

Chapter-8

Comparing Quantities



In Class VI and VII you have got some ideas about comparison of quantities using ratio. Though ratio can be used to compare any two quantities it is more convenient to convert the denominator to 100 to express as a percentage. So, use of percentage in comparing quantities is necessary. You already have some basic knowledge about uses of percentage in buying-selling, discount-commissions, growth-depreciation, profit-loss, simple interest etc. In this chapter we are going to discuss percentage of discount, overhead expenses, compound interest and goods and service tax.

8.1 Profit & Loss You have already learnt about profit and loss in Class VII. Let us try to remember some of the formulae.

Profit and Loss always depend on cost price (CP). If Selling Price (SP) > Cost Price (CP) then there is profit. On the other hand, if CP > SP then, there is loss.

Profit = SP - CP, SP > CPLoss = CP - SP, CP > SP

8.1.1 Profit or Loss as a Percentage

Profit Per cent
$$(p \%) = \frac{\text{SP} - \text{CP}}{\text{CP}} \times 100\%$$

Loss Per cent
$$(l\%) = \frac{CP - SP}{CP} \times 100\%$$

If CP and profit per cent (p) is given, then to find SP we proceed as follows :

$$p = \frac{\text{SP} - \text{CP}}{\text{CP}} \times 100\%$$

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$$SP - CP = p \times \frac{CP}{100}$$

or,

or,

SP = CP +
$$\frac{p}{100} \times CP$$

= $\left(1 + \frac{p}{100}\right) \times CP$

$$\therefore \left[SP - \left(\frac{100}{100} \right) \times CP \right]$$

This formula can be used to find cost price as well. You try it.

$$\mathbf{CP} = \left(\frac{100}{100+p}\right) \times \mathbf{SP}$$

Similarly, if CP and loss per cent (l) is given how to find SP?

We know that,

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

or; $l = \frac{\text{CP} - \text{SP}}{\text{CP}} \times 100$
or; $\text{CP} - \text{SP} = \frac{l}{100} \times \text{CP}$
or; $\text{SP} = \text{CP} - \frac{l}{100} \times \text{CP}$
 $= \left(1 - \frac{l}{100}\right) \times \text{CP}$ or, $\left(\frac{100 - l}{100}\right) \times \text{CP}$
Similarly,

$$\mathbf{CP} = \left(\frac{100}{100-l}\right) \times \mathbf{SP}$$

$$\therefore \qquad \mathbf{S} \mathbf{P} = \left(\frac{100 - l}{100}\right) \times \mathbf{CP}$$

and
$$CP = \left(\frac{100}{100 - l}\right) \times SP$$

Let us see one technique

$$SP = \left(\frac{100 \pm x}{100}\right) \times CP$$

For profit we used ' + x' and for loss ' - x' in the above formula.

Now let us discuss some examples on profit and loss :

Example 1 : A shopkeeper bought a watch for ₹ 250 and sold it for ₹ 190. Calculate his profit or loss. Also calculate the percentage of profit or loss.

Solution : Since,
$$CP = ₹ 250$$

 $SP = ₹ 190$
Here $CP > SP$. Therefore, there is loss.
 \therefore Loss = $CP - SP = ₹ (250 - 190) = ₹ 60$
 \therefore Loss per cent = $\frac{loss}{CP} \times 100\%$
 $= \frac{60}{250} \times 100\%$
 $= 24\%$

Example 2 : The cost of a ball is ₹ 150. If the shopkeeper sells it at a loss of 10%, find the selling price.

Solution : Here, CP = ₹ 150Percentage of loss (*l%*) = 10% Or *l* = 10 **Comparing Quantities**

$$\therefore \qquad SP \qquad = \frac{100 - l}{100} \times CP$$
$$= \frac{100 - 10}{100} \times 150$$
$$= \frac{90}{100} \times 150$$
$$= 135$$
$$\therefore Selling price = ₹135$$

Example 3 : The selling price of a doll is ₹ 540. If the shopkeeper sold it at a profit of 20%, find the cost price.

Solution : Here, SP = ₹ 540

Percentage of profit (p%) = 20% or, p = 20

$$\therefore CP = \frac{100}{100 + p} \times SP$$
$$= \frac{100}{100 + 20} \times 540$$
$$= \frac{100}{120} \times 540$$
$$= 450$$
$$\therefore Cost price = ₹ 450$$

Example 4 : A watch sold at ₹ 450 incurring a loss of 10%. What is the cost price of the watch?

Solution : Here, $SP = \not\in 450$ and l = 10 $\therefore CP = \frac{100}{100 - l} \times SP = \frac{100}{100 - 10} \times 450 = \not\in 500$ $\therefore Cost Price = \not\in 500$

Example 5 : A ball is sold at a loss of 10%, If the ball would have sold at ₹ 117 more, then there would have been a gain of 3 %. At what price the ball sold?

Solution : Let CP be $\gtrless x$

If the loss is 10% then, SP = $\frac{100-10}{100} \times CP$ (*l* = 10)



or, SP =
$$\frac{9}{10}x$$
 ... (i)

If the profit per cent is 3% then, SP = $\left(\frac{100+3}{100}\right) \times CP$ = $\frac{103}{100}x$ According to question, $\frac{9}{10}x + 117 = \frac{103}{100}x$ or, $\frac{103}{100}x - \frac{9}{10}x = 117$

or,
$$\frac{103x - 90x}{100} = 117$$

or, $13x = 117 \times 100$

or,
$$x = \frac{117 \times 100}{13}$$

= 900

 $\therefore \quad \text{CP of the ball} = ₹ 900$

SP of the ball = $\frac{9}{10}$ × ₹ 900 [from (i)] = ₹ 810

Example 6 : If the selling price of 8 pens and cost price of 10 pens are equal, find the profit or loss per cent.

Solution : Let the CP of one pen $= \overline{\xi} x$ \therefore CP of 10 pens $= \overline{\xi} 10x$ According to question S.P. of 8 pens $= \overline{\xi} 10x$

$$\therefore \text{ SP of 1 pen} = \not\in \frac{10x}{8}$$

Since $\frac{10x}{8} > x$, therefore, SP > CP

So, there will be profit in the transaction.

:. Profit = $\frac{10x}{8} - x = \frac{10x - 8x}{8} = \frac{2x}{8} = \frac{x}{4}$

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$$\therefore \text{ Profit per cent} = \frac{\text{profit in 1pen}}{\text{C.P. of 1 pen}} \times 100$$
$$= \frac{\frac{x}{4}}{x} \times 100\%$$
$$= \frac{x}{4} \times \frac{1}{x} \times 100\%$$
$$= 25\%$$

Alternatively,

According to question,

SP of 8 pens = C.P of 10 pens or, $8 \times SP = 10 \times CP$ or, $\frac{SP}{CP} = \frac{10}{8}$ or, $SP = \frac{10}{8} \times CP$

∴ Profit per cent

t
$$= \frac{Profit}{CP} \times 100\%$$
$$= \frac{SP - CP}{100} \times 100\%$$
$$= \frac{\frac{10}{8}CP - CP}{CP} \times 100\%$$
$$= \frac{\frac{2}{8}CP}{CP} \times 100\%$$
$$= \frac{2}{8} \times 100\%$$
$$= \frac{2}{8} \times 100\%$$
ent = 25\%

. Profit per cent

Exercise 8.1

- 1. A watch was bought for ₹ 250 and sold it for ₹ 260. Find the profit and profit per cent.
- 2. Buying a pen at \gtrless 60, at what price should it be sold to get a profit of 15 %?
- 3. Ramen sold a mobile for ₹ 13,500 at a loss of 20%. Find the CP of the mobile.

- 4. If the SP of 10 pens is equal to the CP of 8 pens, calculate the loss or gain percentage.
- 5. A cycle bought for ₹ 5,000 is sold at a profit of 12%. Find the SP of the cycle.
- 6. Kamal bought a water filter for ₹ 4500 and sold it at ₹ 4230. Calculate the loss per cent.
- 7. A shopkeeper sold a watch for ₹ 785 at a loss of 5%. What is the cost price of the watch?
- 8. If the selling price of 10 items is equal to the cost price of 11 items of the same types, find the profit or loss percentage.
- 9. A man bought two cars for ₹ 99,000 each. He sold one of them at a profit of 10% and one at a loss of 10%. Calculate the profit or loss percentage in the whole transactions.

8.2 Discount

While shopping you must have noticed that sometimes there are advertisements in some shops indicating 50% discount or 30% discount or 20% discount etc. If we buy from those shops, we can buy the things in much less prices than the Marked Price.

The printed price of an object is called Marked Price or MP. If an object is sold at a price less than the marked price then it is called discount. Discount is the difference between the MP and SP.

i.e Marked Price – Selling Price = Discount

or, **Discount = MP – SP**

Discount is always calculated on Marked Price.

In business, there are three types of discounts. i.e

- (a) Retail Discount
- (b) Cash Discount
- and (c) Trade Discount

You can learn about cash discount and trade discount later on. Here, we will discuss about retail discount only.

Example 7 : The marked price of an item is ₹ 1600. On account of Puja, the shopkeeper offers a discount of 10 %. At what price he will sell the item?

Solution : Given, marked price = $\gtrless 1600$

Discount = 10% of Marked Price = 10% of ₹1600 = ₹ (10 × $\frac{1}{100}$ × 1600) = ₹ 160 \therefore SP = Marked price – Discount = ₹ (1600 - 160) = ₹ 1440

Example 8 : The marked price of a saree is ₹ 235. If the shopkeeper wants to sell it at a retail discount of 24%, what is the selling price?

Solution : Given marked price of the saree = $\gtrless 235$

Discount = 24% of Marked Price

= 24% of ₹ 235
= ₹
$$(24 \times \frac{1}{100} \times 235)$$

= ₹ 65.40
:. SP = Marked Price – Discount
= ₹ (235.00– 56.40)
= ₹ 178.60

Example 9: The printed price of a shirt is ₹ 500. The shopkeeper allows 20% discount and for christmas he offers an additional discount of 10%. Find the selling price of the shirt.

Solution : Given marked Price (MP) of the shirt = ₹ 500

First discount = 20% of MP = 20% of ₹ 500 = ₹ $\left(500 \times 20 \times \frac{1}{100} \right)$ = ₹ 100

:. SP of the shirt after 20% discount

= MP - discount

=₹(500 - 100) =₹ 400



Additional discount = 10% of the SP after first discount = 10% of ₹400 = $\mathbf{E}\left(10 \times \frac{1}{100} \times 400\right)$ =₹40 Selling Price = $\mathbf{\xi} (400 - 40)$ *.*..



Successive Discounts per cent are always determined on the selling price after every discount.

Example 10 °: A shopkeeper sold an old pair of shoes at ₹480. If the marked price is ₹600, find the rate of discount.

Solution : For the pair of shoes, MP = ₹ 600

- SP =₹ 480 ∴ Discount = MP – SP = ₹ (600 – 480) = ₹ 120 When MP is ₹600, amount of discount = ₹ 120
- When MP is ₹1, amount of discount = ₹ $\frac{120}{600}$
- When MP is ₹ 100, amount of discount = ₹ $\frac{120}{600} \times 100 = ₹ 20$
- Discount per cent = 20%...

Observe:

 $\frac{\text{Discount}}{\text{Marked Price}} \times 100\%$ Discount per cent = $=\frac{\mathrm{MP}-\mathrm{SP}}{\mathrm{MP}}\times100\%$

Example 11 : A shopkeeper sold a saree at ₹ 3000 after a festival discount of 35%. What is the marked price of the saree?

Solution : Let the marked price be $\gtrless x$

Discount = 35% of Marked price ·.

$$= 35\%$$
 of x

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Or, Discount = $x \times 35 \times \frac{1}{100}$

$$=\frac{7x}{20}$$

 \therefore SP of the saree = M.P. – Discount

$$= x - \frac{7x}{20}$$
$$= \frac{20x - 7x}{20}$$
$$= \frac{13x}{20}$$

According to question, $SP = \overline{\xi} 3000$

$$\therefore \frac{13x}{20} = 3000$$
Or, $13x = 3000 \times 20$
Or, $x = \frac{3000 \times 20}{13}$
= 4615.38 (approx)
MP of the saree = ₹ 4615.38

Example 12: A shopkeeper fixed the marked price of a radio after an increase of 25% on the cost price. Find the percentage of profit or loss if he sold it with a 10% discount on the marked price.

Solution :

...

Discount =

Let the cost price of the radio be $\gtrless x$ \therefore Marked price = x + 25% of x

$$= (x + \frac{25}{100} \times x)$$
$$= (x + \frac{x}{4})$$
$$= \frac{5x}{4}$$
10% of M.P.

$$=\frac{10}{100} \times \frac{5x}{4} = \frac{x}{8}$$



- \therefore SP of the radio = M.P. Discount
- $\therefore \text{ SP of the radio} = \frac{5x}{4} \frac{x}{8}$ $= \frac{10x x}{8}$ $= \frac{9x}{8}$

Since $\frac{9x}{8} > x$, the shopkeeper will have profit \therefore Profit = SP - CP

$$= \frac{9x}{8} - x$$
$$= \frac{x}{8}$$

 $\therefore \quad \text{Percentage of profit} = -\frac{\text{Profit}}{\text{Cost Price}} \times 100\%$

$$= \frac{\frac{x}{8}}{x} \times 100\%$$
$$= \frac{x}{8} \times \frac{1}{x} \times 100\%$$
$$= 12.5\%$$

8.3 Overhead Expenses

Generally some expenses occur on a purchase in addition to the cost price such as transportation, labour, tax etc. The sum total of the minor expenses is called overhead expenses.

Therefore, Actual Cost Price = Cost Price + Overhead Expenses

Observe the following examples :

Example 13 : An almirah has been bought at ₹ 2560 and ₹ 150 was spent on transportation. At what price it is to be sold to get a profit of 10%

Solution :

CP of the almirah =₹ 2560 Overhead expense (transportation) =₹ 150 ∴ Actual CP =₹(2560 + 150) = ₹ 2710 Profit = 10% of CP = 10% of ₹ 2710 = 10 × $\frac{1}{100}$ × 2710 =₹ 271 ∴ SP = Actual CP + Profit =₹ 2710 + ₹ 271 =₹ 2981 e 14 : Amar purchased a motorcycle for ₹ 25650 and

Example 14 : Amar purchased a motorcycle for ₹ 25650 and spent ₹ 1350 on repairing it. If he sells it for ₹ 24000, find the loss percent.

Solution :

CP of the motorcycle = ₹ 25650 Overhead expenses = ₹ 1350 ∴ Actual C.P. = ₹ (25650 + 1350) = ₹ 27000 S.P. of the motorcycle = ₹ 24000 ∴ Loss = Actual CP - SP = ₹ (27000 - 24000) = ₹ 3000 ∴ Loss per cent = $\frac{\text{Loss}}{\text{Actual CP}} \times 100\%$ = $\frac{3000}{27000} \times 100\%$ = $\frac{1}{9} \times 100\%$ = 11.11% (approx)



Exercise : 8.2

- 1. The marked price of a radio is ₹ 2055. If it is sold at 3% discount, find the selling price.
- 2. Suman bought a Mathematics Book for ₹ 190 at a discount of 10%. What was the marked price?
- 3. Ramen bought an article for ₹ 630 whose marked price was ₹ 700. What is the percentage of discount he got?
- 4. The marked price of a sofa set is ₹30,000. On occasion of new year, the shopkeeper sold it at ₹25000. What is the percentage of discount ?
- 5. After a discount of 10%, a fan is sold at ₹ 1260. What was the marked price of the fan?
- 6. The marked price on a watch is ₹ 1150. On account of Puja, if it is to be sold at ₹ 1000 then, what will be the rate of discount?
- 7. A cloth seller advertises a discount of 10% and sells his clothes accordingly. A customer buys a pair of suit for ₹ 6050, shirt for ₹ 575 and a saree for ₹ 875. Calculate the total discount she got.
- 8. What is the rate of retail discount on a book priced at \gtrless 200 and sold at \gtrless 175.
- 9. Buying a table for ₹ 2750 from a furnisher shop, a customer gets a discount $8\frac{1}{3}$ % What was the price of the table fixed by the shopkeeper?
- 10. A shopkeeper gave a discount of 30% to a shirt with marked price of ₹ 600. He further gave a discount of 20% on that shirt. At what price did the shopkeeper sell the shirt and what is the total percentage of discount?
- 11. Kamal bought a car for ₹ 4,00,000 and spent ₹ 10,000 on repairing. He sold the car to Suresh at 10% profit and Suresh again sold it to Deepak at 5% profit. At what price Deepak bought the car?
- 12. A shopkeeper bought a radio from a man at ₹ 800. He spent ₹ 200 on repairing and sold it to another person at ₹ 1300. What was his percentage of profit ?
- 13. Migam bought an iron for ₹ 1200. He spent ₹ 40 for transportation. At what price he should sell it to get a profit of 25%.



8.4 Compound Interest

In Class VII, we have learnt about Interest, Principal and Amount. By interest we meant simple interest only, where Principal always remains same. Here we will discuss about another type of interest, where after a particular period of time the interest is added to the principal and next interest is calculated on that increased principal. This type of interest is called Compound Interest. In this chapter we will discuss about Compound Interest eloborately and about simple interest too.

At different situation, people take loans from bank or from other sources. At the time of returning the money they have to pay an additional amount along with it, at a particular rate. This amount is called Interest. The amount borrowed is called 'Principal'. The total returnable money consisting of the principal and the interest is called 'Amount'.

For deposit or loan there exists some fixed rate of interest. The interest rate is normally fixed for 1 year per 100 rupees which is known as **'rate of interest'** per year.

For example, if the interest on \gtrless 100 for one year is \gtrless 5 then it is said 'the rate of interest is 5% per annum or simply, 'rate of interest 5%'. It is to be noted that if time period is not mentioned then it means per annum or for one year.

There are two types of interest :

- (a) Simple Interest
- (b) Compound Interest

(a) Simple Interest : If the interest is calculated on principal only then it is simple interest or S.I.

S. I. = $\frac{P \times R \times T}{100}$, Where P = Principal, R = Rate of interest T = Time period (in years) Amount = Principal (P) + Interest (I)

Let us see one example :

Example 15: Calculate the simple interest and amount on a sum of ₹ 500, at the rate of 5% per annum for 3 years.

Solution :

Method 1: (Unitary Method)

Here Rate of interest = 5%

- $\therefore \text{ Interest on } ₹ 100 \text{ for 1 year } = ₹ 5$
- ∴ Interest on ₹ 1 for 1 year

Interest on ₹ 500 for 1 year

$$= ₹ \frac{5}{100}$$
$$= ₹ \left(\frac{5}{100} \times 500 \right)$$
$$= ₹ 25$$



Interest on ₹ 500 for 3 years = ₹ (25 × 3)

∴ Required Simple Interest = ₹ 75

Amount = Principal (P) + Interest (I) = ₹ (500 + 75) = ₹ 575

Method II (Using formula) :

According to question, Rate of interest R = 5%Principal P = ₹ 500Time T = 3 years \therefore Simple Interest (S.I) $= \frac{P \times R \times T}{100}$ $= \frac{500 \times 5 \times 3}{100}$ = ₹ 75 \therefore Amount, A = P + I = ₹ (500 + 75) = ₹ 575

∴ Simple Interest = ₹75, and Amount = ₹575

(b) Compound Interest :

As we have seen earlier, when interest is calculated on Principal it is called Simple Interest. **Compound interest is the addition of interest to the principal** sum of a loan or deposit, or we could say **interest on interest**. It is the result of reinvesting the interest, where the interest in the next period is calculated on the principal plus the previously accumulated interest. Let us understand with an example.

Arun's father has taken a loan of \gtrless 10000 for 2 years at the rate of 10% per annum and after two years paid back an amount of \gtrless 12100 to the bank. This means he had to pay \gtrless 2100 as interest. By calculating in simple interest Arun saw that the interest amount should have been \gtrless 2000, but his father paid \gtrless 100 more than that. He started thinking about it and asked his mathematics teacher at school. His teacher explained to him as follows–

At 10% per annum the interest on \gtrless 10000 for one year is \gtrless 1000. For the second year the principal becomes \gtrless (10000 + 1000) = \gtrless 11000, and interest on \gtrless 11000 at 10% per annum becomes \gtrless 1100. Therefore at the end of 2nd year, the amount due will be \gtrless (11000 + 1100) = \gtrless 12100. That is why his father had to pay \gtrless 2100 as interest.

Similarly after a particular time (say one year or 6 months) the interest due is to be added to the principal and becomes the new principal on which the interest for next year is calculated. This type of interest is known as compound interest. Therefore, in the case of compound interest, the amount due after the first year (or 6 months) becomes the principal for the 2nd year (or next 6 months). Again, amount due after 2nd year (or the 2nd 6 months) becomes the principal for the 3rd year (or the next 6 months), and so on.

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Observe the following examples :

Example 16 : Calculate the compound interest and amount due on a sum of ₹ 500 for 3 years at 10% per annum compounded annually.

Solution : For the 1st year, Principal = ₹ 500 Interest of ₹ 500 at the rate of 10% = ₹ $\left(\frac{10}{100} \times 500\right)$ = Rs 50

Amount at the end of 1st year = ₹ (500 + 50) = ₹ 550
i.e Principal for the 2nd year = ₹ 550
Interest of ₹ 550 at the rate of 10% = 10% of ₹ 550 = ₹ 55

[Interest calculated on ₹ 550 for the 2nd year]

- ∴ Amount at the end of 2nd year = 10% of ₹ 605 = ₹ 60.50
 i.e Principal for the 3rd year = ₹ 605
 Interest of ₹ 605 at the rate of 10% = 10% of 605 = ₹ 60.50
- :. Amount after 3 years = \mathbf{E} (605 + 60.50) = \mathbf{E} 665.50
- ∴ Required compound interest = ₹ (665.50–500.00) = ₹ 165.50 and amount for 3 years = ₹ 665.50.
- Example 17: Find the compound interest on ₹1000 for one year and six months at 10% per annum compounded half yearly.

Solution : One year 6 months
$$= \left(1 + \frac{1}{2}\right)$$
 years $= 1\frac{1}{2}$ years

Rate of interest = 10% per year

- :. Interest on ₹100 for 1 year = ₹10
- ∴ Interest on ₹100 for 6 months = ₹ 5 [since interest is compounded half-yearly]
 First Principal = ₹1000

Interest for first 6 months = 5% of ₹ 1000 = ₹ 50

∴ Principal for the 2nd 6 months = ₹ (1000+50) = ₹ 1050

Interest for the 2nd 6 months = 5% of $\neq 1050 = \frac{5}{100} \times 1050 = \neq 52.50$

∴ Principal for the 3rd 6 months = ₹ (1050 +52.50) = ₹ 1102.50
 Interest for the 3rd 6 months = 5% of ₹ 1102.50

$$=\frac{5}{100}$$
×1102.50= ₹ 55.125

- :. Amount after $1^{1/2}$ years = $\mathbf{E}(1102.50 + 55.125) = \mathbf{E} 1157.625$
- ∴ Required C.I. = ₹ (1157.625–1000) = ₹ 157.625 = ₹ 157.63 (approx)

Exercise : 8.3

Find the compound interest and the amount of the following (Q1 to Q6)

- 1. $\mathbf{\overline{\xi}}$ 300 for 2 years at 3% per annum
- 2. ₹4,000 for 3 years at 2% per annum
- 3. ₹10,000 for 2 years at 4% per annum
- 4. ₹7,000 for 3 years at 2% per annum
- 5. \gtrless 1,500 for 2 years at 10% per annum
- 6. \gtrless 900 for 3 years at 5% per annum
- 7. Find the compound interest on ₹ 2000 for 1½ years at 4% per annum compounded half-yearly.

8.4.1 Formula for Compound Interest :

Let the Principal be \gtrless P Rate of interest = r% per annum Time = *n* years, Amount = A_n For the first year, Principal = P

Interest for the first year = r% of P = P × $\frac{r}{100}$

Amount at the end of 1st year,
$$A_1 = P + P \times \frac{r}{100}$$

$$= \mathbf{P}\left(1 + \frac{r}{100}\right)$$

 \therefore For the 2nd year, Principal = A₁

Interest for the 2nd year = $r^{0/6}$ of $A_1 = A_1 \times \frac{r}{100}$

 $\therefore \text{ Amount at the end of 2nd year, } A_2 = A_1 + A_1 \times \frac{r}{100}$ $= A_1 \left(1 + \frac{r}{100} \right)$ $= P \left(1 + \frac{r}{100} \right) \left(1 + \frac{r}{100} \right) \left[\because A_1 = P \left(1 + \frac{r}{100} \right) \right]$

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 $= \mathbf{P} \left(1 + \frac{r}{100} \right)^2$

 \therefore For the 3rd year Principal = A₂

Interest for 3rd year = r% of $A_2 = A_2 \times \frac{r}{100}$

Amount at the end of 3rd year $(A_3) = A_2 + A_2 \times \frac{r}{100}$ $= A_2 \left(1 + \frac{r}{100} \right)$ $= P \left(1 + \frac{r}{100} \right)^2 \left(1 + \frac{r}{100} \right) \left[\because A_2 = P \left(1 + \frac{r}{100} \right)^2 \right]$ $\therefore \quad A_3 = P \left(1 + \frac{r}{100} \right)^3$

At the end of n years, amount

Amount
$$A_n = P\left(1 + \frac{r}{100}\right)^n$$

Now taking $A_n as A$,

$$\mathbf{A} = \mathbf{P} \left(1 + \frac{r}{100} \right)^n \quad \text{[amount after } n \text{ years.]}$$

- 1. For the first year, there is no difference between SI_1 and CI_1 since the Principal is same. i.e. $SI_1 = CI_1$
- 2. At the end of 2nd year, the difference between CI_2 and SI_2 is -

C.I. for 'n' years $= P\left(1 + \frac{r}{100}\right) - P$

$$CI_{2} - SI_{2} = \left[P\left(1 + \frac{r}{100}\right)^{2} - P\right] - \frac{P \times r \times 2}{100}$$
$$= \left[P\left(1 + \frac{2r}{100} + \frac{r^{2}}{10000}\right) - P\right] - \frac{2Pr}{100}$$

$$= P + \frac{2P r}{100} + \frac{Pr^{2}}{10000} - P - \frac{2Pr}{100}$$
$$= \frac{Pr^{2}}{10000}$$

∴ $CI_{2} - SI_{2} = \frac{Pr^{2}}{(100)^{2}}$

Example 18 : Find the compound interest and amount on ₹ 500 for 3 years at the rate 10% per annum.

Solution : Here, Principal P = ₹ 500 Rate of interest $r^{0}\% = 10\%$ Time, n = 3 years. \therefore Amount = ₹ $500\left(1 + \frac{10}{100}\right)^{3}$ $= ₹ 500\left(1 + \frac{1}{10}\right)^{3}$ $= ₹ 500 \times \left(\frac{11}{10}\right)^{3}$ $= ₹ 500 \times \frac{11 \times 11 \times 11}{10 \times 10 \times 10}$ $= ₹ \frac{1331}{2}$ = ₹ 665.50 \therefore Compound Interest for 3 years = A-P = ₹ (665.50 - 500.00)= ₹ 165.50

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Example 19 : Find the compound interest on $\gtrless 1000$ for $1\frac{1}{2}$ years at the rate of 10% per annum compounded half yearly.

Solution :

Here, Principal = ₹ 1000 Rate of interest (r%) = $\frac{10}{2}\%$ = 5%, half yearly Since, the interest is compounded half yearly and there are three half years in $1\frac{1}{2}$ year. So, n = 3 \therefore Amount A = ₹ 1000 $\left(1 + \frac{5}{100}\right)^3$ = ₹ 1000 × $\left(1 + \frac{1}{20}\right)^3$ = ₹ 1000 × $\left(\frac{21}{20}\right)^3$ = ₹ 1000 × $\left(\frac{21}{20}\right)^3$ = ₹ 1000 × $\frac{21 \times 21 \times 21}{20 \times 20 \times 20}$ = ₹ $\frac{9261}{8}$ = ₹ 1157.625 = ₹ 1157.63 (approx) Required compound interest = A - P = ₹ (1157.63 - 1000.00) = ₹ 157.63 (approx)

[The earlier examples are being illustrated here using formula]

Example 20 : At what rate the compound interest of \gtrless 400 amounts to \gtrless 441 in 2 years. **Solution :** Let the rate of interest be r%

Principal (P) = $\gtrless 400$

Time (n) = 2 years

Amount (A) =₹441

Comparing Quantities

We know that, $P\left(1+\frac{r}{100}\right)^n = A$

$$\therefore \quad 400\left(1+\frac{r}{100}\right)^2 = 441$$

or,
$$\left(1 + \frac{r}{100}\right)^2 = \frac{441}{400} = \left(\frac{21}{20}\right)^2$$

Taking square root from both sides

$$1 + \frac{r}{100} = \frac{21}{20}$$

or, $\frac{r}{100} = \frac{21}{20} - 1$
$$= \frac{21 - 20}{20}$$
$$= \frac{1}{20}$$

or, $r = \frac{1}{20} \times 100 = 5$

 \therefore Required rate of interest = 5% per annum

Example 21 : If the difference of compound interest and simple interest on a sum for 2 years at 4% per annum is ₹ 150, find the sum.

Solution : Let the Principal be \gtrless P Time (n) = 2 years Rate of interest (r%) = 4% per annum

We know that,

$$CI_2 - SI_2 = \frac{Pr^2}{(100)^2}$$

or, $150 = \frac{Pr^2}{100^2}$
or, $150 = \frac{P \times 4^2}{100^2}$

or, $150 = \frac{16P}{10000}$ or, $P = \frac{150 \times 10000}{16}$ $= 150 \times 625$ = 93750Required sum = Rs. 93750

Example 22 : In a year the population of a town increases at the rate of 2%. But in the next year it decreases by 2%. If at the end of 2 years the population becomes 249900, what was the population at the beginnig?

Solution : Let the original population be P

....

After one year, population becomes when increases by 2 % = P $\left(1 + \frac{2}{100}\right) = \frac{51}{50}$ P

i.e population at the beginning of 2nd year = $\frac{51}{50}$ P

According to question, in the 2nd year population decreases at the rate of 2% ∴ At the end of 2nd year, the population

$$= \frac{51}{50} P \left(1 + \frac{-2}{100}\right)$$

$$= \frac{51}{50} P \times \frac{98}{100}$$

$$= \frac{51}{50} P \times \frac{49}{50} P$$
According to question, $\frac{51}{50} P \times \frac{49}{50} = 249900$
or, $\frac{51 \times 49P}{50 \times 50} = 249900$
or, $\frac{51 \times 49P}{50 \times 50} = 249900$
or, $P = \frac{24990 \times 50 \times 50}{51 \times 49}$

$$= 2,50,000$$

\therefore Population of the town at the beginnig was 2,50,000.

Exercise : 8.4

Find the compound interest and the amount of the following (Q1 to Q6) using formula :

- 1. \gtrless 300 for 2 years at 3% per annum
- 2. \mathbf{R} 4,000 for 3 years at 2% per annum
- 3. ₹ 10,000 for 2 years at 4% per annum
- 4. ₹ 7,000 for 3 years at 3% per annum
- 5. \gtrless 1,500 for 2 years at 10% per annum
- 6. ₹ 900 for 3 years at 5% per annum
- 7. Find the compound interest on ₹ 1000 for 9 months at 4% per annum compounded quarterly.
- 8. Find the compound interest on ₹ 2000 for 1½ years at 4% per annum compounded half-yearly.
- 9. What principal will amount to ₹ 4500 in 2 years at 4% per annum compounded annually?
- 10. At what rate of compound interest ₹ 576 will amount to ₹ 625 in 2 years?
- 11. At what rate of compound interest ₹ 64 will amount to ₹ 125 in 3 years?
- 12. Find the difference of compound interest and simple interest on a sum of ₹ 500 at the rate of 10% per annum for 2 years.
- 13. Find the sum on which the difference of compound interest and simple interest will ₹ 1 after 2 years at the rate of 4% per annum.

8.5 Goods and Sevice Tax :

Tax is a compulsory contribution to state revenue, levied by the government on workers' income, business establishments or organization. There are two types of taxes– Direct tax and Indirect tax.

Direct tax is such a tax which is levied on the income or profits of the person who pays it.

Indirect tax is a tax collected by an intermediary from the person who bears the ultimate economic burden of the tax. The intermediary later files a tax return and forwards the tax proceeds to the Government with the return. Sales tax, Service tax, Excise duty, Entertainment tax, Value Added Tax etc. are indirect taxes. Now all these indirect taxes has been combined and named as goods and services tax or GST. Though G.S.T was introduced to simplify and put in place a simple uniform tax system it is still in the processing stage.

- Mainly, there are two types of GST
- 1. Intra state GST and
- 2. Inter state GST.

The taxes lavied on interstate GST are :-

- $(i)\,CGST\,or\,Central\,GST$
- (ii) SGST or State GST/ UTGST or Union Territory GST
 - The following diagram will give better concept about GST



8.5.1. GST slabs on Sale :

| Types of Sale | Applicable Tax | | |
|---------------|-----------------|--|--|
| Intra-State | CGST+SGST/UTGST | | |
| Inter-State | IGST | | |

Rate of GST :

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Suppose the Govt has declared 5% GST on some goods. Then if the Goods are sold inside the state we have to pay 2.5% CGST and 2.5% SGST. If it is sold outside the state then we have to pay 5% IGST.

| Applied rate of tax on IGST | = Tax on CGST |
|-----------------------------|----------------------|
| | + Tax on SGST/UTGST. |
| | |

Comparing Quantities

Look at the following table :



Example 23 : Suppose rate of CGST is 9% and SGST is 9%; prepare a bill of sales ₹ 20000 where the sale is intra state.

| Solution : | Selling Price | = ₹ | 20,000 | |
|------------|---------------|-----|----------|--|
| | CGST (9%) | = ₹ | 1800 | |
| | SGST (9%) | = ₹ | 1800 | |
| | Total | = र | 5 23,600 | |

Example 24 : Example 23 with interstate sale.

| Solution : | sales | : ₹ | 20000 |
|------------|----------|-------|----------|
| | IGST (18 | %) ₹ | 3600 |
| | | Total | = 23,600 |

Example 25 : In an intra state sale in Assam, the M.R.P ₹ 12,000, Discount 30%, GST = 18%. Calculate total discount, selling price, CGST, SGST, IGST and also the bill amount.

Solution : MRP = ₹ 12000

Discount = 30% of ₹ 12000

$$= ₹ \frac{30}{100} \times 12000$$
$$= ₹ 3600$$

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Comparing Quantities

| paring Quantities |
|-------------------|
| Com |
| |

| Selling Price | = ₹ (12000 - 3600) = ₹ 8400 |
|--------------------|--------------------------------|
| CGST | = 9% of ₹ 8400 |
| | = $\frac{9}{100}$ × ₹ 8400 |
| | =₹756 |
| SGST | = 9% of ₹ 8400 = ₹ 756 |
| IGST | = 0 |
| Bill Amount | = S.P + CGST + SGST |
| | =₹(8400 + 756 + 756) |
| | =₹9912 |
| | |

Exercise : 8.5

1. The transactions between a company in Delhi to one in Jaipur are as follows :

MRP ₹ 60,000, Discount 20%, GST 28%

Find amount of discount, SP, CGST, SGST, IGST and bill amount.

- 2. The transactions between a distribution centre in Guwahati to one in Dhubri are as follows : MRP ₹ 90,000, Discount 30%, SGST- 9%, CGST 9%. Find S.P, SGST, CGST, IGST and bill amount.
- 3. Fill in the blanks :

| Commo- | Number | (MRP) | Total | Discount | Amount | SP | CGST | SGST |
|-----------|------------|-------|-------|----------|-------------|-----|-------|-------|
| dity/Item | of Item(s) | | | | of discount | | 2.5% | 2.5% |
| A | 12 | 50 | 600 | 10% | 60 | 540 | 13.50 | 13.50 |
| В | 30 | 60 | 1800 | 15% | | | 38.25 | |
| С | 10 | 35 | | 12% | | 308 | | 7.70 |
| D | 6 | 15 | | 10% | | | | |
| | | | | | | | | |



- 1. Profit or loss depends on cost price. When selling price is more than C.P. then there will be profit and if SP is less than C.P there will be loss. So,
 - (i) Profit(p) = SP CP
 - (ii) Loss(l) = CP SP

(iii) Percentage of profit = $\frac{\text{Profit}}{\text{CP}} \times 100\% \text{ or } \left(\frac{\text{SP} - \text{CP}}{\text{CP}}\right) \times 100\%$

(iv) Percentage of loss =
$$\frac{\text{Loss}}{\text{CP}} \times 100\% \text{ or } \left(\frac{\text{CP}-\text{SP}}{\text{CP}}\right) \times 100\%$$

(v) Selling Price =
$$\left(\frac{100 - \text{Loss \%}}{100}\right) \times \text{CP}$$
 Cost Price = $\frac{100}{100 - 1\%} \times \text{SP}$
(vi) Selling Price = $\left(\frac{-100 + p\%}{100}\right) \times \text{CP}$ Cost Price = $\left(\frac{-100}{100 + p\%}\right) \times \text{SP}$

2. Discount is always calculated on marked price Discount = MP – SP

Rate of discount =
$$\frac{\text{discount}}{\text{MP}} \times 100\%$$
 or $\left(\frac{\text{MP} - \text{SP}}{\text{MP}}\right) \times 100\%$

- 3. Additional expenses after buying an article is known as overhead expenses. Actual CP = Buying Price + Overhead Expenses.
- 4. Compound interest is the interest calculated on the previous years amount. For the first year, SI and CI remains the same. For later years C.I > S.I
- 5. Amount when interest is calculated compounded annually $A = P \left(1 + \frac{r}{100}\right)^n$ and CI=A–P
- 6. GST is an indirect tax. There are two types of GST, intra state and inter state. Intra state tax is again of two types : GST and SGST. Interstate tax is IGST.