

Comparing Quantities

We'll cover the following key points:

- Per cent
- Profit and loss
- Profit per cent and loss percent
- Sales tax / value added tax
- Discount
- Concept of compound interest
- Computation of compound interest
- Compound interest formula

Do you Remember fundamental concept in previous class.

- In class 7th we learnt
- Percentage
 - Uses of Percentages
 - Profit or Loss



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Learning Outcomes

By the end of this chapter, students will be able to:

- Understand and apply the concept of ratio and proportion in real-life situations.
- Solve problems related to percentages, including profit, loss, discount, and GST.
- Calculate simple and compound interest for given principal, rate, and time.
- Convert fractions, decimals, and percentages interchangeably.
- Apply the concept of percentages to solve problems related to population, elections, and data analysis.
- Use the concept of direct and inverse variation to solve practical problems.
- Interpret and solve word problems involving the comparison of quantities.
- Understand the application of compound interest in real-life situations, such as loans and investments.
- Analyze and interpret quantitative data presented in tables, charts, and graphs.
- Develop critical thinking and problem-solving skills through the application of comparing quantities in diverse contexts.



Mind Map

COMPARING QUANTITIES

Finding Discounts

- **Discount**
= Marked price – sale price
- **Discount %**
$$= \frac{\text{Discount}}{\text{M.P.}} \times 100\%$$

Sales tax / value added tax / goods and services tax

- **Tax % of Bill amount**

e.g.,
Bill = ₹ 3000
GST = 10%
GST = 10% of 3000
$$= \frac{10}{100} \times 3000$$
$$= ₹ 300$$

Applications of compound interest formula

- Increase or decrease in population
- The growth of a bacteria
- The value of an item if its price increases or decreases in the immediate years.

Estimation in percentages

- Round off the number to the nearest ten / hundred etc.
- Find easy percentages
e.g., 5%, 10%, 1%
- Then add / Subtract

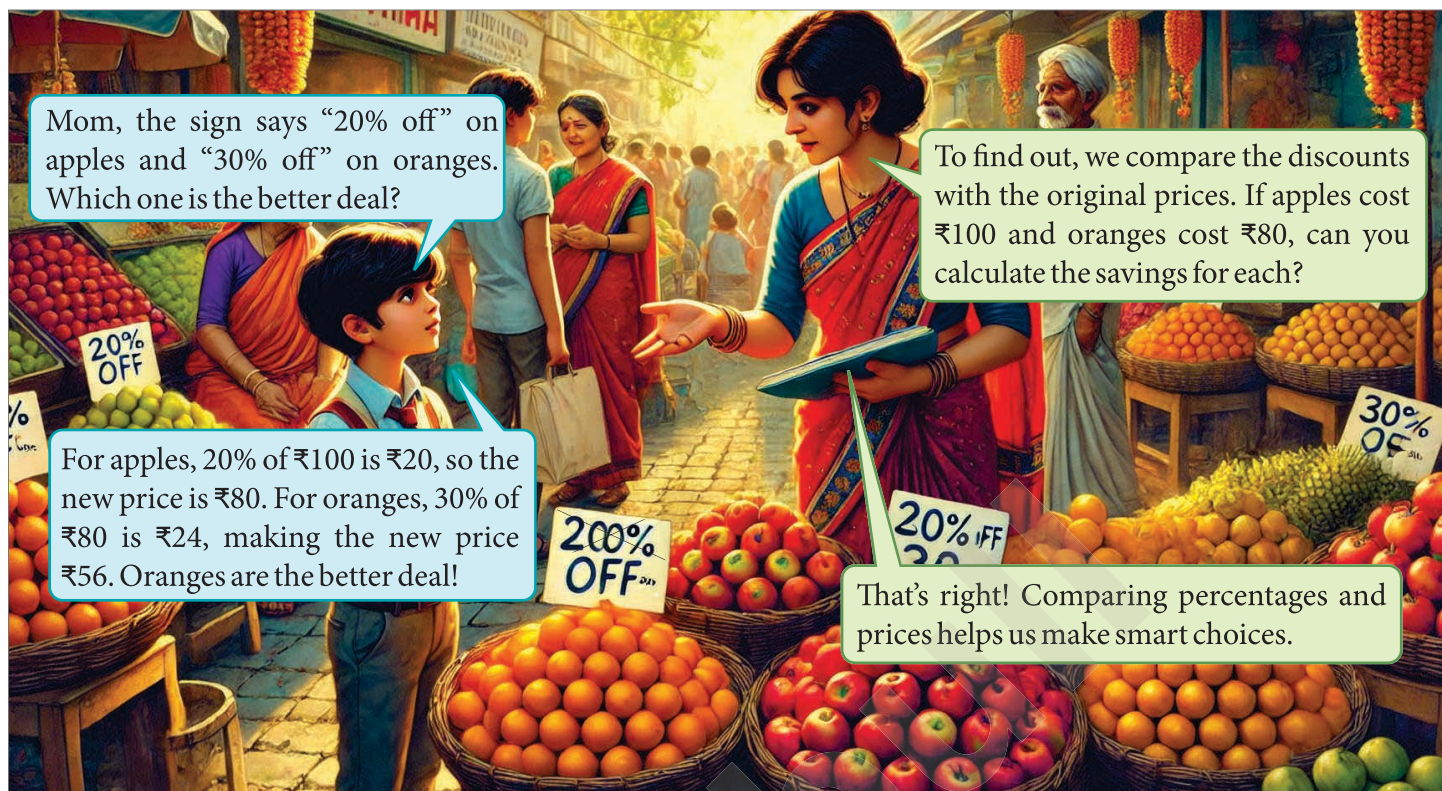
Compound interest

Compound interest formula

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

- A = Amount
- P = Principal
- R = Rate
- n = Terms
- Compound Interest = Amount – Principal

Introduction



Percent

The word per cent is an abbreviation of the Latin phrase '*percentum*' which means per hundred. Thus, the term per cent means 'out of hundred' or 'for every hundred'. When we say that Reshma secured 80 per cent marks in her annual examination, this means that she obtained 80 marks out of every 100 marks.

The symbol '%' is used to represent per cent. Thus, 65 per cent is written as 65%. The symbol '%' stands for $\frac{1}{100}$. (We can always interchange % with $\frac{1}{100}$ and vice-versa.)

Relation Between Per cent and Fraction

We have already learnt that per cent means per hundred or hundredths.

$$\therefore \frac{50}{100} = 50 \times \frac{1}{100} = 50 \text{ hundredths} = 50 \text{ per hundred} = 50\%$$

$$\text{Similarly, } \frac{48}{100} = 48 \times \frac{1}{100} = 48 \text{ hundredths} = 48 \text{ per hundred} = 48\% \text{ and so on.}$$

From the above discussion, we see that:

A fraction with denominator 100 is equal to that per cent, as the numerator.

$$\text{Thus, } \frac{35}{100} = 35\%, \frac{49}{100} = 49\% \text{ and so on.}$$

Relation Between Per cent and Ratio

Since a ratio is a fraction and a per cent can be converted into a fraction, a per cent can be converted into a ratio as well by the same method.



Example: $65\% = 65 : 100 = 13 : 20$ and $40\% = 40 : 100 = 2 : 5$.

Relation between Per cent and Decimal

$$75\% = \frac{75}{100} = 0.75 \text{ and } 108\% = \frac{108}{100} = 1.08$$

Thus, we can express a per cent as a decimal number.

$$\text{Also } 0.5 = \frac{5}{10} = \frac{5 \times 10}{10 \times 10} = \frac{50}{100} = 50\% \text{ and } 7.2 = \frac{720}{100} = 720\%$$

Thus, we can express a decimal number as a per cent.

Example 1: Convert as directed:

- (i) $\frac{4}{5}$ into per cent (ii) $23\frac{1}{3}\%$ into fraction (iii) 33.7% into decimal

Solution: (i) $\frac{4}{5} = \frac{4}{5} \times \frac{100}{100} = \left[\frac{4}{5} \times 100 \right] \times \frac{1}{100}$
 $= \left[\frac{400}{5} \right] \times \frac{1}{100} = 80\%$

(ii) $23\frac{1}{3}\% = 23\frac{1}{3} \times \frac{1}{100} = \frac{70}{3} \times \frac{1}{100} = \frac{7}{30}$

(iii) $33.7\% = \frac{33.7}{100} = 0.337$.

Example 2: Evaluate: 25% of ₹ 700.

Solution: $25\% = \frac{25}{100} = \frac{1}{4}$

$$\text{So, } 25\%, \text{ i.e., } \frac{1}{4} \text{ of ₹ 700} = \frac{1}{4} \times ₹ 700 = ₹ \frac{700}{4} = ₹ 175$$

Hence, 25% of ₹ 700 = ₹ 175.

Example 3: A number is increased by 30% and then decreased by 30%. Find the net increase or decrease per cent.

Solution: Let the number be = 100.

$$\therefore \text{ Number after 30\% increase} = 100 + 30 = 130$$

$$\text{Decrease in the new number} = 30\% \text{ of } 130 = \left(\frac{30}{100} \times 130 \right) = 39$$

$$\text{Final number} = 130 - 39 = 91$$

$$\text{Thus, net decrease} = 100 - 91 = 9$$

Hence, net percentage decrease = 9%.

Example 4: Pincky has some oranges. He sold 30% more than he ate. If he sold 39 oranges, how many did he eat?

Solution: Let x be the number of oranges Pincky ate.

He sold 30% more than he ate means he sold $x + \frac{30}{100}x$ oranges $= x + \frac{3x}{10} = \frac{13}{10}x$ oranges.

According to the question, oranges sold = 39

$$\Rightarrow \frac{13x}{10} = 39 \quad \Rightarrow \quad x = \frac{39 \times 10}{13} = 30.$$

Hence, he ate 30 oranges.

Example 5: The salary of a bus driver has been increased by 40%. By what per cent must the new salary be reduced to restore the original salary?

Solution: Let the original salary be ₹ 100.

Increase in the salary = 40% of ₹ 100 = ₹ 40

Salary after increment = ₹ 140

Now, in order to restore the original salary, a reduction of ₹ 40 should be made on ₹ 140.

$$\text{Percentage reduction in the new salary} = \left(\frac{40}{140} \times 100 \right) \% = \frac{200}{7} \% = 28\frac{4}{7} \%$$

Hence, reduction on the new salary = $28\frac{4}{7} \%$.

Exercise 7.1

1. Express :

- (i) $12\frac{1}{2} \%$ as a fraction (ii) $5\frac{1}{4}$ as a per cent (iii) 200% as a decimal
(iv) 0.78 as a per cent (v) 70% as a ratio (vi) 18 : 6 as a per cent

2. Evaluate :

- (i) 40% of 300 kg (ii) 20% of 60 litres (iii) 30% of 200 metres (iv) $12\frac{1}{2} \%$ of 480 ml

3. Find the value of x if:

- (i) 50% of x is ₹ 35 (ii) $\frac{1}{2} \%$ of x is 16 (iii) 60% of x is 300

4. What per cent is:

- (i) 20 of 40 (ii) 6 of 3 (iii) 300 ml of 3 litre (iv) ₹ 7.50 of ₹ 50

5. (i) If 65% of a number is 260, then find the number. (ii) Increase 320 by 30%.

(iii) Decrease ₹ 120 by $12\frac{1}{2} \%$.

6. Reshma's weight decreased from 80 kg to 56 kg. Find the percentage decrease.

7. A bag that could hold 5 kg of rice earlier has now been increased in size so that it can hold 7 kg. What is the percentage increase in size?

8. If 50% of a number is 250, find the number.

9. In a glass of mixed juice, the juice of orange and pineapple are in the ratio 2 : 3. What is the percentage of orange and pineapple juice in the mixed juice?

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

- Two candidates Ram Prakash and Birendra Mohan contest an election. Ram Prakash gets 36% of the valid votes and is defeated by 700 votes. Find the total number of valued votes cast in the election.
- A number is increased by 15% and then it is decreased by 20%. Find the net increase or decrease per cent.
- The prices of onion increased by 30%. By how much per cent should Rosy reduce her consumption of onion so that her expenditure on onion does not increase?

—• Profit and Loss •—

Let us recall, what we have learnt about profit and loss in class VII.

I. Cost Price (C.P.): The price for which an article is bought is called the cost price.

II. Selling Price (S.P.): The price at which an article is sold is called the selling price.

III. Profit: If $S.P. > C.P.$, then it is profit or gain.

$$\text{Profit or gain} = S.P. - C.P. \text{ or } S.P. = C.P. + \text{Gain}$$

IV. Loss: If $S.P. < C.P.$, then it is loss.

$$\text{Loss} = C.P. - S.P. \text{ or } C.P. = S.P. + \text{Loss}$$

REMEMBER



Usually, a shopkeeper has to bear some additional expenses such as, labour charges, maintenance charges and transportation charges, etc. for the articles before they are sold. Such charges are called *overhead charges*.

These overhead charges become a part of the cost price. Thus, the real cost price of the article is equal to the sum of the actual payment made while purchasing the article and overhead charges, *i.e.*,
Thus, net cost price = Payment made while purchasing the articles + overhead charges

—• Profit Per cent and Loss Per cent •—

Generally, the profit or loss is expressed as *profit %* or *loss %*. It is also important to note that the profit % or loss% is calculated on the cost price, and not on selling price.

Formulae to calculate profit or loss per cent

$$1. \text{ Profit \%} = \frac{\text{Profit}}{C.P.} \times 100$$

$$2. \text{ Loss \%} = \frac{\text{Loss}}{C.P.} \times 100$$

Some more formulae to get Profit per cent and Loss per cent are:

- When C.P. and gain% or loss% are given, S.P. is calculated as under:

$$(i) \text{ S.P.} = \frac{(100 + \text{gain\%})}{100} \times C.P. \quad (ii) \text{ S.P.} = \frac{(100 - \text{loss\%})}{100} \times C.P.$$

2. When S.P. and gain% or loss% are given, C.P. is calculated as under:

$$(i) \text{ C.P.} = \frac{100}{(100 + \text{gain}\%)} \times \text{S.P.} \quad (ii) \text{ C.P.} = \frac{100}{(100 - \text{loss}\%)} \times \text{S.P.}$$

Example 6: Rajesh purchased a wrist-watch for ₹ 750 and sold it to Rohit for ₹ 825. Find his gain per cent.

Solution: C.P. of wrist-watch = ₹ 750

S.P. of wrist-watch = ₹ 825

$$\therefore \text{Gain} = ₹ (825 - 750) = ₹ 75$$

$$\therefore \text{Gain \%} = \frac{\text{Gain}}{\text{C.P.}} \times 100 = \frac{75}{750} \times 100 = 10\%.$$

Example 7: If S.P. of 17 pens is equal to the C.P. of 16 pens, find the gain per cent earned by the dealer.

Solution: Let the C.P. of each pen be ₹ 1.

So, the C.P. of 17 pens = ₹ 17

C.P. of 16 pens = ₹ 16

We have, S.P. of 16 pens = ₹ 17

$$\therefore \text{S.P.} > \text{C.P.} = \text{gain}$$

$$\text{Gain} = \text{S.P.} - \text{C.P.} = ₹ (17 - 16) = ₹ 1$$

$$\text{Gain\%} = \frac{\text{Gain}}{\text{C.P.}} \times 100 = \frac{1}{16} \times 100 = \frac{25}{4} = 6\frac{1}{4}\%.$$

Example 8: Roshan buys some pencils of one kind at 3 for ₹ 6 and equal number of other kind at 4 for ₹ 6. He sells them at 6 for ₹ 8. Find his gain or loss per cent.

Solution: LCM of 3, 4 and 6 is 12. Let the pencils in one packet be 12.

C.P. of pencils of 1st kind = ₹ 6

$$\therefore \text{C.P. of 12 pencils of 1st kind} = ₹ \frac{6}{3} \times 12 = ₹ 24$$

C.P. of 4 pencils of 2nd kind = ₹ 6

$$\text{C.P. of 12 pencils of 2nd kind} = ₹ \frac{6}{4} \times 12 = ₹ 18$$

$$\text{Total C.P. of 24 pencils} = ₹ (24 + 18) = ₹ 42$$

S.P. of 6 pencils = ₹ 8

$$\text{S.P. of 24 pencils} = ₹ \frac{8}{6} \times 24 = ₹ 32$$

As C.P. > S.P., then there is loss.

$$\text{Loss} = \text{C.P.} - \text{S.P.} = ₹ (42 - 32) = ₹ 10.$$

$$\text{Loss\%} = \frac{\text{Loss}}{\text{C.P.}} \times 100 = \frac{10}{42} \times 100 = \frac{1000}{42} = 23.81\%.$$

Example 9: On selling an inverter set for ₹ 7,500, a dealer loses 20%. Find his selling price if he wants to gain 20%.

Solution : In first case:

$$\begin{aligned} \text{S.P.} &= ₹ 7500, \text{ Loss} = 20\% \\ \therefore \text{C.P.} &= \left[\frac{100}{(100 - \text{loss}\%)} \times \text{S.P.} \right] \\ &= ₹ \left[\frac{100}{(100 - 20)} \times 7500 \right] \\ &= ₹ \left[\frac{100}{80} \times 7500 \right] = ₹ 9,375. \end{aligned}$$

In second case:

$$\begin{aligned} \text{Desired profit} &= 20\%, \\ \text{C.P.} &= ₹ 9375 \\ \therefore \text{S.P.} &= \left[\frac{(100 + \text{profit}\%)}{100} \times \text{C.P.} \right] = ₹ \left[\frac{(100 + 20)}{100} \times 9375 \right] \\ &= ₹ \left[\frac{120}{100} \times 9375 \right] = ₹ 11,250 \end{aligned}$$

\therefore Selling Price = ₹ 11,250.

—• Sales Tax / Value Added Tax —•

The tax charged by the government on the sale of an item is called *Sales Tax*.

It is collected by the shopkeeper from the customer and given to the government. This is therefore, always on the selling price of an item and is added to the value of the bill. These days however, the price includes the tax known as *Value Added Tax (VAT)*.

Example 10: The sales tax on a Khadi saree is 5%. If the marked price of an 'item' is ₹ 750, how much would it cost to buy?

Solution: Marked price of the saree = ₹ 750

$$\text{Sales tax at the rate of 5\% on ₹ 750} = \frac{5}{100} \times ₹ 750 = ₹ 37.50$$

$$\therefore \text{The net cost of the saree} = ₹ (750 + 37.50) = ₹ 787.50.$$

Example 11: Renu bought a music system for ₹ 7,700 including VAT of 10%. Find the price of the music system before VAT was Added.

Solution: The price includes the VAT, i.e., the value added tax.

Thus, a 10% VAT means if the price without VAT is ₹ 100 then price including VAT is ₹ 110.



Now, when price including VAT is ₹ 110, original price is ₹ 100.

Hence, when price including tax is ₹ 7,700, the original price

$$= ₹ \frac{100}{110} \times 7700 = ₹ 7,000$$

∴ Original price = ₹ 7,000.

Exercise 7.2

1. Punit purchased a wrist-watch for ₹ 850 and sold it to Sudhir for ₹ 918. Find his gain per cent.
2. Pravat purchased a mobile phone for ₹ 1,260 and due to some scratches on its top he had to sell it for ₹ 1,197. Find his loss per cent.
3. Suhana bought a DVD player for ₹ 4,500 and sold it for ₹ 4,230. Find her loss per cent.
4. Find the selling price of a toaster whose cost price is ₹ 510 and gain earned is 10%.
5. The cost price of 16 articles is equal to selling price of 12 articles. Find the gain or loss per cent.
6. An egg-seller bought at 20 eggs for ₹ 56 and sold them at ₹ 35 per dozen. Find his gain a loss per cent.
7. On selling a refrigerator for ₹ 8,100, Monika loses 10%. Find her selling price if she wants to gain 10%.
8. A shopkeeper sold two tables for ₹ 1,500 each. On one he gained 20% and on the other he lost 20%. Find the loss or gain per cent in the whole transaction.
9. By selling 144 pencils Rachna lost the S.P. of six pencils. Find her loss per cent. Had she purchased them for ₹ 3,600, what would have been the S.P. of one pencil?
10. Ravinder sold his computer set at a loss of 12%. If he had sold it for ₹ 3,600 more, he would have got a profit of 18%. Find the C.P.

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

Discount

In our day-to-day life, we read advertisements in banners, posters, newspapers, magazines, and TV given by various companies declaring discounts such as 'Off Season Discount', 'Festival Discount', etc.

When discount is given, a certain price is attached to the article which the shopkeeper professes to be the cost of the article for the customer. This price is called the 'List Price or Marked Price (M.P.)'. Then the shopkeeper offers discount on the marked price. Customer pays the difference between the marked price and the discount. This amount is therefore, the selling price (S.P.) of the article.



Remember that discount is generally given as a certain per cent of the marked price.

Discount = Marked Price – Selling Price

Further, Rate of Discount or Discount% = $\frac{\text{Discount}}{\text{Marked Price}} \times 100$

$$\text{Also, M.P.} = \frac{100 \times \text{S.P.}}{100 - \text{Discount\%}}$$

Example 12: The Marked Price of a silver box is ₹625. During the off season the shopkeeper allows a discount and sells the silver box for ₹ 562.50. Find the discount per cent allowed.

Solution:

M.P. of silver box = ₹ 625

S.P. of silver box = ₹ 562.50

∴ Discount = ₹ 625 – ₹ 562.50 = ₹ 62.50

If the M.P. is ₹ 1, discount allowed = ₹ $\frac{62.50}{625}$

If the MP is ₹100, discount allowed = $\frac{62.50}{625} \times 100 = 10\%$.

Example 13: At what price should a dealer mark his goods so that after giving Diwali discount of 10%, he still gains 20% on his cost price?

Solution:

Let C.P. of an article be ₹ 100.

Gain = 20%

S.P. of the article = ₹120

Suppose marked price = ₹ 100

Discount = 10%

S.P. = ₹ (100 – 10) = ₹ 90

If S.P. is ₹ 90, marked price = ₹ 100

If S.P. is ₹ 120, marked price = ₹ $\frac{100 \times 120}{90} = ₹ 133.33$

He should mark his goods worth ₹ 100 at ₹ 133.33.

Thus, he should mark the goods 33.3% above C.P.

Example 14: A retailer allows successive discounts of 10% and 5%. Find the net selling price of a DVD player whose marked price is ₹ 5,130.

Solution:

Let the M.P. be x .

First discount = 10% on ₹ 100 = ₹ $\frac{10}{100} \times 100 = ₹ 10$

Price after 1st discount = ₹ (100 – 10) = ₹ 90

$$\text{Second discount} = 5\% = ₹ \frac{5}{100} \times 90 = ₹ 4.50$$

$$\text{Price after 2nd discount} = ₹ (90 - 4.50) = ₹ 85.50$$

When net price is ₹ 85.50, then M.P. = ₹ 100

$$\text{When net price is ₹ 1, then M.P.} = ₹ \frac{100}{85.50}$$

$$\text{When net price is ₹ 5,130, then M.P.} = ₹ \frac{100}{85.50} \times 5130 = ₹ 6000.$$

Example 15: After allowing 20% discount to the customer, a dealer still gains 20%. Find the marked price of the bicycle which costs him ₹ 2,000.

Solution: Here, cost price = ₹ 2,000, gain = 20%

$$\therefore \text{Selling price} = ₹ \frac{120}{100} \times 2000 = ₹ 120 \times 20 = ₹ 2,400$$

Also, discount = 20%

$$\begin{aligned} \therefore \text{Marked price} &= \frac{100 \times \text{S.P.}}{100 - \text{Discount}\%} \\ &= ₹ \left[\frac{100 \times 2400}{100 - 20} \right] \\ &= ₹ \left[\frac{100 \times 2400}{80} \right] = ₹ 100 \times 30 = ₹ 3,000 \end{aligned}$$

Hence, marked price of bicycle is ₹ 3,000.

Exercise 7.3

- Calculate the discount and the discount per cent in the following cases:
 - S.P. = ₹ 18, M.P. = ₹ 24
 - S.P. = ₹ 1,675, M.P. = ₹ 2,675
- Find the selling price when:
 - M.P. = ₹ 1,120, Discount = 20%
 - M.P. = ₹ 1,500, Discount = $\frac{25}{2}\%$
- Find the marked price when:
 - S.P. = ₹ 990, Discount = 10%
 - S.P. = ₹ 1,080, Discount = 10%
- After allowing a discount 20 % on festival of Christmas, a trousers is sold for ₹360. Find the M.P. of the trousers.
- Find the marked price of a DVD player which is sold at ₹ 5,225 after allowing a discount of 5%.
- A trademan allows a discount of 25% on the M.P. How much above the C.P. must he mark his articles to make a profit of 17%?
- A dealer allows his customers 20% discount on the marked price of the goods and still gets a profit of 20%. What is the C.P. of goods for him marked at ₹ 1,000?
- If the rate of discount deducted on book is 20% of its marked price and the sale price of the book is ₹ 64, what is the marked price of the book?

9. A shopkeeper is giving a cash discount of 20% for making cash payment. Priya purchased a computer set worth ₹ 22,000. How much it will cost her, if she makes cash payment?
10. A trader allows a discount of 20% to his customers and still gains 20%. Find the M.P. of a table which costs the trader ₹ 1,100.

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

—● Concept of Compound Interest ●—

We know that if Principal is denoted by P, Rate of interest by R% per annum and Time by T (in years), then the simple interest (S.I.) in ₹ is calculated using the formula :

$$\text{S.I.} = \frac{P \times R \times T}{100}$$

For example, if P = ₹ 1000 and R = 7% per annum, then

$$\text{S.I. for 1 year} = ₹ \left(\frac{1000 \times 7 \times 1}{100} \right) = ₹ 70$$

$$\text{S.I. for 2 years} = ₹ \left(\frac{1000 \times 7 \times 2}{100} \right) = ₹ 140$$

$$\text{S.I. for 3 years} = ₹ \left(\frac{1000 \times 7 \times 3}{100} \right) = ₹ 210 \text{ and so on.}$$

We observe that while calculating S.I., the principal remains constant throughout. However, the method of calculating interest is quite different in banks, post offices, insurance corporations and other companies.

In this method, the borrower and the lender agree to fix up a certain time interval, say one year or a half year or one-quarter of a year, *i.e.*, 3 months for the computation of interest and amount. In such cases, the interest accrued during the first interval of time is added to the original principal and the amount so obtained is considered as the principal for the second interval of time. The amount of this principal at the end of the second interval of time becomes the principal for the third interval of time and so on.

After a certain specified period, the difference between the amount and the money borrowed (Principal) is called the compound interest for that period. Compound interest is abbreviated as C.I.

Thus, **C.I. = Amount – Principal** or **C.I. = A – P**

Note :

The period after which the interest is credited (calculated) is called conversion period.

If no conversion period is mentioned, the conversion period is taken as 1 year.

—● Computation of Compound Interest ●—

Computation of compound interest when interest is compounded annually.

In such problems where interest is compounded yearly, the interest accrued during the 1st year is



added to the principal and the amount so obtained becomes the principal for the 2nd year. The amount at the end of the 2nd year becomes the principal for the 3rd year and so on.

Example 16: Find the compound interest of ₹ 5,000 for 2 years at the rate of 10% per annum, when the interest is compounded annually.

Solution:

We have, $P = ₹ 5,000$, Rate = 10% per annum

$$\therefore \text{Interest for the 1st year} = \frac{PRT}{100} = ₹ \left(\frac{5000 \times 10 \times 1}{100} \right) = ₹ 500$$

$$\text{Amount after 1st year} = \text{Principal} + \text{Interest}$$

$$= ₹ (5000 + 500) = ₹ 5,500$$

$$\text{Principal for the 2nd year} = ₹ 5,500$$

$$\therefore \text{Interest for the 2nd year} = ₹ \left(\frac{5500 \times 10 \times 1}{100} \right) = ₹ 550$$

$$\therefore \text{Amount after two years} = ₹ (5500 + 550) = ₹ 6,050.$$

$$\text{Now, C.I.} = A - P = ₹ (6050 - 5000) = ₹ 1,050.$$

Example 17: Find the difference between S.I. and C.I. on ₹ 8,400 at 9% for 2 years, the compound interest being payable annually.

Solution:

For the 1st year,

$$\text{Principal} = ₹ 8,400$$

$$\text{Rate} = 9\%$$

$$\text{Time} = 1 \text{ year}$$

$$\text{Interest for the 1st year} = \frac{P \times R \times T}{100}$$

$$= ₹ \left(\frac{8400 \times 9 \times 1}{100} \right) = ₹ 756$$

$$\text{Amount} = ₹ (8400 + 756) = ₹ 9,156$$

For the 2nd year,

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

$$= ₹ \left(\frac{9156 \times 9 \times 1}{100} \right) = ₹ 824.04$$

$$\text{Amount} = ₹ (9156 + 824.04) = ₹ 9,980.04$$

$$\text{C.I.} = ₹ (9980.04 - 8400) = ₹ 1,580.04$$

$$\text{S.I.} = \frac{P \times R \times T}{100}$$

$$= ₹ \left(8400 \times \frac{9}{100} \times 2 \right) = ₹ 1,512$$

Difference between C.I. and S.I.,

$$= ₹ (1580.04 - 1512)$$

$$= ₹ 68.04.$$

Example 18: Find the difference between the simple interest and compound interest on ₹ 6,000 at 4% per annum for 2 years.

Solution:

$$\begin{aligned}\text{SI for 2 years} &= \frac{P \times R \times T}{100} \\ &= \frac{6000 \times 4 \times 2}{100} = ₹ 480\end{aligned}$$

For compound interest: (CI)

$$\begin{aligned}\text{Interest for the 1st year} &= \frac{P \times R \times T}{100} \\ &= \frac{6000 \times 4 \times 1}{100} = ₹ 240\end{aligned}$$

$$\begin{aligned}\text{Principal for the 2nd year} &= ₹ 6000 + ₹ 240 \\ &= ₹ 6,240\end{aligned}$$

$$\text{Interest for the 2nd year} = \frac{6240 \times 4 \times 1}{100} = ₹ 249.6$$

Difference between SI and CI

$$\text{CI} = ₹ 480 - ₹ 249.6 = ₹ 230.4$$

Computation of compound interest when interest is compounded half-yearly.

If the rate of interest is R% per annum and the interest is compounded half yearly, then the rate of interest will be $\frac{R}{2}$ % per half year.

The amount after the first half year becomes the principal for the next half year and so on.

Example 19: Find the compound interest on ₹ 6,000 for 2 years at 10% per annum, interest being compounded half-yearly.

Solution:

$$\begin{aligned}\text{We have, rate of interest} &= 10\% \text{ per annum} \\ &= 5\% \text{ half yearly}\end{aligned}$$

$$\text{Time} = 2 \text{ years} = 4 \text{ half years}$$

$$\text{Principal for the 1st half year} = ₹ 6,000$$

$$\text{Interest for the 1st half year} = ₹ \left(\frac{6000 \times 5 \times 1}{100} \right) = ₹ 300$$

$$\therefore \text{Amount at the end of 1st half year} = ₹ 6000 + ₹ 300 = ₹ 6,300$$

$$\therefore \text{Principal for the 2nd half year} = ₹ 6,300$$

$$\text{Interest for the 2nd half year} = ₹ \left(\frac{6300 \times 5 \times 1}{100} \right) = ₹ 315$$

$$\therefore \text{Amount at the end of 2nd half year} = ₹ 6300 + ₹ 315 = ₹ 6,615$$

$$\therefore \text{Principal for the 3rd half year} = ₹ 6,615$$

$$\begin{aligned}\text{Interest for the 3rd half year} &= ₹ \left(\frac{6615 \times 5 \times 1}{100} \right) \\ &= ₹ 330.75\end{aligned}$$

$$\begin{aligned}\therefore \text{Amount at the end of 3rd half year} &= ₹ 6615 + ₹ 330.75 \\ &= ₹ 6,945.75\end{aligned}$$

$$\text{Principal for the 4th half year} = ₹ 6,945.75$$

$$\begin{aligned}\text{Interest for the 4th half year} &= ₹ \left(\frac{6945.75 \times 5 \times 1}{100} \right) \\ &= ₹ 347.29\end{aligned}$$

$$\begin{aligned}\therefore \text{Amount at the end of 4th half year} &= ₹ 6945.75 + ₹ 347.29 \\ &= ₹ 7,293.04\end{aligned}$$

$$\begin{aligned}\backslash \text{Compound interest after 2 years or four half years} \\ &= ₹ (7293.04 - ₹ 6000) \\ &= ₹ 1,293.04.\end{aligned}$$

Computation of Compound Interest when interest is Compounded Quarterly:

If the rate of interest is R% per annum and the interest is compounded quarterly, then it is $\frac{R}{4}\%$ per quarter.

Example 20: Rashmi deposited ₹15,000 for 9 months at 16% per annum in a Bank of India branch. Find the compound interest, if the interest is payable quarterly.

Solution:

We have rate of interest = 16% per annum = 4% per quarter

Time = 9 months

= (3 × 3) months

= 3 × 1 quarter = 3 quarters

Principal for the 1st quarter = ₹ 15,000

$$\text{Interest for the 1st quarter} = ₹ \left(\frac{15000 \times 4 \times 1}{100} \right) = ₹ 600$$

$$\therefore \text{Amount at the end of 1st quarter} = ₹ 15000 + ₹ 600 = ₹ 15,600$$

$$\therefore \text{Principal for the 2nd quarter} = ₹ 15,600$$

$$\text{Interest for the 2nd quarter} = ₹ \left(\frac{15600 \times 4 \times 1}{100} \right) = ₹ 624$$

$$\begin{aligned}\therefore \text{Amount at the end of 2nd quarter} &= ₹ 15600 + ₹ 624 \\ &= ₹ 16,224\end{aligned}$$

$$\therefore \text{Principal for the 3rd quarter} = ₹ 16,224$$

$$\text{Interest for the 3rd quarter} = ₹ \left(\frac{16224 \times 4 \times 1}{100} \right) = ₹ 648.96$$

$$\begin{aligned} \therefore \text{Amount at the end of 3rd quarter} &= ₹ 16224 + ₹ 648.96 \\ &= ₹ 16,872.96 \end{aligned}$$

$$\begin{aligned} \therefore \text{Compound Interest} &= ₹ 16872.96 - ₹ 15000 \\ &= ₹ 1,872.96. \end{aligned}$$

Exercise 7.4

- Compute the compound interest on:
 - ₹ 5,000 for 2 years at 5% per annum.
 - ₹ 3,000 for 2 years at 15% per annum.
 - ₹ 9,000 for 3 years at 10% per annum.
 - ₹ 15,000 for 3 years at 10% per annum.
- Find the compound interest on ₹ 9,000 for 2 years at $7\frac{1}{2}\%$ per annum.
- What will be the compound interest on ₹ 12,000 at the rate of 8% for 1 year, the interest being payable half-yearly.
- Find the difference between C.I. and S.I. on ₹ 3,000 for 3 years at 10% per annum.
- Anju deposited ₹ 9,000 in a bank for 12 months at 16 % per annum. Find the compound interest, if the interest is payable half yearly.
- Find the compound interest on ₹ 3,000 for three years at 10% per annum. Also find the difference between Compound Interest and Simple Interest for that period.
- Find the interest paid by Roshan after a period of 3 years on a loan of ₹ 5,000 at 10% p.a. interest being compounded annually.
- Complete the compound interest on ₹ 8,000 for 2 years at $6\frac{1}{2}\%$ quarterly.

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

Compound Interest Formula

In this section, we shall learn the method of calculating the compound interest by using various cases and formulae. Using these formulae, the computation of compound interest becomes very easy.

Case 1. When the interest is compounded annually:

Let, principal = P, rate = $r\%$ per annum and time = n years

Then, the amount A is calculated using the formula:

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



and compound interest, C.I. = A - P

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

Example 21: Find the amount and compound interest of ₹10,000 for 2 years, compounded annually at 5%.

Solution: We have, $P = ₹10,000$, $r = 5\%$ per annum, $n = 2$ years

$$\begin{aligned} A &= P \left(1 + \frac{r}{100} \right)^n \\ &= ₹10000 \times \left(1 + \frac{5}{100} \right)^2 \\ &= ₹10000 \times \frac{105}{100} \times \frac{105}{100} = ₹10000 \left(\frac{21}{20} \right)^2 \\ &= ₹10000 \times \frac{21}{20} \times \frac{21}{20} = ₹11,025 \end{aligned}$$

Thus, the required amount is ₹11,025 and C.I. = ₹(11025 - 10000) = ₹1,025.

Example 22: Find the compound interest on ₹31,250 at 8% p.a. for $2\frac{3}{4}$ years.

Solution: We have, $P = ₹31,250$, $r = 8\%$ and $n = 2\frac{3}{4}$ years.

$$\begin{aligned} A &= P \left(1 + \frac{r}{100} \right)^2 \times \left(1 + \frac{\frac{3}{4}r}{100} \right) \\ A &= ₹31250 \left(1 + \frac{8}{100} \right)^2 \times \left(1 + \frac{\frac{3}{4} \times 8}{100} \right) \\ \Rightarrow A &= ₹31250 \times \left(\frac{108}{100} \right)^2 \times \left(\frac{106}{100} \right) \\ \Rightarrow A &= ₹31250 \times \frac{27}{25} \times \frac{27}{25} \times \frac{53}{50} \\ \Rightarrow A &= ₹38,637 \end{aligned}$$

Now, C.I. = A - P

$$= ₹(38637 - 31250) = ₹7,387.$$

Example 23: A sum of money lent at compound interest for 2 years at 10% p.a. amount to ₹756.25, find the sum?

Solution:

Rate = 10%

Time = 2 years

$$\text{Amount} = ₹ 756.25$$

Suppose, Principal = P

By using the formula,

$$A = P \left(1 + \frac{r}{100} \right)^n \text{ and putting given values in it}$$

$$\text{we have, } 756.25 = P \left(1 + \frac{10}{100} \right)^2$$

$$\Rightarrow 756.25 = P \left(\frac{110}{100} \right)^2 \quad \Rightarrow 756.25 = P \times \frac{11}{10} \times \frac{11}{10}$$

By cross multiplying

$$121 P = 756.25 \times 100 \quad \Rightarrow 121 P = 75625$$

$$\Rightarrow P = \frac{75625}{121} \quad \Rightarrow P = ₹ 625.$$

Example 24: The difference between compound interest and simple interest between on a certain sum of money at $6\frac{2}{3}\%$ per annum for 3 years is ₹46. Find the sum.

Solution: Let the principal be P, then

$$\text{Simple interest} = \frac{P \times 20 \times 3}{3 \times 100} = \frac{P}{5} \quad \dots(i)$$

$$\begin{aligned} \text{Compound interest} &= P \left[\left(1 + \frac{R}{100} \right)^n - 1 \right] \\ &= P \left[\left(1 + \frac{20}{3 \times 100} \right)^3 - 1 \right] \\ &= P \left[\frac{4096}{3375} - 1 \right] = \frac{721P}{3375} \quad \dots(ii) \end{aligned}$$

We find from (i) and (ii) that

$$\text{Difference in interests} = \frac{721P}{3375} - \frac{P}{5} = \frac{721P - 675P}{3375} = \frac{46P}{3375}$$

It is given that, compound interest – simple interest = 46

$$\text{Therefore, } \frac{46P}{3375} = 46$$

$$P = \frac{46 \times 3375}{46} = ₹ 3,375.$$

Case 2. When the interest is compounded annually but rates are different for different years.

Let principal = ₹ P, time = 4 years, and let the rates of interest be $r_1\%$ per annum during the first year, $r_2\%$ per annum during the second year, $r_3\%$ per annum during the third year and $r_4\%$ per annum during the last year.

Then, amount after 4 years

$$= ₹ \left\{ P \times \left(1 + \frac{r_1}{100}\right) \times \left(1 + \frac{r_2}{100}\right) \times \left(1 + \frac{r_3}{100}\right) \times \left(1 + \frac{r_4}{100}\right) \right\}$$

This formula may similarly be extended for any number of years.

Example 25: Venu lent ₹ 70,000 to his friend on the condition that the interest payable for the first year, second year and third year will be 5%, 10% and 12% respectively. Find the amount of compound interest that Venu will receive.

Solution : We have: $P = ₹70,000$, Rate = 5%, 12%, 14% for first, second and third year respectively:

$$\begin{aligned} \therefore \text{Amount} &= ₹ 70000 \times \left(1 + \frac{5}{100}\right) \times \left(1 + \frac{10}{100}\right) \times \left(1 + \frac{12}{100}\right) \\ &= ₹ 70000 \times \frac{105}{100} \times \frac{110}{100} \times \frac{112}{100} = ₹ 90,552 \end{aligned}$$

$$\text{C.I. that Venu get} = ₹ (90552 - 70000) = ₹ 20,552.$$

Example 26: In what time will ₹ 64,000 amount to ₹ 68,921 at the rate of 5% per annum, interest being payable half-yearly?

Solution : We have $A = ₹ 68,921$

$$P = ₹ 64,000$$

$$r = 5\% \text{ per annum} = \frac{5}{2}\% \text{ half-yearly}$$

Let the time be n years, i.e., $2n$ half-years, then using, $A = P\left(1 + \frac{r}{100}\right)^n$, we have :

$$\begin{aligned} 68921 &= 64000 \times \left(1 + \frac{5}{200}\right)^{2n} \\ \Rightarrow \frac{68921}{64000} &= \left(1 + \frac{1}{40}\right)^{2n} \\ \Rightarrow \frac{68921}{64000} &= \left(\frac{41}{40}\right)^{2n} \\ \Rightarrow \left(\frac{41}{40}\right)^3 &= \left(\frac{41}{40}\right)^{2n} \text{ or } 2n = 3 \\ \Rightarrow n &= \frac{3}{2} = 1\frac{1}{2} \text{ years} \\ \therefore \text{Time} &= 1\frac{1}{2} \text{ years} \end{aligned}$$

Exercise 7.5

- Find the amount and compound interest when the interest is compounded annually:
 - Principal = ₹ 2,000, Time = 2 years, Rate = 8% per annum
 - Principal = ₹ 5,000, Time = 3 years, Rate = 5% per annum

- (iii) Principal = ₹ 72,000, Time = 3 years, Rate = $12\frac{1}{2}\%$ per annum
- (iv) Principal = ₹ 48,000, Time = 3 years, Rate = $6\frac{1}{2}\%$ per annum
- Find the amount and C.I. on ₹ 5,000 for 1 year at the rate of 10% annum, when the interest is compounded semi-annually.
 - Calculate the amount and the compound interest on ₹ 16,000 for 9 months, if the interest is compounded quarterly at 16% per annum.
 - Find the amount that Rashed will receive if he deposits ₹ 16,000 for 3 years at 10% per annum, compounded annually. Also, find the compound interest.
 - The compound interest on ₹ 30,000 at 7% per annum for a certain time is ₹ 4,347. Find the time period if the interest is compounded annually.
 - The difference between the C.I. and S.I. on a certain sum of money at 5% p.a. for 3 years is ₹ 30.50. Find the sum.
 - The difference between C.I. compounded annually and S.I. on a certain sum for 2 years at 6% p.a. is ₹ 18. Find the sum.
 - Find the difference between the compound interest (compounded annually) and the simple interest on a sum of ₹ 5,000 for 3 years at 4% per annum.
 - At what rate per cent per annum will ₹ 2,000 amount to ₹ 2,205 in 2 years, compound annually?

Skills covered: Evaluation skills, analytical skills, problem solving skills, numeracy skills

HOTS (Higher Order Thinking Skills)

Experiential Learning

- What single discount is equivalent to two successive discounts of 30% and 10%?
- A shopkeeper allows a discount of 20% to his customers and still gains 20%. Find the M.P. of an article which cost him ₹ 620.
- A stereo was sold for ₹ 5,760 after giving successive discounts of 10% and 20% respectively. What was the marked price?

Revision Exercise

1. Tick (✓) the correct option:

Conceptual Learning

- (i) A piece of elastic was stretched by 24% to a length of 31 cm. Find its unstretched original length.
- (a) 20 cm (b) 24 cm (c) 25 cm (d) 26 cm
- (ii) By selling a table for ₹ 330 a trader gains 10%. Find the cost price of the table.
- (a) ₹ 320 (b) ₹ 300 (c) ₹ 430 (d) ₹ 430



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(iii) If the ratio of selling price and cost price of an article is 51:50, then the gain per cent on it is:

- (a) 4% (b) 3% (c) 2% (d) 6%

(iv) If the cost price of 18 mangoes is the same as the selling price of 16 mangoes, find the gain per cent.

- (a) 12% (b) 12.5% (c) 15.5% (d) 15%

(v) Ravi has to pay 4% sales tax in addition to the price of a certain article. Find the price of the article, if he pays ₹ 260 in all.

- (a) ₹ 200 (b) ₹ 220 (c) ₹ 256 (d) ₹ 250

(vi) The formula for calculating simple interest is

- (a) $\frac{P \times R \times T}{10}$ (b) $\frac{P \times R \times T}{50}$ (c) $\frac{P \times R \times T}{100}$ (d) $P \left(1 + \frac{R}{100}\right) T$

(vii) The correct formula is

- (a) $P = A \left(1 + \frac{R}{100}\right) T$ (b) $A = P \left(1 + \frac{R}{100}\right)^T$ (c) $C = 1 \left(1 + \frac{R}{100}\right)$ (d) none

- The cost of 30 articles is the same as the selling price of x articles. If the profit is 25%, then find the value of x .
- On selling 450 cassettes a man had a gain equal to the SP of 45 cassettes. Find gain %.
- In an electronics store, a ₹9500 iPod is labeled, "Save 15%." What is the sale price of the iPod?
- Shreyas purchased 100 oranges at the rate of ₹2 per orange. He sold 60% of the oranges at the rate of ₹2.50 per orange and the remaining oranges at the rate of ₹2 per orange. Find his profit per cent.

Mental Maths

Experiential Learning

- By selling a table for ₹ 504, a shopkeeper gains 12%. How much he sell it to gain 18%?
- Nilima brought a pen for ₹ 23.75 after getting 5% discount on it. What is the marked price of the pen?
- A retailer marks his goods at 35% above the cost price and allows a discount of 20% on the M.P. Find his gain% or loss%.



4. Find the gain or loss%, if

(i) C.P. = ₹ 3.50 and S.P. = ₹ 2

(ii) C.P. = ₹ 250, overhead expenses = ₹ 50 and Loss = ₹ 50

5. (i) If C.P. = ₹ 300, Gain% = 2, find S.P.

(ii) If S.P. = ₹ 261, Loss% = 10, find C.P.

Assertion and Reason

Critical Thinking

In each of the following questions, an Assertion (A) and a corresponding Reason (R) supporting it is given.

Study both the statements and state which of the following is correct.

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true but R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

1. **Assertion (A)**: If 8.5% of a number is 51, then the number is 600.

Reason (R): Profit = selling price – cost price

2. **Assertion (A)**: The profit % or loss % is calculated on the cost price only.

Reason (R): Loss = selling price – cost price.

3. **Assertion (A)**: $\text{Loss \%} = \frac{\text{loss}}{\text{CP}} \times 100$

Reason (R): $\text{SP} = \text{CP} \left(\frac{100 - \text{loss \%}}{100} \right)$

4. **Assertion (A)**: $\text{CP} = \frac{100 \times \text{SP}}{100 + \text{profit \%}}$

Reason (R): $\text{Profit \%} = \frac{\text{Profit}}{\text{CP}} \times 100\%$

5. **Assertion (A)**: Net selling price = Marked price + Discount

Reason (R): $\text{Discount \%} = \left(\frac{\text{Discount}}{\text{Market price}} \right) \times 100\%$

Thinking Skills

1. Nina had some amount of money. She deposited 50% of it in her bank account. After a few days, she deposited 40% of the remaining amount. Now, the total amount in her bank account is ₹15,000. What was the initial amount Nina had?
2. A person invests ₹15,000 in a scheme that promises a 6% annual interest. How much interest will he earn in 2 years?

Skills covered: Creativity, Observation, Critical Thinking, Logical Reasoning, Reflective Thinking

Competency based Questions

1. A person's lung capacity is measured at 4.2 liters. They inhale 12% of their lung capacity during a normal breath. However, when they engage in a physical activity, their breath volume increases to 25% of their maximum capacity. How many milliliters (ml) of air does the person breathe in during a normal breath?

How many milliliters (ml) of air does the person breathe in during a deep breath while engaging in physical activity?

- a) 504 ml, 1050 ml b) 504 ml, 1080 ml c) 540 ml, 1050 ml d) 540 ml, 1080 ml



Skills covered: Interpersonal skills, Observation, Application and Decision making skills

Case Study

Goods and Services Tax (GST) in India

In India, GST (Goods and Services Tax) is applied on various goods and services. It is a single tax that replaces various indirect taxes like VAT, Service Tax, etc. GST is applied as a percentage of the price of the product or service. Below is a table showing the GST rates for different categories of goods:

Category of Goods	Price (₹)	GST Rate	GST Amount (₹)	Total Price Including GST (₹)
Food Items (e.g., Rice, Wheat)	1000	5%	50	1050
Electronics (e.g., Mobile, TV)	20000	18%	3600	23600
Clothing (e.g., T-shirt)	5000	12%	600	5600
Medicines (e.g., Paracetamol)	200	5%	10	210
Luxury Items (e.g., Watches, Jewellery)	15000	28%	4200	19200

1. What is the GST amount on a mobile phone priced at ₹20,000 with an 18% GST rate?
2. A customer buys rice worth ₹1000. Calculate the total price including GST at a rate of 5%.
3. How much more GST does a luxury item worth ₹15,000 incur compared to a medicine worth ₹200?

Skills covered: Research, Logical Reasoning, Problem-Solving, Practical Application