Chapter 8

Comparing Quantities

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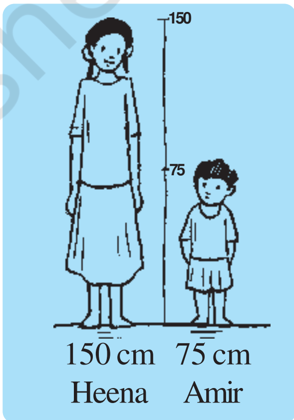
8.1 Introduction



In our daily life, there are many occasions when we compare two quantities. Suppose we are comparing heights of Heena and Amir. We find that

1. Heena is two times taller than Amir.

Or

2. Amir's height is $\frac{1}{2}$ of Heena's height.

Consider another example, where 20 marbles are divided between Rita and Amit such that Rita has 12 marbles and Amit has 8 marbles. We say,

1. Rita has $\frac{3}{2}$ times the marbles that Amit has.

Or

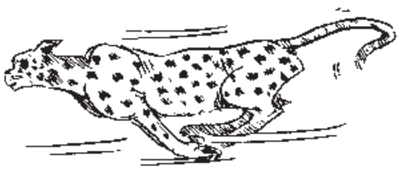
2. Amit has $\frac{2}{3}$ part of what Rita has.

Yet another example is where we compare speeds of a Cheetah and a Man.

The speed of a Cheetah is 6 times the speed of a Man.

Or

The speed of a Man is $\frac{1}{6}$ of the speed of the Cheetah.



Speed of Cheetah
120 km per hour

Speed of Man
20 km per hour

Do you remember comparisons like this? In Class VI, we have learnt to make comparisons by saying how many times one quantity is of the other. Here, we see that it can also be inverted and written as what part one quantity is of the other.

In the given cases, we write the ratio of the heights as :

Heena's height : Amir's height is 150 : 75 or 2 : 1.

Can you now write the ratios for the other comparisons?

These are relative comparisons and could be same for two different situations.

If Heena's height was 150 cm and Amir's was 100 cm, then the ratio of their heights would be,

Heena's height : Amir's height = 150 : 100 = $\frac{150}{100} = \frac{3}{2}$ or 3 : 2.

This is same as the ratio for Rita's to Amit's share of marbles.

Thus, we see that the ratio for two different comparisons may be the same. Remember that *to compare two quantities, the units must be the same.*

A ratio has no units.

EXAMPLE 1 Find the ratio of 3 km to 300 m.

SOLUTION First convert both the distances to the same unit.

So, 3 km = 3 × 1000 m = 3000 m.

Thus, the required ratio, 3 km : 300 m is 3000 : 300 = 10 : 1.

8.2 EQUIVALENT RATIOS

Different ratios can also be compared with each other to know whether they are equivalent or not. To do this, we need to write the ratios in the form of fractions and then compare them by converting them to like fractions. If these like fractions are equal, we say the given ratios are equivalent.

EXAMPLE 2 Are the ratios 1:2 and 2:3 equivalent?

SOLUTION To check this, we need to know whether $\frac{1}{2} = \frac{2}{3}$.

We have, $\frac{1}{2} = \frac{1\times3}{2\times3} = \frac{3}{6}$; $\frac{2}{3} = \frac{2\times2}{3\times2} = \frac{4}{6}$

We find that $\frac{3}{6} < \frac{4}{6}$, which means that $\frac{1}{2} < \frac{2}{3}$.

Therefore, the ratio 1:2 is not equivalent to the ratio 2:3.

Use of such comparisons can be seen by the following example.

EXAMPLE 3 Following is the performance of a cricket team in the matches it played:

Year	Wins	Losses
Last year	8	2
This year	4	2

In which year was the record better?

How can you say so?

SOLUTION Last year, Wins: Losses = 8 : 2 = 4 : 1

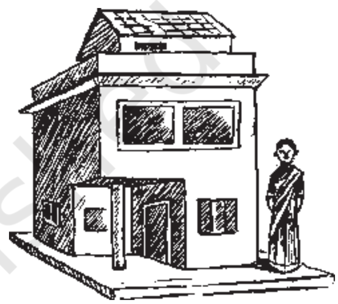
This year, Wins: Losses = 4 : 2 = 2 : 1

Obviously, 4 : 1 > 2 : 1 (In fractional form, $\frac{4}{1} > \frac{2}{1}$)

Hence, we can say that the team performed better last year.

In Class VI, we have also seen the importance of equivalent ratios. The ratios which are equivalent are said to be in proportion. Let us recall the use of proportions.

Keeping things in proportion and getting solutions



Aruna made a sketch of the building she lives in and drew sketch of her mother standing beside the building.

Mona said, "There seems to be something wrong with the drawing"

Can you say what is wrong? How can you say this?

In this case, the ratio of heights in the drawing should be the same as the ratio of actual heights. That is

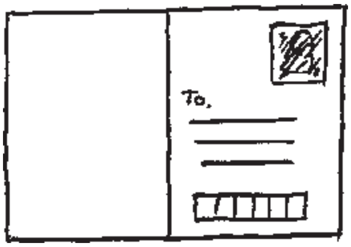
$$\frac{\text{Actual height of building}}{\text{Actual height of mother}} = \frac{\text{Height of building in drawing}}{\text{Height of mother in the drawing}}.$$

Only then would these be in proportion. Often when proportions are maintained, the drawing seems pleasing to the eye.

Another example where proportions are used is in the making of national flags.

Do you know that the flags are always made in a fixed ratio of length to its breadth? These may be different for different countries but are mostly around 1.5 : 1 or 1.7 : 1.

We can take an approximate value of this ratio as 3 : 2. Even the Indian post card is around the same ratio.



Now, can you say whether a card with length 4.5 cm and breadth 3.0 cm is near to this ratio. That is we need to ask, is 4.5 : 3.0 equivalent to 3 : 2?

We note that $4.5 : 3.0 = \frac{4.5}{3.0} = \frac{45}{30} = \frac{3}{2}$

Hence, we see that 4.5 : 3.0 is equivalent to 3 : 2.

We see a wide use of such proportions in real life. Can you think of some more situations?

We have also learnt a method in the earlier classes known as *Unitary Method* in which we first find the value of one unit and then the value of the required number of units.

Let us see how both the above methods help us to achieve the same thing.

EXAMPLE 4 A map is given with a scale of 2 cm = 1000 km. What is the actual distance between the two places in kms, if the distance in the map is 2.5 cm?

SOLUTION

Arun does it like this

Let distance = x km

then, $1000 : x = 2 : 2.5$

$$\frac{1000}{x} = \frac{2}{2.5}$$

$$\frac{1000 \times x \times 2.5}{x} = \frac{2}{2.5} \times x \times 2.5$$

$$1000 \times 2.5 = x \times 2$$

$$x = 1250$$

Meera does it like this

2 cm means 1000 km.

So, 1 cm means $\frac{1000}{2}$ km

Hence, 2.5 cm means $\frac{1000}{2} \times 2.5$ km

= 1250 km

Arun has solved it by equating ratios to make proportions and then by solving the equation. Meera has first found the distance that corresponds to 1 cm and then used that to find what 2.5 cm would correspond to. She used the unitary method.

Let us solve some more examples using the unitary method.

EXAMPLE 5 6 bowls cost ₹ 90. What would be the cost of 10 such bowls?

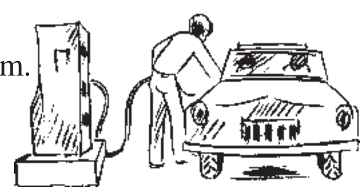
SOLUTION Cost of 6 bowls is ₹ 90.

Therefore, cost of 1 bowl = ₹ $\frac{90}{6}$

Hence, cost of 10 bowls = ₹ $\frac{90}{6} \times 10$ = ₹ 150

EXAMPLE 6 The car that I own can go 150 km with 25 litres of petrol. How far can it go with 30 litres of petrol?

SOLUTION With 25 litres of petrol, the car goes 150 km.



With 1 litre the car will go $\frac{150}{25}$ km.

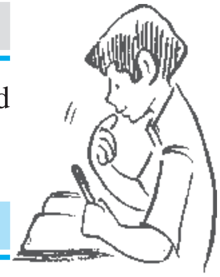
Hence, with 30 litres of petrol it would go $\frac{150}{25} \times 30$ km = 180 km

In this method, we first found the value for one unit or the unit rate. This is done by the comparison of two different properties. For example, when you compare total cost to number of items, we get cost per item or if you take distance travelled to time taken, we get distance per unit time.

Thus, you can see that we often use per to mean for each.

For example, km per hour, children per teacher etc., denote unit rates.

THINK, DISCUSS AND WRITE



An ant can carry 50 times its weight. If a person can do the same, how much would you be able to carry?

EXERCISE 8.1

1. Find the ratio of:
   (a) ₹ 5 to 50 paise
   (b) 15 kg to 210 g
   (c) 9 m to 27 cm
   (d) 30 days to 36 hours

2. In a computer lab, there are 3 computers for every 6 students. How many computers will be needed for 24 students?
3. Population of Rajasthan = 570 lakhs and population of UP = 1660 lakhs. Area of Rajasthan = 3 lakh km^2 and area of UP = 2 lakh km^2.
   (i) How many people are there per km^2 in both these States?
   (ii) Which State is less populated?

8.3 PERCENTAGE – ANOTHER WAY OF COMPARING QUANTITIES

Anita's Report
Total 320/400
Percentage: 80

Rita's Report
Total 300/360
Percentage: 83.3

Anita said that she has done better as she got 320 marks whereas Rita got only 300. Do you agree with her? Who do you think has done better?

Mansi told them that they cannot decide who has done better by just comparing the total marks obtained because the maximum marks out of which they got the marks are not the same.

She said why don't you see the Percentages given in your report cards?

Anita's Percentage was 80 and Rita's was 83.3. So, this shows Rita has done better.

Do you agree?

Percentages are numerators of fractions with denominator 100 and have been used in comparing results. Let us try to understand in detail about it.

8.3.1 Meaning of Percentage

Per cent is derived from Latin word 'per centum' meaning 'per hundred'.

Per cent is represented by the symbol % and means hundredths too. That is 1% means 1 out of hundred or one hundredth. It can be written as: $1\% = \frac{1}{100} = 0.01$

To understand this, let us consider the following example.

Rina made a table top of 100 different coloured tiles. She counted yellow, green, red and blue tiles separately and filled the table below. Can you help her complete the table?

Colour	Number of Tiles	Rate per Hundred	Fraction	Written as	Read as
Yellow	14	14	$\frac{14}{100}$	14%	14 per cent
Green	26	26	$\frac{26}{100}$	26%	26 per cent
Red	35	35	----	----	----
Blue	25	--------	----	----	----
Total	**100**				

TRY THESE

1. Find the Percentage of children of different heights for the following data.

Height	Number of Children	In Fraction	In Percentage
110 cm	22		
120 cm	25		
128 cm	32		
130 cm	21		
Total	**100**		

2. A shop has the following number of shoe pairs of different sizes.

Size 2 : 20 Size 3 : 30 Size 4 : 28

Size 5 : 14 Size 6 : 8

Write this information in tabular form as done earlier and find the Percentage of each shoe size available in the shop.

Percentages when total is not hundred

In all these examples, the total number of items add up to 100. For example, Rina had 100 tiles in all, there were 100 children and 100 shoe pairs. How do we calculate Percentage of an item if the total number of items do not add up to 100? In such cases, we need to convert the fraction to an equivalent fraction with denominator 100. Consider the following example. You have a necklace with twenty beads in two colours.

Colour	Number of Beads	Fraction	Denominator Hundred	In Percentage
Red	8	$\frac{8}{20}$	$\frac{8}{20}\times\frac{100}{100}=\frac{40}{100}$	40%
Blue	12	$\frac{12}{20}$	$\frac{12}{20}\times\frac{100}{100}=\frac{60}{100}$	60%
Total	**20**			

Anwar found the Percentage of red beads like this

Out of 20 beads, the number of red beads is 8.

Hence, out of 100, the number of red beads is

$\frac{8}{20}\times 100 = 40$ (out of hundred) $= 40\%$

Asha does it like this

$$\frac{8}{20} = \frac{8\times 5}{20\times 5}$$

$$= \frac{40}{100} = 40\%$$

We see that these three methods can be used to find the Percentage when the total does not add to give 100. In the method shown in the table, we multiply the fraction by $\frac{100}{100}$. This does not change the value of the fraction. Subsequently, only 100 remains in the denominator.

Anwar has used the unitary method. Asha has multiplied by $\frac{5}{5}$ to get 100 in the denominator. You can use whichever method you find suitable. May be, you can make your own method too.

The method used by Anwar can work for all ratios. Can the method used by Asha also work for all ratios? Anwar says Asha's method can be used only if you can find a natural number which on multiplication with the denominator gives 100. Since denominator was 20, she could multiply it by 5 to get 100. If the denominator was 6, she would not have been able to use this method. Do you agree?

TRY THESE

1. A collection of 10 chips with different colours is given .

Colour	Number	Fraction	Denominator Hundred	In Percentage
Green				
Blue				
Red				
Total				

G G G G
B B B
R R R

Fill the table and find the percentage of chips of each colour.

2. Mala has a collection of bangles. She has 20 gold bangles and 10 silver bangles. What is the percentage of bangles of each type? Can you put it in the tabular form as done in the above example?

Think, Discuss and Write

1. Look at the examples below and in each of them, discuss which is better for comparison.

   In the atmosphere, 1 g of air contains:

   .78 g Nitrogen
   .21 g Oxygen
   .01 g Other gas

   or

   78% Nitrogen
   21% Oxygen
   1% Other gas

2. A shirt has:

   $\frac{3}{5}$ Cotton
   $\frac{2}{5}$ Polyster

   or

   60% Cotton
   40% Polyster

8.3.2 Converting Fractional Numbers to Percentage

Fractional numbers can have different denominator. To compare fractional numbers, we need a common denominator and we have seen that it is more convenient to compare if our denominator is 100. That is, we are converting the fractions to Percentages. Let us try converting different fractional numbers to Percentages.

Example 7 Write $\frac{1}{3}$ as per cent.

Solution We have, $\frac{1}{3}=\frac{1}{3}\times\frac{100}{100}=\frac{1}{3}\times 100\%$

$$=\frac{100}{3}\% = 33\frac{1}{3}\%$$

Example 8 Out of 25 children in a class, 15 are girls. What is the percentage of girls?

Solution Out of 25 children, there are 15 girls.

Therefore, percentage of girls $=\frac{15}{25}\times 100=60$. There are 60% girls in the class.

Example 9 Convert $\frac{5}{4}$ to per cent.

Solution We have, $\frac{5}{4}=\frac{5}{4}\times 100\%=125\%$

From these examples, we find that the percentages related to proper fractions are less than 100 whereas percentages related to improper fractions are more than 100.

Think, Discuss and Write

(i) Can you eat 50% of a cake? Can you eat 100% of a cake?
Can you eat 150% of a cake?

(ii) Can a price of an item go up by 50%? Can a price of an item go up by 100%?
Can a price of an item go up by 150%?

8.3.3 Converting Decimals to Percentage

We have seen how fractions can be converted to per cents. Let us now find how decimals can be converted to per cents.

Example 10 Convert the given decimals to per cents:

(a) 0.75 (b) 0.09 (c) 0.2

Solution

(a) $0.75 = 0.75 \times 100\ \%$

$= \frac{75}{100} \times 100\ \% = 75\%$

(b) $0.09 = \frac{9}{100} = 9\ \%$

(c) $0.2 = \frac{2}{10} \times 100\% = 20\ \%$

Try These

1. Convert the following to per cents:

(a) $\frac{12}{16}$ (b) 3.5 (c) $\frac{49}{50}$ (d) $\frac{2}{2}$ (e) 0.05

2. (i) Out of 32 students, 8 are absent. What per cent of the students are absent?
(ii) There are 25 radios, 16 of them are out of order. What per cent of radios are out of order?
(iii) A shop has 500 items, out of which 5 are defective. What per cent are defective?
(iv) There are 120 voters, 90 of them voted yes. What per cent voted yes?

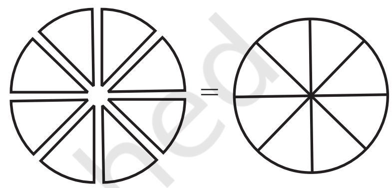
8.3.4 Converting Percentages to Fractions or Decimals

We have so far converted fractions and decimals to percentages. We can also do the reverse. That is, given per cents, we can convert them to decimals or fractions. Look at the table, observe and complete it:

Make some more such examples and solve them.

Per cent	1%	10%	25%	50%	90%	125%	250%
Fraction	$\frac{1}{100}$	$\frac{10}{100}=\frac{1}{10}$					
Decimal	0.01	0.10					

Parts always add to give a whole



In the examples for coloured tiles, for the heights of children and for gases in the air, we find that when we add the Percentages we get 100. All the parts that form the whole when added together gives the whole or 100%. So, if we are given one part, we can always find out the other part. Suppose, 30% of a given number of students are boys.

This means that if there were 100 students, 30 out of them would be boys and the remaining would be girls.

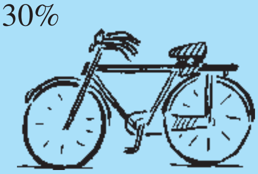
Then girls would obviously be (100 – 30)% = 70%.

Try These

1. 35% + ________% = 100%, 64% + 20% +________ % = 100%

   45% = 100% – __________ %, 70% = ______% – 30%

2. If 65% of students in a class have a bicycle, what per cent of the student do not have bicycles?



3. We have a basket full of apples, oranges and mangoes. If 50% are apples, 30% are oranges, then what per cent are mangoes?

Think, Discuss and Write

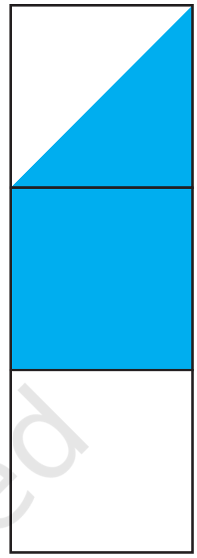
Consider the expenditure made on a dress

20% on embroidery, 50% on cloth, 30% on stitching.

Can you think of more such examples?

8.3.5 Fun with Estimation

Percentages help us to estimate the parts of an area.



EXAMPLE 11 What per cent of the adjoining figure is shaded?

SOLUTION We first find the fraction of the figure that is shaded. From this fraction, the percentage of the shaded part can be found.

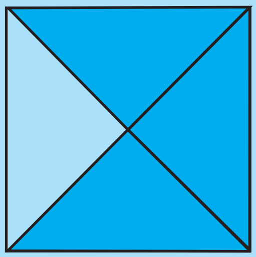
You will find that half of the figure is shaded. And, $\frac{1}{2} = \frac{1}{2} \times 100\ \% = 50\ \%$

Thus, 50 % of the figure is shaded.

TRY THESE

What per cent of these figures are shaded?

(i)



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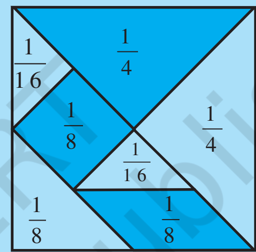


Tangram

You can make some more figures yourself and ask your friends to estimate the shaded parts.

8.4 USE OF PERCENTAGES

8.4.1 Interpreting Percentages

We saw how percentages were helpful in comparison. We have also learnt to convert fractional numbers and decimals to percentages. Now, we shall learn how percentages can be used in real life. For this, we start with interpreting the following statements:

— 5 % of the income is saved by Ravi. — 20 % of Meera's dresses are blue in colour.

— Rekha gets 10 % on every book sold by her.

What can you infer from each of these statements?

By 5 % we mean 5 parts out of 100 or we write it as $\frac{5}{100}$. It means Ravi is saving ₹ 5 out of every ₹ 100 that he earns. In the same way, interpret the rest of the statements given above.

8.4.2 Converting Percentages to "How Many"

Consider the following examples:

EXAMPLE 12 A survey of 40 children showed that 25% liked playing football. How many children liked playing football?

SOLUTION Here, the total number of children are 40. Out of these, 25% like playing football. Meena and Arun used the following methods to find the number. You can choose either method.

Arun does it like this

Out of 100, 25 like playing football

So out of 40, number of children who like playing football $= \frac{25}{100} \times 40 = 10$

Meena does it like this

25% of $40 = \frac{25}{100} \times 40$
$= 10$

Hence, 10 children out of 40 like playing football.

TRY THESE

1. Find:

   (a) 50% of 164 (b) 75% of 12 (c) $12\frac{1}{2}\%$ of 64

2. 8 % children of a class of 25 like getting wet in the rain. How many children like getting wet in the rain.

EXAMPLE 13 Rahul bought a sweater and saved ₹ 200 when a discount of 25% was given. What was the price of the sweater before the discount?

SOLUTION Rahul has saved ₹ 200 when price of sweater is reduced by 25%. This means that 25% reduction in price is the amount saved by Rahul. Let us see how Mohan and Abdul have found the original cost of the sweater.

Mohan's solution

25% of the original price = ₹ 200

Let the price (in ₹) be P

So, 25% of $P = 200$ or $\frac{25}{100} \times P = 200$

or, $\frac{P}{4} = 200$ or $P = 200 \times 4$

Therefore, $P = 800$

Abdul's solution

₹ 25 is saved for every ₹ 100

Amount for which ₹ 200 is saved

$= \frac{100}{25} \times 200 =$ ₹ 800

Thus both obtained the original price of sweater as ₹ 800.

TRY THESE

1. 9 is 25% of what number?
2. 75% of what number is 15?

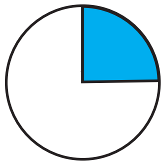
EXERCISE 8.2

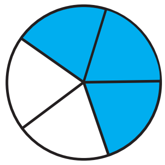
1. Convert the given fractional numbers to per cents.

   (a) $\frac{1}{8}$ (b) $\frac{5}{4}$ (c) $\frac{3}{40}$ (d) $\frac{2}{7}$

2. Convert the given decimal fractions to per cents.
   (a) 0.65 (b) 2.1 (c) 0.02 (d) 12.35

3. Estimate what part of the figures is coloured and hence find the per cent which is coloured.


(i)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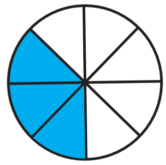

(iii)

4. Find:
   (a) 15% of 250 (b) 1% of 1 hour (c) 20% of ₹ 2500 (d) 75% of 1 kg

5. Find the whole quantity if
   (a) 5% of it is 600. (b) 12% of it is ₹ 1080. (c) 40% of it is 500 km.
   (d) 70% of it is 14 minutes. (e) 8% of it is 40 litres.

6. Convert given per cents to decimal fractions and also to fractions in simplest forms:
   (a) 25% (b) 150% (c) 20% (d) 5%

7. In a city, 30% are females, 40% are males and remaining are children. What per cent are children?

8. Out of 15,000 voters in a constituency, 60% voted. Find the percentage of voters who did not vote. Can you now find how many actually did not vote?

9. Meeta saves ₹ 4000 from her salary. If this is 10% of her salary. What is her salary?

10. A local cricket team played 20 matches in one season. It won 25% of them. How many matches did they win?

8.4.3 Ratios to Percents

Sometimes, parts are given to us in the form of ratios and we need to convert those to percentages. Consider the following example:

Example 14 Reena's mother said, to make *idlis*, you must take two parts rice and one part *urad dal*. What percentage of such a mixture would be rice and what percentage would be *urad dal*?

Solution In terms of ratio we would write this as Rice : *Urad dal* = 2 : 1.

Now, 2 + 1=3 is the total of all parts. This means $\frac{2}{3}$ part is rice and $\frac{1}{3}$ part is *urad dal*.

Then, percentage of rice would be $\frac{2}{3}\times 100\ \% = \frac{200}{3} = 66\frac{2}{3}\ \%$.

Percentage of *urad dal* would be $\frac{1}{3}\times 100\ \% = \frac{100}{3} = 33\frac{1}{3}\ \%$.

EXAMPLE 15 If ₹ 250 is to be divided amongst Ravi, Raju and Roy, so that Ravi gets two parts, Raju three parts and Roy five parts. How much money will each get? What will it be in percentages?

SOLUTION The parts which the three boys are getting can be written in terms of ratios as 2 : 3 : 5. Total of the parts is 2 + 3 + 5 = 10.

Amounts received by each	Percentages of money for each
$\frac{2}{10} \times$ ₹ 250 = ₹ 50	Ravi gets $\frac{2}{10} \times 100\ \% = 20\ \%$
$\frac{3}{10} \times$ ₹ 250 = ₹ 75	Raju gets $\frac{3}{10} \times 100\ \% = 30\ \%$
$\frac{5}{10} \times$ ₹ 250 = ₹ 125	Roy gets $\frac{5}{10} \times 100\ \% = 50\ \%$

TRY THESE

1. Divide 15 sweets between Manu and Sonu so that they get 20 % and 80 % of them respectively.
2. If angles of a triangle are in the ratio 2 : 3 : 4. Find the value of each angle.

8.4.4 Increase or Decrease as Per Cent

There are times when we need to know the increase or decrease in a certain quantity as percentage. For example, if the population of a state increased from 5,50,000 to 6,05,000. Then the increase in population can be understood better if we say, the population increased by 10 %.

How do we convert the increase or decrease in a quantity as a percentage of the initial amount? Consider the following example.

EXAMPLE 16 A school team won 6 games this year against 4 games won last year. What is the per cent increase?

SOLUTION The increase in the number of wins (or amount of change) = 6 – 4 = 2.

$$\text{Percentage increase} = \frac{\text{amount of change}}{\text{original amount or base}} \times 100$$

$$= \frac{\text{increase in the number of wins}}{\text{original number of wins}} \times 100 = \frac{2}{4} \times 100 = 50$$

EXAMPLE 17 The number of illiterate persons in a country decreased from 150 lakhs to 100 lakhs in 10 years. What is the percentage of decrease?

SOLUTION Original amount = the number of illiterate persons initially = 150 lakhs.

Amount of change = decrease in the number of illiterate persons = 150 – 100 = 50 lakhs

Therefore, the percentage of decrease

$$= \frac{\text{amount of change}}{\text{original amount}} \times 100 = \frac{50}{150} \times 100 = 33\frac{1}{3}$$

Try These

1. Find Percentage of increase or decrease:
   – Price of shirt decreased from ₹ 280 to ₹ 210.
   – Marks in a test increased from 20 to 30.
2. My mother says, in her childhood petrol was ₹ 1 a litre. It is ₹ 52 per litre today. By what Percentage has the price gone up?

8.5 Prices Related to an Item or Buying and Selling

I bought it for ₹ 600

and will sell it for ₹ 610

The buying price of any item is known as its **cost price**. It is written in short as CP.

The price at which you sell is known as the **selling price** or in short SP.

What would you say is better, to you sell the item at a lower price, same price or higher price than your buying price? You can decide whether the sale was profitable or not depending on the CP and SP. If CP < SP then you made a profit = SP – CP.

If CP = SP then you are in a no profit no loss situation.

If CP > SP then you have a loss = CP – SP.

Let us try to interpret the statements related to prices of items.

- A toy bought for ₹ 72 is sold at ₹ 80.
- A T-shirt bought for ₹ 120 is sold at ₹ 100.
- A cycle bought for ₹ 800 is sold for ₹ 940.

Let us consider the first statement.

The buying price (or CP) is ₹ 72 and the selling price (or SP) is ₹ 80. This means SP is more than CP. Hence profit made = SP – CP = ₹ 80 – ₹ 72 = ₹ 8

Now try interpreting the remaining statements in a similar way.

8.5.1 Profit or Loss as a Percentage

The profit or loss can be converted to a percentage. It is always calculated on the CP.

For the above examples, we can find the profit % or loss %.

Let us consider the example related to the toy. We have CP = ₹ 72, SP = ₹ 80, Profit = ₹ 8. To find the percentage of profit, Neha and Shekhar have used the following methods.

Neha does it this way

$$\text{Profit per cent} = \frac{\text{Profit}}{\text{CP}} \times 100 = \frac{8}{72} \times 100$$

$$= \frac{1}{9} \times 100 = 11\frac{1}{9}$$

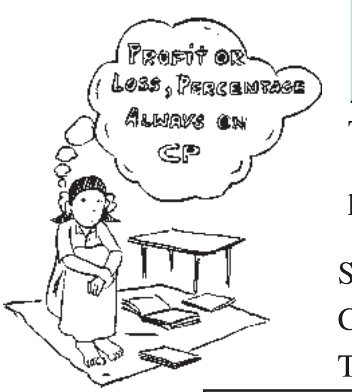
Thus, the profit is ₹ 8 and profit Per cent is $11\frac{1}{9}$.

Shekhar does it this way

On ₹ 72 the profit is ₹ 8

On ₹ 100, profit $= \frac{8}{72} \times 100$

$= 11\frac{1}{9}$. Thus, profit per cent $= 11\frac{1}{9}$



Similarly you can find the loss per cent in the second situation. Here, CP = ₹ 120, SP = ₹ 100.

Therefore, Loss = ₹ 120 – ₹ 100 = ₹ 20

$$\text{Loss per cent} = \frac{\text{Loss}}{\text{CP}} \times 100$$

$$= \frac{20}{120} \times 100$$

$$= \frac{50}{3} = 16\frac{2}{3}$$

On ₹ 120, the loss is ₹ 20

So on ₹ 100, the loss

$$= \frac{20}{120} \times 100 = \frac{50}{3} = 16\frac{2}{3}$$

Thus, loss per cent is $16\frac{2}{3}$

Try the last case.

Now we see that given any two out of the three quantities related to prices that is, CP, SP, amount of Profit or Loss or their percentage, we can find the rest.

Example 18 The cost of a flower vase is ₹ 120. If the shopkeeper sells it at a loss of 10%, find the price at which it is sold.

Solution We are given that CP = ₹ 120 and Loss per cent = 10. We have to find the SP.

Sohan does it like this

Loss of 10% means if CP is ₹ 100, Loss is ₹ 10

Therefore, SP would be

₹ (100 – 10) = ₹ 90

When CP is ₹ 100, SP is ₹ 90.
Therefore, if CP were ₹ 120 then

$$\text{SP} = \frac{90}{100} \times 120 = ₹\ 108$$

Anandi does it like this

Loss is 10% of the cost price
= 10% of ₹ 120

$$= \frac{10}{100} \times 120 = ₹\ 12$$

Therefore

SP = CP – Loss
= ₹ 120 – ₹ 12 = ₹ 108

Thus, by both methods we get the SP as ₹ 108.

EXAMPLE 19 Selling price of a toy car is ₹ 540. If the profit made by shopkeeper is 20%, what is the cost price of this toy?

SOLUTION We are given that SP = ₹ 540 and the Profit = 20%. We need to find the CP.

Amina does it like this

20% profit will mean if CP is ₹ 100, profit is ₹ 20

Therefore, SP = 100 + 20 = 120

Now, when SP is ₹ 120, then CP is ₹ 100.

Therefore, when SP is ₹ 540,

then CP = $\frac{100}{120} \times 540$ = ₹ 450

Arun does it like this

Profit = 20% of CP and SP = CP + Profit

So, 540 = CP + 20% of CP

$= \text{CP} + \frac{20}{100} \times \text{CP} = \left[1 + \frac{1}{5}\right]\text{CP}$

$= \frac{6}{5}\text{CP}$. Therefore, $540 \times \frac{5}{6} = \text{CP}$

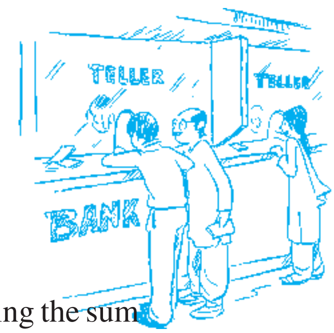
or ₹ 450 = CP

Thus, by both methods, the cost price is ₹ 450.

TRY THESE

1. A shopkeeper bought a chair for ₹ 375 and sold it for ₹ 400. Find the gain Percentage.
2. Cost of an item is ₹ 50. It was sold with a profit of 12%. Find the selling price.
3. An article was sold for ₹ 250 with a profit of 5%. What was its cost price?
4. An item was sold for ₹ 540 at a loss of 5%. What was its cost price?

8.6 CHARGE GIVEN ON BORROWED MONEY OR SIMPLE INTEREST



Sohini said that they were going to buy a new scooter. Mohan asked her whether they had the money to buy it. Sohini said her father was going to take a loan from a bank. The money you borrow is known as **sum** borrowed or **principal**.

This money would be used by the borrower for some time before it is returned. For keeping this money for some time the borrower has to pay some extra money to the bank. This is known as **Interest.**

You can find the amount you have to pay at the end of the year by adding the sum borrowed and the interest. That is, **Amount = Principal + Interest.**

Interest is generally given in per cent for a period of one year. It is written as say 10% per year or per annum or in short as 10% p.a. (per annum).

10% p.a. means on every ₹ 100 borrowed, ₹ 10 is the interest you have to pay for one year. Let us take an example and see how this works.

EXAMPLE 20 Anita takes a loan of ₹ 5,000 at 15% per year as rate of interest. Find the interest she has to pay at the end of one year.

SOLUTION The sum borrowed = ₹ 5,000, Rate of interest = 15% per year.

This means if ₹ 100 is borrowed, she has to pay ₹ 15 as interest for one year. If she has borrowed ₹ 5,000, then the interest she has to pay for one year

$$= ₹\ \frac{15}{100} \times 5000 = ₹\ 750$$

So, at the end of the year she has to give an amount of ₹ 5,000 + ₹ 750 = ₹ 5,750.

We can write a general relation to find interest for one year. Take P as the principal or sum and R % as Rate per cent per annum.

Now on every ₹ 100 borrowed, the interest paid is ₹ R

Therefore, on ₹ P borrowed, the interest paid for one year would be $\frac{R \times P}{100} = \frac{P \times R}{100}$.

8.6.1 Interest for Multiple Years

If the amount is borrowed for more than one year the interest is calculated for the period the money is kept for. For example, if Anita returns the money at the end of two years and the rate of interest is the same then she would have to pay twice the interest i.e., ₹ 750 for the first year and ₹ 750 for the second. This way of calculating interest where principal is not changed is known as **simple interest**. As the number of years increase the interest also increases. For ₹ 100 borrowed for 3 years at 18%, the interest to be paid at the end of 3 years is 18 + 18 + 18 = 3 × 18 = ₹ 54.

We can find the general form for simple interest for more than one year.

We know that on a principal of ₹ P at R% rate of interest per year, the interest paid for one year is $\frac{R \times P}{100}$. Therefore, interest I paid for T years would be

$$\frac{T \times R \times P}{100} = \frac{P \times R \times T}{100} \text{ or } \frac{PRT}{100}$$

And amount you have to pay at the end of T years is $A = P + I$

TRY THESE

1. ₹ 10,000 is invested at 5% interest rate p.a. Find the interest at the end of one year.
2. ₹ 3,500 is given at 7% p.a. rate of interest. Find the interest which will be received at the end of two years.
3. ₹ 6,050 is borrowed at 6.5% rate of interest p.a.. Find the interest and the amount to be paid at the end of 3 years.
4. ₹ 7,000 is borrowed at 3.5% rate of interest p.a. borrowed for 2 years. Find the amount to be paid at the end of the second year.

Just as in the case of prices related to items, if you are given any two of the three quantities in the relation $I = \frac{P \times T \times R}{100}$, you could find the remaining quantity.

EXAMPLE 21 If Manohar pays an interest of ₹ 750 for 2 years on a sum of ₹ 4,500, find the rate of interest.

Solution 1

$$I = \frac{P \times T \times R}{100}$$

Therefore, $750 = \frac{4500 \times 2 \times R}{100}$

or $\frac{750}{45 \times 2} = R$

Therefore, Rate $= 8\frac{1}{3}\%$

Solution 2

For 2 years, interest paid is ₹ 750

Therefore, for 1 year, interest paid ₹ $\frac{750}{2}$ = ₹ 375

On ₹ 4,500, interest paid is ₹ 375

Therefore, on ₹ 100, rate of interest paid

$$= \frac{375 \times 100}{4500} = 8\frac{1}{3}\%$$

TRY THESE

1. You have ₹ 2,400 in your account and the interest rate is 5%. After how many years would you earn ₹ 240 as interest.
2. On a certain sum the interest paid after 3 years is ₹ 450 at 5% rate of interest per annum. Find the sum.

EXERCISE 8.3

1. Tell what is the profit or loss in the following transactions. Also find profit per cent or loss per cent in each case.
   (a) Gardening shears bought for ₹ 250 and sold for ₹ 325.
   (b) A refrigerater bought for ₹ 12,000 and sold at ₹ 13,500.
   (c) A cupboard bought for ₹ 2,500 and sold at ₹ 3,000.
   (d) A skirt bought for ₹ 250 and sold at ₹ 150.
2. Convert each part of the ratio to percentage:
   (a) 3 : 1 (b) 2 : 3 : 5 (c) 1:4 (d) 1 : 2 : 5
3. The population of a city decreased from 25,000 to 24,500. Find the percentage decrease.
4. Arun bought a car for ₹ 3,50,000. The next year, the price went upto ₹ 3,70,000. What was the Percentage of price increase?
5. I buy a T.V. for ₹ 10,000 and sell it at a profit of 20%. How much money do I get for it?
6. Juhi sells a washing machine for ₹ 13,500. She loses 20% in the bargain. What was the price at which she bought it?
7. (i) Chalk contains calcium, carbon and oxygen in the ratio 10:3:12. Find the percentage of carbon in chalk.
   (ii) If in a stick of chalk, carbon is 3g, what is the weight of the chalk stick?

8. Amina buys a book for ₹ 275 and sells it at a loss of 15%. How much does she sell it for?

9. Find the amount to be paid at the end of 3 years in each case:

(a) Principal = ₹ 1,200 at 12% p.a. (b) Principal = ₹ 7,500 at 5% p.a.

10. What rate gives ₹ 280 as interest on a sum of ₹ 56,000 in 2 years?

11. If Meena gives an interest of ₹ 45 for one year at 9% rate p.a.. What is the sum she has borrowed?

WHAT HAVE WE DISCUSSED?

1. We are often required to compare two quantities in our daily life. They may be heights, weights, salaries, marks etc.

2. While comparing heights of two persons with heights150 cm and 75 cm, we write it as the ratio 150 : 75 or 2 : 1.

3. Two ratios can be compared by converting them to like fractions. If the two fractions are equal, we say the two given ratios are equivalent.

4. If two ratios are equivalent then the four quantities are said to be in proportion. For example, the ratios 8 : 2 and 16 : 4 are equivalent therefore 8, 2, 16 and 4 are in proportion.

5. A way of comparing quantities is percentage. Percentages are numerators of fractions with denominator 100. Per cent means per hundred.

For example 82% marks means 82 marks out of hundred.

6. Fractions can be converted to percentages and vice-versa.

For example, $\frac{1}{4} = \frac{1}{4} \times 100\,\%$ whereas, 75% = $\frac{75}{100} = \frac{3}{4}$

7. Decimals too can be converted to percentages and vice-versa.

For example, 0.25 = 0.25 × 100% = = 25%

8. Percentages are widely used in our daily life,

(a) We have learnt to find exact number when a certain per cent of the total quantity is given.

(b) When parts of a quantity are given to us as ratios, we have seen how to convert them to percentages.

(c) The increase or decrease in a certain quantity can also be expressed as percentage.

(d) The profit or loss incurred in a certain transaction can be expressed in terms of percentages.

(e) While computing interest on an amount borrowed, the rate of interest is given in terms of per cents. For example, ₹ 800 borrowed for 3 years at 12% per annum.