

Commercial Mathematics

Percentage, Profit and Loss

A percentage is the fraction with its denominator as 100. However it is expressed as the value of its numerator followed by a percentage % sign and the denominator 100 is omitted.

For example $7\% = 7/100$ and read as seven percent

Percent means per hundred.

All fractions, quotients and decimals can be expressed as percentages.

a) $3/4$ can be expressed as a percentage by converting the denominator to 100.

This is done by multiplying and dividing by 25, so that the value of the fraction remains unchanged, but the denominator becomes 100.

$$3/4 \times 25/25 = 75\%$$

b) 0.35 can be expressed as $35/100 = 35\%$

c) 0.125 can be expressed as $12.5/100 = 12.5\%$

d) 2.1 can be expressed as $210/100 = 210\%$

Percentage needs not be a whole number, it can be positive or negative, and can exceed 100.

A percent can also be converted to a fraction or decimal or quotient.

$$\text{a) } 32\% = 32/100 = 0.32$$

$$\text{b) } 46\% = 46/100 = 23/50$$

Percentages are often used to compare ratios of different denominators. For example, profit margins of different brands of refrigerators priced differently are compared. For convenience, sales tax and other types of duties are expressed as a percent of cost price of goods and services.

Profit is the additional sum of money charged by a shopkeeper to the customer. Occasionally, a shopkeeper may have to sell a product below the cost price. In the latter case, the profit will be negative, or termed as a loss.

Example 1:

Population of a village increases from 18,000 to 18,900. Calculate the percent increase in population.

Working:

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Increase in population

$$18900 - 18000 = 900$$

$$\text{Therefore percent increase} = 900/18000 \times 100 = 5\%$$

Answer: 5%

Example 2:

Company A makes a profit of Rs 500/- on a refrigerator of cost price Rs 5000/-, company B makes a profit of Rs 600/- on a refrigerator of cost price Rs 8000/-. Find which company is making a better percentage profit.

Working:

Note: Selling Price = S.P., Cost Price = C.P.

$$\text{Profit of A} = \text{S.P.} - \text{C.P.} = 500$$

$$\% \text{ Profit of A} = \frac{\text{profit}}{\text{C.P.}} \times 100$$

$$= 500/5000 \times 100 = 10\%$$

$$\text{Profit of B} = \text{S.P.} - \text{C.P.} = 600$$

$$\% \text{ Profit of B} = \frac{\text{profit}}{\text{C.P.}} \times 100$$

$$= 600/8000 \times 100 = 7.5\%$$

10% Profit of A is more than 7.5% profit of B

Answer: Company A is making a better percentage profit.

Example 3:

Mukund scores 75% or 60 marks in the Mathematics test. Find the maximum marks for this test.

Working:

Let x be the maximum marks

$$60/x = 75/100$$

$$x = 60 \times 100/75 = 80 \text{ marks}$$

Answer: 80 marks maximum

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Example 4:

Amitab used to buy potatoes at Rs 20/- per kg spending Rs 100/- per week. Price of potatoes was subsequently increased by 25%. Amitab does not wish to spend more than Rs100/- per week. How many kgs of potatoes can he buy?

Working:

No of kgs of potatoes Amitab can buy at Rs 20/- per kg

$$= 100 / 20 = 5\text{kgs}$$

New price of potatoes = Original price + increase in price

$$= 20 + 25/100 \times 20$$

$$= 20 + 5 = 25 \text{ Rs per kg}$$

Hence, number of kgs of potatoes Amitab can buy at Rs25/- per kg

$$= 100/25 = 4\text{kgs}$$

Answer: 4 kgs of potatoes

Example 5:

Vivek buys 2 kgs of oil sold at Rs 52/- per kg plus 4% sales tax. Find the amount paid by Vivek.

Working:

Price paid by Vivek = list price + sales tax

$$= (2 \times 52) + \text{sales tax}$$

$$= 104 + 104 \times 4/100$$

$$= 104 + 416/100 = 104 + 4.16$$

$$= 108 \text{ Rs and } 16\text{ps}$$

Answer: Amount paid by Vivek = Rs 108.16

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EXERCISES

1. Convert the following to percentages.

- a) 0.77 b) $\frac{3}{15}$ c) 1.2 d) 0.05 e) $\frac{1}{8}$

2. A dealer buys a radio for Rs 240/- He spends Rs 10/- on repairs, he sells the radio for Rs 300/-. Find the percentage profit.

3. A vendor buys 24 watches, but recovers the cost price by selling 20 of them. Find the percentage profit.

4. A dealer buys 2 cars for Rs 30,000/- each. He sells one at 19% profit and the other at a loss of 16%. Find the overall profit made by the dealer.

5. List price (Cost price + Profit + Expenses) of a scooter is Rs 45,000/-. If the sales tax is 12.5%, find the total price at which the scooter is sold to the customer including tax.

6. Manu purchases the following items

- a) Books for Rs 50/-
- b) Textiles for Rs 300/-
- c) Food items for Rs 100/-
- d) Jewellery for Rs 700/-,

Sales tax is calculated at 2% for books, 10% for textiles, 3% for food items and 15% for jewellery. Find the total amount paid.

7. The following items were on discount sales. Find the selling price, inclusive of taxes, for each one of them.

	Item	List price (including taxes) Rs	Discount
a)	Alarm Clock	375/-	15%
b)	Towels	175/-	10%
c)	C.D player	1750/-	20%

8. Abhiram buys a T.V. at 10% discount over the list price of Rs 10,500/-. He pays sales tax at 12.5% on the price after discount. Find the amount of tax paid.

9. A dealer buys an old car at Rs 35,000/- and spends Rs 15,000/- on its repair. He sells the car at Rs 62,000/-. Find the percentage profit made by the dealer.

10. Calculate the increase in cost of items in percentage for the year 2005 taking the base year as 2000.

	Commodity	Quantity (in kgs)	Rate per kg Base year 2000 Rs	Year 2005 Rs
a)	Apple	5	20/-	30/-

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b)	Rice	40	14/-	19/-
c)	Coffee	2	78/-	102/-
d)	Vegetable	15	25/-	30/-
e)	Milk powder	5	90/-	120/-
f)	Butter	5	180/-	210/-

Answers

1. a) 77% b) 20% c) 120% d) 5% e) 12.5%
2. 20%
3. 20%
4. Rs 900 /
5. Rs 50,625 /-
6. 6. Rs 1289 /- (Rs 51.00 + Rs 330.00 + Rs 103.00 + Rs 805.00)
7. 7. a) Rs 318.50 b) Rs 157.50 c) Rs 1400/-
8. Rs 1181.25
9. 24%
10. 10. a) 30% b) 36% c) 31% d) 20% e) 33.3% f) 16.7%

SIMPLE INTEREST (S.I.)

Interest is the extra money paid by a borrower. Simplest form of interest or Simple Interest is the additional sum of money paid by the borrower at the end of a term or period.

Let 'P' be Principal or the amount borrowed

R is the rate of interest expressed as R% per year

T is the term or number of years borrower keeps the money

Principal plus interest is the amount due Then the simple interest

$$S.I. = P \times R \times T / 100$$

Simple interest does not include any interest or interest already due.

COMPOUND INTEREST (C.I.)

Compound interest is defined as the interest which is every time added to the principal whenever it is due. Further interest will be based on this added amount plus the principal. Thus the difference between the original principal amount and the final amount is called compound interest.

Compound interest is calculated as below

$$C.I. = P \times [1 + R/100]^T - P$$

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where C.I. = Compound Interest = Amount – Principal

$$A = \text{final amount} = [1 + R/100]^T$$

P = Principal

R = Rate of interest expressed as a percentage for a period

T = Total period or time as a multiple or factor of the period used to denote the rate of interest.

Final Amount is the money received by an investor or payable by a borrower. This amount is the sum of principal and compound interest.

$$A = P + C.I$$

For example, if the rate of compound interest is 10% per year and principal is held for 1 year, the compound interest payable will be as follows.

$$\text{C.I. for 1 year} = P \times [1 + R/100]^1 - P$$

$$= 1.1 P - P$$

$$= 0.1 P$$

If the period is 2 years, then

$$\text{C.I. for 2 years} = p \times [1 + R/100]^2$$

$$= 1.1^2 P - P$$

$$= 1.21P - P$$

$$= 0.21P$$

Please note that the compound interest calculated above will be slightly more than the simple interest on the same principal for 2 years at 10% per annum.

GROWTH AND DEPRECIATION

Growth of population in a country is compounded. Hence we can estimate the population or the increase in population using a formula similar to that used for calculating compound interest. This concept is applicable for many real life situations.

For example the population growth in a country is estimated to be 1% compounded annually. The percentage increase in the population P can be estimated as follows.

$$R = \text{Growth percentage of } P = x = \frac{(P \text{ in the current year} - P \text{ in the previous year})}{P \text{ in the previous year}} \times 100$$

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In case the population growth is to be calculated for a period of more than 1 year, then the following formula is used.

Let P_e be the population in the estimated year, P_b be the population in the base year, R be the percentage growth of population per year, N be the number of years which is the difference of estimated year and base year. Then

$$P_e = P_b \times [1 + R/100]^N$$

Depreciation is negative growth. For example, the value of used cars depreciate annually in a compounded manner.

$$V_{\text{present}} = V_{\text{base year}} [1 - D/100]^N$$

where V_{present} is the present value of the car

$V_{\text{base year}}$ is the value of the car in the base year which may be the previous year or years

D is the Depreciation rate per year

N is the number of years

The above formula is based on the rate of growth or depreciation calculated per year. However, if it is required to be calculated on a quarterly, monthly or any other set period, then the rate of Growth R or Depreciation D becomes the corresponding rate for the set period and N will be the number of periods.

Example 1:

Find the amount payable by a borrower who has taken a loan of Rs 1000/- at 8% per year compound interest after a period of two years.

Working:

$$A = P \times [1 + R/100]^N$$

$$A = 1000 \times [1 + 8/100]^2$$

$$A = 1000 \times (1.08)^2 = 1166.40$$

Answer: Rs.1166.40

Example 2:

The number of years a loan is held is $N = 3$ years. Find the amount payable A and compound interest, if the rate R is 4% per year and the principal P is Rs 2000/- .

Working:

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$$A = P [1 + R/100]^N$$

$$A = 2000 \times [1 + 4/100]^3$$

$$A = 2000 \times (1.04)^3 = 2249.73$$

$$C.I = A - P$$

$$= 2249.73 - 2000 = 249.73$$

Answer: A = Rs 2249.73 and C.I. = Rs 249.73