

UNIT-7 COMMERCIAL MATHEMATICS



- Proportion
- Direct and Inverse Proportion
- Application of Percentage (Profit, Loss, Discount, Income Tax, Sale Tax, Simple Interest)
- Meaning of Compound Interest
- To determine compound amount and compound interest by Unitary Method
- Formula of compound amount and its application
- Tax and Type of Tax

7.1 Introduction :

What is proportion and we have studied about mutual relation of its different terms in detail in previous class. If four proportional quantities are given in which one quantity is unknown, we know to determine the value of unknown quantity.

Percentage is a method to compare quantities. There are different interesting and practical application of percentage such as to **determine ratio** of numbers from percentage to determine percentage from ratio, to determine growth or deficiency in the form of percentage, to determine percentage of profit and loss etc. The concept of taking interest on interest is compound interest. Simple interest and compound interest are same in end of first year.

7.2 Proportion :

We know that if two ratios are equal these are called as proportion e.g. $\frac{5}{10} = 1:2$ and $\frac{4}{8} = 1:2$, we may say that ratio $\frac{5}{10}$ and ratio $\frac{4}{8}$ are equal. This relation is called as proportion. We write this proportional relation in the following ways :

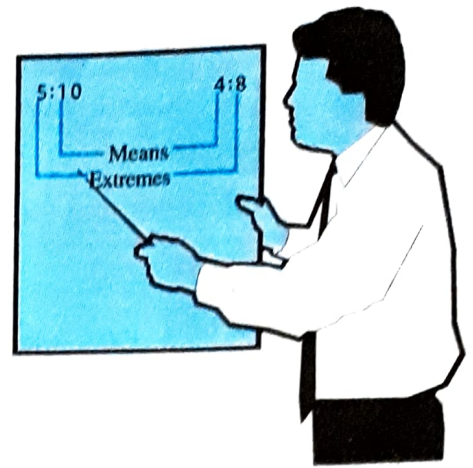
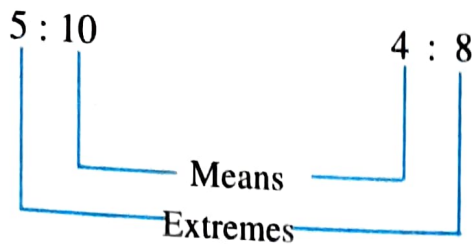
$$\frac{5}{10} = \frac{4}{8} \quad \text{or} \quad 5 : 10 = 4 : 8$$

$$\text{or } 5 : 10 :: 4 : 8$$

There are four terms in a proportion first and last terms called as extremes and both terms of middle are called as **means**. There is a special property between extreme's and means, which may be understood in the following way.

There was total four terms in $5 : 10 = 4 : 8$

For example,



Multiplication of extremes = $5 \times 8 = 40$

Multiplication of **means** = $10 \times 4 = 40$

So multiplication of extremes = multiplication of **means**

7.2.1 Direct Proportion

We know that if two ratio are equal, those are called proportion. We may understand it through the following example. Cost of 5 books is ₹100.00, cost of 15 books and 3 book will be ₹ 300.00 and ₹ 60.00 respectively.

Pay Attention : The number of books being 3 times (15 from 5) of previous number of books their cost also becomes three times of previous cost *i.e.* ₹ 300. It is clear here that with increase in number of books, total cost increases in that ratio. With decreases in number of books, its cost decreases in that ratio.

Such type of proportion is called as direct proportion. Its application is very much frequent in daily life.

Example : Number of pencils is expressed by 'x' in the following table. Looking it carefully, answer the following question :

Number of pencils x	18	36	54	72	9
Cost of pencils in rupee y	20	40	60	80	10
$\frac{x}{y}$	$\frac{18}{20} = \frac{9}{10}$	$\frac{36}{40} = \frac{9}{10}$	$\frac{54}{60} = \frac{9}{10}$	$\frac{72}{80} = \frac{9}{10}$	$\frac{9}{10}$

- On becoming twice the 18 number of pencils, how many times does its cost?
- On becoming thrice the 18 number of pencils, how many times does it cost?

We see that :

- (i) On becoming twice the number of pencils their corresponding cost also becomes two times.
- (ii) On becoming thrice the number of pencils, its corresponding cost will also become thrice.

From (i) and (ii) we see that in which ratio number of pencils increases their costs in increasing in that ratio eg.

$$\frac{36 \text{ pencils}}{54 \text{ pencils}} = \frac{\text{₹ } 40}{\text{₹ } 60}$$

or $36 : 54 :: 40 : 60$

36 pencils and 72 pencils and ₹60 and ₹80 are in direct proportion.

So, we may say that in number of pencils and their costs, there is relation of direct proportion.

Similarly 54 pencils, 72 pencils and ₹60, ₹80 are in direct proportion

$$\text{i.e. } \frac{54 \text{ pencils}}{72 \text{ pencils}} = \frac{\text{₹ } 60}{\text{₹ } 80}$$

or $54 : 72 :: 60 : 80$

Look table, we may say that $\frac{\text{number of pencils}}{\text{cost of pencils}}$ i.e. value of $\frac{x}{y}$ is $\frac{9}{10}$ in each situation
i.e. equal so value of $\frac{x}{y}$ is constant say k ,

$$\text{Here } k = \frac{9}{10}$$

Example 1 : Number of balls and their corresponding cost are shown in table given below:

Number of balls x	4	3	2	1
Price in rupee y	20	15	10	5
$\frac{x}{y}$	$\frac{4}{20} = \frac{1}{5}$	$\frac{3}{15} = \frac{1}{5}$	$\frac{2}{10} = \frac{1}{5}$	$\frac{1}{5}$

Looking the table and find :

- (i) Price of 4 balls is ₹20, what will be price of 2 balls?
- (ii) What is price of one ball at the same rate?

We see that number of 2 ball is half of number of 4 balls and its corresponding price is also ₹10, half of ₹20. Similarly 1 ball is one fourth of 4 balls. So the price of 1 ball will also be ₹5, one fourth of ₹20.

Thus as well as number of balls decreases, corresponding price will also be decreases in that ratio. This relation is called direct relation. Here 4 balls, 2 balls, ₹ 20, ₹ 10 are in direct proportion.

$$\text{i.e.} \quad \frac{4 \text{ balls}}{2 \text{ balls}} = \frac{\text{₹ } 20}{\text{₹ } 10}$$

$$\text{or } 4 : 2 :: 20 : 10$$

It is also clear from above table that $\frac{x}{y} = \frac{1}{5}$ is constant i.e. $\frac{x}{y} = k$ where $k = \frac{1}{5}$.

Try it :

1. Price of 2 kilogram Potato is ₹20. Find price of 4 kilogram potato.
2. A labour completes 3 metre long wall in a day. How much long metre wall do 3 labours complete in same one day?

So conclusion is that :

1. When two quantities x and y are related in such a way that with increase in x another quantity y increases in same ratio or with decreases in value of x , value of y also decreases in the same ratio. These quantities are called direct proportion.
2. Value of $\frac{x}{y}$ is constant.

Relation of

Direct proportion may be expressed putting arrow in same direction in the following way :

(1) Numer of pencil	Price of pencils (in rupee)
10 ↓	9 ↓
20 ↓	18 ↓
i.e. $10 : 20 :: 9 : 18$	

(2) Number of balls	Price of balls (in rupee)
4 ↓	20 ↓
2 ↓	10 ↓
i.e. $4 : 2 :: 20 : 10$	

Example 2. A train covers a distance of 120 km in 2 hours. How far does it cover in 5 hours with the same speed?

Solution : With excess of time distance covered will also be excess. So there is relation of direct proportion here. Suppose x km distance will be covered in 5 hours.

So

Time (in hours)	Distance covered (in km)
2 ↓	120 ↓
5 ↓	x ↓

$$\text{i.e. } 2 : 5 :: 120 : x$$

$$\text{or } 2x = 5 \times 120$$

$$\therefore x = \frac{5 \times 120}{2} = 300$$

Required distance = 300 km.

Example 3. 25 labours make 7.5 km long way in a week. How many labours will make 10.2 km long way in the same time?

Solution : There is a relation of direct proportion in length of way and number of labours. Suppose x labours will make 10.2 km long way.

Length of way (in km)	Number of labours
7.5 ↓	25 ↓
10.2 ↓	x ↓

$$\text{i.e. } 7.5 : 10.2 :: 25 : x$$

$$\text{or } 7.5x = 25 \times 10.5$$

$$\text{or } x = \frac{10.2 \times 25}{7.5}$$

$$\text{or } x = \frac{102 \times 25}{75}$$

$$\text{or } x = 34$$

Required number of labours = 34

Example 4. If the price of 6 pens is ₹24. What will be the price of 7 pens ?

Solution : There is relation of direct proportion between number of pens and their corresponding prices.

Let price of 7 pens be ₹ x .

Number of pens	Price (in rupee)
6 ↓	24 ↓
7 ↓	x ↓

$$\text{i.e. } 6 : 7 :: 24 : x$$

$$\text{or } 6x = 7 \times 24$$

$$\text{or } x = \frac{7 \times 24}{6}$$

$$\text{or } x = 28$$

Required price is ₹28

Try it :

1. Some labours complete a work in 4 days. How much work do some labours complete in 1 day and how much work will remain ?
2. How much time will be required to cover a distance of 120 km with speed of 20 km. per hour?

Exercise – 7(a)

1. Find the value of “k” in your exercise book as shown in the following table.

x	20	40	60	80
y	40	80	120	160
$k = \frac{x}{y}$				

There are four options of answer in the following question 2 and 3. Choose the right option.

2. Price of 4 kilogram tea is ₹420. Price of 12 kilogram tea will be :
 (a) ₹1000 (b) ₹760 (c) ₹1160 (d) ₹1260
3. A car moves with speed of 30 m/second. How far it will cover after 1 hour?
 (a) 300 km (b) 13 km (c) 108 km (d) 30 km
4. Fill in the blanks in the following table of direct proportion in your exercise book :

Number of labours x	1	2		4	5
Wages (in rupee) y	50		150	200	
5. Price of 6 pens is ₹24. Find price of 10 pens.
6. The wage of 5 labours ₹1250. How much wage would be required for 8 labours?
7. The price of 4 bells or 3 pens is ₹12. Find price of 6 bells and 6 pens.
8. A machine prints 200 papers in 5 minutes. How much time will be required to print 2×10^3 similar type of papers ?

9. 36 kilogram wheat is given on a ration card of $4\frac{1}{2}$ unit of a family. What amount of wheat will be given on a ration card of unit of $3\frac{1}{2}$?
10. A train is 315 metres long. In how much time it crosses a pillar with a speed of 54 km per hour?

7.2.2. Inverse Proportion

We see in daily activities in practical life that same time an increasing of a quantity, another quantity decreases in that ratio. Lets understand this by an example. 5 labours do white washing a building in 10 days. In has many days 10 labours perform the same work?

Think number of labours became 10 from 5 *i.e.* number of labours became twice, number of days utilised in white washing will be certainly less and number of days will be half of the previous number.

Here we see that number of labours is increased in which ratio, number of days became less in that ratio. Such proportion is called inverse proportion (reverse proportion).

Example 5 : Number of required labours and number of days for white washing of the science building of a school is given in the following table :

Number of labours x	2	4	8
Number of days y	20	10	5
$x \times y$	$2 \times 20 = 40$	$4 \times 10 = 40$	$8 \times 5 = 40$

2 labours can complete the work of white washing in 20 days. On utilising services of 4 labours for white washing work, it may complete in only 10 days. It is clear that on making the number of labours twice of previous number, number of days become half of previous one *i.e.* 10. Similarly an using services of 8 labours, work may complete in 5 days.

Thus we see that number of labours changes in which ratio, number of days changes in just its opposite or reverse ratio. We also see this here that value of $x \times y$ is 40 in each situation *i.e.* value of $x \times y$ is constant.

So, we may say that there is opposite relation between number of required labours and days and four terms such as 2 labours, 4 labours, 20 days 10 days are in inverse proportion *i.e.*

$$\begin{aligned} \frac{20}{10} & \text{ is reverse ratio of } \frac{2}{4} \\ \text{or } \frac{2}{4} & = \frac{10}{20} \\ \text{or } 2 : 4 & :: 10 : 20 \end{aligned}$$

Similarly 8 labours, 4 labours, 5 days 10 days being in reverse proportion 5 : 10 is written as inverse form as follows :

$$\frac{8}{4} = \frac{10}{5}$$

or $8 : 4 = 10 : 5$

i.e.,

When four quantities are in inverse proportion, then ratio of last two quantities is written in opposite form.

The statement of number of pumping machines of evacuate water from a water filled pond and required time to evacuate it is given in the following table.

Number of pumping machines x	5	10	15	20	30
Time taken to evacuate pond (in hours) y	60	30	20	15	10
$x \times y$	5×60 = 300	10×30 = 300	15×20 = 300	20×15 = 300	30×10 = 300

- (i) 5 Pumping machines can evacuate a pond in 60 hours. What will be ratio between twice of number of machines and number of hours?
- (ii) If number of pumping machines be three times, what will be ratio between the number of machines and number of hours?

You see that on becoming number of machines 10 from 5 (ratio 1 : 2), time taken will be half of previous time *i.e.* becomes 30 hours from 60 hours and ratio is 2 : 1.

Similarly number of machines being 15 in place of 5 (ratio 1 : 3) number of hours required becomes 20 hours one third of 60 hours (ratio 3 : 1) *i.e.*

$$5 : 15 = 1 : 3 \text{ and } 60 : 20 = 3 : 1$$

Here we also see that value of $x \times y$ is 300 in each situation *i.e.* value of $x \times y$ is constant.

Seeing other proportional quantities for the table we came to know that in which ratio number of pumping machines changes, number of hours changes in reverse ratio. So, there is relation of inverse proportion between number of pumping machines and number of hours. 5 machines, 10 machines, 60 hours, 30 hours are in reverse proportional. It is written in the following way.

$$\frac{60}{30} \text{ is reverse ratio of } \frac{5}{10}$$

$$\text{or } \frac{5}{10} = \frac{30}{60} \quad \text{or} \quad 5 : 10 = 30 : 60$$

The relation of reverse proportion is expressed by arrows in the following way :

Number of pumping machines	Expected time (in hours)
5	60
10	30

Example 6 : Read the following table, think and answer the following questions.

Number of labours x	2	4	8	16	32
Number of days y	32	16	8	4	2
$x \times y$					

- As the value of x increases the corresponding value of y increases or decreases?
- When value of y becomes 8 from 16 *i.e.* half then value of x becomes 8 from 4 are double. If value of x becomes 16 from 8 *i.e.* double, what will be corresponding value of y ?
- Find value of $x \times y$ and see, whether its value remain same in every situation.

Example 7 : Find value of k from the following table :

Pumping set x	2	3	4	5	6
Time (in hours) y	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$
$k = x \times y$					

From above mentioned example (6) and (7) it is clear that number of labours from 2 to 4 *i.e.* having twice of the previous number days become 16 from 32 *i.e.* half $\left(\frac{1}{2}\right)$ and number of pumpsets 3 from 2 *i.e.* $2 : 3$ expected corresponding time become $\frac{1}{3}$ from $\frac{1}{2}$ that is $\frac{1}{2} : \frac{1}{3}$ or $3 : 2$ that is $3 : 2$ reverse of $2 : 3$.

So, we reach on this conclusion that :

- When two quantities x and y are related in such a way that on changing x in any ratio, y changes in its reverse ratio and $x \times y = k$ where k is constant, those quantities are called reverse proportion.
- It becomes easy to solve the problems by representing by arrows in opposite direction ($\uparrow \downarrow$) of both quantities of reverse proportion.

Example 8. There are food grains of 40 days for 50 students in a hostel. If 30 students come more in the hostel. In how many days will be food grain finished?

Solution : Number of students in the hostel with 30 more students = $50 + 30 = 80$
To certain food grain, less students finish in more days and more students finish in less days.

So, in this question there is relation of reverse proportion between food grains and number of students.

Let food grains will be finished in x days.

Numbers of Students	Number of days of finishing food grains
50 ↓	40 ↑
80 ↓	x ↑

i.e. $50 : 80 :: x : 40$

or $80x = 50 \times 40$

or $x = \frac{50 \times 40}{80}$

or $x = 25$

Required number = 25

Example 9. A car covers a distance in 3 hours with speed of 30 km per hour. In what time does another car cover the same distance with speed of 40 km per hour?

Solution : $\therefore$ Speed and time are in inverse proportion.

Suppose that second car covers same distance in x hours.

Speed (km/hour)	Time (in hour)
30 ↓	3 ↑
40 ↓	x ↑

i.e. $30 : 40 :: x : 3$

or $40x = 30 \times 3$

or $x = \frac{30 \times 3}{40}$

or $x = \frac{9}{4}$

or $x = 2\frac{1}{4}$

Required time = $2\frac{1}{4}$ hour = 2 hour 15 minute.

Example 10. 12 labours can make a wall in 10 days. How many labours will be required to make same wall in 6 days?

Solution : Time and number of labours are in reverse proportion.

let required number of labours be x

Time (in days)	Numbers of labours
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10 ↓	12 ↑
6 ↓	x ↑

So, $10 : 6 :: x : 12$

or $6x = 10 \times 12$

$$x = \frac{10 \times 12}{6}$$

or $x = 20$

$\therefore$ number of required labours = 20

Example 11. 12 cows or 8 buffalos can graze a field in 10 days. In how many days 3 cows and 3 buffalos do graze the same field?

Solution : $\therefore$ grazing of 12 cows = grazing of 8 buffaloes

$\therefore$ grazing of 1 cow = grazing of $\frac{8}{12}$ buffaloes

$\therefore$ grazing of 3 cows = $\frac{8}{12} \times 3$ buffaloes
= grazing of 2 buffaloes

Grazing of (3 cows + 3 buffaloes) = grazing of (2 + 3) buffaloes
= grazing of 5 buffaloes

Let required number of days be x :

Buffaloes	Days
8 ↓	10 ↑
5 ↓	x ↑

So, $8 : 5 :: x : 10$

or $5x = 8 \times 10$

or $x = \frac{8 \times 10}{5}$

or $x = 16$

$\therefore$ Required number of days = 16

Lets,also consider on the following questions :

1. The age of Sharda is 15 years and that of her mother is 45 years. When Sharda become 30 years old, what will be the age of her mother?
2. Govind placed 4 shirts to dry in sun shine and Mahendra placed such 20 shirts to dry. If 2 hours is required to dry 4 shirts. How much time, does Mahesh require to dry 20 shirts?

Think :

1. You have thought that when Sharda becomes 30 years old after increase of 15 years in her age. This 15 years time will be available to her mother also, and she also become of age of $45 + 15 = 60$ years.
2. 2 hours time are required to dry 4 shirts. To dry 20 shirts *i.e.* 5 times that is $2 \times 5 = 10$ hours would he required. Think this statement seems not correct why? Shirts are of same type. Therefore, to dry same time would he required and that will be 2 hours.

Try it :

1. 10 labours can do a work in 2 days. In how many days 2 labours complete the same work?
2. A labour requires 1 hour to carry 100 bricks from one place to other. If 2 labours start carying bricks, how much time do they require for the same number of bricks carried from the same places ?
3. A cyclist covers a distance in 4 hours with speed of 15 km/hour. How much time do he require to cover the same distance with speed of 12 km/hour?
4. If 7 men do a work in 15 days. In how many days do 21 men complete same work?

Exercise – 7(b)

1. Sheela reaches school from her home in 20 minutes by cycle with speed of 12 km per hour. What will be speed of cycle to reach the school in 15 minutes?
2. A car covers the distance in 10 hours with speed of 48 km per hour. What will be speed of car to cover the same distance only in 8 hours?

3. Suneeta completes a sweater, in 8 days with knitting 4 hours per day. If it is to be done in 6 days. How many hours per day does she require to complete ?
4. 6 labours can make a room in 7 days. How many days can 21 labours make the same room?
5. 45 men complete a work in 27 days. If 81 men are employed on the same work. In how many days do they complete the work ?
6. A motor car reaches to a place from another place in 3 hours having speed of 40 km per hour. In how many hours it reaches the same place with speed of 30 km per hour?
7. There are food grains for 42 days in a fort at the rate of 700g per day per soldier. If the meal of per day is reduce 600g. per soldier, then for how many days will that food grain sufficient?
8. When a pipe fills 640 litres water in one hour. 10 hours time is required to fill a water tank. If same water tank was filled by another pipe in 8 hours, then how many litre of water per hour was required by another pipe?
9. There are food stock for fifteen days for 300 students in a hostel. If 200 students go outside due to leave. How many days will that food be available?
10. A traveller is reached to a place by a tempo in 5 hours with speed of 40 km per hour. If the speed of tempo would have been 25 km per hour, how many hours are required to reach to the same place ?
11. 2 skilled labour or 3 non-skilled labour can do a work in 20 days. In how many days do 6 skilled labours and one non-skilled labour complete the same work?
12. Length of an ant is 4 mm. and length of a grasshopper is 4 cm. Find the ratio of lengths of ant and grasshopper. Length of lizard found in house is 20 mm and length of crocodile found in rivers is 4 metres. What is the ratio of lengths of Lizard and crocodile? Whether ratio of lengths of ant and grass hopper and length of lizard and crocodile are in proportion?

7.3. Application of percentage

We know profit, loss, simple interest related to application of percentage and normal questions related to daily life. Here we will learn about application of percentage on different questions of profit loss, income tax, discount and simple interest.

Harish obtained 15 marks out of 20 in mathematics and 20 out of 25 in science.

- (i) How many percentage did Harish obtain in mathematics?
- (ii) How many percentage did Harish obtain in science?
- (iii) In which subject did Harish obtain more good marks?

We see that :

$$\begin{aligned}\text{(i) Marks in Maths} &= \frac{15 \times 100}{20} \times \frac{1}{100} \\ &= \frac{75}{100} = 75\%\end{aligned}$$

$$\begin{aligned}\text{(ii) Marks in Science} &= \frac{20 \times 100}{25} \times \frac{1}{100} \\ &= 8 \times \frac{1}{100} = \frac{80}{100} = 80\%\end{aligned}$$

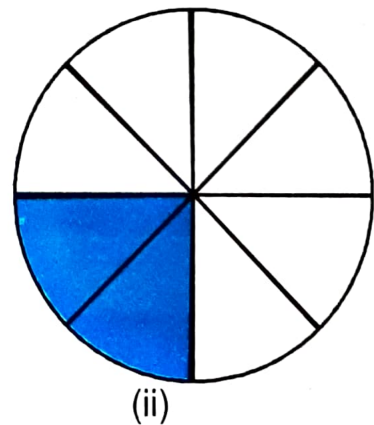
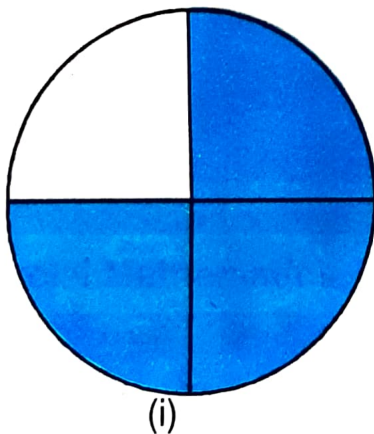
(iii) Harish obtained more good marks in science.

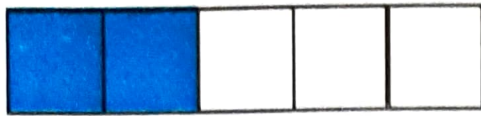
Example 12. Looking at the following figures, find what percentage is coloured out of the total part?

Solution :

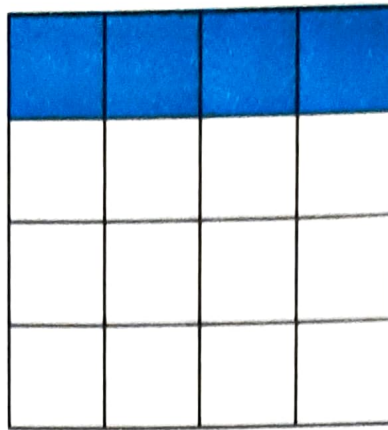
$$\text{Coloured part in figure (i)} = \frac{3}{4} = \frac{3 \times 100}{4 \times 100} = \frac{75}{100} = 75\%$$

$$\text{Coloured part in figure (ii)} = \frac{2}{8} = \frac{2 \times 100}{8 \times 100} = \frac{25}{100} = 25\%$$

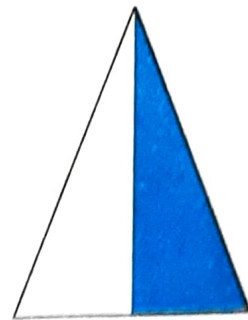




(iii)



(iv)



(v)

$$\text{Coloured part in figure (iii)} = \frac{2}{5} = \frac{2 \times 100}{5 \times 100} = \frac{40}{100} = 40\%$$

$$\text{Coloured part in figure (iv)} = \frac{4}{16} = \frac{4 \times 100}{16 \times 100} = \frac{25}{100} = 25\%$$

$$\text{Coloured part in figure (v)} = \frac{1}{2} = \frac{1 \times 100}{2 \times 100} = \frac{50}{100} = 50\%$$

Example 13. If a 15% of an amount is Rs. 45. Find the amount.

Solution : Let the amount be Rs. x

Hence 15% of $x = 45$

$$\text{or } \frac{x \times 15}{100} = \frac{45}{1}$$

$$\text{or } x \times 15 = 45 \times 100$$

$$\text{or } x = \frac{45 \times 100}{15}$$

$$\text{or } x = 300$$

So required amount = Rs. 300

Example 14. The population of a village is 7500. If 500 persons are illetrate. Find out percentage of literacy in the village.

Solution : Literate people in the village
 = Total person – Illetrate person
 = 7500 – 500
 = 7000

$$\therefore \text{Percentage (\%)} \text{ of literacy in the village} = \left(\frac{7000 \times 100}{7500 \times 100} \right) = 93.33\%$$

Literacy in village = 93.33%

Example 15. Rajesh spends 15% of his salary as house rent as 30% on food grains and 30% on the education of children. If his monthly salary is ₹75,000, find his expenses on room rent, food grains and education of children separately. Find also monthly savings of Rajesh.

Solution : Room rent of Rajesh = 15% of salary
= 15% of ₹75,000
= ₹ $\frac{75,000 \times 15}{100}$
= ₹11250

Expenditure of food grains
= 30% of salary
= 30% of ₹75,000
= ₹ $\frac{75,000 \times 30}{100}$
= ₹22500

Expenditure on education of children
= 20% of salary
= ₹ $\frac{75,000 \times 20}{100}$
= ₹15000

Total monthly savings = ₹75,000 – (11,250 + 22,500 + 15,000) = ₹26,250

Example 16. There are 50% copper, 35% zinc and rest nickel in german silver. If mass of nickel in a piece of german silver is 7.5 gm. Find out total amount of that piece.

Solution : Nickel = 100% – (50 + 35)%

According to question = 15%

Mass of Nickel = 7.5 gm

15% of total mass of piece = 7.5 gm

Total mass of piece $\times \frac{15}{100} = 7.5$ gm

$\therefore$ Total mass of piece = $\frac{7.5 \times 100}{15} = 50$ gm

So the mass of piece of german silver = 50 gm.

Example 17. If total 40% in science and total 35% in English students are failed and 15% failed in both the subjects, in an examination out passing percentage in both subjects ? If the number of passed students is 240, how many students were appeared in the examination?

Solution :

Number of failed students in science = 40%

Number of failed students in English = 35%

Number of failed students in both subjects = 15%

Number of failed students only in Science = $(40 - 15)\% = 25\%$

Number of failed students only in English = $(35 - 15)\% = 20\%$

Total failed students = $(15 + 25 + 20)\% = 60\%$

$\therefore$ Percentage of Total passed students in both subjects = $100\% - 60\% = 40\%$

According to question

Total number of passed students in both subjects = 240

$\therefore$ 40% of total students = 240

$$\text{Total students} \times \frac{40}{100} = 240$$

$$\therefore \text{Total students} = \frac{240 \times 100}{40} = 600$$

$\therefore$ Number of students appeared in exam = 600

Exercise – 7(c)

- Find the quantity, whose :
 (i) $35\% = 280$ (ii) $\frac{3}{5}\% = 90$ (iii) $0.25\% = 600$
- If 5% of a quantity is equal to 15% of Rs. 600. find the quantity.
- 20% voters did not cast votes among 7,500 votes in an election. Find how many persons did cast the votes?
- There are 40% calcium, 12% carbon and 48% oxygen in chalk. Find out mass of each in gm in 1 kg chalk.
- The population of a village is 1200. There are 40% men, 30% women and rest are children. Find their numbers separately.
- There are 20% iron, 38% sand and rest glass in a mixture. If amount of glass is 168 gm in the mixture, find total amount of the mixture.

7. Total 42% in mathematics, 32% in English students were failed in annual examination. If 12% students are failed in both subjects. How many percent of students did pass? If 760 is number of passing students, how many students did appear in the examination?
8. The population of a village is 4000. 500 persons among them are suffered from Jaundice due to use of contaminated water. How many percentage of the people does suffer from jaundice?

7.3.1 Profit – Loss

We have learned about profit and loss in previous class, we know that when there is profit and when there is loss. We have studied about relation of formulae to know profit and loss. Besides this we have learnt to know profit % and loss % among verbal questions related to daily life. Come, now we understand different aspect of profit, loss with application of percentage.

In situation of Profit

$$\text{Profit} = \text{Selling Price} - \text{Cost Price}$$

$$\text{Selling Price} = \text{Cost Price} + \text{Profit}$$

$$\text{Cost Price} = \text{Selling Price} - \text{Profit}$$

$$\text{Profit percent} = \frac{\text{Profit} \times 100}{\text{Cost Price}}$$

In situation of Loss

$$\text{Loss} = \text{Cost Price} - \text{Selling Price}$$

$$\text{Selling Price} = \text{Cost Price} - \text{Loss}$$

$$\text{Cost Price} = \text{Selling Price} + \text{Loss}$$

$$\text{Loss Percent} = \frac{\text{Loss} \times 100}{\text{Cost Price}}$$

Example 18. A shopkeeper sells a sewing machines in ₹1020 after pruchasing in ₹850. Find, how many percent profit did shopkeeper get?

Solution :

$$\text{Cost Price} = ₹850$$

$$\text{Selling Price} = ₹1020$$

$$\text{Profit} = \text{Selling Price} - \text{Cost Price}$$

$$= ₹1020 - ₹850$$

$$= ₹170$$

$$\begin{aligned}\text{Profit percent} &= \frac{\text{Profit} \times 100}{\text{Cost Price}} \\ &= 170 \times \frac{100}{850} = 20\end{aligned}$$

$$\therefore \text{Profit} = 20\%$$

To find selling Price :

Example 19. Ramesh purchased cycle by ₹1200 and sold on 25% profit. Find its selling price.

Solution :

$$\begin{aligned}\text{Cost Price of cycle} &= ₹1200 \\ \text{Profit} &= ₹1200 \times 25\% \\ &= ₹1200 \times \frac{25}{100} \\ &= ₹300\end{aligned}$$

$$\begin{aligned}\therefore \text{Selling Price of cycle} &= \text{Cost Price} + \text{Profit} \\ &= ₹1200 + ₹300 \\ &= ₹1500\end{aligned}$$

Try it :

1. Cost Price of a flower pot is ₹180. If shopkeeper had to sell it with 10% loss. Find its selling price.
2. An object is purchased by ₹60 and sold on 20% profit. Find its selling price.

Example 20. A trader purchased 10 quintal wheat at the rate of ₹1000 per quintal. He had to sell it with a loss of $8\frac{4}{5}\%$ due to attack of weevils in wheat. Find the selling price.

Solution :

$$\begin{aligned}\text{Cost price of 10 quintal wheat} &= ₹10 \times 1000 \\ &= ₹10,000 \\ \text{Loss} &= 8\frac{4}{5}\% \text{ of ₹10,000}\end{aligned}$$

$$= ₹10,000 \times \frac{44}{5 \times 100}$$

$$\text{Loss} = ₹880$$

$$\begin{aligned}\therefore \text{Selling Price of Wheat} \\ &= \text{Cost Price} - \text{Loss} \\ &= ₹10,000 - 880 \\ &= ₹9,120\end{aligned}$$

To know cost price :

Example 21. Dinesh earns a profit of 20%, selling a watch by ₹360. Find cost price of watch.

Solution : Suppose cost price of watch = ₹100

$$\therefore \text{Profit} = ₹20$$

$$\begin{aligned}\text{Selling of Price of watch} &= \text{Cost price} + \text{Profit} \\ &= ₹100 + ₹20 \\ &= ₹120\end{aligned}$$

$$\text{Since when S.P. is ₹120, C.P.} = ₹100$$

$$\therefore \text{When S.P. is ₹1, C.P.} = ₹\frac{100}{120}$$

$$\therefore \text{When S.P. is ₹360, C.P.} = ₹\frac{100 \times 360}{120}$$

$$\therefore \text{Cost price of watch} = ₹300$$

Try :

1. A watch was purchased by ₹400 and sold on profit of 10%. Find its selling price.
2. If a goods of ₹100, is sold by ₹120. What will be percentage of profit on loss?
3. A look is purchased in ₹80, but sold in ₹60. What is percent of profit or loss?

Exercise – 7(d)

1. Mohan having purchased a television by ₹10,200. sold it by ₹11,730 after two years. What is his profit percent or loss percent?
2. A trader purchased ten oxes by ₹3,00,000 and if he had to sell them at the rate of ₹24,000 per ox. Find percentage of profit or loss.
3. A furniture seller having purchased a Almirah by ₹5,000 sells to Rakesh taking $14\frac{1}{2}\%$ profit. In which amount did Rakesh purchase that Almirah?
4. A trader purchased 15 quintal wheat at the rate of ₹980 per quintal on affected by weevils in wheat he had to sell by 5% loss. Find selling price of wheat.
5. 5% profit is earned on selling a pen by ₹21. Find its cost price.
6. Shyam sold his transistor set being in disorder by ₹1280 with loss of 20%. Find the cost price of his transistor set.
7. A milkman sold his two cows at the rate of ₹20,000 per cow. He earns on profit of 5% on a cow and suffers a loss of 10% on another cow. Find total profit or total loss in this trade.

7.3.2. Increase or depreciation in the form of percentage:

We need to know increase or decrease in the form of percentage of a quantity on many occasions. For example the population of a village increases to 6312 from 5260. In such circumstances it is easy to understand for example we say that the population of a village in the form of percentage is increased by 20%.

In which way we may represent increase or decrease of a quantity in the form of total quantity. Come consider on the following example.

Example 22. Cricket team of a school obtained win in 8 games out of 10 games this year. While on previous year obtained win 6 times out of 10. (A) What is increase in percentage of this year in comparison to that of previous year? (B) What percentage of winning did increase in comparison to previous year?

Solution :

$$\begin{aligned} \text{(A)} \quad \text{Increase in number of wins this year} &= \left(\frac{8}{10} - \frac{6}{10} \right) \times 100 \\ &= 20\% \\ \text{(B)} \quad \text{Increase in number of win} &= 8 - 6 \\ &= 2 \end{aligned}$$

$$\begin{aligned}
 \therefore \text{Percent increase} &= \frac{\text{Growth in number of win}}{\text{Number of wins in previous year}} \times 100 \\
 &= \frac{2}{6} \times 100 \\
 &= 33\frac{1}{3} \\
 &33\frac{1}{3} \% \text{ increase in win.}
 \end{aligned}$$

Example 23. 600 patients of Covid-19 were admitted in April 2020 in a hospital and only 400 patients were admitted in June 2020. Number of patients in April 2020 in comparison to June 2020, is there any increase or decrease and by what percent?

Solution : In beginning *i.e.* in April 2020 , number of patients = 600

Change in number = decrease in number of patients = 600 – 400 = 200

$$\begin{aligned}
 \therefore \text{Decrease Percent} &= \frac{\text{Change in quantity}}{\text{Initial quantity}} \times \frac{100}{100} \\
 &= \left(\frac{200}{600} \times \frac{100}{100} \right) = \left(\frac{200}{6} \times \frac{1}{100} \right) \\
 &= 33\frac{1}{3} \% \\
 \text{So, percentage of decrease} &= 33\frac{1}{3} \%
 \end{aligned}$$

Try :

1. Find decrease or increase percent :

- (i) Rate of sugar becomes ₹16 per kg in certain time to ₹15 kg.
- (ii) Consumption of sugar in a family was 15 kg per month and with increase in number of members of the family increases in consumption of sugar 20 kg.

2. (i) Price of 1 kg cashew becomes ₹425 from ₹ 400. What will be percentage of increasment ?
- (ii) Explain the meaning of 112 percent.

7.3.3 Discount :

We see that shopkeepers offer some rebates to attract the consumers on price of some selling goods. this rebate is called Discount. Printed price on the article is called Marked Price (M.P.) The selling price at which the article is sold to the customer after deducting the discount from the marked price is called the Net Price (N.P.) or Selling Price (S.P.).

A statement 20% relate on khadi was written on shop. It means that ₹80 is to be payed on a goods printed price as ₹100. Here discount of ₹20 is given on an article of ₹100.

- **Printed price on an article is called Market Price.**
- **Rebate given on marked price on an article is called as discount.**
- **Discount is given an only market Price.**
- **In which amount (Rupees), article is sold, that is called Selling Price of the article that is Selling Price = Marked Price – Dicount**
- **Dicount Percentage = $\frac{\text{Discount} \times 100}{\text{Marked Price}}$**

Example 24. Salama purchased a sari of marked price ₹600 on a rebate of 25% in sales of sari. In which amount did she purchase that sari?

Solution :

Marked Price of Sari = ₹600

Rebate or discount = 25%

Amount of discount = 25% of ₹600 = $\frac{25}{100} \times 600 = 150$

∴ Selling Price of Sari = Marked Price – Dicount
= ₹600 – 150
= ₹450

So, Salama purchased that sari by ₹450.

Example 25. Marked price of a shirt is ₹50 and it was available in ₹45. What is discount in percentage given on it?

Solution : Marked price of the shirt = ₹50

Selling Price = ₹45

Discount = Marked Price – Selling Price

$$= ₹50 - \text{Rs. } 45$$

$$= ₹5$$

$$\% \text{ of Discount} = \frac{5}{50} \times 100 = 10\%$$

Therefore, rate of discount = 10%

Example 26. Find marked price, when selling price and discount are ₹1920 and 4% respectively.

Solution : Let marked price = ₹100
 Discount = 4%
 Selling price = ₹(100 - 4)
 = ₹96

$$\therefore \text{ Selling price is ₹96, marked price} = ₹100$$

$$\therefore \text{ Selling price is ₹1, marked price} = ₹ \frac{100}{96}$$

$$\therefore \text{ Selling price is ₹1920 marked price} = ₹ \frac{100 \times 1920}{96}$$

$$= ₹2000$$

Try :

Fill in blanks in the following table making in your answer book :

S.No.	Marked Price	Selling Price discount	Amount of discount	Rate of
(i)	₹200	₹150	₹50	
(ii)	₹400	₹320		
(iii)	₹250		Rs. 100	
(iv)		₹160		20%
(v)	₹600			25%

7.3.4 Simple Interest

We obtained general knowledge of simple interest in previous class. Now we will solve some other questions based on the following formulae.

$$\text{Simple interest} = \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}; \quad \text{Principal} = \frac{\text{Interest} \times 100}{\text{Rate} \times \text{Time}}$$

$$\text{Rate} = \frac{\text{Interest} \times 100}{\text{Principal} \times \text{Time}}$$

$$\text{Time} = \frac{\text{Interest} \times 100}{\text{Principal} \times \text{Rate}}$$

$$\text{Compound} = \text{principal} + \text{intrest}$$

Example 27. Find simple interest of ₹400 at the rate of $7\frac{1}{2}\%$ per annum for $3\frac{1}{2}$ years.

Solution : Principal = ₹400, Rate = $7\frac{1}{2}\%$ annual = $\frac{15}{2}\%$ per annum,

$$\text{Time} = 3\frac{1}{2} \text{ years} = \frac{7}{2} \text{ years.}$$

$$\begin{aligned} \text{Simple interest} &= \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100} \\ &= ₹ \frac{400 \times 15 \times 7}{100} \\ &= ₹105 \end{aligned}$$

Example 28. Rate of simple interest is 4% per annum in savings bank account of a financial company. Seema deposited ₹5,000. How much interest and amount will she get in $2\frac{1}{2}$ years.

Solution : Principal = ₹5,000, Rate = 4% annually, Time = $2\frac{1}{2}$ years = $\frac{5}{2}$ years.

$$\begin{aligned} \text{Simple interest} &= \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100} \\ &= ₹ \frac{5000 \times 4 \times 5}{100 \times 2 \times 2} \\ &= ₹500 \end{aligned}$$

$$\begin{aligned} \therefore \text{Amount} &= \text{Principal} + \text{Interest} \\ &= ₹5000 + ₹500 \\ &= ₹5500 \end{aligned}$$

Example 29. Simple interest of a sum becomes ₹121 at the rate of $2\frac{1}{5}\%$ per annum for 2 years. Find the principal.

Solution : Rate = $2\frac{1}{5}\% = \frac{11}{5}\%$ per annum,
Time = 2 years, Interest = ₹121

$$\text{Principal} = \frac{\text{Interest} \times 100}{\text{Rate} \times \text{Time}}$$

$$\begin{aligned}
 &= ₹ \frac{121 \times 100}{5} \times 2 \\
 &= ₹ \frac{121 \times 100 \times 5}{11 \times 2} = ₹2750
 \end{aligned}$$

•Look :

Shambhu pays ₹640 simple interest on a loan of ₹5000 after 2 years. Find % rate of interest. Solution of this question is given in following two methods. Look with attention and recognize applied methods.

Solution :	Solutions :
$\text{Interest} = \frac{P \times R \times T}{100}$ $\frac{5000 \times R \times 2}{100} = 640$ $R = \frac{640 \times 100}{5000 \times 2}$ $= \frac{32}{5}$ $= 6.4$ ∴ Rate of interest = 6.4 % annually	∴ Interest of 2 years = ₹640 ∴ Interest of 1 year = $\frac{640}{2} = ₹320$ ∴ Interest of 1 year of ₹5000 = ₹320 ∴ Interest of 1 year of ₹1 = $\frac{320}{5000}$ ∴ Interest of 1 year of ₹100 = $\frac{320 \times 100}{5000}$ $= \frac{32}{5} = 6.4$ ∴ Rate of interest = 6.4% per annum

Try :

1. What will the simple interest of ₹100 for 2 years at the rate of 3% per annum.
2. Find interest and amount of principal ₹400 for 3 years with rate of interest 5% per annum.
3. For which principal will simple interest be ₹45 for 2 years at the rate of 5% per annum?
4. For which percent rate per annum will simple interest be ₹60 on principal ₹200 for 3 years?
5. In how much time will simple interest ₹90 on principal ₹300 at the rate of 6% per annum?

Exercise – 7(e)

1. Find simple interest on ₹800 for 5 years at the rate of $3\frac{1}{2}\%$ annually.
2. Find simple interest and amount on ₹1,500 for 6 months at the rate of 12% per annum.
3. Determine interest and amount on ₹1,600 for $3\frac{1}{2}$ years at the rate of $5\frac{1}{2}\%$ per annum.
4. Simple interest of the principal becomes ₹150 at the rate of $6\frac{1}{4}\%$ per annum for 3 years. Find the principal.
5. Interest of ₹7,200 for 3 years is 1080. Calculate rate of interest.
6. In $6\frac{1}{4}$ years the amount of the principal ₹800, becomes ₹1150. Find the rate of interest %.
7. In how much time will interest be ₹4,125 of ₹7,500 at the rate of 11% per annum.
8. The amount of ₹1200 in $5\frac{1}{2}$ years becomes ₹1860. Find the rate of interest.
9. In how much time ₹350 at the rate of $2\frac{1}{2}\%$ will become ₹385?
10. In how much time ₹200 will become its three times at the rate of 10% per annum?
11. Marked price of an article is ₹500. It is sold on discount of 10%. Find the selling price of the article.
12. Selling price of a watch is ₹420. It is sold on discount of 25%. Find the marked price of the watch.
13. Marked price of sewing machine is ₹830. If shopkeeper offers 20% discount to the customer. Find the selling price of the machine.
14. Marked price of a book is ₹75 and shopkeeper sold it by ₹60. Which percentage of rebate does he offer?
15. Marked price of a radio is ₹500 and is available to customer by ₹450. Explain, which percent of discount is given on it?
16. The selling price of a box is ₹1400 and shopkeeper offers 30% discount to customers. Find marked price of the box.

7.4 Compound Interest

We know that :

$$(i) \text{ Simple interest} = \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$$

$$(ii) \text{ Amount} = \text{Principal} + \text{Interest}$$

Observe the following tables :

Table 1 : Table of simple interest and amount of ₹1000 at the rate of 10% per annum for 1 year and 2 years.

Principal (₹)	Rate (%) per annum)	Time (year)	Interest (₹)	Compound (₹)
1000	10	1	100	1100
1000	10	2	200	1200

- (i) What is the interest after 1 year?
- (ii) What is the amount after 1 year?
- (iii) What is the interest after 2 years?
- (iv) What is the amount after 2 years?

Mohan took a loan of ₹1000 from the bank at the rate of 10% per annum.

Interest become ₹100 after 1 year.

Due to non-deposit the loan amount after 1 year, Mohan had a debt of ₹1000 and ₹100 (of interest) added to loan, thus becomes ₹(1000 + 100) = ₹1100. Therefore, Mohan will have to pay interest on ₹1100 to bank for second year, which is represented in the following table.

Table 2 :

Principal (₹)	Rate (%) per annum	Time (year)	Interest (₹)	Amount (₹)
1000	10	1 (First year)	100	1100
1100	10	2 (Second year)	110	1210

- (i) What is the interest of first year?
- (ii) What is the amount in the end of first year?
- (iii) What is the Principal of second year?
- (iv) What is the amount in the end of second year?

We see from the table (2) that amount of ₹1000 after 2 years = ₹1210

Interest of 2 years of ₹1000 = Compound – Principal

$$= ₹1210 - ₹1000$$

$$= ₹210$$

This interest is greater than interest of 2 years as showing in table (1) by ₹(210 – 200) = ₹10

This amount is interest of 1 year of interest ₹100 with rate 10% p.a.

Thus in table (2) calculation of interest on interest is done.

Example 30. Seema deposits ₹500 in savings bank account of a post office. If rate of interest 5% p.a. and calculation of interest on annual remainder what is amount of interest after 2 years? What is difference between this interest and simple interest for 2 years?

Solution : Interest after 1 year = ₹ $\frac{500 \times 5 \times 1}{100} = ₹25$

$$\text{Amount after 1 year} = ₹(500 + 25) = ₹525$$

$$\text{Principal for second year} = ₹525$$

$$\text{Interest of 2nd year} = ₹ \frac{525 \times 5 \times 1}{100} = ₹26.25 = ₹551.25$$

$$\text{Amount in the end of 2nd year} = ₹(525 + 26.25)$$

$$\text{Interest after 2 years} = ₹551.25 - ₹500 = ₹51.25$$

$$\text{Simple interest after 2 years} = ₹ \frac{500 \times 5 \times 2}{100} = ₹50.00$$

$$\text{Excess interest} = ₹(51.25 - 50.00) = ₹1.25$$

This interest is interest on interest ₹25 of first year.

$$\text{Here calculation of interest on interest} = ₹ \frac{25 \times 5 \times 1}{100} = ₹1.25$$

- What will be interest after 2 years of ₹200 at rate of 10% p.a. you will see, that interest of second year will be calculated on interest of first year also. This system to calculate interest is different from simple one. This interest is called **compound interest** and amount thus obtained is called compound amount.

From observations of both tables, we reach on following conclusions.

- For one year on equal principal equal time and equal rate of interest
Compound interest = Simple interest
- In calculation of compound interest amount of first year becomes principal for second year. Similarly it is done for years ahead.
- Compound interest = Compound amount – Principal

Example 31. Find compound interest of 2 years of ₹400 at the rate of 5% p.a.

Solution :

Principal of first year	= ₹400
Interest of first year	$= \frac{P \times R \times T}{100} = ₹ \frac{400 \times 5 \times 1}{100} = ₹ 20$
Amount after 1 year	$= (₹400 + 20)$ $= ₹420$
Interest of 2nd year	$= ₹ \frac{420 \times 5 \times 1}{100} = ₹ 21$
Amount of 2nd year	$= ₹(420 + 21)$ $= ₹441$
Compound interest of 2 year	$= ₹(441 - 400)$ $= ₹41$

Example 32. Calculate the difference between compound interest and simple interest for 2 years of ₹5000 at the rate of 4% per annum.

Solution :

Principal of first year	= ₹5,000
Interest of first year	$= ₹ \frac{5000 \times 4 \times 1}{100}$ $= ₹200$
Amount in end of first year	$= ₹(5000 + 200)$ $= ₹5200$
Principal for second year	= ₹5200
Interest of 2nd year	$= ₹ \frac{5200 \times 4 \times 1}{100}$ $= ₹208$

$$\begin{aligned}\text{Amount in the end of 2nd year} &= ₹5200 + ₹208 \\ &= ₹5408\end{aligned}$$

$$\begin{aligned}\therefore \text{Compound interest of 2 years} &= ₹(5408 - 5000) \\ &= ₹408\end{aligned}$$

$$\text{Simple interest of 2 years} = \text{Rs. } \frac{5000 \times 4 \times 1}{100} = \text{Rs. } 400$$

$$\therefore \text{Difference between the two} = \text{Rs. } (408 - 400) = \text{Rs. } 8$$

Example 33. Sheela deposited ₹1200 in bank. Find out compound interest for 3 years if rate of compound interest is 10% per annum.

Solution :

$$\begin{aligned}\text{Principal of first year} &= ₹1200 \\ \text{Interest of first year} &= ₹ \frac{1200 \times 10 \times 1}{100} \\ &= ₹120 \\ \text{Amount in end of first year} &= ₹(1200 + 120) = ₹1320 \\ \text{Principal for 2nd year} &= ₹1320 \\ \text{Interest of second year} &= ₹ \frac{1320 \times 10 \times 1}{100} \\ &= ₹132 \\ \text{Amount in end of second year} &= ₹1320 + ₹132 = ₹1452 \\ \text{Principal for 3rd year} &= ₹1452 \\ \text{Interest of 3rd year} &= ₹ \frac{1452 \times 10 \times 1}{100} \\ &= ₹145.20 \\ \text{Amount in end of 3rd year} &= ₹1452 + ₹145.20 \\ &= ₹1597.20 \\ \therefore \text{Compound interest} &= ₹(1597.20 - 1200) \\ &= ₹397.20\end{aligned}$$

Try :

Fill in the blanks in following table in your exercise book:

Principal (₹)	Rate (% per annum)	Time (year)	Interest (₹)	Amount (₹)
200	6	1	12	—
300	5	2	—	330
450	4	3	—	—

Exercise – 7(f)

1. Choose right option of following questions :

(a) Simple interest of ₹150 for 1 year at the rate of 4% p.a. will be :

- (i) ₹2 (ii) ₹4 (iii) ₹6 (iv) ₹7

(b) Simple interest of Rs. 200 for 2 years at the rate of 5% will be :

- (i) ₹10 (ii) ₹20 (iii) ₹30 (iv) ₹40

- What will be compound interest of ₹800 at the rate of 5% pa. for 2 years?
- Find compound interest of ₹1250 at the rate of 4% p.a. for 2 years.
- A loan of ₹2400 at the compound rate of interest of 10% p.a. for two years, was paid. Find the compound interest.
- Find difference between compound and simple interest of ₹4,000 at the rate of 10% for 3 years.
- Find difference between compound interest and simple interest of ₹5,000 at the rate of 8% p.a. for 3 years.
- Abdul deposited ₹1500 in savings account of bank. What interest did he get after 2 year, if bank provides 4% p.a. compound interest?
- find compound interest of ₹8000 for 3 years at the rate of 5% per annum.
- Find compound amount of ₹1600 at the rate of 12.5% per annum for 2 years.

7.4.1 To find compound amount and compound interest by unitary method :

In this method compound amount of a principal amount may be calculated after finding the compound amount of ₹1.

- To find compound amount for 3 years at the rate of 10% per annum of ₹1.

Principal for first year = ₹1

$$\therefore \text{Interest of 1 year of ₹100} = ₹10$$

$$\therefore \text{Interest of 1 year of ₹1} = ₹\frac{10}{100} = \text{Rs. } \frac{1}{10}$$

$$\text{Amount in end of first year} = ₹\left(1 + \frac{1}{10}\right)$$

$$\therefore \text{Principal for 2nd year} = ₹\left(1 + \frac{1}{10}\right)$$

$$\text{On ₹1 principal in end of 1 year compound amount} = ₹\left(1 + \frac{1}{10}\right)$$

$$\text{On principal } \left(1 + \frac{1}{10}\right) \text{ compound amount in end of 1 year}$$

$$= ₹\left(1 + \frac{1}{10}\right) \times \left(1 + \frac{1}{10}\right)$$

$$= ₹\left(1 + \frac{1}{10}\right)^2$$

$$\text{Principal for 3rd year} = ₹\left(1 + \frac{1}{10}\right)^2$$

$$\text{In similar way compound amount for 3rd year} = ₹\left(1 + \frac{1}{10}\right)^3$$

With help of above find compound amount in the end of 4 years.

$$\therefore \text{Compound amount of ₹1 for } n \text{ years} = ₹\left(1 + \frac{1}{10}\right)^n$$

$$\text{and compound amount of principal ₹}P \text{ for } n \text{ years} = ₹P\left(1 + \frac{1}{10}\right)^n$$

To know compound amount of n years of ₹1, power n is used on compound amount of ₹1 for 1 year. Required compound amount is found by multiplying amount of principal to it.

Exempl 34. Find compound amount and compound interest of ₹800 at the rate of 5% per annum for 2 years using unitary method.

Solution : $\therefore$ Interest of ₹100 of 1 year = ₹5

$$\therefore \text{Interest of ₹1 of 1 year} = ₹ \frac{5}{100} = ₹ \frac{1}{20}$$

$$\begin{aligned}\therefore \text{Amount of 1 year of ₹1} &= ₹ \left(1 + \frac{1}{20} \right) \\ &= ₹ \frac{21}{20}\end{aligned}$$

$$\therefore \text{Compound amount of Rs. 1 for 2 years} = ₹ \left(\frac{21}{20} \right)^2$$

$$\therefore \text{Compound amount of ₹800 of 2 years} = \text{Rs. } \left(\frac{21}{20} \right)^2 \times 800$$

$$= ₹ \frac{21}{20} \times \frac{21}{20} \times 800$$

$$= ₹882$$

$$\begin{aligned}\therefore \text{Compound interest} &= \text{Compound amount} - \text{Principal} \\ &= ₹(882 - 800) \\ &= ₹82\end{aligned}$$

Example 35. Find out compound amount and compound interest of ₹5000 at the rate of 10% per annum interest after 3 years?

Solution : $\therefore$ Interest of ₹100 for 1 year = ₹10

$$\therefore \text{Interest of ₹1 for 1 year} = ₹ \frac{10}{100} = ₹ \frac{1}{10}$$

$$\text{or Amount of ₹1 for 1 year} = ₹ \left(1 + \frac{1}{10} \right) = ₹ \frac{11}{10}$$

$$\text{Similarly compound amount of ₹1 for 3 years} = ₹ \left(\frac{11}{10} \right)^3$$

$$\therefore \text{Compound amount of ₹5000 for 3 years} = \left(\frac{11}{10} \right)^3 \times 5000$$

$$= ₹ \frac{11 \times 11 \times 11}{10 \times 10 \times 10} \times 5000$$

$$= ₹ \frac{1331}{1000} \times 5000$$

$$= ₹6655$$

$$\begin{aligned} \text{and Compound interest} &= \text{Compound amount} - \text{Principal amount} \\ &= ₹(6655 - 5000) \\ &= ₹1655 \end{aligned}$$

Exercise – 7(g)

Solve by the unitary method :

1. Find compound interest of ₹500 at the rate of 10% per annum for 2 years.
2. Find compound interest of ₹400 at the rate of 5% per annum for 2 years.
3. What will be compound amount of ₹1000 at the rate 10% per annum for 3 years?
4. Find the compound amount of ₹8000 at the rate of 10% per annum for 3 years?
5. Find the compound amount and compound interest of ₹3000 at the rate of 10% interest per annum for 3 years.
6. Find compound interest of ₹600 at the rate of 5% per annum for 2 years.
7. Find compound interest of ₹6250 at the rate of 4% per annum for 2 years.
8. Naseem deposited ₹5000 in fixed deposit scheme in his nearby rural bank at the rate of 10% per annum; compound Interest for 3 years. How much rupee will he get after two years.
9. Hemlata deposited ₹2500 in savings account of post office. How much money will she get after two years, if rate of compound interest is 4% per annum?
10. David took a loan of ₹1600 at rate of compound interest 2.5% per annum. 2 years later he paid total loan amount. Explain, how much rupee had he to pay and how much rupees had to pay as interest?
11. Dimpal deposited ₹5120 in a bank for 2 years at the rate of compound interest $6\frac{1}{4}\%$ per annum. How much rupees will she get after the duration?

5.4.2 Formula of Compound Amount and its application

First method :

To find compound amount of ₹200 at the rate of 7% per annum for 1 year, 2 years and 3 years

$$\therefore \text{Interest of ₹100 of year} = ₹7$$

$$\therefore \text{Interest of ₹1 of 1 year} = ₹\frac{7}{100}$$

$$\therefore \text{Amount of ₹1 of 1 years} = ₹\left(1 + \frac{7}{100}\right)$$

$$\therefore \text{Amount of ₹200 of 1 year} = ₹200\left(1 + \frac{7}{100}\right)$$

$$\therefore \text{Amount of ₹200 of 2 years} = ₹200\left(1 + \frac{7}{100}\right)^2$$

$$\text{and Amount of ₹200 of 3 years} = ₹200\left(1 + \frac{7}{100}\right)^3$$

Thus we may calculate that :

- Compound amount of ₹500 at the rate of 8% per annum after 5 years

$$= 500\left(1 + \frac{8}{100}\right)^5$$

- Compound amount of ₹1200 at the rate of 15% per annum after 5 years

$$= ₹1200\left(1 + \frac{15}{100}\right)^5$$

Second Method :

$$\text{Suppose Principal} = ₹ P$$

$$\text{Interest rate} = r \%$$

$$\therefore \text{Simple interest of 1 year} = \frac{p \times r \times 1}{100}$$

$$= \frac{p \times r}{100}$$

$$\text{Compound Amount in end of one year} = p + \frac{pr}{100}$$

$$= p \left(1 + \frac{r}{100} \right)$$

$$\text{Principal of second year} = p \left(1 + \frac{r}{100} \right)$$

$$\text{Interest of 2nd year} = p \left(1 + \frac{r}{100} \right) \times \frac{r}{100}$$

$$\begin{aligned} \text{Amount in end of second year} &= p \left(1 + \frac{r}{100} \right) + p \left(1 + \frac{r}{100} \right) \times \frac{r}{100} \\ &= p \left(1 + \frac{r}{100} \right) \left[1 + \frac{r}{100} \right] \\ &= p \left(1 + \frac{r}{100} \right)^2 \end{aligned}$$

$$\text{Principal for 3rd year} = p \left(1 + \frac{r}{100} \right)^2$$

$$\text{Interest of 3rd year} = p \left(1 + \frac{r}{100} \right)^2 \times \frac{r}{100}$$

$$\begin{aligned} \text{Amount in the end of 3rd year} &= p \left(1 + \frac{r}{100} \right)^2 \times \frac{r}{100} + p \left(1 + \frac{r}{100} \right)^2 \\ &= p \left(1 + \frac{r}{100} \right)^2 \left(1 + \frac{r}{100} \right) \\ &= p \left(1 + \frac{r}{100} \right)^3 \end{aligned}$$

If the number of years = n
and Compound amount after n years = A

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

Example 36. Find compound amount and compound interest of ₹3000 at the rate of 10% per annum after 3 years.

Solution : Principal (P) = ₹3000, Rate (r) = 10%, Time (n) = 3 years

∴ Compound amount

$$\begin{aligned} A &= P \left(1 + \frac{r}{100} \right)^n \\ &= ₹ 3000 \left(1 + \frac{10}{100} \right)^3 \\ &= ₹ 3000 \left(1 + \frac{1}{10} \right)^3 \\ &= ₹ 3000 \left(\frac{11}{10} \right)^3 \\ &= ₹ 3000 \times \frac{11}{10} \times \frac{11}{10} \times \frac{11}{10} \\ &= ₹ 3000 \times \frac{1331}{1000} \\ &= ₹ 3993 \end{aligned}$$

$$\begin{aligned} \therefore \text{Compound interest} &= ₹3993 - ₹3000 \\ &= ₹993 \end{aligned}$$

Example 37. Abdul deposited ₹2000 in a bank. He had to draw full amount after 2 years to purchase cow. If rate of interest is 5% per annum compound, what amount did he got?

Solution : $P = ₹2,000$, $r = 5\%$, $n = 2$ years.

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

$$\begin{aligned}
\text{Compound amount} &= ₹ 2000 \left(1 + \frac{5}{100} \right)^2 \\
&= ₹ 2000 \left(1 + \frac{1}{20} \right)^2 \\
&= ₹ 2000 \left(\frac{21}{20} \right)^2 \\
&= ₹ 2000 \times \frac{21}{20} \times \frac{21}{20} \\
&= ₹ 2000 \times \frac{441}{400} \\
&= ₹ 2205
\end{aligned}$$

Example 28. Suman took loan of ₹16000 at the rate of $12\frac{1}{2}\%$ per annum on compound interest from a society for repairing of her house. 2 years later she deposited full loan. Calculate the deposited amount.

Solution : $P = ₹16,000$, $r = 12\frac{1}{2}\% = \frac{25}{2}\%$, $n = 2$ years.

$$\begin{aligned}
A &= P \left(1 + \frac{r}{100} \right)^n \\
&= ₹ 16000 \left(1 + \frac{25}{200} \right)^2 \\
&= ₹ 16000 \left(\frac{9}{8} \right)^2 \\
&= ₹ 16000 \times \frac{9}{8} \times \frac{9}{8} \\
&= ₹ 16000 \times \frac{81}{64} \\
&= ₹ 20250
\end{aligned}$$

Amount deposited = ₹20,250

Exercise – 7(h)

Find compound amount with application of formula :

1. Compound amount of ₹400 of 2 years at the rate of 5% per annum.
2. Compound amount of ₹500 of 2 years at the rate of 10% per annum.
3. Compound interest of ₹625 of 2 years at the rate of 4% per annum.
4. Compound interest of ₹1000 of 3 years at the rate of 10% per annum.
5. Compound interest of ₹16,000 of 3 years at the rate of 5% per annum.
6. Manoj deposited ₹2500 in his savings account of bank. What interest does he get after 2 years at rate of 4% per annum compound interest in savings account?
7. Fatima deposited ₹1250 in fixed deposit account of Post Office for 2 years. If rate of interest be 8% per annum compound. Find compound amount and compound interest after 2 year.
8. George took loan of ₹8000 for 2 years at the rate of 15% per annum compound interest from a financial company. Which amount will he pay to company?
9. Tanu deposited ₹2000 in a financial company. If the company offers 10% per annum compound interest. What amount did she get after 3 years?
10. Aneeta deposited ₹2500 in a nationalised bank. Which amount did she get after 2 years, if bank offers 8% per annum compound interest?

7.5 Tax :

Different works in the interest of common people for example, keeping of army due to security of the country, construction of road and bridge, to make arrangement for medical treatment of common citizens and education etc. are done by the every country. **Money** is require for a above works. Collection of money is done imposing tax. Thus system of money collection is called as Tax system.

If country/state does not realise tax from the people, there will be no money in treasury of country/state and country/state will not be able to carry her responsibilities.

In our country, central and state government both do different public welfare work in their area/field The field work of central and state Government are divided separately. On state land road, bridge, dam, school, hospital, construction of Government building police administration etc. are managed by State Government. Revenue is obtained by imposing tax on different goods at state level, like land revenue, vat, sales tax etc.

Similarly money is collected by tax of different types like income tax, excise duty, custom duty, service tax by Central Government for keeping of Army, higher education institutions (IIT, NIT, Central University) judiciary etc.

Type of tax :

Tax are mainly of two types.

Direct Tax

Tax imposed on an individual or group of persons, which affects them directly is called direct tax. e.g. Income Tax, Wealth Tax, Gifts tax etc. Income tax is to be paid by those all persons and commercial establishment/firm, whose annual income exceeds from desided limits.

Rate of income tax depends on level of income. Rate of income tax at present is as follows:

- | | |
|--|--------|
| A. Income Tax upto annual income ₹2,50,000 | = zero |
| B. Income Tax between, annual income from ₹2,50,000 to ₹5,00,000 | = 5% |
| C. Income Tax on income from ₹5,00,000 to ₹10,00,000 | = 20% |
| D. Income Tax on annual income beyond ₹10,00,000 | = 30% |

Indirect tax

Like excise duty, service tax, etc. In system of this type of tax, responsibility of payment of tax lie on seller of article or service provider but tax is mixed in price of the article or service. In this way purchaser has to pay indirect tax along with price of the article or service to seller. Thus load of in direct tax is to be taken by last consumer (purchaser), who use article or service.

Realisation of Indirect tax is easier but poor/rich all have to pay it. Part of indirect tax is much more in total tax (direct and indirect).

Good and Service Tax (G.S.T.) :

Central Government imposed a new indirect tax, which is known as G.S.T. (Goods and Service Tax) on 1st July, 2017, on a abolishing previous indirect taxes like Excise Duty, Service Tax and Sale Tax of State Government. Its (GST) rate are 5%, 12%, 18% and 28% on different goods. Central Government used to revise these rates time to time.

Example 29. Annual income of Rakesh's father is ₹ 2,58,000. If income upto 2,50,000 be free from income tax. How much income tax has he to pay at the rate of 10%?

Solution :

Annual income	= ₹2,58,000
Income free from income tax	= ₹2,50,000
Income on which tax to be paid	= ₹2,58,000 – ₹2,50,000
	= ₹8,000
Payable Income Tax	= 10% of ₹8,000
	$= ₹ \frac{8000 \times 10}{100}$
	= ₹800

Example 40. Marked price of a pair of shoes is ₹1500. If 18% G.S.T. is to pay on it. How much money will customer pay to purchase it?

Solution :

Marked price of shoes	= ₹1500
GST	= 18%
Payable GST	= 18% of ₹1500
	$= 1,500 \times \frac{18}{100}$
	= ₹270

$\therefore$ Payable price of Shoes = Marked Price + GST

$$= ₹(1500 + 270)$$

$$= ₹1770$$

Exercise – 7(i)

1. What is limit of income free from tax?
2. The monthly income of Keshav is ₹20,000. Explain, whether annual income of Keshav is taxable or not?
3. Annual income of Shyam's father is ₹3,60,000. If upto ₹2,50,000 is free from income tax. How much income tax will he pay at rate of 5%?
4. What do you mean by G.S.T.?
5. The price of a pair of a Sandle is ₹1000. If 18% G.S.T. on it is to pay. How much money will customer pay for purchasing the Sandle.

6. Pratibha purchases a table by ₹24,000 in which 12% G.S.T. is included. Find marked price of the table.
7. Vishal invited his 20 friends on food in a hotel on his birthday. Expenditure on food was ₹5,000. Besides it he has to pay 18% G.S.T. What is expenditure on food per friend of Vishal ?

Ability Exercise - 7

Write, choosing right option of following answer of question from 1 to 4 in your exercise book.

1. If a motor car covers 45 km per hour, it will cover the distance in 1 second.
 (a) 45 m (b) 40 m
 (c) 12.5m (d) 12.5 km
2. If 6 men do a work in 4 days, 3 men do the same work :
 (a) in 21 days (b) in 6 days
 (c) in 8 days (d) in 18 days
3. If Ram can do $\frac{1}{4}$ part of a work in 5 days. He will do the complete work.
 (a) in 20 day (b) in $\frac{5}{4}$ days
 (c) in 5 days (d) in 80 days
4. 3 labours can do white washing of a house in 20 days. If white washing is to be completed in 6 days, number of labours required will be :
 (a) 20 labours (b) 10 labour (c) 6 labour (d) 30 labour
5. A man expends 80% of monthly salary. If his monthly savings is ₹1200. How much is his monthly salary?
6. Length of a train is 450 m. It crosses an electric pole in $22\frac{1}{2}$ seconds. Find the speed of train in km per hour.
7. Two cyclists go in opposite direction from a fixed place with speed of 10 km per hour and 12 km per hour respectively what will be the distance between them after 5 hours.
8. There are 55% boys in a school. If number of girls is 900. Find the number of boys.
9. Total 45% students in mathematics 25% students in science failed. If 15% are failed in both subjects. What is percentage of successful students?
10. 9% loss occurred in selling a radio by ₹364. Find the cost price of the radio.
11. What is selling price of a sari of marked price ₹720 after rebate of 20%?

12. Kiran deposited ₹1600 in savings bank account in the Post Office. She did not withdraw any amount upto 3 years. She withdraw the whole amount after 3 years. Tell how much amount of interest did she get if rate of interest in post office be 5% per annum compound interest?
13. Mazid deposited ₹5000 in fixed deposit account of a post office for 2 years. How much rupee did he get, if rate of compound interest is 8% per annum ?

We learnt in this Unit :

1. The necessary condition of four quantities in proportion :
multiplication of **external terms** = multiplication of **internal terms**
2. When two quantities x and y are related in such away that there is increase in quantity y in the same ratio due to increase in x , or there will be decrease in quantity y in the same ratio due to decrease in x . These quantities are called indirected proportion. During solving these, direction of arrows are made in same direction as $\downarrow\downarrow$.
3. When four quantities are in reverse proportion last two quantities are wirtten in opposite form.
4. There be easy to solve the questions by representing arrows in opposite direction ($\uparrow, \downarrow$) of both quantities of reverse proportion.
5. Exceptionally rule of proportion or unitary are not used in age related operations and some special operations like to dry in sun shine, to see by eye, to walk from physical organs.
6. Percentage is a method of comparison. For percentage value on per one 100 is to be known like meaning of $\frac{5}{100}$ is from 5 on each 100.
7. There are vast use of percent in our daily life :
 - (i) When we know percent of any quantity. We may know whole quantity.
 - (ii) If we are given ratio of parts of a quantity. We may also change it in percent.
 - (iii) Decrease or increase of a quantity may also be shown in percent.
 - (iv) Profit or loss in purchasing selling of an article may also be shown in percent.
 - (v) To calculation of interest on borrowed money, its rate is given almost in percent.
8. Discount is related on marked price of an article. It is found in percent.
9. There is also common use of percent for income tax and sale tax.

10. The formula to find simple interest $\frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100}$ is used.
11. Simple interest taken on a principal at the equal rate of interest for each year is equal.
12. There are also tradition to take interest on interest in other tradings along with bank. Calculation from this method is called compound calculation and interest obtained is compound interest. Thus compound amount is obtained by adding the compound interest in principal.
13. From unitary law method we find the value of required quantity from many to unit system.
14. Formula of compound amount is $A = P \left(1 + \frac{r}{100} \right)^n$
 Where $A = \text{Amount}$
 $P = \text{Principal}$
 $r = \text{rate of interest per annum}$
 $n = \text{time in years.}$
15. Use of above mentioned formula is useful in different fields of daily life. Usefulness of this formula is not only for compound amount rather than also for population growth, depreciation, environment, production etc.
16. Tax and types of tax.

ARAYBHATTA-I (476 ac)

His birth place is Patna (Bihar). Aryabhatta was Astronomist, rather was also famous mathematician. He had knowledge of zero and he found the value of π as 3.1416. He worked in the field of geometry (Rekhaganit) and also explained trigonometry and sine (jya) and cosine (kotijjya).

He enumerated method of determining square root, cube root in the field of Arithmetics. He also gave formula of area of **triangles quadrilaterals** and **circle** and **volume** of solids.

ANSWERS

Exercise – 7(a)

1. $\frac{1}{2}$; 2. (d); 3. (c) 108 km/hr; 4. $x = 3$, $y = 100$, 250; 5. ₹40; 6. ₹2000; 7. ₹42;
8. 50 minute; 9. 28 kg; 10. 21 second.

Exercise – 7(b)

1. 16 km/hr; 2. 60 km/hr; 3. 5 hour, 20 minute; 4. 2 days' 5. 15 days; 6. 4 hour; 7. 49 days; 8. 800 litre; 9. 45 days; 10. 8 hr.; 11. 6 days; 12. 10:1, 20:1, No

Exercise – 7(c)

1. (i) 800, (ii) 15000, (iii) 240000; 2. ₹ 1800; 3. 6000; 4. 400 gm, 120 gm, 480 gm; 5. 480 men, 360 women, 360 children; 6. 400 gm; 7. 38%, 2000; 8. 12.5%

Exercise – 7(d)

1. 15% profit; 2. 20% loss; 3. ₹57,25; 4. ₹13965; 5. ₹20; 6. ₹1600; 7. ₹1269.84 loss

Exercise – 7(e)

1. ₹140; 2. ₹90, ₹1590; 3. ₹308, ₹1908, 4. ₹ 800; 5. 5%; 6. 7%; 7. 5 years; 8. 10%; 9. 4 years; 10. 20 years; 11. ₹560; 12. ₹300; 13. ₹664; 14. 20%; 15. 10%; 16. ₹2000.

Exercise – 7(f)

1. (a) (iii) ₹6, (b) (i) ₹20; 2. ₹82; 3. ₹102; 4. ₹504; 5. ₹124; 6. ₹98.56; 7. ₹122.40; 8. ₹1261; 9. ₹2025

Exercise – 7(g)

1. ₹105; 2. ₹41; 3. ₹1331; 4. 10648; 5. ₹3993, ₹993; 6. ₹164; 7. ₹510; 8. ₹6655; 9. ₹2704; 10. ₹1681, ₹81; 11. ₹5780

Exercise – 7(h)

1. ₹441; 2. ₹605; 3. ₹51; 4. ₹331; 5. ₹2522; 6. ₹204; 7. ₹1458, ₹208; 8. ₹10580; 9. ₹2662; 10. ₹2916

Exercise – 7(i)

2. No; 3. ₹5,500; 4. ₹1180; 6. ₹21428.57; 7. ₹295

Ability Exercise - 7

1. (c) 12.5 m; 2. (c) 8 days; 3. (a) 20 days; 4. (b) 10 labour; 5. ₹6000; 6. 72 km/hr; 7. 110 km; 8. 1100 toys; 9. 45 percent; 10. ₹400; 11. ₹576; 12. ₹252.20; 13. ₹5832

