Percent and Percentage

Conversion of Fractions, Ratios, Decimals and Whole Numbers to Equivalent Percentages and Vice-versa

The following table shows the numbers of matches played and won in a season by two cricket clubs − Balmain Star and New Star.

	BALMAIN STAR	**NEW STAR**
Number of matches played	75	90
Number of matches won	48	54

Now, how can we tell which one is the better team? Though New Star had won more matches than Balmain Star, but New Star had also played more matches than Balmain Star. Therefore, we cannot compare the better performing team just by looking at the number of matches won by the two teams.

We could have easily compared this data if the two teams had played the same number of matches. To solve such type of problems, we have to know the concept of **percentages.**

First of all, let us know what a percentage is and after that we will solve this problem.

Per cent is derived from Latin word ‘per centum’ meaning ‘per hundred’ and it is defined as

Percentages are numerators of fractions with denominator 100.

Now that we know how to convert whole numbers, fractions, decimals into percentages and vice-versa, let us use these concepts to find the better team between Balmain Star and New Star.

Before finding the percentage of match won by each team, we have to find the fraction of matches won by them out of the total number of matches played by the team.

Now, the fractions of matches won by Balmain Star and New Star are $\frac{48}{75}$ and $\frac{54}{90}$ respectively.

Therefore, percentage of matches won by Balmain Star $= \left(\frac{48}{75} \times 100 \right)\% = 64\%$

Similarly, percentage of matches won by New Star $= \left(\frac{54}{90} \times 100 \right)\% = 60\%$

Here, we can see that though New Star had won more matches than Balmain Star, the percentage of matches won by Balmain Star is more than that of New Star. Therefore, Balmain Star is a better team than New Star.

We know that a fraction represents a part of a whole and 1 represents the whole. Since 1 = 100%, 100% represents the whole of an object and the percentages below 100% represent parts of a whole.

Percentages can be added and subtracted, but the total percentage of a whole will be 100%.

For example, Sonu has a pizza and he ate 45% of it.

Now, percentage of remaining pizza = 100% − 45% = (100 − 45)% = 55%

Let us discuss some more examples based on the conversion of fractions, ratios, decimals, and whole numbers to equivalent percentage, and vice-versa.

Example 1:

Convert the percentages 325%, 9.5%, and 800% into fraction, whole number, and decimal.

Solution:

$325\% = \frac{325}{100} = \frac{13}{4}$

$\frac{13}{4}$ is a fraction. It cannot be a whole number.

Also, $325\% = \frac{325}{100} = 3.25$

$\therefore$ The fraction and decimal forms of 325% are $\frac{13}{4}$ and 3.25 respectively.

Now, $9.5\% = \frac{9.5}{100} = \frac{95}{1000} = \frac{19}{200}$

$\frac{19}{200}$ is a fraction. It cannot be a whole number.

Also, $9.5\% = \frac{9.5}{100} = 0.095$

$\therefore$ The fraction and decimal form of 9.5% are $\frac{19}{200}$ and 0.095 respectively.

Now, $800\% = \frac{800}{100} = 8$

Also, $800\% = \frac{800}{100} = 8.00$

$\therefore$ The whole number and the decimal form of 800% are 8 and 8.00 respectively.

Example 2:

Convert the numbers $0.0075, \frac{9}{25}, 2, \frac{31}{16}$ into percentage form.

Solution:

$0.0075 = (0.0075 \times 100)\% = 0.75\%$

$\frac{9}{25} = \left(\frac{9}{25} \times 100\right)\% = 36\%$

$2 = (2 \times 100)\% = 200\%$

$\frac{31}{16} = \left(\frac{31}{16} \times 100\right)\% = 193.75\%$

Example 3:

In a hostel, 30% students like to watch BCB, 25% students like to watch NDVT, 27% students like to watch VT18 channel, and the remaining students like to watch NCN. If a student likes to watch only one channel, then what percentage of students like to watch NCN?

Solution:

Percentage of students who like to watch BCB = 30

Percentage of students who like to watch NDVT = 25

Percentage of students who like to watch VT18 = 27

Now, the percentage of students who like to watch these three channels = 30 + 25 + 27 = 82

We know that all the parts that form the whole when added together give the whole or 100%.

Therefore, percentage of students who like to watch NCN = 100 − 82 = 18

Thus, 18% students like to watch NCN.

Example 4:

A certain amount of money is divided among Pallavi, Manjri, and Payal in the ratio 3:9:8. What percentage of the amount distributed does each girl get?

Solution:

Ratio in which the amount is divided = 3:9:8

Sum of the parts of the ratio = 3 + 9 + 8 = 20

Therefore, Pallavi, Manjri, and Payal respectively got $\frac{3}{20}, \frac{9}{20}$ and $\frac{8}{20}$ of the total amount that was distributed among them.

Thus, Pallavi got $\left(\frac{3}{20}\times 100\right)\% = 15\%$ of the total amount that was distributed.

Similarly, Manjri got $\left(\frac{9}{20}\times 100\right)\% = 45\%$ of the total amount that was distributed.

Payal got $\left(\frac{8}{20}\times 100\right)\% = 40\%$ of the total amount that was distributed.

Example 5:

A child won 12 games out of a number of games. If the win percentage was 30, how many games were there in total?

Solution:

It is given that win percentage is 30. So,
30 games were won out of 100 games.

∴ 12 games were won out of $\frac{100}{30}\times 12 = 40$ games.
Hence, there were 40 games in total.

Example 6:

The salary of Rohan is increased by 20%. If his new salary is Rs 18,000, then what was his salary before increment?

Solution:

Let the salary before increment be Rs 100. Since his increment is 20%, so his salary after increment is Rs 100 + Rs 20 = Rs 120.

If the new salary is Rs 120, then the salary before increment is Rs 100.

So, if the new salary is Rs 18,000, then the salary before increment is
Rs $\frac{100}{120}\times 18000 = \text{Rs}\,15,000$

Thus, the salary of Rohan before the increment was Rs 15, 000.

Example 7:
Shyam's income is 40% more than that of Ram. What percent is Ram's income less than that of Shyam?
Solution:

Let Ram's income be Rs 100. Then Shyam's income will be Rs 140.

So, if Shyam's income is Rs 140, then Ram's income will be Rs 100.

If Shyam's income is Rs 1, then Ram's income will be Rs 100/140**.**

If Shyam's income is Rs 100, then Ram's income will be Rs $\frac{100}{140}\times 100 = \text{Rs}\ \frac{5}{7}\times 100 = \text{Rs}\ 71\frac{3}{7}$

Hence, Ram's income is $\left(100 - 71\frac{3}{7}\right)\% = 28\frac{4}{7}\%$ less than that of Shyam's income.

Word Problems on Percentages

The following tables list the marks obtained by Bhaskar in his first unit test and the final term examinations.

1st Unit Test Mark Sheet

Subject	Marks Obtained	Total Marks
English	16	20
Mathematics	19.5	20
Science	16	20
French	18.5	20
Social Studies	16	20

Final Term Mark Sheet

Subject	Marks Obtained	
English	75	100
Mathematics	95	100
Science	83	100
French	81	100
Social Studies	66	100

Now, how can we determine whether Bhaskar's overall performance was better in the 1st unit test or in the final term examination?

Total marks in the 1st unit test = 20 × 5 = 100

Total marks obtained by Bhaskar in the 1st unit test = 16 + 19.5 + 16 + 18.5 + 16

= 86

Total marks in the final term examination = 100 × 5 = 500

Total marks obtained by Bhaskar in the final term examination = 75 + 95 + 83 + 81 + 66 = 400

Here, the total marks in the unit test and the final term examination are not equal. Therefore, we cannot compare Bhaskar's performance just by looking at the marks obtained by him in the test and in the examination. We can solve this problem by calculating his percentage score in the unit test and in the final term examination.

'Percent' means 'per hundred' or 'out of hundred'. To express *x* as a percentage of *y*, we use the following formula:

To express *x* as a percentage of *y*, percentage = $\left(\frac{x}{y}\times 100\right)\%$

Thus, Bhaskar's percentage score in the 1st unit test

$$=\frac{\text{Marks obtained}}{\text{Total marks}}\times 100=\frac{86}{100}\times 100=86$$

Bhaskar's percentage score in the final term examination $=\frac{400}{500}\times 100=80$

Thus, Bhaskar scored 80% in the final term examination and 86% in the 1st unit test. Looking at this information, we can safely say that his performance was better in the 1st unit test as compared to that in the final term examination.

Let us consider another situation where Ramesh, Deepika, and Devyani are cousins. One day, their uncle gave them Rs 800 and told Deepika and Devyani to take 35% and 40% of this amount respectively and Ramesh to take the remaining amount. However, the three cousins were confused about how they would share this money. Let us try to help them out.

For this, first of all we have to know the method to find certain percentage of a quantity. For this, we use the following formula:

***x* % of a given quantity**
= (x100 × given quantity) x100 × given quantity

Deepika's share = 35%

Devyani's share = 40%

∴ Ramesh's share = [100 − (35 + 40)]% = (100 − 75)% = 25%

Thus, Deepika's share out of Rs 800 $= \text{Rs}\left(\frac{35}{100}\times 800\right) = \text{Rs } 280$

Similarly, Devyani's share out of Rs 800 $= \text{Rs}\left(\frac{40}{100}\times 800\right) = \text{Rs } 320$

Similarly, Ramesh's share out of Rs 800 $= \text{Rs}\left(\frac{25}{100}\times 800\right) = \text{Rs } 200$

Therefore, the shares of Ramesh, Deepika, and Devyani are Rs 200, Rs 280, and Rs 320 respectively.

Now, let us consider another situation where Rohit scored 68% mark in an exam. If he scored 340 marks, then can we find the total marks for which the exam was held?

For this, we have to know the formula to calculate the total quantity, when its certain quantities are given in terms of percentage.

If *x* % of a given quantity is *y*, then quantity = $\frac{y}{x}\times 100$

Hence, the total marks for which the exam was held = $\frac{340}{68}\times 100 = 500$ marks

In this way, we can find the whole quantity or a part of the given quantity when the percentage is given. This concept is known as the "How Many" concept.

Let us discuss some more examples based on the discussed concepts.

Example 1:

Find the following values.

(i) 16% of 100

(ii) 25% of 325

(iii) 65% of 1.2 kg

Solution:

(i) 16% of 100 $= \frac{16}{100} \times 100 = 16$

(ii) 25% of 325 $= \frac{25}{100} \times 325 = 81.25$

(iii) 65% of 1.2 kg = 65% of 1200g = $\left(\frac{65}{100} \times 1200 \right)$ g = 780 g = 0.78 kg

Example 2:

There were 25 chocolates in a bag, out of which Rohit ate 7 chocolates. What percentage of chocolates was eaten by Rohit?

Solution:

Number of chocolates eaten by Rohit = 7

Total number of chocolates in the bag = 25

∴ Fraction of chocolates eaten by Rohit = $\frac{7}{25}$

Therefore, percentage of chocolates eaten by Rohit = $\frac{7}{25} \times 100 = 28$

Thus, Rohit ate 28% chocolates in the bag.

Example 3:

A shopkeeper has a stock of 200 cricket bats of three brands − A, B, and C. Out of these, 65 bats are of brand A, 90 bats are of brand B, and the remaining bats are of brand C. Find the percentage of bats of each brand with the shopkeeper.

Solution:

Total number of cricket bats = 200

Number of bats of brand A = 65

Number of bats of brand B = 90

∴ Number of bats of brand C = 200 − (65 + 90) = 200 − 155 = 45

Thus, fraction of bats of brand A $= \frac{65}{200}$

Similarly, fraction of bats of brand B $= \frac{90}{200}$

Similarly, fraction of bats of brand C $= \frac{45}{200}$

∴ Percentage of bats of brand A $= \left(\frac{65}{200} \times 100\right)\% = 32.5\%$

∴ Percentage of bats of brand B $= \left(\frac{90}{200} \times 100\right)\% = 45\%$

∴ Percentage of bats of brand C $= \left(\frac{45}{200} \times 100\right)\% = 22.5\%$

Example 4:

There are 500 students in a school. Out of these, 325 students are day scholars while the remaining students are hostlers. Find the percentage of the students who are hostlers?

Solution:

Number of day scholars in the school = 325

Total number of students in the school = 500

Thus, number of hostlers in the school = 500 − 325 = 175

Thus, percentage of students who are hostlers $= \left(\frac{175}{500} \times 100\right)\% = 35\%$

This question can also be solved by another method.

Number of day scholars in the school = 325

Total number of students in the school = 500

Percentage of students who are day scholars $= \left(\frac{325}{500} \times 100\right)\% = 65\%$

Thus, percentage of students who are hostlers = 100% − 65% = 35%

Example 5:

Vicky spends Rs 4000 and saves Rs 1000 every month. What percentage of his monthly income constitutes his monthly savings?

Solution:

Vicky's monthly expenditure = Rs 4000

Vicky's monthly savings = Rs 1000

∴ Vicky's monthly income = Rs (4000 + 1000) = Rs 5000

∴ Percentage of money saved by Vicky every month $= \left(\frac{\text{Rs } 1000}{\text{Rs } 5000} \times 100\right)\% = 20\%$

Thus, 20% of Vicky's monthly salary constitutes his monthly savings.

Example 6:

In badminton, Sonia played 25 matches and lost 5 matches whereas Sunita played 32 matches and lost 6 matches. Who is a better player among them?

Solution:

Number of matches played by Sonia = 25

Number of matches lost by Sonia = 5

Therefore, number of matches won by Sonia = 25 − 5 = 20

∴ Percentage of matches won by Sonia $= \left(\frac{20}{25} \times 100\right)\% = 80\%$

Number of matches played by Sunita = 32

Number of matches lost by Sunita = 6

Therefore, number of matches won by Sunita = 32 − 6 = 26

∴ Percentage of matches won by Sunita $= \left(\frac{26}{32} \times 100\right)\% = 81.25\%$

Since the winning percentage of Sunita is more than that of Sonia, we can say that Sunita is the better player among the two.

Example 7:

What percentage of 1 minute is 21 seconds?

Solution:

1 minute = 60 seconds

Let *x*% of 60 seconds be 21 seconds.

∴ *x*% of 60 = 21

We know that, *x*% $= \frac{x}{100}$

$$\Rightarrow \frac{x}{100} \text{ of } 60 = 21$$

$$\Rightarrow \frac{x}{100} \times 60 = 21$$

$$\Rightarrow x \times \frac{3}{5} = 21$$

Multiplying both sides by 5, we obtain

$$x \times \frac{3}{5} \times 5 = 21 \times 5$$

$$\Rightarrow x \times 3 = 105$$

Dividing both sides by 3, we obtain

$$\frac{x \times 3}{3} = \frac{105}{3}$$

$$\Rightarrow x = 35$$

Thus, 35% of 1 minute is 21 seconds.

Example 8:

In a class, 60% of all the students are boys. It was observed that 90 girls were present in the class on a specific day. If these girls were 75% of the entire girls, then how many boy students are there in the class?

Solution:

Let the total number of students in the class be *x*.

It is given that 60% of all the students are boys.

Therefore, number of boy students in the class = $\frac{60}{100} \times x = \frac{3x}{5}$

And, number of girl students in the class = $x - \frac{3x}{5} = \frac{2x}{5}$

It is also given that 75% of all the girls were present on the day.

Therefore, number of girls present in the class = $\frac{75}{100} \times \frac{2x}{5} = \frac{3x}{10}$

It is also given that 90 girls were present in the class.

$$\therefore \frac{3x}{10} = 90$$

$$\Rightarrow 3x = 900$$

$$\Rightarrow x = \frac{900}{3} = 300$$

Therefore, number of boy students in the class $= \frac{3x}{5} = \frac{3 \times 300}{5} = 180$

Example 9:

Sujit saved 33% of his salary last month. If he saved Rs 4950 that month, then what is his monthly salary?

Solution:

Let Rs *n* be his monthly salary.

Now, 33% of *n* = 4950

⇒ 33% × *n* = 4950

$$\Rightarrow \frac{33}{100} n = 4950$$

Multiplying both sides by 100, we obtain

33*n* = 495000

Now, dividing both sides by 33, we obtain

$$\frac{33n}{33} = \frac{495000}{33}$$

⇒ *n* = 15000

Therefore, his monthly salary is Rs 15000.

Example 10:

In a carton of 250 bulbs, 4.8% bulbs are found to be defective. How many bulbs in that carton are in working condition?

Solution:

Total number of bulbs in the carton = 250

Percentage of defective bulbs = 4.8%

$$\therefore \text{Number of defective bulbs in the carton} = 4.8\% \text{ of } 250 = \frac{4.8}{100} \times 250 = \frac{1200}{100} = 12$$

Therefore, number of bulbs that are in working condition = 250 − 12 = 238

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Percentage Increase and Decrease

In many cases, it is better if we represent increase or decrease in quantities in percentage terms rather than describing them numerically.

Let us take the case where Manoj got a raise of Rs 5000 in his monthly salary. Now, we also have to consider his original salary in order to ascertain whether the raise was high or low. For example, if his original salary was Rs 10000, then this means that he got a raise of 50% in his monthly salary, which is quite high. However, let us suppose that his original monthly salary was Rs 50000. Now this would mean that Manoj got a raise of only 10%, which is quite low.

Thus, if we talk only about the increase or decrease in a quantity without referring to its original value, then it will cause confusion in some cases. However, this problem does not arise if we use percentages.

To understand the concept of percentage increase, look at the following video.

In the same way, we can find the percentage decrease, using the following formula.

$$\text{Percentage decrease} = \frac{\text{Decrease in quantity}}{\text{Original quantity}} \times 100$$

Let us consider an example to understand percentage decrease.

In an athletic event, 60 students of a school participated last year. This year, the number of students of that school taking part is decreased by 5%. Find the number of students taking part in the athletic event this year.

Here, we have percentage decrease = 5%

Original number of students = 60

$$\therefore \text{Percentage decrease} = \frac{\text{Decrease in number of students}}{\text{Original number of students}} \times 100$$

$$\Rightarrow 5 = \frac{\text{Decrease in number of students}}{60} \times 100$$

$$\Rightarrow \text{Decrease in number of students} = \frac{5 \times 60}{100}$$

⇒ Decrease in number of students = 3

Thus, number of students taking part this year = 60 – 3 = 57

Thus, 57 students participated this year.

Let us solve some examples to understand the concept better.

Example 1:

The price of a toy was decreased by 20%. If this meant a decrease of Rs 125 in its price, then what were the original and the reduced prices of that toy?

Solution:

Let the original price of the toy to be *x*.

Percentage decrease in the price of the toy = 20

Decrease in the price of the toy = Rs 125

In this case, $$\text{percentage decrease} = \frac{\text{Decrease in price of the toy}}{\text{Original price of the toy}} \times 100$$

$$\therefore 20 = \frac{\text{Rs } 125}{x} \times 100$$

$$x = \text{Rs}\left(\frac{125}{20} \times 100\right) = \text{Rs } 625$$

Thus, original price of the toy = Rs 625

And, reduced price of the toy = Rs 625 − Rs 125 = Rs 500

Example 2:

The population of a city in 2002 was 2.5 crores. If it increased by 15% in a year, then what was the population in 2003?

Solution:

Original population of the city = 2.5 crores

Percentage increase in population = 15 %

Let *x be* the increase in population of the city.

In this case, $$\text{percentage increase in population} = \frac{\text{Increase in population}}{\text{Original population}} \times 100$$

$$\therefore 15 = \frac{x}{2.5 \text{ crores}} \times 100$$
$$\Rightarrow x = \frac{15 \times 2.5}{100} \text{ crores} = 0.375 \text{ crores}$$

Thus, the population increased by 0.375 crores over the year.

Thus, population of the town in 2003 = (2.5 + 0.375) crores = 2.875 crores

Example 3:

The enrolment at a school increased from 1400 to 1500 in one year. What is the percentage increase in the enrolment?

Solution:

Increase in the enrolment = 1500 - 1400 = 100

Percentage increase in the enrolment $= \frac{100}{1400} \times 100$

$$= \frac{100}{14}$$
$$= 7.14\%$$

Thus, the enrolment is increased by 7.14%.

Example 4:

The selling price of a DVD player was dropped by 20% in one year. If the selling price of the DVD player is Rs 8000 now, then find the selling price of the DVD player one year before.

Solution:

Let *x* be the selling price of the DVD player before one year. The selling price of the DVD player was dropped by 20%. Therefore, now the selling price of the DVD is (100 - 20)% of *x* = 80% of *x*

∴ 80% of *x* = Rs 8000

$$\frac{80}{100} \times x = \text{Rs } 8000$$

$$x = \text{Rs } \frac{8000 \times 100}{80}$$

$$x = \text{Rs } 10000$$

Thus, the selling price of the DVD player before one year was Rs 10000.