CHAPTER 12

Commercial Mathematics

SYNOPSIS

❍ **Percentage:** Percentage means 'for every hundred'.

$\frac{1}{2} = \frac{50}{100} = 50\%$; $\frac{1}{3} = \frac{33.\overline{3}}{100} = 33.\overline{3}\%$.

Percentage points is the difference between two percentages. It is not equal to either percentage increase or percentage decrease.

❍ **Profit:** Profit = selling price – cost price.

Percentage of profit is always calculated on the cost price of the article.

When SP > CP;

(i) Profit = SP – CP

(ii) SP = CP + Profit

(iii) CP = SP – Profit

(iv) Profit Percentage = $\frac{\text{Profit}}{\text{CP}}(100)\%$

(v) When CP and Profit Percentage are given,

$$\text{SP} = (\text{CP})\left(\frac{100 + \text{Profit Percentage}}{100}\right)$$

Loss = cost price – selling price.

Percentage of loss is always calculated on the cost price of the article.

When SP < CP,

(i) Loss = CP – SP

(ii) SP = CP – Loss

(iii) CP = Loss + SP

(iv) Loss Percentage = $\frac{\text{Loss}}{\text{CP}} \times 100\%$

(v) When CP and Loss Percentage are given,

$$\text{SP} = \text{CP}\left(\frac{100 - \text{Loss Percentage}}{100}\right)$$

❍ **Partnership:** The total amount of money required to start a business is called its **capital**. It is not always possible for a single person to invest huge amounts. So, two or more persons come together and start the business jointly. Such business which is undertaken jointly is called **partnership**. The people who run the business jointly are called **partners** and the money invested by them in the business is called **investment**.

Types of Partnership

(i) In general partnership, the period of investment is the same and the partners divide profit or loss in the ratio of their investments.

(ii) In compound partnership, the investments and the periods of investment differ. Then their investments reduce to investments per month or year and the profit or loss is divided in the ratio of these converted investments.

- **Simple interest** = $\frac{Pnr}{100}$

  Total Amount (A) = $P + \frac{Pnr}{100} = P\left(1 + \frac{nr}{100}\right)$

- **Compound interest** = $P\left(1 + \frac{R}{100}\right)^n - P$, where P is principal, R is the rate of interest per period and n is the number of periods interest is calculated.

- **Calculation of interest on Savings Accounts in Banks:** The monthly minimum balances (**Minimum balance** is the least of all the balances left in the account from the 10th to the last day of that month) from January to the end of June are added and this total amount is called the **'product'** in Banks. Interest is calculated on this product and added to the opening balance on 1st July. In the same way, the interest for the next half year is calculated and is added to the opening balance on 1st January.
  In savings account, interest is calculated as per the following steps.
  (1) The least of the balances from the 10th day of a month to the last day of the month is taken as the balance for the month.
  (2) The sum of all these monthly balances is taken as the principle for calculating interest.
  (3) Interest = $\frac{\text{Principal} \times \text{Rate of interest}}{12 \times 100}$.

- **Calculation of interest on Recurring Deposit Accounts:** If a man deposits `k per month and for n months at R% p.a, then
  Simple interest = ₹$\left[k \times \frac{n(n+1)}{2} \times \frac{1}{12} \times \frac{R}{100}\right]$.

- **Calculation of interest on loans:** Interest on loans is calculated on daily product basis once in every quarter, the loan amount is increased by that amount. Daily product = Balance × Number of days it has remained as balance.
  Interest = $\frac{\text{Sum of daily products} \times \text{Rate}}{100 \times 365}$

Important Features of Hire Purchase Scheme

(1) The hirer pays an initial payment known as down payment.
(2) The vendor allows the hirer to take possession of the goods on the date of signing the agreement, but he does not transfer the ownership of the goods.
(3) The hirer promises to pay the balance amount in instalments.
(4) If the hirer fails to pay the instalments the vendor can repossess the goods.
(5) When goods are repossessed, the hirer cannot ask for the repayment of the instalments of money already paid. This money paid will be treated as rent for the period.
Instalment Scheme: Under the instalment scheme the seller transfers the possession as well as the ownership of the goods to the buyer. The buyer has the right to resell, pledge the goods, but he has to repay the instalments due.

- **Calculating the rate of interest on buying in instalment scheme:** The formula that is used to calculate the rate of interest on instalment buying is
  $R = \frac{2400E}{n[(n+1)I - 2E]}$;
  R = Rate of interest; E = Excess amount paid
  n = Number of instalments; I = Amount of each instalment. E = Down payment + Sum of instalment amounts – Cash price.

Solved Examples

1. What percentage of 3.6 km is 360 metres?

Solution: We know that 1 km = 1000 metres
$\Rightarrow$ 3.6 km = 3.6 × 1000 = 3600 metres
$\therefore$ The required percentage = $\left(\frac{360}{3600} \times 100\right)$ %
= 10%.

2. Find the number, 30% of which is 36.

Solution: Let the number be x.
Given that 30% of the number is 36.
$\Rightarrow$ 30% of x = 36 $\Rightarrow \frac{30}{100} \times x = 36$
$\Rightarrow x = \frac{36 \times 100}{30} \Rightarrow x = 120$
$\therefore$ The required number is 120.

3. If Anil's salary is 20% less than Raju's salary, then by what percentage is Raju's salary more than that of Anil?

Solution: Let Raju's salary be ₹100.

Anil's salary is 20% less than Raju's salary.

$\Rightarrow$ Salary of Anil = 80% of 100 = ₹80

Raju's salary is ₹20 more than that of Anil's.

$\Rightarrow$ Now, the required percentage $= \frac{20}{80}(100)\%$

$= 25\%$

$\therefore$ Raju's salary is 25% more than Anil's salary.

4. Mohit's weight is 40 kg and Rohan's weight is 35 kg. By what percentage is Rohan's weight less than that of Mohit?

Solution: $\left(\frac{40-35}{40}\right)(100)\% = 12.5\ \%$

Note: *When a quantity changes from time to time, we find percentage change in the quantity.*

For example, the price of an article is ₹20 in the year 2005 and it became ₹24 in the year 2006.

The percentage in change in the article is $\frac{4}{20} \times 100 = 20\%$ increase.

Percentage change can be defined as

$\frac{\text{final value} - \text{initial value}}{\text{initial value}} \times 100.$

Percentage change could be increase or decrease.

5. In an examination, Mohit secured 60% of the maximum marks, which is more than the pass marks by 45 marks. Find the maximum marks in the examination if the pass mark is 45%.

Solution: Marks secured by Mohit = 60%. Pass mark = 45%

Difference between the marks secured and pass mark = (60 – 45)% = 15%

Given that Mohit got 45 marks more than the pass marks.

Let the maximum marks be x.

$\Rightarrow$ 15% of x = 45 $\Rightarrow$ $x = \frac{45 \times 100}{15} = 300$

$\therefore$ The maximum marks in the examination = 300.

6. A shopkeeper bought a cycle for ₹1200 and sold it for ₹1500. Find his profit (or) loss percentage.

Solution: Cost price of the cycle = ₹1200

Selling price of the cycle = ₹1500

SP > CP $\Rightarrow$ there is a gain.

$\Rightarrow$ Gain = SP – CP = 1500 – 1200 = ₹300

$\therefore$ Gain Percentage $= \frac{\text{Gain}}{\text{CP}}(100)\%$

$= \frac{300}{1200}(100)\% = 25\%$

$\therefore$ The shopkeeper makes a profit of 25%

7. Rakesh purchased a TV for ₹5000 and paid ₹250 for its transportation. If he sold the TV for ₹5075, find his profit or loss percentage.

Solution: Price at which TV was bought = ₹5000

Overheads in the form of transportation = ₹250

$\therefore$ The total cost price of the TV = (5000 + 250)

= ₹5250

Selling price of the TV = ₹5075

SP < CP $\Rightarrow$ There is a loss and loss = CP – SP = 5250 – 5075 = ₹175.

$\therefore$ loss percentage $= \frac{\text{Loss}}{\text{CP}}(100)\% = \frac{175}{5250}(100)\%$

$= \frac{10}{3}\% = 3.33\%$

$\therefore$ Rakesh incurred a loss of 3.33%

8. By selling 24 pens, Kranthi lost an amount equal to the CP of 3 pens. Find his loss percentage.

Solution: Let us assume that cost price of each pen is Re1

$\Rightarrow$ CP of 24 pens = ₹24

Loss = CP of 3 pens = 3 × 1 = ₹3

$\Rightarrow$ Loss Percentage $= \left(\frac{\text{Loss}}{\text{CP}} \times 100\right)\%$

$= \frac{3}{24} \times 100\% = 12.5\%$

$\therefore$ Kranthi's loss is 12.5%

PRACTICE EXERCISE 12 (A)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. Ramu marked his bicycle at ₹800. He sold it without offering any discount. The price at which he bought it was ₹500. Find his profit percentage.

(1) 60 (2) 80
(3) 50 (4) 30

2. Sohan bought 16 kg of sugar for a total of ₹360. He sold it at a profit equal to the selling price of 4 kg of it. Find his selling price (in ₹/kg).

(1) 45 (2) 60
(3) 90 (4) 30

3. A number when increased by 30% becomes 78. Find the number.

(1) 60 (2) 70
(3) 40 (4) 48

4. The ratio of two numbers is 5/6: 2/3. By what percentage is the second number more/less than the first number?

(1) 20% less
(2) 25% more
(3) 25% less
(4) 20% more

5. If 30% of x = 60% of 96, then find the value of x.

(1) 384 (2) 192
(3) 48 (4) 24

6. If X is 20% more than Y, then find 120% of Y in terms of X.

(1) $\frac{X}{2}$ (2) 2X
(3) X (4) $\frac{X}{6}$

7. In a test, Arun got 20% and failed by 10 marks. Bala got 40% in the same test and got 10 marks more than the pass mark. Find the maximum marks.

(1) 400 (2) 300
(3) 200 (4) 100

8. A dealer purchases 15 articles for ₹25 and sells 12 articles for ₹30. Find the profit percentage.

(1) 50% (2) 40%
(3) 20% (4) 10%

9. X sells an article to Y at 15% profit. Y sells it to Z at 10% profit. What is X's cost price, if Y makes a profit of ₹23? (In ₹)

(1) 200 (2) 180
(3) 150 (4) 120

10. In a certain season, the Indian cricket team had a 25% success rate in the first 40 matches it played. What is the minimum number of additional matches it must play so that it has a $66^2/_3$% success rate for the season?

(1) 40 (2) 50
(3) 60 (4) 80

11. A man sells two scooters at ₹36000 each. On one scooter he makes 15% profit and on the other he makes 15% loss. Find the profit or loss percentage in the whole transaction.

(1) 2.25% loss (2) 2.25% profit
(3) 22.5% loss (4) 22.5% profit

12. A dishonest trader claims that he sells his goods at the cost price, but weighs 900 gm for every kg that he sells. Find his profit percentage.

(1) $9\frac{1}{11}\%$ (2) 10%
(3) $11\frac{1}{9}\%$ (4) 12.5%

13. The difference between S.I. and C.I. (compounded annually) on a sum of ₹64000 for 2 years is ₹1000. What is the rate of interest per annum?

(1) 25% (2) $16\frac{2}{3}\%$
(3) $13\frac{1}{3}\%$ (4) $12\frac{1}{2}\%$

14. An article can be sold for ₹20000 cash or for ₹12000 down payment and 4 equal monthly instalments of ₹2200 each. Find the interest paid (In ₹).

(1) 400 (2) 600
(3) 800 (4) 1000

15. A computer is sold by a company for ₹20000 cash or ₹8000 down payment followed by 5 equal monthly instalments of ₹2500 each. Find the total principal on which the interest is charged to realize the total interest in a month (In ₹).

(1) 35000 (2) 36000
(3) 38000 (4) 40000

16. Javed makes a fixed deposit of ₹100000 in a bank for one year. If the rate of interest is 6% per annum, compounded half-yearly, then find the maturity value (In ₹).

(1) 106090 (2) 105000
(3) 104060 (4) 104000

17. A sum of money at simple interest amounts to ₹800 in 2 years and to ₹1200 in 6 years. The sum is

(1) ₹600 (2) ₹1000
(3) ₹400 (4) ₹500

18. A sum of money invested at compound interest doubles itself in six years. In how many years will it become 64 times itself at the same rate of compound interest?

(1) 30 (2) 36
(3) 42 (4) 48

19. The integral number of years in which a sum of money at 25% p.a. under compound interest will become more than twice itself, is at least.

(1) 3 (2) 2
(3) 4 (4) 1

20. A double cot is available for ₹13000 cash or for ₹1300 down payment followed by four equal monthly instalments of ₹3000 each. Find the principal for the third month, if interest charged under simple interest is (in ₹).

(1) 5200 (2) 4900
(3) 6200 (4) 5700

21. The difference between the compound interest and simple interest on a certain sum at 12% per annum for 2 years is ₹126.72. Find the sum (in ₹).

(1) 8000 (2) 8800
(3) 10200 (4) 12400

22. The compound interest earned in the third and the fourth years on a certain sum of money are ₹576 and ₹691.2. Find the sum (in ₹).

(1) 1000 (2) 1200
(3) 1600 (4) 2000

23. A man borrowed Rs.25000 from a bank at 20% compound interest. At the end of every year he paid ₹8000. At the end of the third year, he wanted to clear the loan. How much should he pay to clear the loan?

(1) ₹12400 (2) ₹16040
(3) ₹20800 (4) ₹22080

24. Find the present worth of ₹1749.6 due in 2 years at 8% per annum compound interest (in ₹).

(1) ₹1200 (2) ₹1400
(3) ₹1500 (4) ₹1650

25. A sum of money compounded annually amounts to ₹1375 in 5 years and ₹1980 in 7 years. Find the annual rate of interest.

(1) 12% (2) 20%
(3) 15% (4) 10%

26. In how many years will a sum of money become sixteen times itself at 30% p.a. simple interest?

(1) 40 (2) 50
(3) 60 (4) 70

27. A sum becomes three times itself at compound interest in eight years. In how many years will the sum become twenty seven times itself?

(1) 24 (2) 20
(3) 18 (4) 10

28. A man borrows ₹80,000 at 15% p.a. simple interest. He repays ₹48,000 at the end of first year and the balance at the end of second year. What amount did he repay at the end of the second year (in ₹)?

(1) 24600 (2) 36200
(3) 48800 (4) 52500

29. A certain sum is lent at compound interest for three years. The rate of interest for the three years are 5%, 8% and 10% respectively. If the amount at the end of three years is ₹1,247.40, find the sum (in ₹).

(1) 1000 (2) 1050
(3) 1080 (4) 1100

30. The value of an old bike decreases every year at the rate of 4% over that of the previous year. If its value at the end of three years is ₹13824, then find its present value.

(1) ₹15625
(2) ₹14525
(3) ₹16625
(4) ₹15425

31. A student secured 80% of the total marks and got 720 marks. How many marks did a student who scored 90% get?

(1) 770 (2) 810
(3) 900 (4) 990

32. An article is marked 20% over the cost. A discount of 8% is offered on the marked price of the article. What is profit percentage in selling the article?

(1) 6.8% (2) 8.2%
(3) 9.6% (4) 10.4%

33. A trader professes to sell his goods at cost price and still earns a profit of $33^1/_3\%$. What weight does he use for every kilogram (in grams)?

(1) $333.\overline{3}$ (2) 600
(3) $666.\overline{6}$ (4) 750

34. A certain sum is lent at compound interest for three years at rate of interests of 5%, 10% and 12% respectively for three consecutive years. Find the sum if the total interest for the three years is ₹5284.80 (in ₹).

(1) 18000 (2) 16000
(3) 15000 (4) 12000

35. How much more does a man get by investing ₹40,000 at 40% p.a. compound interest, compounded half yearly, than at 40% p.a. compound interest, compounded yearly per one year?

(1) 1000
(2) 1200
(3) 1500
(4) 1600

PRACTICE EXERCISE 12 (B)

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. What percentage of 840 is 180?

(1) $22^6/_7\%$ (2) $23^4/_7\%$
(3) $24^2/_7\%$ (4) $21^3/_7\%$

2. 32% of what number is 256?

(1) 1024 (2) 800
(3) 640 (4) 400

3. Which of the following fraction equals $101^3/_5\%$?

(1) 508/5 (2) 254/5
(3) 51/25 (4) 127/125

4. If 60% of x is 60 more than 60% of 60, then 60% of x = ____.

(1) 90 (2) 94
(3) 96 (4) 92

5. If 60% of 70% of a number is 1680, find the number.

(1) 2000 (2) 3000
(3) 4000 (4) 5000

6. In a test, P got 150 marks and Q got 120 marks. What percentage of P's mark was Q's mark?

(1) 80% (2) 75%
(3) 60% (4) 65%

7. If a% of b + b% of a is equal to $33^1/_3\%$ of (a + b), then find the value of $\left(\frac{1}{a}+\frac{1}{b}\right)$

(1) $\frac{1}{50}$ (2) $\frac{3}{50}$
(3) $\frac{7}{50}$ (4) $\frac{9}{50}$

8. A man sells two articles at the same selling price - one at 25% profit and other at 25% loss. What is the overall profit or loss percentage?

(1) 10% (2) 5%
(3) 6.25% (4) 12.5%

9. A sum amounts to nineteen times itself in five years under simple interest. In how many months will the same sum become four times itself?

(1) 10 (2) 12
(3) 15 (4) 18

10. Find the difference between the simple interest and the compound interest for two years on a sum of ₹28,000 at 25% p.a. rate of interest (in ₹).

(1) 1750 (2) 2000
(3) 2250 (4) 3000

11. In what time will a sum become three times itself at 20% per annum, at simple interest?

(1) 8 years (2) 10 years
(3) 15 years (4) 20 years

12. Find the compound interest on ₹5000 at 10% per annum for 1 year, interest compounded annually.

(1) ₹400 (2) ₹250
(3) ₹1000 (4) ₹500

13. A water filter is available for ₹500 down payment followed by two instalments of ₹600 each. If the total interest paid is ₹100, then what is the cash price of the water filter?

(1) ₹1600 (2) ₹1700
(3) ₹1500 (4) ₹1400

14. A mobile phone is available for a cash price of ₹1200 or for a certain down payment followed by three equal instalments of ₹300 each. The total interest paid is ₹100 when bought under the instalment scheme. How much is the down payment for the mobile phone?

(1) ₹800 (2) ₹450
(3) ₹350 (4) ₹400

15. A car is available for ₹200000 cash or ₹50000 down payment followed by 16 equal monthly instalments. If the total interest charged in this scheme is ₹10000, how much is each monthly instalment?

(1) ₹16000 (2) ₹10000
(3) ₹13000 (4) ₹20000

16. Find the annual income derived from an investment of ₹18000 in ₹150 shares available at ₹180 of a company paying 11% dividend.

(1) 1500 (2) 1650
(3) 1750 (4) 1800

17. The difference between the C.I. and S.I. on a sum of ₹7200 for two years is ₹72. Find the rate of interest per annum.

(1) 10% (2) 12%
(3) 15% (4) 20%

18. A washing machine is available for ₹9000 cash or 45% down payment and 3 equal monthly instalments. Each instalment is 20% of the cash payment. What is the approximate annual rate of interest?

(1) 56% (2) 57%
(3) 58% (4) 59%

19. Srija makes a fixed deposit of ₹125000 with a bank. The bank pays interest at 8% per annum compounded annually and she received ₹157464 at the time maturity. Find the time period for which she held account (in years).

(1) 1 (2) 2
(3) 3 (4) 4

20. Tilak opened a recurring deposit account with a bank and deposited ₹600 per month for one year. Find the interest that Tilak will receive, if the bank pays 6% per annum (in ₹).

(1) 312 (2) 234
(3) 624 (4) 468

21. Anand paid ₹30 as sales tax on a bottle of mineral water with marked price as ₹400. Calculate the rate of sales tax.

(1) 15% (2) 12.5%
(3) 6% (4) 7.5%

22. A sum triples itself in three years at simple interest. In how many years will the same sum become nine times itself at the same rate?

(1) 18 (2) 9
(3) 12 (4) 27

23. A sum is split into two equal parts. One of the parts is lent at simple interest at 20% p.a. for 6 years. The other part is lent at 40% p.a. simple interest for 2 years. The difference in the interests is ₹72. Find the total sum (in ₹).

(1) 180 (2) 240
(3) 300 (4) 360

24. ₹60000 is invested in buying ₹120 shares of a company which are available at a premium of 25%. Find the number of shares bought and the annual rate of return on the investment, if the dividend is paid at the rate of 10% per annum.

(1) 8% (2) 10%
(3) 12% (4) 15%

25. A man borrows ₹10500 from a finance company and repays it in two equal annual instalments. If the rate of interest being compounded annually is 10% p.a., then find the value of each instalment. (in ₹)

(1) 6000 (2) 6050
(3) 6100 (4) 6150

26. What would a sum of ₹8800 amount to in 16 years at a simple interest rate of 12% every year (in ₹)?

(1) 14440 (2) 18846
(3) 25696 (4) 32322

27. A sum of money invested at simple interest amounts to ₹2480 at the end of four years and ₹4080 at the end of eight years. Find the principal (in ₹).

(1) ₹2040 (2) ₹1480
(3) ₹1240 (4) ₹880

28. A certain loan amounts, under compound interest, compounded annually earns an interest of ₹1980 in the second year and ₹2178 in the third year. How much interest did it earn in the first year (in ₹)?

(1) 1600 (2) 1800
(3) 1900 (4) 2000

29. The difference between the interest earned under compound interest, interest being compounded annually and simple interest for two years on the same sum and at the same rate of interest is ₹25.60. Find the sum if the rate of interest is 8% p.a (in ₹).

(1) 2000 (2) 2500
(3) 3200 (4) 4000

30. A sum of money under compound interest doubles itself in 4 years. In how many years will it become 16 times itself?

(1) 12 (2) 16
(3) 8 (4) 6

31. Raju took a loan at 8% per annum simple interest for a period of 5 years. At the end of five years he paid ₹10640 to clear his loan. How much loan did he take (in ₹)?

(1) 8500 (2) 8000
(3) 7700 (4) 7600

32. What annual installment will discharge a debt of ₹1815 due in 3 years at 10% simple interest (in ₹)?

(1) 500 (2) 520
(3) 550 (4) 580

33. Under simple interest, due to the fall in the interest rate by 0.5 percentage point my yearly income from savings come down by ₹884. Find the savings (in ₹).

(1) 80400 (2) 112000
(3) 176800 (4) 224000

34. Find the amount obtained by investing ₹24,000 at 18% p.a. simple interest for five years.

(1) ₹21,600 (2) ₹44,000
(3) ₹45,600 (4) ₹48,000

35. Find the amount obtained by investing ₹20,000 at 10% p.a. compound interest for two years, compounded annually.

(1) ₹22,000 (2) ₹24,000
(3) ₹26,000 (4) ₹24,200

ANSWER KEYS

PRACTICE EXERCISE 12 (A)

1. 1	**2.** 4	**3.** 1	**4.** 1	**5.** 2	**6.** 3	**7.** 4	**8.** 1	**9.** 1	**10.** 2
11. 1	**12.** 3	**13.** 4	**14.** 3	**15.** 1	**16.** 1	**17.** 1	**18.** 2	**19.** 3	**20.** 4
21. 2	**22.** 4	**23.** 4	**24.** 3	**25.** 2	**26.** 2	**27.** 1	**28.** 3	**29.** 1	**30.** 1
31. 2	**32.** 4	**33.** 4	**34.** 1	**35.** 4					

PRACTICE EXERCISE 12 (B)

1. 4	**2.** 2	**3.** 4	**4.** 3	**5.** 3	**6.** 1	**7.** 2	**8.** 3	**9.** 1	**10.** 1
11. 2	**12.** 4	**13.** 1	**14.** 4	**15.** 2	**16.** 2	**17.** 1	**18.** 2	**19.** 3	**20.** 2
21. 4	**22.** 3	**23.** 4	**24.** 1	**25.** 2	**26.** 3	**27.** 4	**28.** 2	**29.** 4	**30.** 2
31. 4	**32.** 3	**33.** 3	**34.** 3	**35.** 4					