CHAPTER 5

# PERCENTAGES

## BASIC DEFINITION OF PERCENTAGE

The word per cent means per hundred or for every hundred. The symbol '%' is used for the term percent. Thus, 20 per cent is written as 20% and it means 20 out of 100.

This is written in ratio form as $\frac{20}{100}$.

The percentage value of a ratio is obtained when we multiplying the ratio by 100.

Thus percentage value of the ratio $\frac{3}{5}$ will be $\frac{3}{5}\times 100\% = 60\%$.

**Illustration 1: A person saves ₹ 5,000 per month from his monthly salary ₹ 30,000. Find the percentage monthly saving of the person.**

**Solution:** Out of monthly salary ₹ 30,000, saving is ₹ 5,000

$\Rightarrow$ Out of monthly salary ₹ 1, saving is ₹ $\frac{5,000}{30,000}$

$\Rightarrow$ Out of monthly salary ₹ 100, saving is ₹ $\frac{5,000}{30,000}\times 100$

$= ₹ \frac{50}{3} = ₹ 16.67$ (approx.)

Hence percentage monthly saving = 16.67% (approx.)

**Illustration 2: 250 students of *ABC* school and 350 students of *XYZ* school appeared in secondary board examination conducted by CBSE in 2013. 20 students of *ABC* school and 25 students of *XYZ* school did not pass in this board examination. Students of which of the two schools *ABC* and *XYZ* have shown poor performance?**

**Solution:** We cannot compare the performance of the students of the two schools in secondary board examination by just looking the number of students 20 of *ABC* school and 25 of *XYZ* school who did not pass in secondary board examination.

To compare the performance, you have to find the percentage of the students who did not pass the secondary board examination of each school out of those students of each school who appeared in the secondary board examination.

Percentage of the students of *ABC* school who did not pass

$$= \frac{20}{250}\times 100\% = 8\%$$

Percentage of the student of *XYZ* school who did not pass

$$= \frac{25}{350}\times 100\% = 7.1\% \text{ (approximately)}$$

Hence students of the *XYZ* school have shown poor performance.

**Illustration 3: In a survey, voters of a national party *A* are increase by 2.5 lakhs and voters of national party *B* are increase by 4 lakhs in 2012. Which party *A* or *B* has grown more in 2012 ?**

**Solution:** In first shot the answer to the question seems to be national party *B*. But actually the question can not be answered, because we don't know the just previous year's voters of each of the national party *A* and *B*.

If we had further information that in 2011, voters of national party *A* were 5 lakhs and voters of national party *B* were 10 lakhs, we can compare growth rates of two national parties.

Percentage growth rate of national party *A* in 2012

$$= \frac{250000}{500000}\times 100\% = 50\%$$

Percentage growth rate of national party *B* in 2012

$$= \frac{400000}{1000000}\times 100\% = 40\%$$

Hence, national party *A* has higher growth rate in 2012. Thus national party *A* has grown more than *B* in 2012.

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In the illustrations 2 and 3, you have seen that percentage is the most powerful tool for comparing the data. 500000 and 1000000 in illustration 3 are called base values of percentage growth rate of party *A* and party *B* respectively.

Without knowing these base values, percentage growth rate of party *A* and party *B* could not be determined.

Thus percentage of anything (let *X*) = $\frac{\text{Value of } X}{\text{Base value of } X}\times 100$

In illustration 1, ₹ 30000 is the base value of percentage monthly saving. In illustration 2, 250 is the base value of the percentage of students of *ABC* school who did not pass and 350 is the base value of the percentage of student of *XYZ* school who did not pass.

**Illustration 4: Express the following as fraction**

**(a) 25%** **(b) $33\frac{1}{3}\%$**

**Solution :**

(a) $25\% = \frac{25}{100}$ $\left(\text{Since \% means } \frac{1}{100}\right) = \frac{1}{4}$

(b) $33\frac{1}{3}\% = \frac{100}{3}\% = \frac{100}{3\times 100} = \frac{1}{3}$

**Illustration 5: 25% of a number is 80. What is the number ?**

**Solution:**

Let the number be $X$. According to the given condition

$$\frac{25}{100}\times X = 80 \Rightarrow X = \frac{80\times 100}{25} = 320.$$

**Illustration 6: Express $\frac{1}{8}$ as a percentage.**

**Solution:** $\frac{1}{8} = \frac{1}{8}\times 100\%$

$$= \frac{100}{8}\% = \frac{25}{2}\% = 12\frac{1}{2}\%$$

**Illustration 7: Two third of three fifth of one eighth of a certain number is 268.50. What is 30% of the number?**

**(a) 1611** **(b) 1616**

**(c) 1343** **(d) 594.60**

**Solution: (a)** Let the number be $x$.

According to the question $\frac{2}{3}$ of $\frac{3}{5}$ of $\frac{1}{8}\times x = 268.50$

$$\Rightarrow \quad \frac{2}{3}\times\frac{3}{5}\times\frac{1}{8}\times x = 268.50$$

$$x = \frac{268.50\times 3\times 5\times 8}{2\times 3} = 5370$$

$$30\% \text{ of } x = \frac{30}{100}\times 5370 = 1611.00$$

**Illustration 8: 4598 is 95% of ?**

**(a) 4800** **(b) 4840**

**(c) 4850** **(d) 4880**

**Solution: (b)** Let 95% of $x = 4598$.

Then, $\frac{95}{100}\times x = 4598 \Rightarrow x = \left(4598\times\frac{100}{95}\right) = 4840.$

## PERCENTAGE INCREASE, PERCENTAGE DECREASE AND PERCENTAGE CHANGE

$$\text{Percentage increase} = \frac{\text{Increase}}{\text{Initial value (i.e., Base value)}}\times 100$$

$$\text{Percentage decrease} = \frac{\text{Decrease}}{\text{Initial value (i.e., Base value)}}\times 100$$

$$\text{Percentage change} = \frac{\text{Change}}{\text{Initial value (i.e., Base value)}}\times 100$$

Let income of a family in the years 2010, 2011 and 2012 are ₹ 50000, ₹ 80000 and ₹ 60000 respectively.

Here income of the family increases in 2011 but decreases in 2012.

Increase in family income in 2011 from 2010

= (Higher Income) – (Lower Income)

= (Income in 2011) – (Income in 2010)

= ₹ 80000 – ₹ 50000 = ₹ 30000

Decrease in family income in 2012 from 2011

= (Higher Income) – (Lower Income)

= (Income in 2011) – (Income in 2012)

= ₹ 80000 – ₹ 60000 = ₹ 20000

Percentage increase in family income in 2011 from 2010

$$= \frac{\left(\begin{matrix}\text{Increase in income}\\ \text{in 2011 from 2010}\end{matrix}\right)}{(\text{Income in 2010})}\times 100$$

$$= \frac{30000}{50000}\times 100 = 60\%$$

Percentage decrease in family income in 2012 from 2011

$$= \frac{\left(\begin{matrix}\text{Decrease in income}\\ \text{in 2012 from 2011}\end{matrix}\right)}{(\text{Income in 2011})}\times 100$$

$$= \frac{20000}{80000}\times 100 = 25\%$$

**Illustration 9: Rent of the house is increased from ₹ 7000 to ₹ 7700. Express the increase in price as a percentage of the original rent.**

**Solution:**

Increase value = ₹ 7700 – ₹ 7000 = ₹ 700

$$\text{Increase \%} = \frac{\text{Increase value}}{\text{Base value}}\times 100 = \frac{700}{7000}\times 100$$

$$= 10$$

∴ Percentage rise = 10 %.

**Illustration 10: The cost of a bike last year was ₹ 19000. Its cost this year is ₹ 17000. Find the percent decrease in its cost.**

**Solution:**

$$\text{\% decrease} = \frac{19000-17000}{19000}\times 100$$

$$= \frac{2000}{19000}\times 100 = 10.5.$$

∴ Percent decrease = 10.5 %.

If the value of any thing increases, then percentage change is the percentage increase and if the value of any thing decreases, then percentage change is the percentage decrease. Thus,

Percentage change = Percentage increase, if value of any thing increases

and Percentage change = Percentage decrease, if value of anything decreases.