Chapter—13

APPLICATION OF PERCENTAGE

INTRODUCTION:

We have seen that in the calculation of interest we must know the rate of interest generally. This rate is considered equal to the interest on Rs. 100 in one year. We have solved several problems on rate of interest and percentage earlier we have also solved problems on profit & loss and have also calculated the rates in cost prices & selling prices. The more the rate, the higher the gain or loss or interest.

To repeat all this, let us solve some problems and revise some points once again.

1. If a student gets 396 out of 600, what is the percentage of marks obtained by him?
2. In a school 80% students passed out in 2004 if 12 students failed, find out the total number of students.
3. Rajani sold 8 calculators for Rs. 3500, if she gained Rs. 500, then what is the percentage of gain per calculator also find the cost price of per calculator.
4. Gamila purchased 50 card sheets for Rs. 400/- she made pictures on the card sheets after purchasing colour brush etc. for Rs. 100/- Out of each cardsheet she made 12 cards and sold them for Rs. 2 each How much profit did she get? Find the percentage of gain also.
5. A business man purchased 50 Kg of paddy for Rs. 1000/- and got it cleaned and packed in smaller packets of one kilogram, for this he spent Rs. 200. There was large incoming stock of paddy in the market and the price of paddy went down. So he could only sell the paddy at the rate of Rs. 21 per kilogram was he at loss or did he gain? Find out the rate percent also.
6. Mohan returned the borrowed amount after two years along with an interest of Rs. 500. If the rate of simple interest is 10% per annum, how much paddy did he borrow?

7. Rita gave someone Rs. 5000. After two years, how much amount will she get back if the rate of interest is 12% per annum.

8. Mohan returned Rs. 3024 to a merchant after 4 years. If the rate of interest is 11% per annum, how much money did he borrow?

We have found solutions to several such problems in class VI and VII.

Let us find solution for a new problem of this type.

Compound Interest :

Akhilesh borrowed in 10000 from the bank for some occasion in his family. He had to pay 10% interest per annum. This year he had a low income, he went to the bank to seek excuse for his debt and said that he would return Rs. 12000 next year. He was told that he would have to return Rs. 12100. Akhilesh pleaded that he shouldn't be charged for the delay and he will pay Rs. 12000 only.

The officer at the bank said that he was not being charged anything extra, but that was the interest over the interest that Akhilesh was not paying that year. Which meant that the annual interest on Rs. 10000 was Rs. 1000 since that interest was not being returned the next year his total principal amount turned to be 10000 + 1000 that is Rs. 11000. So, the coming year they would take an interest on Rs. 11000 Akhilesh said "And if I cant pay the amount next year you would take an interest on Rs. 12,100? This was something different for him. The people at the bank explained Akhilesh that generally we talk of simple interest only where the interest does not get added to the principal amount but when a person is given a loan, the loaner has to pay an interest over the interest also. This is known as Compound interest

Let us find out how much amount Akhilesh has to pay look at the table below :

TABLE 13.1

S.No.	Principal Amount	Rate	First year		Second year		Third year	
			Interest	Amount	Interest	Amount	Interest	Amount
1.	10,000	10%	1000	11000	1100	12100	1210	3310
2.	80,000	5%						
3.	5,000	10%						

Naturally, Compound interest is more than simple interest let us solve a few problems.

Example 1 : Find the compound interest on Rs. 1500 at 6% interest for 2 years find out the amount also.

Solution : According to the question.

For the first year P = Rs. 1500

R = 6%

T = 1 year

The interest for 1st year $= \frac{P \times R \times T}{100}$

$= \frac{1500 \times 6 \times 1}{100}$

= Rs. 90

At the end of 1st year the amount would be

= Principal + Interest

= 1500 + 90

= Rs. 1590

The amount at the end of the first year becomes the Principal amount for the next year.

So for the Second year.

P = Rs. 1590

R = 6%

T = 1 year

Hence interest for the Second year $= \frac{P \times R \times T}{100}$

$= \frac{1590 \times 6 \times 1}{100}$

$= \frac{159 \times 6}{10}$ = Rs. 95.40

Compound Interest = Interest for the First year + Interest for the Second year

= 90.00 + 95.40

= Rs. 185.40

Amount = Principal + Compound Interest

= Rs. 1500 + Rs. 185.40

= Rs. 1685.40

This is how we calculate compound interest. Thus we need to calculate the interest every year to calculate compound interest.

Example 2 :

Find the amount for Rs. 4000/- for 2 years at the rate of 8% per annum.

Solution : Here Principal P = Rs. 4000

Rate R = 8% or $\frac{8}{100}$

Time T = 2 years

We need to find out the interest of 1 year

Interest in 1st year $= \frac{P \times R \times T}{100}$

$= \frac{4000 \times 8 \times 1}{100}$ = Rs. 320

Amount at the end of 1st year

= Principal + Interest

= 4000 + 320

= Rs. 4320

This is the Principal for 2nd year

Interest in 2nd year $= \frac{P \times R \times T}{100}$

$= \frac{4320 \times 8 \times 1}{100}$ = Rs. 345.60

Amount at the end of 2nd year = Principal + Interest

= Rs. 4320 + Rs. 345.60

= Rs. 4665.60

Exercise 13.1

Q. 1. Find the compound interest for

(i) Rs. 4000 at the rate of 5% for 2 years.

(ii) Rs. 6000 at the rate of 10% for 3 years

(iii) Rs. 6250 at the rate of 8% for 2 years

Q. 2. Find the amount while interest is calculated every year.

(i) Rs. 7500 at the rate of 6% for 2 years

(ii) Rs. 2500 at the rate of 8% for 2 years

(iii) Rs. 5120 at the rate of 12½% for 2 years

Q. 3. A farmer wanted to buy a diesel pump and took a loan of Rs. 5500 from the rural bank at 4% annual compound interest. Calculate annually & find out how much money will the farmer return to the bank after 2 years?

Q. 4. Anuradha deposited Rs. 8000 in an institute at 5% interest per annum in Compound interest, find out the amount of money that she would get after a period of 3 years.

Compound Interest on quarterly and half yearly calculations

In banks and many other institutes, the calculation of interest is not only annual but also half yearly & some times quarterly also. This means that every six or three months the principal amount changes.

Example 3 :

Sakina deposited Rs. 4000 in the bank. Bank gives an interest at the rate of 5% per annum and the interest is calculated every 6 months. What will be the amount is her account after one year?

Solution :

If this interest is calculated annually then Sakina would get $\frac{4000 \times 5 \times 1}{100}$ that is Rs. 200 and there will be Rs. 4200 as her account. Since interest is calculated in 6 months so we hed to calculate the interest till 6 months and add principal amount to this.

Interest for first 6 months $= \frac{4000 \times 5}{100} \times \frac{6}{12} = 100$ (6 months could be written as 6/12 years)

Therefore after 6 months the Principal amount is Rs. 4100

Interest for second 6 months is

$$= \frac{4100 \times 5}{100} \times \frac{6}{12} = \text{Rs. } 102.50$$

Thus after an year the amount in the account =

4000 + 100 + 102.50 Or

4100 + 102.50 = 4202.50

Obviously the calculation for 6 months we would get an excess interest of Rs. 2.50. The less or the time for which the interest is calculated, the faster will interest be calculated on the interest and the deposited or balance amount will keep on increasing.

EXERCISE 13.2

Q. 1. In a savings bank account the bank offers an annual compound interest of 5% If the interest is added to the principal amount every 6 months, then how much interest will Naresh get after 1 year If he deposited Rs. 1600/- in the bank.

Q. 2. Anamika deposited Rs. 24000/- at 10% annual interest for 1½ years. If the interest is calculated every 6 months, how much money will she get on maturity?

Q. 3. Find out the difference between the compound interest and simple interest for Rs. 7500 at the rate of 8% per annum for one year. Note that Compound interest is calculated every 6 months.

Q.4. What will be the compound interest on a principal of Rs. 8000 in 1 year when rate of interest is 5% per annum. Note that interest is calculated every 6 month.

Formula for Compound Interest:

Obviously as the number of years increase the calculation for compound interest will also become lengthy. So, we must make a formula.

For Principal amount we write P_1, for the rate of interest we write R and time is indicated by T. If the calculation of interest is annual, this the principal amount for the second year is P_2. Which is the sum of interest for the first year (I_1), and the principal amount P_1

$\therefore\ P_2 = P_1 + I_1$

Also, the interest for the 1st year $I_1 = \frac{P_1 \times R}{100}$ (Time T = 1 year)

This means, $P_2 = P_1 + I_1 = P_1 + \frac{P_1 \times R}{100} = P_1\left(1 + \frac{R}{100}\right)$

Interest for the second year $I_2 = P_2 \frac{R}{100}$

The principal amount for the 3rd year $= P_2 + I_2 = P_1\left(1 + \frac{R}{100}\right) + P_2 \frac{R}{100}$

$$= P_1\left(1 + \frac{R}{100}\right) + P_1\left(1 + \frac{R}{100}\right)\frac{R}{100}$$

$$= P_1\left(1 + \frac{R}{100}\right)^2$$

Thus if we more on like this the principal amount and the interest can be calculated.

Therefore the total amount at the end of the 3rd year

= Principal amount for the 4th year (P_4) $= P_1\left(1 + \frac{R}{100}\right)^3$

Total amount at the end of the 4th year = $P_1\left(1 + \frac{R}{100}\right)^4$

And similarly.

This means that if after "t" years we need to find the amount (Total amount), then we would indicate. This as $P_1\left(1 + \frac{R}{100}\right)^t$, Where P, is the basic principal amount.

Therefore the interest obtained in "t" years = the total amount after "t" years – principal amount $P_1\left(1+\frac{R}{100}\right)^t - P_1$

Therefore compound Interest in "t" years = (C.I.) = $P_1\left[\left(1+\frac{R}{100}\right)^t-1\right]$

Example 4 :

Find out the compound interest for Rs. 800/- at the rate of 10% per annum for 2 years.

Solution : According to the question.

Principal (P) = 800/- Rs.

Interest rate (R) = 10% annum

Time (t) = 2 years

Here the calculation of interest is annual therefore compound interest

$$\text{C.I.} = P\left[\left(1+\frac{R}{100}\right)^t-1\right]$$

$$= 800\times\left[\left(1+\frac{10}{100}\right)^2-1\right] = 800\times\left[\left(1+\frac{1}{10}\right)^2-1\right]$$

$$= 800\times\left[\left(\frac{11}{10}\right)^2-1\right] \qquad = 800\times\left[\frac{121}{100}-1\right]$$

$$= 800\left(\frac{121-100}{100}\right) = 800\times\frac{21}{100} \qquad = \text{Rs. } 168$$

Example 5 :

If Jacob borrowed Rs. 80000/- as a loan to purchase a house from a housing society at the rate of 15% annual compound interest then how much amount will be returned by him after 3 years Find also the interest paid by him.

Solution : According to the question.

Principal (P) = 80000/- Rs.

Interest rate (R) = 15% annum

Time (t) = 3 years

Therefore to find amount $A = P\left(1+\frac{R}{100}\right)^t$

$= 80000 \times \left(1+\frac{15}{100}\right)^3$

$= 80000 \times \left(1+\frac{3}{20}\right)^3 = 80000 \times \left(\frac{23}{20}\right)^3$

$= 80000 \times \frac{23}{20} \times \frac{23}{20} \times \frac{23}{20} = 80000 \times \frac{12167}{8000} = 10 \times 12167$

= Rs. 121670

Jackob will have to return Rs. 121670/- after 3 years.

Therefore compound interest = Amount – Principal

= A – P

= 1,21,670 – 80,000

= Rs. 41670

In the above examples, compound interest has been calculated annually but it is not necessary that compound interest should always be calculated annually. Almost all banks calculate their interest half yearly or every six months. Some banking agencies also calculate their interest quarterly and keep adding the amount to the principal amount. It is remarkable that when time period is not mentioned, it is considered to be annual.

Therefore if interest is calculated every 6 months or half yearly, the time period is increases to double and the rate is reduced to half with the help of a formula we can calculate compound interest and the amount.

Let us understand this with the help of an example.

Example 6 :

Urvashi borrowed a loan of Rs. 2000/- at the rate of 20% annual interest. If interest is calculated half yearly, how much money will she return in after 1½ years? Also tell the amount of interest.

Solution : According to the question.

Principal amount (P) = Rs. 2000

Rate (R) = 20% annual

= 10% half yearly

Time (t) = 1½ years = 3 half yearly interest.

Therefore, $A = p\left(1+\frac{R}{100}\right)^t$

$= 2000 \times \left(1+\frac{10}{100}\right)^3 = 2000 \times \left(1+\frac{1}{10}\right)^3$

$= 2000 \times \left(\frac{11}{10}\right)^3 = 2000 \times \frac{1331}{1000}$

= Rs. 2662

C.I. = A – P

= 2662 - 2000 = 662

Example 7 :

Find out the amount which will be Rs. 13310 in 3 years at the rate of 10% per annum compound interest.

Solution : According to the question.

A = 13310

R = 10%

T = 3 years

$A = P \times \left(1+\frac{R}{100}\right)^T$

$13310 = P \times \left(1+\frac{10}{100}\right)^3$

or $13310 = P \times \left(\frac{11\cancel{0}}{10\cancel{0}}\right)^3$

$$\text{or} \qquad 13310 = P \times \frac{11 \times 11 \times 11}{10 \times 10 \times 10}$$

$$\text{or} \qquad P = \frac{\overset{10}{\cancel{13310}\ \cancel{1210}} \times 10 \times 10 \times 10}{\cancel{11} \times \cancel{11} \times \cancel{11}} = \text{Rs. } 10000$$

Therefore the principal amount is Rs. 10000/-

EXERCISE 13.3

Q. 1. Find out the compound interest and amount for the following :

(i) Principal = Rs. 6000, Time = 3 years, Rate 10% annual

(ii) Principal = Rs. 1600, Time = 2 years, Rate 5% annual

(iii) Principal = Rs. 8500, Time = 2 years, Rate 15% annual

(iv) Principal = Rs. 20000, Time = 3 years, Rate 5% annual

Q. 2. Salma took a loan of Rs. 625/- from the Mahila Samiti to purchase a sewing machine. If the rate of interest be 8% calculated annually, then how much money would salma return to the samiti after 2 years.

Q. 3. Find out the principal that becomes Rs. 5832/- in two years at the rate of 8% compound interest.

Q. 4. At what percentage of annual interest does Rs. 4000 become Rs. 5290/- in 2 years if interest be calculated annually.

Q. 5. At what rate does the compound interest for Rs. 1800 be Rs. 378 in 2 years if interest has been calculated annually.

Q. 6. Find out the difference between the simple interest and compound interest for Rs. 3200/- at the rate of 12% annually in 2 years.

Another application of percentage discount

Rehana went to buy a compass box with her mother. Her mother asked the shopkeeper “How much does this cost” The shopkeeper said “This is for Rs. 50/- but I will take Rs. 46/- only from you” Mother said “ give me some more discount for it” ? She persuaded the shopkeeper for sometime and the compass box was purchased for Rs. 42/-.

Rehana got her compass box, but did you understand what does discount mean? Discount or rebate is given on the base price (print value) of an item and after discount the item is sold at a lower price than that is fixed for it. Thus.

Discount or rebate = fixed price – selling price

Many a times the shopkeeper gives a considerable discount on a large purchase. Sometimes they give us a fixed discount only. The rate of discount is always calculated on the print value or fixed price of the item.

Example 8.

The printed value of a book is Rs. 40 and 12% discount is available find the discount & selling price of the book.

Solution :

Print value = Rs. 40, discount = 12%

Since on a print value of Rs. 100, discount in Rs. 12

$\therefore$ on a print value of Rs. 1, discount is $= \text{Rs.}\frac{12}{100}$

$\therefore$ on a print value of Rs. 40, discount will be $= \frac{12}{10\cancel{0}} \times 4\cancel{0} = \frac{48}{10}$

$\therefore$ Discount = Rs. 4.80

There selling price = Rs. 40 – Rs. 4.80 = Rs. 35.20

Example : 9

The print value of a table is Rs. 1250/- It is sold to a customer on Rs. 1100/- find out the percentage of discount given on the table.

Solution :

Print value = Rs. 1250/-

Selling value = Rs. 1100/-

Discount = 1250 – 1100 – 150/-

Discount on Rs. 1250 = 150/-

Discount on Rs. 1 = $\frac{150}{1250}$

Discount on Rs. 100 $= \frac{150 \times 100}{1250} = \frac{15\cancel{0} \times 4}{5\cancel{0}} = \frac{\overset{3}{\cancel{15}} \times 4}{\cancel{5}}$

This percentage of discount on the table is 12%.

Example 10 :

After a discount of 15% on the print value a shirt was sold for Rs. 442/- find the print value or print value of the shirt.

Solution :

Suppose the print value of the shirt = Rs. x

Discount = 15% of Rs. $x = x \times \frac{15}{100} =$ Rs. $\frac{3x}{20}$

Selling price = print value – discount

$$442 = x - \frac{3x}{20}$$

$$442 = \frac{20x - 3x}{20}$$

$$442 = \frac{17x}{20}$$

$$\frac{442 \times 20}{17} = x$$

$x = 520$

$\therefore$ Therefore the print value of the shirt is Rs. 520/-

Activity 1.

Now look at the table below & fill in the blanks given below :

Table 13.2

S.No.	Name of the student	Name of the book purchased	Print Value	Selling Price	Discount	Rate of discount
1	Rohit	Dictionary	Rs. 50	Rs. 40	Rs. 10	$\frac{10 \times 100}{50}$ = 20%
2	Alpana	Games in arithmetic	Rs. 60	Rs. 45	--------	$\frac{....\times 100}{60}$ = 25%
3	Abida	Songs for Children	Rs. 45	--------	Rs. 30	----------
4	Helen	Fast Mathematic	Rs. 60	Rs. 48	Rs. 12	----------
5	Mahesh	Story book	--------	--------	Rs. 7.20	---- = 5%
6	Ahmed	Ramanujan	Rs. 72	--------	--------	---- = 10%
7	----------	----------	--------	--------	--------	----------
8	----------	----------	--------	--------	--------	----------

Example 11 :

A shopkeeper gave a off season 10% discount on sweaters to his customers in summer even then, 12.5% gain was in the shopkeepers pocket. At what price did the shopkeeper buy the sweaters if the print price on the sweaters is Rs. 500.

Solution :

Print value = Rs. 500

rate of Discount = 10%

Discount given = $\frac{500 \times 10}{100}$ = Rs. 50

Selling price of the sweater = (500 – 50) = Rs. 450

Gain by the shopkeeper (in percentage) = Rs. 12.5

Cost price = $\frac{450 \times 100}{100 + 12.5} = \frac{450 \times 100}{112.5} = 400$

$$\left[\because \text{Cost Price} = \frac{\text{Selling Price} \times 100}{100 + \%\text{ gain}} = \frac{\text{Selling Price} \times 100}{100 - \%\text{ less}}\right]$$

Thus the cost price of a sweater = Rs. 400/-

TAX

You must have read and heard about taxes there are different kinds of taxes like income tax, sales tax, agriculture revenue tax, entertainment tax etc. Some taxes are collected by the central government and some others are collected by the state government. Some tax amounts are also paid to the Municipality or village, Panchayat why are taxes put, what are the uses of amount collected through taxes? You will study about these in your social studies book.

Example 12 :

Farmer Ramdeen has 25 acres of land If property or land tax is charged Rs. 15 per area annually, how much tax would Ramdeen pay for his land every year?

Solution :

Tax for per acre = Rs. 15

$\therefore$ Tax for 25 acres of land = 25×15 = Rs. 375/-

$\therefore$ Ramdeen would pay Rs. 375/- as land tax for his land.

Example 13 :

A motor cycle costs Rs. 42000 and 4% VAT or value added tax is charged on it. How much tax as VAT would be paid on the motor cycle?

Solution :

On Rs. 100 VAT is Rs. 4

$\therefore$ On Rs. 1 VAT is 4/100

$\therefore$ On Rs. 42000 VAT is $4/100 \times 42000$

= Rs. 1680 VAT would be paid

Example 14 :

A city has 5242 houses and if Rs. 2/- per house is deposited as property tax and Rs. 20/- as water tax every year, then calculate the amount deposited as tax for the city every year.

Solution :

According to the question :

Property / house tax = Rs. 2/- per house every year

Water tax = Rs. 20/- per house every year

Total property tax = Total houses x per house tax

= 5242 × 2

= Rs. 10484/-

Water tax = Total houses × per house water tax

= 5242 × 20

= Rs. 104840

Total amount Deposited as Tax = 10484 + 104840 = Rs. 115324

Example 15 :

A shopkeeper deposited Rs. 4500 as VAT after 6 months of sale. If VAT rate is 4% find out how much material of original amount did he sell?

Solution : Accroding to the question , Vat rate = 4%

When VAT is Rs. 4/- the original amount for the material = Rs. 100

When VAT is Rs. 1/- the original amount for the material =Rs. $\frac{100}{4}$

When VAT is Rs. 4500,

the original amount for the material $= \frac{100}{4} \times 4500 = \text{Rs.}1,12,500/-$

Example 16 :

Rajia went to purchase medicines. She brought medicines of Rs. 625/- as print amount and paid an extra tax of Rs. 12.50 on it what is the percentage of the rate of tax?

Solution :

tax on Rs. 625/- = Rs. 12.50

tax on Rs. 1 $= \frac{12.50}{625}$

tax on Rs. 100 $= \frac{12.50}{625} \times \frac{100}{1}$

$= \frac{1250}{625} \times \frac{\cancel{100}}{\cancel{100}}$

= 2%

Example 17 :

Suresh bought a Radio. He paid Rs. 780/- to the shopkeeper including 4% tax. Find the original price of the Radio.

Solution :

Let us suppose, the original price of the Radio Rs. 100/-

Rate of tax = 4%

Now the cost amount paid to the shopkeeper = 100 + 4 = Rs. 104

For Rs. 104, original price is Rs. 100/-

For is 780/- original price is Rs. $= \frac{780 \times 100}{104}$

= Rs. 750

Now you must have noticed that these questions are applications of unitary Method and percentage application only. The only thing you need to remember is what is the original price, the rate of tax and the money paid for tax and you can understand what is asked in the question & what is given. For example, in example 15 the amount paid as tax and the rate of tax is given and we have to find out the original amount and in example 16, the print amount and tax a given you need to find the rate of tax.

EXERCISE 13.4

Q. 1. Sarjus bought a bicycle that costs Rs. 1750/-. If the rate of sales tax on the cycle is 4% how much amount have Sarjues paid for the cycle?

Q. 2. The Gram Panchayat Gidhpuri near Mahanadi collects tax of Rs. 20 per cubic metre for the sand from the river bank. If a truck contains 5 cubic metre of sand, then how much tax would the Panchayat collects for 12 such trucks?

Q. 3. Anjali bought scents that cost Rs. 500 and ornaments that cost Rs. 800/- from a shop. The sale tax on scent is 16% and that on ornaments is 8% how much amount did Anjali in total pay to the shopkeeper.

Q.4. A farmer pay Rs. 4 per acre as land revenue to the government. If Ramdeen has 85 acres of agricultural land, how much land revenue would he pay to the government?

Q.5. Municipal Corporation of Sunderpur decided Rs. 8/- per square feet as development tax. If the land owned by Bhanuprakash measures 50 feet × 30 feet, how much development tax will be pay?

Q.6. Dinesh brings trucks of grains from other states for Rs. 37500. If 2.5% entry tax is payable on grains, how much entry tax would Dinesh pay?

Q. 7. Gram Panchayat Adrena charges house tax of Rs. 25/- per house and if there are 216 houses under the Panchayat area, how much income will the village Panchayat have through house tax?

Q. 8. The Indian government charges 11% production tax on tractor over the invested amount. If a tractor produced in a factory costs Rs. 120000, find out the production tax amount for per tractor?

We have learnt

1. When interest after a fixed time is added to the principal amount and then interest is calculated this kind of interest is called compound interest.

2. Compound Interest $C.I = P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]$

3. Amount $A = P\times\left(1+\frac{R}{100}\right)^{T}$

4. When the interest is calculated half yearly time is double & rate becomes half.

5. Discount is always given on the print price or print value.

6. The tax put on the sale of any item is its sale tax.

7. If the selling price & the percentage of gain or loss is known then cost price would be $\text{Cost Price} = \frac{\text{Selling Price}\times 100}{100+\%\text{ gain}} = \frac{\text{Selling Price}\times 100}{100-\%\text{ loss}}$.