac{3}{5} \times 2\right)}{\left(\frac{1}{2} + \frac{2}{3}\right)} = \frac{1.2}{1.16}$$

Now as  $\frac{SP}{CP} > 1$ . It is a gain and also the gain is less than 3% as  $\frac{1.2}{1.16} - 1 \approx \frac{0.03}{1.16}$  and

as 3% of  $1.16 \approx 0.034 > 0.03$ .

25. b He is left with  $x(0.95 \times 0.07) = 266$

(Assuming that initially he had x number of eggs)

$$So \times \frac{286}{0.07 \times 0.95} = 4000$$

26. c Since selling price of 80 kg = CP of 80 kg - CP of 16 kg.

(Assuming SP = Rs. x per kilogram)

$$80x = CP - 16x$$

$$\therefore CP = (80 + 16)x = 96x$$

$$= 96x = 384$$

Hence,  $x = \frac{384}{96} = 4$ . So SP = Rs. 4 per kilogram.

27. a Let's assume that the cost price of tea be Rs. x.

Since profit = 15%, SP =  $1.15x = 5.75$

$$\Rightarrow x = \text{Rs. } 5$$

On selling 1 kg he gained Re 0.75.

So to gain Rs. 60, the required quantity is

$$\frac{60}{0.75} = 80 \text{ kg}$$

$$28. e SI = \frac{P \times R \times T}{100}$$

We know that T = 2 and SI = 360. Thus, we have two variables (P and R) and only one equation.

Hence, the data is inadequate.

$$29. b (100 - 20), i.e. 80\% \text{ of MP} = (100 + 60)$$

i.e. 160% of CP

$$\text{Percentage of CP} = \{100 - 25\} = 75\%.$$

$$\text{Hence, profit percentage} = \left( \frac{160}{80} \times 75\% \text{ of CP} \right) - 100\% = 50\%$$

### Alternative method:

Let the CP be Rs. 100.

$$\therefore SP = 100 + \frac{60}{100} \times 100 = \text{Rs. } 160.$$

$$\therefore SP = (100 - 20)\% \text{ of retail price.}$$

$$= \text{Retail price} \times \frac{80}{100} = \text{Rs. } 160.$$

$$= \text{Retail price} = \text{Rs. } 200.$$

Now new commission = 25% of Rs. 200 = Rs. 50.

$$\therefore SP (\text{new}) = 200 - 50 = \text{Rs. } 150.$$

$$\therefore \text{Profit} = \frac{150 - 100}{100} = 50\%.$$

$$30. d (12.5\% \text{ of C}) + C = 540 \text{ (where C = CP)}$$

$$112.5\% \text{ of C} = 540$$

Now (25% of C) + C = 125% of C.

$$SP = \frac{540}{112.5} \times 125 = \text{Rs. } 600 \text{ (earlier profit = 12.5%; double the profit = 25%).}$$

$$31. e \text{ Number of males} = \frac{4}{7} \times 8400 = 4800.$$

Number of women = 8400 - 4800 = 3600.

Number of married men =  $0.65 \times 4800 = 3120$

= Number of married women.

Percentage of unmarried women = 13.33%.

32. d SP = 24 = 80% of MP

MP = 30

New SP = 70%, MP = 21

### Practice Exercise 7 – Level 2

1. a Difference between CI and SI in 3 years

$$= P \left( \frac{r}{100} \right)^3 + 3P \left( \frac{r}{100} \right)^2$$

$$\text{or } P \left( \frac{5}{100} \right)^3 + 3P \left( \frac{5}{100} \right)^2 = 122$$

On solving this, we get P = Rs. 16,000.

2. b Average cost per kilogram = Total cost per quantity =  $\frac{20 \times 15 + 10 \times 20}{10 + 20} = 16.67$  per kilogram

3. e Suppose SP is 100, profit is 25; CP = 100 - 25 = 75.

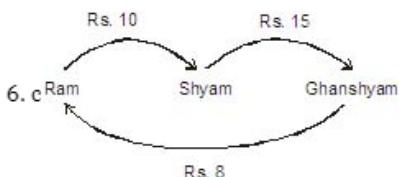
$$\text{Profit percentage} = \frac{25}{75} \times 100 = 33\frac{1}{3}\%$$

4. c In fact, you get things worth Rs. 3,000, but you pay Rs. 2,000 only. So you are getting a discount of  $33\frac{1}{3}\%$ .

5. c Here we have two equations:

$$a^2b = b^3c \text{ and } c^4a = b^2.$$

On solving, we get  $a^9 = b^{10}$ .



The given transaction is portrayed as above.

Now we can operate the transaction by following the way Ram  $\xrightarrow{\text{Rs. 10}}$  Shyam  $\xrightarrow{\text{Rs. 15}}$  Ghanshyam.

7. b The seller of the typewriter is reducing three-eighths of the price at every reduction and therefore after reduction, the typewriter should be offered for Rs. 156.25.

8. b In this case, we need not use the data that SP = Rs. 300 each. This has to be used only to figure out that the SP of both the articles is the same. Also, since the profit percentage on one is equal to the loss percentage on the other, viz. 10% effectively, it will be a loss of  $\frac{10^2}{100} = 1\%$ .

#### Alternative method:

It can also be done by the formula

$$a + b + \frac{ab}{100} = -10 + 10 + \frac{(-10)(10)}{100} = -1$$

Hence, the correct answer is 1%.

9. b The original prices before increases are Re 1 and

Rs.  $1.68 \times \frac{100}{16} =$  Rs. 10.50. Difference = Rs. 9.50.

10. c Here the loss is  $\frac{7}{30} \times 100 = 23\frac{1}{3}\%$ .

11. c A sum of money, compounded at the rate of 10% doubles itself in 8 years.

or  $(1.1)^8 = 2 \Rightarrow$  answer = 10%

12. b  $7.25 \times 200 = 1450$

$5.75 \times 400 = 2300$

CP = 3750 = SP = 4500

$\frac{1}{3} \times 600 = 200$  at the rate of 6 = 1200

= 400 kg at Rs. 3300

= SP =  $\frac{3300}{400} =$  Rs 8.25/kg

13. b Compounded growth rate per decade = 10%

Let P be the population in 1970s.

$$363000 = P \left( \frac{100+10}{100} \right)^2$$

$$= 1.21 P = 363000 \therefore P = 300000$$

14. c  $0.15 \times CP_1 = 0.10 \times CP_2$

$$\Rightarrow \frac{CP_1}{CP_2} = \frac{2}{3} \text{ and } CP_1 + CP_2 = 560 \text{ (Given)}$$

$$\text{So } CP_1 = 224 \text{ and } CP_2 = 336$$

15. b If CP = 100 for 1 kg, actual CP = 84 = SP = 96

$$= \text{Profit} = \frac{12}{84} \times 100 = 14\frac{2}{7} \text{ percentage gain}$$

16. c Total amount pledged = Rs. PR

Amount actually received = Rs. (PR - QS)

$$\text{Percentage required} = \frac{PR - QS}{PR} \times 100 = \left( 100 - \frac{QS}{PR} \times 100 \right)$$

17. c The rate of inflation is 1,000%.

= The cost of the unit will increase at 1,000%

$\therefore$  The cost of the unit will increase at the rate of

$$1000 + 100 = 1,100\% \text{ rate}$$

= The cost of 5 units after 2 years will be

$$5 \times \frac{1100}{100} \times \frac{1100}{100} = 55 \times 11 = 605 \text{ units}$$

18. c Observation:

In all the cases the denominator is one less than the double of numerator except P and S.

In that case, lower numbers ratio will give the higher percentage.

So, R will be the highest in Q, R and T.

S is simply ruled out as S = 50%. Which is least.

Now between P and R, R is greater.

19. d Weight of first lump = x kg

$$\text{Second} = (20 - x) \text{ kg}$$

$$31.25x + 30(20 - x) = 617.5 \Rightarrow x = 14 \text{ kg}$$

$$\text{Ratio} = 14 : 6 = 7 : 3$$

$\Rightarrow$  %age of gold in the combined lump

$$\frac{75}{7+3} = 75\% \quad \frac{85}{7+3} = 85\% \quad \Rightarrow 75\% \text{ gold}$$

20. c Let the number of walnuts bought be W and the number of pineapples bought be P.

$$\text{Given } \frac{W}{5} + \frac{P}{4} = 19.50 \dots (\text{i})$$

$$\text{and } \left(\frac{W+P}{4}\right) - 19.50 = \text{Rs. 3} \dots (\text{ii})$$

$$\frac{W+P}{4} = 22.50$$

Solving (i) and (ii), we get P = 30 and W = 60

**Alternative method:**

$$\left(\frac{W+P}{20}\right) 5 = \frac{W}{5} + \frac{P}{4} + 3$$

$$\text{Therefore, } \frac{W+P}{4} = \frac{4W+5P+60}{20}$$

$$5W + 5P = 4W + 5P + 60, W = 60$$

21. c  $P \propto D$  when N is constant.

$P \propto (N - n)$ , when D is constant

$\Rightarrow P \propto D(N - n)$ , when both N and D vary

$$= P = KD(N - n)$$

$$P = 80, N = 30, D = 40$$

$$P = 180, N = 35, D = 60$$

$$= 80 = K40(30 - n) \text{ and } 180 = K60(35 - n)$$

$$= \frac{80}{180} = \frac{40(30 - n)}{60(35 - n)} \Rightarrow n = 20$$

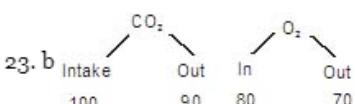
If there is no loss, then P  $\propto$  o, i.e.  $KD(N - n) \propto$  o

$$= N - n \propto$$

$$= N \propto 20$$

$\therefore$  Minimum passengers = 20

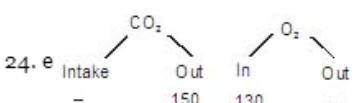
22. b Time for a complete cycle- 2.5 secs. Then number of cycles are upto 11: 21: 12.5 pm when light blinks on and it remains upto 11:21:14 pm. So it was on.



Net consumption of  $\text{O}_2$  per hour = 10 gm

Quantity available = Original  $\text{O}_2$  content - Minimum required = 7% - 2% = 5% of 100 kg = 5 kg

$$\text{Time for survival} = \frac{5 \text{ kg}}{10 \text{ gm/hr}} = 500 \text{ hours}$$



∴ Net increase in weight per hour = 20 gm

If  $\text{CO}_2$  takes  $x$  hours to reach 1%.

$$x = \frac{1\% \text{ of } \left(100 + \frac{20x}{1000}\right) - 0.5}{0.15}$$

$\Rightarrow x = 3$  hrs 20 minutes 16 seconds

|            | $\text{CO}_2$ |     | $\text{O}_2$ |     |
|------------|---------------|-----|--------------|-----|
| 25. b      | Intake        | Out | In           | Out |
|            | 110           | 135 | 120          | 77  |
| Net intake | -25           | 43  |              |     |

Net decrease in weight every hour = 18 gm

If  $x$  = number of hours the fishes can survive,

$$x = \frac{7 - 2\% \text{ of } \left(100 - \frac{18x}{1000}\right)}{0.043} \Rightarrow x = 714 \text{ hours}$$

|       | $\text{CO}_2$ |               | $\text{O}_2$ |     |
|-------|---------------|---------------|--------------|-----|
| 26. a | In            | Out           | In           | Out |
|       | 100           | $90 + 11.25x$ | $80t$        | 70  |

10X

Net intake  $\rightarrow 10 - 11.25X 10X + 70$

Net decrease in weight per hour = 20 - 1.25X

$$100 = \frac{7 - 2\% \text{ of } \left(100 - \frac{20}{1000} + \frac{1.25x}{1000}\right)}{\left(\frac{10x - 10}{1000}\right)}$$

$$\Rightarrow x = 3.99$$

$$\Rightarrow x = 3 \text{ (truncating .99)}$$

For questions 27 to 31:

First season :

|                    | Rice    | Vegetables | Total   |
|--------------------|---------|------------|---------|
| Qty. produced (kg) | 80,000  | 32,000     |         |
| Value (Rs.)        | 640,000 | 352,000    | 992,000 |
| Urea cost (Rs.)    | 60,000  | 4,500      |         |
| Water cost (Rs.)   | 8,000   | 400        |         |
| Insecticide (Rs.)  | 1,500   | -          |         |
| Wastage @ 6% (Rs.) | 38,400  | -          |         |
| Profit             | 532,100 | 347,100    | 879,200 |

Second season :

|                     | Wheat   | Vegetables | Total     |
|---------------------|---------|------------|-----------|
| Value of crop (Rs.) | 378,000 | 528,000    | 1,006,000 |
| Urea                | 15,750  | 6,750      |           |
| Water               | 1,400   | 600        |           |
| Insecticide         | 1,500   | -          |           |
| Profit              | 359,350 | 520,650    | 880,000   |

27. a Required difference = Rs. 800

$$28. b \text{ Percentage of profit from vegetable} = \frac{3,47,100 + 5,20,650}{8,79,200 + 8,80,000} \times 100 \approx 49\%$$

29. e Farmer will lose = Rs. 38,400 - Rs. 1,500 = Rs. 36,900

30. a Rice is least profitable.

31. a Let the minimum amount be Rs. x.

$\Rightarrow x = 3.99$

$\Rightarrow x = 3$  (truncating .99)

Thus,  $x \times 8/100 = 8,79,200 + 8,80,000 = 17,59,200$

$\Rightarrow x \approx \text{Rs. } 22,000,000.$

### For questions 27 to 31:

First season :

|                    | Rice    | Vegetables | Total   |
|--------------------|---------|------------|---------|
| Qty. produced (kg) | 80,000  | 32,000     |         |
| Value (Rs.)        | 640,000 | 352,000    | 992,000 |
| Urea cost (Rs.)    | 60,000  | 4,500      |         |
| Water cost (Rs.)   | 8,000   | 400        |         |
| Insecticide (Rs.)  | 1,500   | —          |         |
| Wastage @ 6% (Rs.) | 38,400  | —          |         |
| Profit             | 532,100 | 347,100    | 879,200 |

Second season :

|                     | Wheat   | Vegetables | Total     |
|---------------------|---------|------------|-----------|
| Value of crop (Rs.) | 378,000 | 528,000    | 1,006,000 |
| Urea                | 15,750  | 6,750      |           |
| Water               | 1,400   | 600        |           |
| Insecticide         | 1,500   | —          |           |
| Profit              | 359,350 | 520,650    | 880,000   |

27. a Required difference = Rs. 800

28. b Percentage of profit from vegetable =  $\frac{3,47,100 + 5,20,650}{8,79,200 + 8,80,000} \times 100 \approx 49\%$

29. e Farmer will lose = Rs. 38,400 - Rs. 1,500 = Rs. 36,900

30. a Rice is least profitable.

31. a Let the minimum amount be Rs. x.