7. AVERAGE

IMPORTANT FACTS AND FORMULAE

1. Average = $\left(\frac{Sum\ of\ observations}{Number\ of\ observations}\right)$
2. Suppose a man covers a certain distance at x kmph and an equal distance at y kmph. Then, the average speed during the whole journey is $\left(\frac{2xy}{x+y}\right)$ *kmph.*

SOLVED EXAMPLES

Ex. 1. ***Find the average of first 40 natural numbers.***

Sol. Sum of first *n* natural numbers $= \frac{n(n+1)}{2}$

So, sum of first 40 natural numbers $= \frac{40\times 41}{2} = 820.$

$\therefore$ Required average $= \frac{820}{40} = 20.5.$

Ex. 2. ***The average of four consecutive even numbers is 27. Find the largest of these numbers.***

Sol. Let the numbers be x, x + 2, x + 4 and x + 6. Then,

$$\frac{x+(x+2)+(x+4)+(x+6)}{4} = 27 \quad \Rightarrow \quad \frac{4x+12}{4} = 27 \quad \Rightarrow \quad x+3=27 \quad \Rightarrow \quad x=24.$$

$\therefore$ Largest number = (x + 6) = 24 + 6 = 30.

Ex. 3. ***There are two sections A and B of a class, consisting of 36 and 44 students respectively. If the average weight of section A is 40 kg and that of section B is 35 kg, find the average weight of the whole class.***

Sol. Total weight of (36 + 44) students = (36 $\times$ 40 + 44 $\times$ 35) kg = 2980 kg.

$\therefore$ Average weight of the whole class = $\left(\frac{2980}{80}\right)$ kg = 37.25 kg.

Ex. 4. ***The average of 25 results is 18. The average of first twelve of them is 14 and that of last twelve is 17. Find the thirteenth result.***

Sol. Clearly, thirteen result = (sum of 25 results) – (sum of 24 results)

$= (18 \times 25) - \left[(14\times 12)+(17\times 12)\right]$

$= 450 – (168 + 204) = 450 – 372 = 78.$

Ex. 5. ***The average of 11 results is 60. If the average of first six results is 58 and that of the last six is 63, find the sixth result.***

Sol. Sixth result = $(58 \times 6 + 63 \times 6 - 60 \times 11) = 66$.

Ex. 6. ***The average age of a class of 39 students is 15 years. If the age of the teacher be included, then the average increases by 3 months. Find the age of the teacher.***

Sol. Total age of 39 persons = (39×15) years = 585 years.

Average age of 40 persons = 15 years 3 months $= \frac{61}{4}$ years.

Total age of persons $= \left(\frac{61}{4} = \times 40 \right)$ years = 610 years.

$\therefore$ Age of the teacher = (610 - 585) years = 25 years.

Ex. 7. ***The average weight of 10 oarsmen in a boat is increased by 1.8 kg when one of the crew, who weighs 53 kg is replaced by a new man. Find the weight of the new man.***

Sol. Total weight increased = (1.8×10) kg = 18 kg.

$\therefore$ Weight of the new man = (53 + 18) kg = 71 kg.

EXERCISE – 1

(OBJECTIVE TYPE QUESTIONS)

1. If the mean of *a, b, c* is M and $ab + bc + ca = 0$, then the mean of a^2, b^2, c^2 is :

(a) M^2 (b) $3m^2$ (c) $6M^2$ (d) $9M^2$

2. The average of 2, 7, 6 and x is 5 and the average of 18, 1, 6 x and y is 10. What is the value of y?

(a) 5 (b) 10 (c) 20 (d) 30

3. The average of the first nine prime numbers is :

(a) 9 (b) 11 (c) $11\frac{1}{9}$ (d) $11\frac{2}{9}$

4. Find the average of all the numbers between 6 and 34 which are divisible by 5.

(a) 18 (b) 20 (c) 24 (d) 30

5. In Arun's opinion, his weight is greater than 65 kg but less than 72 kg. His brother does not agree with Arun and he thinks that Arun's weight is greater than 60 kg but less than 70 kg. His mother's view is that his weight cannot be greater than 68 kg. If all of them are correct in their estimation, what is the average of different probable weights of Arun?

(a) 67 kg (b) 68 kg (c) 69 kg

(d) Data inadequate (d) None of these

6. The average age of the boys in a class is 16 years and that of the girls is 15 years. The average age for the whole class is :

(a) 15 years (b) 15.5 years (c) 16 years

(d) Cannot be computed with the given information

7. The average of five consecutive odd numbers is 61. What is the difference between the highest and lowest numbers?

(a) 2 (b) 5 (c) 8

(d) Cannot be determined (d) None of these

8. The average of a non-zero number and its square is 5 times the number. The number is :

(a) 9 (b) 17 (c) 29 (d) 295

9. The average of all odd numbers upto 100 is :

(a) 49 (b) 49.5 (c) 50 (d) 51

10. The average of first 50 natural numbers is :

(a) 12.25 (b) 21.25 (c) 25 (d) 25.5

11. The average of five numbers is 27. If one number is excluded, the average becomes 25. The excluded number is :

(a) 25 (b) 27 (c) 30 (d) 35

12. Out of 9 persons, 8 persons spent Rs. 30 each for their meals. The ninth one spent Rs. Rs. 20 more than the average expenditure of all the nine. The total money spent by all of them was :

(a) Rs. 260 (b) Rs. 290 (c) Rs. 292.50 (d) Rs. 400.50

13. A car owner buys petrol at Rs. 7.50, Rs. 8 and Rs. 8.50 per litre for three successive years. What approximately is the average cost per litre of petrol if be spends Rs. 4000 each year?

(a) Rs. 7.98 (b) Rs. 8 (c) Rs. 8.50 (d) Rs. 9

14. If the average marks of three batches of 55, 60 and 45 students respectively is 50, 55 and 60, then the average marks of all the students is :

(a) 53.33 (b) 54.68 (c) 55 (d) None of these

15. A family consists of grandparents, parents and three grandchildren. The average age of the grandparents is 67 years, that of the parents is 35 years and that of the grandchildren is 6 years. What is the average age of the family?

(a) $28\frac{4}{7}$ *years* (b) $31\frac{5}{7}$ years (c) $32\frac{1}{7}$ years (d) None of these

16. In the first 10 overs of a cricket game, the run rate was only 3.2. What should be the run rate in the remaining 40 overs to reach the target of 282 runs?

(a) 6.25 (b) 6.5 (c) 6.75 (d) 7

17. A grocer has a rule of Rs. 6435, Rs. 6927, Rs. 6855, Rs. 7230 and Rs. 6562 for 5 consecutive months. How much sale must he have in the sixth month so that he gets an average sale of Rs. 6500?

(a) Rs. 4991 (b) Rs. 5991 (c) 6001 (d) Rs. 6991

18. The average price of 10 books is Rs. 12 while the average price of 8 these books is Rs. 11.75. of the remaining two books, if the price of one book is 60% more than the price of the other, what is the price of each of these two books?

(a) Rs. 5, Rs. 7.50 (b) Rs. 8, Rs. 12 (c) Rs. 10, Rs. 16 (d) Rs. 12, Rs. 14

19. The average of six numbers is 3.95. The average of two of them is 3.4, while the average of the other two is 3.85. What is the average of the remaining two numbers?

(a) 4.5 (b) 4.6 (c) 4.7 (d) 4.8

20. 16 children are to be divided into two groups A and B of 10 and 6 children. The average percent marks obtained by the children of group A is 75 and the average percent marks of all the 16 children is 76. What is the average percent marks of children of group B?

(a) $77\frac{1}{3}$ (b) $77\frac{2}{3}$ (c) $78\frac{1}{3}$ (d) $78\frac{2}{3}$

21. The mean of 50 observations was 36. It was found later that an observation 48 was wrongly taken as 23. the corrected new mean is :

(a) 35.2 (b) 36.1 (c) 36.5 (d) 39.1

22. The average of ten numbers is 7. If each number is multiplied by 12, then the average of the new set of numbers is :

(a) 7 (b) 19 (c) 82 (d) 84

23. The average of 8 numbers is 20. The average of first two numbers is $15\frac{1}{2}$ and that of the next three is $21\frac{1}{3}$. If the sixth number be less than the seventh and eighth numbers by 4 and 7 respectively, then the eighth number is :

(a) 18 (b) 22 (c) 25 (d) 27

24. Of the three numbers, the first is twice the second and the second is twice the third. The average of the reciprocal of the number is $\frac{7}{72}$. The numbers are :

(a) 16, 8, 4 (b) 20, 10, 5 (c) 24, 12, 6 (d) 36, 18, 9

25. Of the four numbers, the first is twice the second, the second is one-third of the third and the third is 5 times the fourth. The average of the numbers is 24.75. The largest of these numbers is:

(a) 9 (b) 25 (c) 30 (d) None of these

26. The average weight of a class of 24 students is 35 kg. If the weight of the teacher be included, the average rises by 400 g. The weight of the teacher is :

(a) 45 kg (b) 50 kg (c) 53 kg (d) 55 kg

27. The average age of 36 students in a group is 14 years. When teacher's age is included to it, the average increases by one. What is the teacher's age in years?

(a) 31 (b) 36 (c) 51

(d) Cannot be determined (e) None of these

28. The average weight of A, B and C is 45 kg. If the average weight of A and B be 40 kg and that of B and C be 43 kg, then the weight of B is :

(a) 17 kg (b) 20 kg (c) 26 kg (d) 31 kg

29. The average weight of three boys A, B and C is $54\frac{1}{3}$ kg, while the average weight of three boys B, D and E is 53 kg. What is the average weight of A, B, C, D and E?

(a) 52.4 kg (b) 53.2 kg (c) 53.8 kg

(d) Data inadequate (e) None of these

30. The average age of 15 students of a class is 15 years. Out of these, the average age of 5 students is 14 years and that of the other 9 students is 16 years. The age of the 15^{th} student is :

(a) 11 years (b) 14 years (c) 15 years (d) $15\frac{2}{7}$

11. PERCENTAGE

IMPORTANT FACTS AND FORMULAE

I. Concept of Percentage : By a certain ***percent***, we mean that many hundredths.
Thus, x percent means x hundredths, written as x*%*.

To express x% as a fraction : We have, ***x%*** $= \frac{x}{100}$.

Thus, $20\% = \frac{20}{100} = \frac{1}{5}; 48\% = \frac{48}{100} = \frac{12}{25}, etc.$

To express $\frac{a}{b}$ ***as a percent :*** *We have,* $\frac{a}{b} = \left(\frac{a}{b} \times 100\right)\%$.

Thus, $\frac{1}{4} = \left(\frac{1}{4} \times 100\right)\% = 25\%; 0.6 = \frac{6}{10} = \frac{3}{5} = \left(\frac{3}{5} \times 100\right)\% = 60\%.$

II. If the price of a commodity increases by R%, then the reduction in consumption so as not to increase the expenditure is

$$\left[\frac{R}{(100+R)} \times 100\right]\%$$

If the price of a commodity decreases by R%, then the increase in consumption so as not to decrease the expenditure is

$$\left[\frac{R}{(100-R)} \times 100\right]\%$$

III. Results on Population : Let the population of a town be P now and suppose it increase at the rate of R% per annum, then :

1. Population after *n* years = $P\left(1+\frac{R}{100}\right)^n$.
1. Population *n* years ago = $\frac{P}{\left(1+\frac{R}{100}\right)^n}$.

IV. Results on Depreciation : Let the present value of a machine be P. Suppose it depreciates at the rate of R% per annum. Then :

1. Value of the machine after *n* years = $P\left(1-\frac{R}{100}\right)^n$.
2. Value of the machine *n* years ago = $\frac{P}{\left(1-\frac{R}{100}\right)^n}$.

V. If A is R% more than B, then B is less than A by

$$\left[\frac{R}{(100+R)}\times 100\right]\%$$

If A is R% less than B, then B is more than A by

$$\left[\frac{R}{(100-R)}\times 100\right]\%$$

SOLVED EXAMPLES

Ex. 1. Express each of the following as a fraction :

(i) 56% ***(ii) 4%*** ***(iii) 0.6%*** ***(iv) 0.08%***

Sol. *(i)* $56\% = \frac{56}{100} = \frac{14}{25}.$ *(ii)* $4\% = \frac{4}{100} = \frac{1}{25}.$

(iii) $0.6\% = \frac{0.6}{100} = \frac{6}{1000} = \frac{3}{500}.$ *(iv)* $0.08\% = \frac{0.08}{100} = \frac{8}{10000} = \frac{1}{1250}.$

Ex. 2. Express each of the following as a decimal :

(i) 6% ***(ii) 28%*** ***(iii) 0.2%*** ***(iv) 0.04%***

Sol. *(i)* $6\% = \frac{6}{100} = 0.06.$ *(ii)* $28\% = \frac{28}{100} = 0.28.$

(iii) $0.2\% = \frac{0.2}{100} = 0.002.$ *(iv)* $0.04\% = \frac{0.04}{100} = 0.0004.$

Ex. 3. Express each of the following as rate percent :

(i) $\frac{23}{36}$ ***(ii)*** $6\frac{3}{4}$ ***(iii) 0.004***

Sol. *(i)* $\frac{23}{36} = \left(\frac{23}{36}\times 100\right)\% = \left(\frac{575}{9}\right)\% = 63\frac{8}{9}\%.$

(ii) $0.004 = \frac{4}{1000} = \left(\frac{4}{1000}\times 100\right)\% = 0.4\%.$

(iii) $6\frac{3}{4} = \frac{27}{4} = \left(\frac{27}{4}\times 100\right)\% = 675\%.$

Ex. 4. Evaluate :

(i) 28% of 450 + 45% of 280

(ii) $16\frac{2}{3}\%\, of\ 600\, gm - 33\frac{1}{3}\%\, of\ 180\, gm$

Sol. *(i)* 28% of 450 + 45% of 280 $= \left(\frac{28}{100}\times 450 + \frac{45}{100}\times 280\right) = (126+126) = 252.$

(ii) $16\frac{2}{3}\%\, of\, 600\, gm - 33\frac{1}{3}\%\, of\, 180\, gm$

$= \left[\left(\frac{50}{3}\times\frac{1}{100}\times 600\right) - \left(\frac{100}{3}\times\frac{1}{100}\times 180\right)\right]$ gm = (100 – 60) gm = 40 gm.

Ex. 5. (i) 2 is what percent of 50?

(ii) $\frac{1}{2}$ ***is what percent of*** $\frac{1}{3}$ ***?***

(iii) What percent of 7 is 84?

(iv) What percent of 2 metric tonnes is 40 quintals?

(v) What percent of 6.5 litres is 130 ml?

Sol. *(i)* Required percentage = $\left(\frac{2}{50}\times 100\right)\% = 4\%.$

(ii) Required percentage = $\left(\frac{1}{2}\times\frac{3}{1}\times 100\right)\% = 150\%.$

(iii) Required percentage = $\left(\frac{84}{7}\times 100\right)\% = 1200\%.$

(iv) 1 metric tonne = 10 quintals.

$\therefore$ Required percentage = $\left(\frac{40}{2\times 10}\times 100\right)\% = 200\%.$

(v) Required percentage = $\left(\frac{130}{6.5\times 1000}\times 100\right)\% = 2\%.$

Ex. 6. Find the missing figures :

(i) ? % of 25 = 2.125 ***(ii) 9% of ? = 63*** ***(iii) 0.25% of ? = 0.04***

Sol. *(i)* Let x% of 25 = 2.125. Then, $\frac{x}{100}\times 25 = 2.125 \Leftrightarrow x = (2.125\times 4) = 8.5.$

(ii) Let 9% of x = 6.3. Then, $\frac{9}{100}x = 6.3 \Leftrightarrow x = \left(\frac{6.3\times 100}{9}\right) = 70.$

(iii) Let 0.25% of x = 0.04. Then, $\frac{0.25}{100}x = 0.04 \Leftrightarrow x = \left(\frac{0.04\times 100}{0.25}\right) = 16.$

Ex. 7. An inspector rejects 0.08% of the meters as defective. How many will he examine to reject 2?

Sol. Let the number of meters to be examined be x.

Then, 0.08% of x = 2 $\Leftrightarrow \left(\frac{8}{100}\times\frac{1}{100}\times x\right) = 2 \Leftrightarrow x = \left(\frac{2\times 100\times 100}{8}\right) = 2500.$

Ex. 8. Sixty-five percent of a number is 21 less than four-fifth of that number. What is the number?

Sol. Let the number be x.

Then, $\frac{4}{5}x-(65\%\,of\ x)=21 \Leftrightarrow \frac{4}{5}x\frac{65}{100}x=21 \Leftrightarrow 15x=2100 \Leftrightarrow x=140.$

Ex. 9. If 50% of (x - y) = 30% of (x + y), then what percent of x is y?

Sol. $50\%\,of\ (x-y)=30\%\,of\ (x-y) \Leftrightarrow \frac{50}{100}(x-y)=\frac{30}{100}(x+y)$

$\Leftrightarrow \quad 5(x-y)=3(x+y) \Leftrightarrow 2x=8y \Leftrightarrow x=4y.$

$\therefore$ Required percentage = $\left(\frac{y}{x}\times 100\right)\%=\left(\frac{y}{4y}\times 100\right)\%=25\%.$

Ex. 10. 10% of the inhabitants of a village having died of cholera, a panic set in, during which 25% of the remaining inhabitants left the village. The population is then reduced to 4050. Find the number of original inhabitants.

Sol. Let the total number of original inhabitants be x.

Then, (100 – 25)% of (100 – 10)% of x = 4050

$\Leftrightarrow \quad \left(\frac{75}{100}\times\frac{90}{100}\times x\right)=4050 \Leftrightarrow \frac{27}{40}x=4050 \Leftrightarrow x=\left(\frac{4050\times 40}{27}\right)=6000.$

$\therefore$ Number of original inhabitants = 6000.

Ex. 11. The value of a machine depreciates at the rate of 10% per annum. If its present value is Rs. 1,62,000, what will be its worth after 2 years? What was the value of the machine 2 years ago?

Sol. Value of the machine after 2 years

$=Rs.\left[162000\times\left(1-\frac{10}{100}\right)^2\right]=Rs.\left(162000\times\frac{9}{10}\times\frac{9}{10}\right)=Rs.131220.$

Value of the machine 2 years ago

$=Rs.\left[\frac{162000}{\left(1-\frac{10}{100}\right)^2}\right]=Rs.\left(162000\times\frac{10}{9}\times\frac{10}{9}\right)=Rs.200000.$

Ex. 12. If A earns $33\frac{1}{3}\%$ ***more than B, how much percent does B earn less than A?***

Sol. Required percentage $=\left[\frac{\left(\frac{100}{3}\right)}{\left(100+\frac{100}{3}\right)}\times 100\right]\%=\left(\frac{100}{400}\times 100\right)\%=25\%.$

Ex. 13. If A's salary is 20% less than B's salary, by how much percent is B's salary more than A's?

Sol. Required percentage = $\left[\frac{20}{(100-20)}\times 100\right]\% = 25\%.$

Ex. 14. How many kg of pure salt must be added to 30 kg of 2% solution of salt and water to increase it to a 10% solution?

Sol. Amount of salt in 30 kg solution = $\left(\frac{2}{100}\times 30\right)$ kg = 0.6 kg.

Let x kg of pure salt be added.

Then, $\frac{0.6+x}{30+x}=\frac{10}{100} \Leftrightarrow 60+100x=300+10x \Leftrightarrow 90x=240 \Leftrightarrow x=\frac{8}{3}=2\frac{2}{3}.$

Ex. 15. Due to a reduction of $6\frac{1}{4}$% in the price of sugar, a man is able to buy 1 kg more for Rs. 120. Find the original and reduced rate of sugar.

Sol. Let original rate be Rs. x per kg.

Reduced rate = Rs. $\left[\left(100-\frac{25}{4}\right)\times\frac{1}{100}x\right]=Rs.\frac{15x}{16}\ per\ kg.$

$\therefore \quad \frac{120}{\frac{15x}{16}}-\frac{120}{x}=1 \Leftrightarrow \frac{128}{x}-\frac{120}{x}=1 \Leftrightarrow x=8.$

So, original rate = Rs. 8 per kg.

Reduced rate = Rs. $\left(\frac{15}{16}\times 8\right)$ per kg = Rs. 7.50 per kg.

Ex. 16. In an examination, 35% of total students failed in Hindi, 45% failed in English and 20% in both. Find the percentage of those who passed in both the subjects.

Sol. Let A and B be the sets of students who failed in Hindi and English respectively.

Then, n (A) = 35, n (B) = 45, n (A $\cap$ B) = 20.

So, n (A $\cup$ B) = n (A) + n (B) – n (A $\cap$ B) = (35 + 45 – 20) = 60.

$\therefore$ Percentage failed in Hindi or English or both = 60%.

Hence, percentage passed = (100 – 60)% = 40%.

EXERCISE – 1

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (√) against the correct answer :***

1. The ratio 5 : 4 expressed as a percent equals :

(a) 12.5% (b) 40% (c) 80% (d) 125%

2. 3.5 can be expressed in terms of percentage as :

(a) 0.35% (b) 3.5% (c) 35% (d) 350%

3. Half of 1 percent written as a decimal is :

(a) 0.005 (b) 0.05 (c) 0.02 (d) 0.2

4. What is 15 percent of Rs. 34?

(a) Rs. 3.40 (b) Rs. 3.75 (c) Rs. 4.50 (d) Rs. 5.10

5. 63% of $3\frac{4}{7} is:$

(a) 2.25 (b) 2.40 (c) 2.50 (d) 2.75

6. 860% of 50 + 50% of 860 = ?

(a) 430 (b) 516 (c) 860 (d) 960

7. 45% of 750 – 25% of 480 = ?

(a) 216 (b) 217.50 (c) 236.50 (d) 245

8. 40% of 1640 + ? = 35% of 980 + 150% of 850

(a) 372 (b) 842 (c) 962 (d) 1052

9. 60% of 264 is the same as :

(a) 10% of 44 (b) 15% of 1056 (c) 30% of 132 (d) None of these

10. 0.01 is what percent of 0.1?

(a) $\frac{1}{100}$ (b) $\frac{1}{10}$ (c) 10 (d) 100

11. What percent of Rs. 2650 is Rs 1987.50 ?

(a) 60% (b) 75% (c) 80% (d) 90%

12. What percent of a day is 3 hours?

(a) $12\frac{1}{2}\%$ (b) $16\frac{2}{3}\%$ (c) $18\frac{2}{3}\%$ (d) $22\frac{1}{2}\%$

13. It costs Rs. 1 to photocopy a sheet of paper. However, 2% discount is allowed on all photocopies done after first 1000 sheets. How, much will it cost to copy 5000 sheets of paper?

(a) Rs. 3920 (b) Rs. 3980 (c) Rs. 4900 (d) Rs. 4920

14. How many litres of pure acid are there in 8 litres of a 20% solution?

(a) 1.4 (b) 1.5 (c) 1.6 (d) 2.4

15. Rajeev buys goods worth Rs. 6650. He gets a rebate of 6% on it. After getting the rebate, he pays sales tax @ 10%. Find the amount he will have to pay for the goods.

(a) Rs. 6876.10 (b) Rs. 6999.20 (c) Rs. 6654 (d) Rs. 7000

16. Which one of the following shows the best percentage?

(a) $\frac{384}{540}$ (b) $\frac{425}{500}$ (c) $\frac{570}{700}$ (d) $\frac{480}{660}$

17. 0.15% of $33\frac{1}{3}\%$ of Rs. 10,000 is :

(a) Rs. 0.05 (b) Rs. 5 (c) Rs. 105 (d) Rs. 150

18. ?% of 360 = 129.6

(a) 36 (b) 64 (c) 72 (d) 77

19. ?% of 932 + 30 = 309.6

(a) 25 (b) 30 (c) 35 (d) 40

20. 45% of 1500 + 35% of 1700 = ?% of 3175

(a) 30 (b) 35 (c) 45 (d) None of these

21. 65% of ? = 20% of 422.50

(a) 84.5 (b) 130 (c) 139.425 (d) 200

22. If Rs. 2800 is $\frac{2}{7}$ percent of the value of a house, the worth of the house (in Rs.) is :

(a) 8, 00, 000 (b) 9,80,000 (c) 10,00,000 (d) 12,00,000

23. If 35% of a number is 175, then what percent of 175 is that number?

(a) 35% (b) 65% (c) 280% (d) None of these

24. Two-fifth of one-third of three-seventh of a number is 15. What is 40 percent of that number?

(a) 72 (b) 84 (c) 136

(d) 140 (e) None of these

25. The difference between a number and its two-fifth is 510. What is 10% of that number?

(a) 12.75 (b) 85 (c) 204 (d) None of these

26. If 35% of a number is 12 less than 50% of that number, then the number is :

(a) 40 (b) 50 (c) 60 (d) 80

27. The number which exceeds 16% of it by 42 is :

(a) 50 (b) 52 (c) 58 (d) 60

28. What percentage of numbers from 1 to 70 have squares that end in the digit 1?

(a) 1 (b) 14 (c) 20 (d) 21

29. If a number x is 10% less than another number y and y is 10% more than 125, then x is equal to:

(a) 123.75 (b) 140.55 (c) 143 (d) 150

30. If 75% of a number is added to 75, then the result is the number itself. The number is :

(a) 50 (b) 60 (c) 300 (d) 400

31. A number, when 35 is subtracted from it, reduces to its 80 percent. What is four-fifth of that number?

(a) 70 (b) 90 (c) 120 (d) 140

32. The sum of two numbers is 2490. if 6.5% of one number is equal to 8.5% of the other, then the numbers are :

(a) 989, 1501 (b) 1011, 1479 (c) 1401, 1089 (d) 1411, 1079

33. The sum of two numbers is $\frac{28}{25}$ of the first number. The second number is what percent of the first?

(a) 12% (b) 14% (c) 16% (d) 18%

34. If 25% of a number is subtracted from a second number, the second number reduces to its five-sixth. What is the ratio of the first number to the second number?

(a) 1 : 3 (b) 2 : 3 (c) 3 : 2 (d) Data inadequate

35. The difference of two numbers is 20% of the larger number. If the smaller number is 20, then the larger number is :

(a) 25 (b) 45 (c) 50 (d) 80

36. When any number is divided by 12, then dividend becomes $\frac{1}{4}$th of the other number. By how much percent first number is greater than the second number?

(a) 150 (b) 200 (c) 300 (d) Data inadequate

37. If one number is 80% of the other and 4 times the sum of their squares is 656, then the numbers are :

(a) 4, 5 (b) 8, 10 (c) 16, 20 (d) None of these

38. Two numbers A and B are such that the sum of 5% of A and 4% of B is two-third of the sum of 6% of A and 8% of B. Find the ratio of A : B.

(a) 2 : 3 (b) 1 : 1 (c) 3 : 4 (d) 4 : 3

39. Three candidates contested an election and received 1136, 7636 and 11628 votes respectively. What percentage of the total votes did the winning candidate get?

(a) 57% (b) 60% (c) 65% (d) 90%

40. The population of a town increased from, 1,75,000 to 2,62,500 in a decade. The average percent increase of population per year is :

(a) 4.37% (b) 5% (c) 6% (d) 8.75%

12. PROFIT AND LOSS

IMPORTANT FACTS

Cost Price : The price at which an article is purchased, is called its ***cost price***, abbreviated as ***C.P***.

Selling Price : The price at which an article is sold, is called its ***selling price***, abbreviated as ***S.P***.

Profit or Gain : If S.P. is greater than C.P., the seller is said to have a ***profit*** or ***gain.***

Loss *:* If S.P. is less than C.P., the seller is said to have incurred a ***loss.***

FORMULAE

1. Gain = (S.P.) – (C.P.)

2. Loss = (C.P.) – (S.P.)

3. Loss or gain is always reckoned on C.P.

4. Gain % = $\left(\frac{Gain \times 100}{C.P.}\right)$

5. Loss % $\left(\frac{Loss \times 100}{C.P.}\right)$

6. S.P. $= \frac{(100 + Gain\%)}{100} \times C.P.$

7. S.P. = $= \frac{(100 - Loss\%)}{100} \times C.P.$

8. C.P. $= \frac{100}{(100 + Gain\%)} \times S.P.$

9. C.P. $= \frac{100}{(100 - Loss\%)} \times S.P.$

10. If an article is sold at a gain of say, 35%, then S.P. = 135% of C.P.

11. If an article is sold at a loss of say, 35%, then S.P. = 65% of C.P.

12. When a person sells two similar items, one at a gain of say, x%, and the other at a loss of x%, then the seller always incurs a loss given by :

$$Loss\% = \left(\frac{Common\ Loss\ and\ Gain\%}{10}\right)^2 = \left(\frac{x}{10}\right)^2.$$

13. If a trader professes to sell his goods at cost price, but uses false weights, then

$$Gain\% = \left[\frac{Error}{(True\ Value) - (Error)} \times 100\right]\%.$$

SOVLED EXAMPLES

Ex. 1. A man buys an article for Rs. 27.50 and sells it for Rs. 28.60. Find his gain percent.

Sol. C.P. = Rs. 27.50, S.P. = Rs. 28.60.
So, Gain = Rs. (28.60 – 27.50) = Rs. 1.10.

$\therefore$ Gain% = $\left(\frac{1.10}{27.50}\times 100\right)\% = 4\%$.

Ex. 2. If a radio is purchased for Rs. 490 and sold for Rs. 465.50, find the loss percent.

Sol. C.P. = Rs. 490, S.P. = Rs. 465.50.
Loss = Rs. (490 – 465.50) = Rs. 24.50.

$\therefore$ Loss% = $\left(\frac{24.50}{490}\times 100\right)\% = 5\%$.

Ex. 3. Find C.P., when
(i) S.P. = Rs. 40.60, Gain = 16% ***(ii) S.P. = Rs. 51.70, Loss = 12%***

Sol. *(i)* C.P. = Rs. $\left(\frac{100}{116}\times 40.60\right) = Rs.35$.

(ii) C.P. = Rs. $\left(\frac{100}{88}\times 51.70\right) = Rs.58.75$.

Ex. 4. The C.P. of 21 articles is equal to S.P. of 18 articles. Find the gain or loss percent.

Sol. Let C.P. of each article be Rs. 1.
Then, C.P. of 18 articles = Rs. 18, S.P. of 18 articles = Rs. 21.

$\therefore$ Gain% = $\left(\frac{3}{18}\times 100\right)\% = 16\frac{2}{3}\%$.

Ex. 5. A man bought toffees at 3 for a rupee. How many for a rupee must he sell to gain 50%?

Sol. C.P. of 3 toffees = Re. 1; S.P. of 3 toffees = 150% of Re. $1 = \frac{3}{2}$.

For Rs. $\frac{3}{2}$, toffees sold = 3. For Re. 1, toffee sold $= \left(3\times\frac{2}{3}\right) = 2$.

Ex. 6. Monika purchased a pressure cooker at $\frac{9}{10}th$ of its selling price and sold it at 8% more than its S.P. Find her gain percent.

Sol. Let the S.P. be Rs. x. Then, C.P. = Rs. $\frac{9x}{10}$, Receipt = 108% of Rs. X = Rs. $\frac{27x}{25}$.

Gain = Rs. $\left(\frac{27x}{25}-\frac{9x}{10}\right)$ = Rs. $\left(\frac{108x-90x}{100}\right) = Rs.\frac{18x}{100}$.

$\therefore$ Gain% = $\left(\frac{18x}{100}\times\frac{10}{9x}\times 100\right)\% = 20\%$.

Ex. 7. A tradesman sold an article at a loss of 20%. If the selling price had been increased by Rs. 100, there would have been a gain of 5%. What was the cost price of the article?

Sol. Let C.P. be Rs. x. Then, (105% of x) – (80% of x) = 100 or 25% of x = 100

$\therefore \quad \frac{x}{4}=100$ or $x = 400$.

So, C.P. = Rs. 400.

Ex. 8. A retailer buys 40 pens at the marked price of 36 pens from a wholesaler. If he sells these pens giving a discount of 1%, what is the profit percent?

Sol. Let the marked price of each pen be Re. 1.

Then, C.P. of 40 pens = Rs. 36. S.P. of 40 pens = 99% of Rs. 40 = Rs. 39.60.

$\therefore \quad \text{Profit\%} = \left(\frac{3.60}{36}\times 100\right)\% = 10\%.$

EXERCISE – 1

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (√) against the correct answer :***

1. In terms of percentage profit, which is the best transaction?

	C.P (in Rs.)	Profit (in Rs.)
(a)	36	17
(b)	50	24
(c)	40	19
(d)	60	29

2. Alfred buys an old scooter for Rs. 4700 and spends Rs. 800 on its repairs. If he sells the scooter for Rs. 5800, his gain percent is :

(a) $4\frac{4}{7}\%$ (b) $5\frac{5}{11}\%$ (c) 10% (d)12%

3. A shopkeeper purchased 70 kg of potatoes for Rs. 420 and sold the whole lot at the rate of Rs. 6.50 per kg. What will be his gain percent?

(a) $4\frac{1}{6}\%$ (b) $6\frac{1}{4}\%$ (c) $8\frac{1}{3}\%$ (d) 20%

4. Sam purchased 20 dozens of toys at the rate of Rs. 375 per dozen. He sold each one of them at the rate of Rs. 33. What was his percentage profit?

(a) 3.5 (b) 4.5 (c) 5.6 (d) 6.5

5. A man buys a cycle for Rs. 1400 and sells it at a loss of 15%. What is the selling price of the cycle?

(a) Rs. 1090 (b) Rs. 1160 (c) Rs. 1190 (d) Rs. 1202

6. Peter purchased a machine for Rs. 80,000 and spent Rs. 5000 on repair and Rs. 1000 on transport and sold it with 25% profit. At what price did he sell the machine?

(a) Rs. 1,05,100 (b) Rs. 1,06,250 (c) Rs. 1,07,500

(d) Rs. 1,17,500 (e) None of these

7. A shopkeeper expects a gain of $22\frac{1}{2}\%$ on his cost price. If in a week, his sale was of Rs. 392, what was his profit?

(a) Rs. 18.20 (b) Rs. 70 (c) Rs. 72 (d) Rs. 88.25

8. Jacob bought a scooter for a certain sum of money. He spent 10% of the cost on repairs and sold the scooter for a profit of Rs. 1100. How much did he spend on repairs if he made a profit of 20%?

(a) Rs. 400 (b) Rs. 440 (d) Rs. 500 (d) Rs. 550

9. A manufacturer undertakes to supply 2000 pieces of a particular component at Rs. 25 per piece. According to his estimates, even if 5% fail to pass the quality tests, then he will make a profit of 25%. However as it turned out. 50% of the components were rejected. What is the loss to the manufacturer?

(a) Rs. 12,000 (b) Rs. 13,000 (c) Rs. 14,000 (d) Rs. 15,000

10. When a plot is sold for Rs. 18,700 the owner loses 15%. At what price must the plot be sold in order to gain 15%?

(a) Rs. 21,000 (b) Rs. 22,500 (c) Rs. 25,300 (d) Rs. 25,800

11. A fruit-seller sells mangoes at the rate of Rs. 9 per kg and thereby loses 20%. At what price per kg, he should have sold them to make a profit of 5%?

(a) Rs. 11.81 (b) Rs. 12 (c) Rs. 12.25 (d) Rs. 12.31

12. A property dealer sells a house for Rs. 6,30,000 and in the bargain makes a profit of 5%. Had he sold it for Rs. 5,00,000, then what percentage of loss or gain he would have made?

(a) $2\frac{1}{4}\%$ (b) 10% loss (c) $12\frac{1}{2}\%$ (d) $16\frac{2}{3}\%$

13. A shopkeeper sells one transistor for Rs. 840 at a gain of 20% and another for Rs. 960 at a loss of 4%. His total gain or loss percent is :

(a) $5\frac{15}{17}\%$ (b) $5\frac{15}{17}\%$ (c) $6\frac{2}{3}\%$ (d) None of these

14. The ratio of the cost price and the selling price is 4 : 5. The profit percent is :

(a) 10% (b) 20% (c) 25% (d) 30%

15. The ratio between the sale price and the cost price of an article is 7 : 5. What is the ratio between the profit and the cost price of that article?

(a) 2 : 7 (b) 5 : 2 (c) 7 : 2

(d) Data inadequate (e) None of these

16. A man gains 20% by selling an article for a certain price. If he sells it at double the price, the percentage of profit will be:

(a) 40 (b) 100 (c) 120 (d) 140

17. If selling price is doubled, the profit triples. Find the profit percent :

(a) $66\frac{2}{3}$ (b) 100 (c) $105\frac{1}{3}$ (d) 120

18. In a certain store, the profit is 320% of the cost. If the cost increase by 25% but the selling price remains constant, approximately what percentage of the selling price is the profit?

(a) 30% (b) 70% (c) 100% (d) 250%

19. The profit earned by selling an article for Rs. 832 is equal to the loss incurred when the same article is sold for Rs. 448. What should be the sale price for making 50% profit?

(a) Rs. 920 (b) Rs. 960 (c) Rs. 1060

(d) Rs. 1200 (e) None of these

20. The percentage profit earned by selling an article for Rs. 1920 is equal to the percentage loss incurred by selling the same article for Rs. 1280. At what price should the article be sold to make 25% profit?

(a) Rs. 2000 (b) Rs. 2200 (c) Rs. 2400

(d) Data inadequate (e) None of these

21. If the cost price of 12 pens is equal to the selling price of 8 pens, the gain percent is :

(a) 25% (b) $33\frac{1}{3}\%$ (c) 50% (d) $66\frac{2}{3}\%$

22. If the selling price of 50 articles is equal to the cost price of 40 articles, then the loss or gain percent is:

(a) 20% loss (b) 20% gain (c) 25% loss (d) 25% gain

23. The cost price of 20 articles is the same as the selling price of x articles. If the profit is 25%, then the value of x is:

(a) 15 (b) 16 (c) 18 (d) 25

24. On an order of 5 dozen boxes of a consumer product, a retailer receives an extra dozen free. This is equivalent to allowing him a discount of:

(a) 15% (b) $16\frac{1}{6}\%$ (c) $16\frac{2}{3}\%$ (d) 20%

25. A man sold 18 cots for Rs. 16,800, gaining thereby the cost price of 3 cots. The cost price of a cot is:

(a) Rs. 650 (b) Rs. 700 (c) Rs. 750 (d) Rs. 800

26. If on selling 12 notebooks, a seller makes a profit equal to the selling price of 4 notebooks, what is his percent profit?

(a) $16\frac{2}{3}$ (b) 25 (c) 50

(d) Data inadequate (e) None of these

27. On selling 17 balls at Rs. 720, there is a loss equal to the cost price of 5 balls. The cost price of a ball is:

(a) Rs. 45 (b) Rs. 50 (c) Rs. 55 (d) Rs. 60

28. A man buys 2 dozen, bananas at Rs. 16 per dozen. After selling 18 bananas at the rate of Rs. 12 per dozen, the shopkeeper reduced the rate to Rs. 4 per dozen. The percent loss is:

(a) 25.2% (b) 32.4% (c) 36.5% (d) 37.5%

29. A man bought apples at the rate of 8 for Rs. 34 and sold them at the rate of 12 for Rs. 57. How many apples should be sold to earn a net profit of Rs. 45?

(a) 90 (b) 100 (c) 135 (d) 150

30. Some articles were bought at 6 for Rs. 5 and sold at 5 for Rs. 6. Gain percent is:

(a) 30% (b) $33\frac{1}{3}\%$ (c) 35% (d) 44%

31. A man bought some fruits at the rate of 16 for Rs. 24 and sold them at the rate of 8 for Rs. 18. What is the profit percent?

(a) 25% (b) 40% (c) 50%

(d) 60% (e) None of these

32. A man purchased a box full of pencils at the rate of 7 for Rs. 9 and sold all of them at the rate of 8 for Rs. 11. In this translation, he gained Rs. 10. How many pencils did the box contain?

(a) 100 (b) 112 (c) 114 (d) 115

33. A vendor bought toffees at 6 for a rupee. How many for a rupee must he sell to gain 20%?

(a) 3 (b) 4 (c) 5 (d) 6

34. By selling 12 toffees for a rupee, a man loses 20%. How many for a rupee must he sell to gain 20%?

(a) 5 (b) 8 (c) 10 (d) 15

35. A trader mixes 26 kg of rice at Rs. 20 per kg with 30 kg of rice of other variety at a Rs. 36 per kg and sells the mixture at Rs. 30 per kg. His profit percent is:

(a) No profit, no loss (b) 5% (c) 8%

(d) 10% (e) None of these

36. Arun purchased 30 kg of wheat at the rate of Rs. 11.50 per kg and 20 kg of wheat at the rate of Rs. 14.25 per kg. He mixed the two and sold the mixture. Approximately what price per kg should he sell the mixture to make 30% profit?

(a) Rs. 14.80 (b) Rs. 15.40 (c) Rs. 15.60

(d) Rs. 16.30 (e) Rs. 18.20

37. Padam purchased 30 kg of rice at the rate of Rs. 17.50 per kg and another 30 kg rice at a certain rate. He mixed the two and sold the entire quantity at the rate of Rs. 18.60 per kg and made 20% overall profit. At what price per kg did he purchase the lot of another 30 kg rice?

(a) Rs. 12.50 (b) Rs. 13.50 (c) Rs. 14.50

(d) Rs. 15.50 (e) None of these

38. A trader mixes three varieties of groundnuts costing Rs. 50, Rs. 20 and Rs. 30 per kg in the ratio 2 : 4 : 3 in terms of weight, and sells the mixture at Rs. 33 per kg. What percentage of profit does he make?

(a) 8% (b) 9% (c) 10% (d) None of these

39. A dairyman pays Rs. 6.40 per litre of milk. He adds water and sells the mixture at Rs. 8 per litre, thereby making 37.5% profit. The proportion of water to milk received by the customers is :

(a) 1 : 10 (b) 1 : 12 (c) 1 : 15 (d) 1 : 20

40. By mixing two brands of tea and selling the mixture at the rate of Rs. 177 per kg, a shopkeeper makes a profit of 18%. If to every 2 kg of one brand costing Rs. 200 per kg, 3 kg of the other brand is added, then how much per kg does the other brand cost?

(a) Rs. 110 (b) Rs. 120 (c) Rs. 140 (d) None of these

13. SIMPLE INTEREST

IMPORTANT FACTS AND FORMULAE

1. **Principal :** The money borrowed or lent out for a certain period is called the ***principal*** or the ***sum.***
2. **Interest :** Extra money paid for using other's money is called ***interest.***
3. **Simple Interest (S.I.) :** If the interest on a sum borrowed for a certain period is reckoned uniformly, then it is called ***simple interest***.

   Let Principal = P, Rate = R% per annum (p.a.) and Time = T years. Then,

   (i) S.I. = $\left(\frac{P\times R\times T}{100}\right)$.

   (ii) P = $\left(\frac{100\times S.I.}{R\times T}\right)$; $R=\left(\frac{100\times S.I.}{P\times T}\right)$ and T = $\left(\frac{100\times S.I.}{P\times R}\right)$

SOLVED EXAMPLES

Ex. 1. Find the simple interest on Rs. 68,000 at $16\frac{2}{3}\%$ ***per annum for 9 months.***

Sol. P = Rs. 68000, R = $\frac{50}{3}\%$ p.a and T = $\frac{9}{12}$ years = $\frac{3}{4}$ years.

$\therefore$ S.I. = $\left(\frac{P\times R\times T}{100}\right)=Rs.\left(68000\times\frac{50}{3}\times\frac{3}{4}\times\frac{1}{100}\right)=Rs.8500.$

Ex. 2. A sum at simple interest at $13\frac{1}{2}\%$ ***per annum amounts to Rs. 2502.50 after 4 years. Find the sum.***

Sol. Let sum be Rs. x. Then, S.I. = Rs. $\left(x\times\frac{27}{2}\times4\times\frac{1}{100}\right)=Rs.\frac{27x}{50}$.

$\therefore$ Amount = Rs. $\left(x+\frac{27x}{50}\right)=Rs.\frac{77x}{50}$.

Ex. 3. Adam borrowed some money at the rate of 6% p.a. for the first two years, at the rate of 9% p.a. for the next three years, and at the rate of 14% p.a. for the period beyond five years. If he pays a total interest of Rs. 11,400 at the end of nine years, how much money did he borrow?

Sol. Let the sum borrowed be x. Then,

$$\left(\frac{x\times 6\times 2}{100}\right)+\left(\frac{x\times 9\times 3}{100}\right)+\left(\frac{x\times 14\times 4}{100}\right)=11400$$

$$\Leftrightarrow \quad \left(\frac{3x}{25}+\frac{27x}{100}+\frac{14x}{25}\right)=11400 \Leftrightarrow \frac{95x}{100}=11400 \Leftrightarrow x=\left(\frac{11400\times 100}{95}\right)=12000.$$

Hence, sum borrowed = Rs. 12,000.

Ex. 4. At what rate percent per annum will a sum of money double in 16 years?

Sol. Let principal = P. Then, S.I. = P and T = 16 yrs.

$$\therefore \quad \text{Rate} = \left(\frac{100\times P}{P\times 16}\right)\%=6\frac{1}{4}\%\ p.a.$$

Ex. 5. The simple interest on a sum of money is $\frac{4}{9}$ of the principal. Find the rate percent and time, if both are numerically equal.

Sol. Let sum = Rs. x. Then, S.I. = Rs. $\frac{4x}{9}$.

Let rate = R% and time = R years.

Then, $\left(\frac{x\times R\times R}{100}\right)=\frac{4x}{9} or\ R^2=\frac{400}{9} or\ R=\frac{20}{3}=6\frac{2}{3}$.

$\therefore$ Rate = $6\frac{2}{3}\%$ and Time = $6\frac{2}{3}$ yrs = 6 yrs 8 months.

EXERCISE – 1

(OBJECTIVE TYPE QUESTIONS)

Directions : ***Mark (√) against the correct answer*** **:**

1. A person borrows Rs. 5000 for 2 years at 4% p.a. simple interest. He immediately lends it to another person at $6\frac{1}{4}\%$ p.a. for 2 years. Find his gain in the transaction per year.

(a) Rs. 112.50 (b) Rs. 125 (c) Rs. 150 (d) Rs. 167.50

2. How much time will it take for an amount of Rs. 450 to yield Rs. 81 as interest at 4.5% per annum of simple interest?

(a) 3.5 years (b) 4 years (c) 4.5 years (d) 5 years

3. A sum of Rs. 12,500 amounts to Rs. 15,500 in 4 years at the rate of simple interest. What is the rate of interest?

(a) 3% (b) 4% (c) 5%

(d) 6% (e) None of these

4. Reena took a loan of Rs. 1200 with simple interest for as many years as the rate of interest. If she paid Rs. 432 as interest at the end of the loan period, what was the rate of interest?

(a) 3.6 (b) 6 (c) 18

(d) Cannot be determined (e) None of these

5. A man took a loan from a bank at the rate of 12% p.a. simple interest. After 3 years he had to pay Rs. 5400 interest only for the period. The principal amount borrowed by him was :

(a) Rs. 2000 (b) Rs. 10,000 (c) Rs. 15,000 (d) Rs. 20,000

6. What is the present worth of Rs. 132 due in 2 years at 5% simple interest per annum?

(a) Rs. 112 (b) Rs. 118.80 (c) Rs. 120 (d) Rs. 122

7. A sum fetched a total simple interest of Rs. 4016.25 at the rate of 9 p.c.p.a. in 5 years. What is the sum?

(a) Rs. 4462.50 (b) Rs. 8032.50 (c) Rs. 8900

(d) Rs. 8925 (d) None of these

8. Rs. 800 becomes Rs. 956 in 3 years at a certain rate of simple interest. If the rate of interest is increased by 4%, what amount will Rs. 800 become in 3 years?

(a) Rs. 1020.80 (b) Rs. 1025 (c) Rs. 1052

(d) Data inadequate (e) None of these

9. A certain amount earns simple interest of Rs. 1750 after 7 years. Had the interest been 2% more, how much more interest would it have earned?

(a) Rs. 35 (b) Rs. 245 (c) Rs. 350

(d) Cannot be determined (e) None of these

10. In how many years, Rs. 150 will produce the same interest @ 8% as Rs. 800 produce in 3 years @ $4\frac{1}{2}\%$?

(a) 6 (b) 8 (c) 9 (d) 12

11. A sum invested at 5% simple interest per annum grows to Rs. 504 in 4 years. The same amount at 10% simple interest per annum in $2\frac{1}{2}$ years will grow to :

(a) Rs. 420 (b) Rs. 450 (c) Rs. 525 (d) Rs. 550

12. What will be the ratio of simple interest earned by certain amount at the same rate of interest for 6 years and that for 9 years?

(a) 1 : 3 (b) 1 : 4 (c) 2 : 3

(d) Data inadequate (e) None of these

13. Nitin borrowed some money at the rate of 6% p.a. for the first three years, 9% p.a. for the next five years and 13% p.a. for the period beyond eight years. If the total interest paid by him at the end of eleven years is Rs. 8160, how much money did he borrow ?

(a) Rs. 8000 (b) Rs. 10,000 (c) Rs. 12,000

(d) Data inadequate (e) None of these

14. An automobile financier claims to be lending money at simple interest, but he includes the interest every six months for calculating the principal. If he is charging an interest of 10% the effective rate of interest becomes :

(a) 10% (b) 10.25% (c) 10.5% (d) None of these

15. A sum of money at simple interest amounts to Rs. 815 in 3 years and to Rs. 854 in 4 years. The sum is :

(a) Rs. 650 (b) Rs. 690 (c) Rs. 698 (d) Rs. 700

16. A sum of money lent out at simple interest amounts to Rs. 720 after 2 years and to Rs. 1020 after a further period of 5 years. The sum is:

(a) Rs. 500 (b) Rs. 600 (c) Rs. 700 (d) Rs. 710

17. A sum of money amounts to Rs. 9800 after 5 years and Rs. 12005 after 8 years at the same rate of simple interest. The rate of interest per annum is:

(a) 5% (b) 8% (c) 12% (d) 15%

18. At what rate percent interest will a sum of money double itself in 12 years?

(a) $8\frac{1}{4}\%$ (b) $8\frac{1}{3}\%$ (c) $8\frac{1}{2}\%$ (d) $6\frac{1}{2}\%$

19. At what rate percent per annum will the simple interest on a sum of money be $\frac{2}{5}$ of the amount in 10 years?

(a) 4% (b) $5\frac{2}{3}\%$ (c) 6% (d) $6\frac{2}{3}\%$

20. In how much time would the simple interest on a certain sum be 0.125 times the principal at 10% per annum?

(a) $1\frac{1}{4}$ *years* (b) $1\frac{3}{4}$ *years* (c) $2\frac{1}{4}$ *years* (d) $2\frac{3}{4}$ *years*

21. A sum of money becomes $\frac{7}{6}$ of itself in 3 years at a certain rate of simple interest. The rate per annum is :

(a) $5\frac{5}{9}\%$ (b) $6\frac{5}{9}\%$ (c) 18% (d) 25%

22. Simple interest on a certain amount is $\frac{1}{9}$ of the sum. If the numbers representing rate percent and time in years be equal, then the rate of interest is:

(a) $5\frac{1}{2}$ *years* (b) $6\frac{1}{2}$ *years* (c) 7 years (d) $7\frac{1}{2}$ *years*

23. A lends Rs. 2500 to B and a certain sum to C at the same time at 7% p.a. simiple interest. If after 4 years, A altogether receives Rs. 1120 as interest from B and C, then the sum lent to C is:

(a) Rs. 700 (b) Rs. 1500 (c) Rs. 4000 (d) Rs. 6500

24. A lent Rs. 5000 to B for 2 years and Rs. 3000 to C for 4 years on simple interest at the same rate of interest and received Rs. 2200 in all from both of them as interest. The rate of interest per annum is:

(a) 5% (b) 7% (c) $7\frac{1}{8}\%$ (d) 10%

25. A sum of Rs. 725 is lent in the beginning of a year at a certain rate of interest. After 8 months, a sum of Rs. 362.50 more is lent but at the rate twice the former. At the end of the

year, Rs. 33.50 is earned as interest from both the loans. What was the original rate of interest?

(a) 3.6% (b) 4.5% (c) 5%

(d) 6% (e) None of these

26. The difference between the simple interest received from two different sources on Rs. 1500 for 3 years is Rs. 13.50. The difference between their rates of interest is:

(a) 0.1% (b) 0.2% (c) 0.3%

(d) 0.4% (e) None of these

27. Peter invested an amount of Rs. 12,000 at the rate of 10 p.c.p.a. simple interest and another amount at the rate of 20 p.c.p.a. simple interest. The total interest earned at the end of one year on the total amount invested became 14 p.c.p.a. Find the total amount invested.

(a) Rs. 20,000 (b) Rs. 22,000 (c) Rs. 24,000

(d) Rs. 25,000 (e) None of these

28. If the annual rate of simple interest increases from 10% to $12\frac{1}{2}\%$, a man's yearly income increases by Rs. 1250. His principal (in Rs.) is :

(a) 45,000 (b) 50,000 (c) 60,000 (d) 65,000

29. A moneylender finds that due to a fall in the annual rate of interest from 8% to $7\frac{3}{4}\%$, his yearly income diminishes by Rs. 61.50. His capital is:

(a) Rs. 22,400 (b) Rs. 23,800 (c) Rs. 24,600 (d) Rs. 26,000

30. The price of a T.V. set worth Rs. 20,000 is to be paid in 20 installments of Rs. 1000 each. If the rate of interest be 6% per annum, and the first installments be paid at the time of purchase, then the value of the last installment covering the interest as well will be:

(a) Rs. 1050 (b) Rs. 2050 (c) Rs. 3000 (d) None of these

14. COMPOUND INTEREST

Compound Interest : Sometimes it so happens that the borrower and the lender agree to fix up a certain unit of time, say yearly or half-yearly or quarterly to settle the previous account.

In such cases, the amount after first unit of time becomes the principal for the second unit, the amount after second unit becomes the principal for the third unit and so on.

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

IMPORTANT FACTS AND FORMULAE

Let Principal = P, Rate = R% per annum, Time = *n* years.

I. When interest is compound Annually :

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

II. When interest is compounded Half-yearly :

$$\text{Amount} = P\left[1+\frac{(R/2)}{100}\right]^{2n}$$

III. When interest is compounded Quarterly :

$$\text{Amount} = P\left[1+\frac{(R/4)}{100}\right]^{4n}$$

IV. When interest is compounded Annually but time is in fraction, say $3\frac{2}{5}$ years.

$$\text{Amount} = P\left(1+\frac{R}{100}\right)^{3}\times\left(1+\frac{\frac{2}{5}R}{100}\right)$$

V. When Rates are different for different years, say R_1%, R_2%, R_3% for 1st, 2nd and 3rd year respectively.

Then, Amount = $P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\left(1+\frac{R_3}{100}\right)$.

VI. Present worth of Rs. x due n years hence is given by :

$$\text{Present Worth} = \frac{x}{\left(1+\frac{R}{100}\right)^n}.$$

SOLVED EXAMPLES

Ex. 1. ***Find compound interest on Rs. 7500 at 4% per annum for 2 years, compounded annually.***

Sol. Amount = Rs. $\left[7500\times\left(1+\frac{4}{100}\right)^2\right] = Rs.\left(7500\times\frac{26}{25}\times\frac{26}{25}\right) = Rs.8112.$

Ex. 2. ***Find the compound interest Rs. 16,000 at 20% per annum for 9 months, compound quarterly.***

Sol. Principal = Rs. 16000; Time = 9 months = 3 quarters;

Rate = 20% per annum = 5% per quarter.

$\therefore$ Amount = Rs. $\left[16000\times\left(1+\frac{5}{100}\right)^3\right] = Rs.\left(16000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20}\right) = Rs.18522.$

$\therefore$ C.I. = Rs. (18522 – 16000) = Rs. 2522.

Ex. 3. ***In what time will Rs. 1000 become Rs. 1331 at 10% per annum compounded annually?***

Sol. Principal = Rs. 1000; Amount = Rs. 1331; Rate = 10% p.a.

Let the time be n years. Then,

$$\left[1000\left(1+\frac{10}{100}\right)^n\right] = 1331 \; or \left(\frac{11}{10}\right)^n = \left(\frac{1331}{1000}\right) = \left(\frac{11}{10}\right)^3$$

$\therefore$ n = 3 years.

Ex. 4. ***If Rs. 500 amounts to Rs. 583.20 in two years compounded annually, find the rate of interest per annum?***

Sol. Principal = Rs. 500; Amount = Rs. 583.20; Time = 2 years.

Let the rate be R% per annum. Then,

$$\left[500\left(1+\frac{R}{100}\right)^2\right] = 583.20 \; or \left(1+\frac{R}{100}\right)^2 = \frac{5832}{5000} = \frac{11664}{10000}$$

$\therefore$ $\left(1+\frac{R}{100}\right)^2 = \left(\frac{108}{100}\right)^2 \; or \; 1+\frac{R}{100} = \frac{108}{100} \; or \; R = 8.$

So, rate = 8% p.a.

Ex. 5. ***The difference between the compound interest and simple interest on a certain sum at 10% per annum for 2 years is Rs. 631. Find the sum.***

Sol. Let the sum be Rs. x. Then,

$$\text{C.I.} = x\left(1+\frac{10}{100}\right)^2 - x = \frac{21x}{100},\ S.I. = \left(\frac{x\times 10\times 2}{100}\right) = \frac{x}{5}.$$

$$\therefore \quad (C.I.) - (S.I.) = \left(\frac{21x}{100} - \frac{x}{5}\right) = \frac{x}{100}.$$

$$\therefore \quad \frac{x}{100} = 631 \Leftrightarrow x = 63100.$$

Hence, the sum is Rs. 63,100.

Ex. 6. ***A certain sum amounts to Rs. 7350 in 2 years and to Rs. 8575 in 3 years. Find the sum and rate percent.***

Sol. S.I. on Rs. 7350 for 1 year = Rs. (8575 – 7350) = Rs. 1225.

$$\therefore \quad Rate = \left(\frac{100\times 1225}{7350\times 1}\right)\% = 16\frac{2}{3}\%.$$

Let the sum be Rs. x. Then,

$$x\left(1+\frac{50}{3\times 100}\right)^2 = 7350 \Leftrightarrow x\times\frac{7}{6}\times\frac{7}{6} = 7350 \Leftrightarrow x = \left(7350\times\frac{36}{49}\right) = 5400.$$

$\therefore$ Sum = Rs. 5400.

Ex. 7. ***A sum of money doubles itself at compound interest in 15 years. In how many years will it become eight times?***

Sol. $$P\left(1+\frac{R}{100}\right)^{15} = 2P \quad \Rightarrow \left(1+\frac{R}{100}\right)^{15} = \frac{2P}{P} = 2 \qquad \ldots.(i)$$

$$Let\ P\left(1+\frac{R}{100}\right)^{n} = 8P \Rightarrow \left(1+\frac{R}{100}\right)^{n} = 8 = 2^3 = \left\{\left(1+\frac{R}{100}\right)^{15}\right\}^3 \qquad [u \sin g\,(i)]$$

$$\Rightarrow \left(1+\frac{R}{100}\right)^{n} = \left(1+\frac{R}{100}\right)^{45} \Rightarrow n = 45.$$

Thus, the required time = 45 years.

EXERCISE – 1

(OBJECTIVE TYPE QUESTIONS)

Direction : ***Mark (√) against the correct answer :***

1. Albert invested an amount of Rs. 8000 in a fixed deposit scheme for 2 years at compound interest rate 5 p.c.p.a. How much amount will Albert get on maturity of the fixed deposit?

(a) Rs. 8600 (b) Rs. 8620 (c) Rs. 8800

(d) Rs. 8840 (d) None of these

2. What will be the compound interest on a sum of Rs. 25,000 after 3 years at the rate of 12 p.c.p.a.?

(a) Rs. 9000.30 (b) Rs. 9720 (c) Rs. 10123.20

(d) Rs. 10483.20 (e) None of these

3. A man saves Rs. 200 at the end of each year and lends the money at 5% compound interest. How much will it become at the end of 3 years?

(a) Rs. 565.25 (b) Rs. 635 (c)Rs. 662.02

(d) Rs. 666.50

4. Sam invested Rs. 15,000 @ 10% per annum for one year. If the interest is compounded half-yearly, then the amount received by Sam at the end of the year will be:

(a) Rs. 16,500 (b) Rs. 16,525.50 (c)Rs. 16,537.50

(c) Rs. 18,150 (d) None of these

5. A bank offers 5% compound interest calculated on half-yearly basis. A customer deposits Rs. 1600 each on 1st January and 1st July of a year. At the end of the year, the amount he would have gained by way of interest is

(a) Rs. 120 (b) Rs. 121 (c) Rs. 122 (d) Rs. 123

6. What is the difference between the compound interests on Rs. 5000 for $1\frac{1}{2}$ years at 4% per annum compounded yearly and half-yearly?

(a) Rs. 2.04 (b) Rs. 3.06 (c) Rs. 4.80 (d) Rs. 8.30

7. Find the compound interest of Rs. 15,625 for 9 months at 16% per annum compounded quarterly.

(a) Rs. 1851 (b) Rs. 1941 (c) Rs. 1951 (d) Rs. 1961

8. If the simple interest on a sum of money for 2 years at 5% per annum is Rs. 50, what is the compound interest on the same sum at the same rate and for the same time?

(a) Rs. 51.25 (b) Rs. 52 (c) Rs. 54.25 (d) Rs. 60

9. What will be the difference between simple and compound interest @ 10% per annum on a sum of Rs. 1000 after 4 years?

(a) Rs. 31 (b) Rs. 32.10 (c) Rs. 40.40

(d) Rs. 64.10 (e) None of these

10. The difference between simple interest and compound interest on Rs. 1200 for one year at 10% per annum reckoned half-yearly is:

(a) Rs. 2.50 (b) Rs. 3 (c) Rs. 3.75

(d) Rs. 4 (e) None of these

11. The compound interest on Rs. 30,000 at 7% per annum is Rs. 4347. The period (in years) is:

(a) 2 (b) $2\frac{1}{2}$ (c) 3 (d) 4

12. The principal that amounts to Rs. 4913 in 3 years at $6\frac{1}{4}\%$ per annum compound interest compounded annually, is:

(a) Rs. 3096 (b) Rs. 4076 (c) Rs. 4085 (d) Rs. 4096

13. In how many years will a sum of Rs. 800 at 10% per annum compounded semiannually become Rs. 926.10?

(a) $1\frac{1}{3}$ (b) $1\frac{1}{2}$ (c) $2\frac{1}{3}$ (d) $2\frac{1}{2}$

14. If the compound interest on a sum for 2 years at $12\frac{1}{2}\%$ per annum is Rs. 510, the simple interest on the same sum at the same rate for the same period of time is:

(a) Rs. 400 (b) Rs. 450 (c) Rs. 460 (d) Rs. 480

15. The compound interest on a certain sum for 2 years at 10% per annum is Rs. 525. The simple interest on the same sum for double the time at half the rate percent per annum is:

(a) 400 (b) Rs. 500 (c) Rs. 600 (d) Rs. 800

16. The simple interest on a certain sum of money for 3 years at 8% per annum is half the compound interest on Rs. 4000 for 2 years at 10% per annum. The sum placed on simple interest is:

(a) Rs. 1550 (b) Rs. 1650 (c) Rs. 1750 (d) Rs. 2000

17. There is 60% increase in an amount in 6 years at simple interest. What will be the compound interest of Rs. 12,000 after 3 years at the same rate?

(a) Rs. 2160 (b) Rs. 3120 (c) Rs. 3972

(d) Rs. 6240 (e) None of these

18. The difference between compound interest and simple interest on an amount of Rs. 15,000 for 2 years in Rs. 96. What is the rate of interest per annum?

(a) 8 (b) 10 (c) 12

(d) Cannot be determined (e) None of these

19. The difference between simple and compound interests compounded annually on a certain sum of money for 2 years at 4% per annum in Rs. 1. The sum (in Rs.) is:

(a) 625 (b) 630 (d) 640 (d) 650

20. The difference between the simple interest on a certain sum at the rate of 10% per annum for 2 years and compound interest which is compounded every 6 months is Rs. 124.05. What is the principal sum?

(a) Rs. 6000 (b) Rs. 8000 (c) Rs. 10,000

(d) Rs. 12,000 (e) None of these

21. On a sum of money, the simple interest for 2 years is Rs. 660, while the compound interest is Rs. 696.30, the rate of interest being the same in both the cases. The rate of interest is:

(a) 10% (b) 10.5% (c) 12% (d) None of these

22. Mr. Dua invested money in two schemes A and B offering compound interest @ 8 p.c.p.a. and 9 p.c.p.a. respectively. If the total amount of interest accrued through two schemes together in two years was Rs. 4818.30 and the total amount invested was Rs. 27,000, what was the amount invested in Scheme A?

(a) Rs. 12,000 (b) Rs. 13,500 (c) Rs. 15,000

(d) Cannot be determined (e) None of these

23. A sum of money invested at compound interest amounts to Rs. 800 in 3 years and to Rs. 840 in 4 years. The rate of interest per annum is:

(a) $2\frac{1}{2}\%$ (b) 4% (c) 5% (d) $6\frac{2}{3}\%$

24. A sum of money placed at compound interest doubles itself in 5 years. It will amount to eight times itself at the same rate of interest in:

(a) 7 years (b) 10 years (c) 15 years (d) 20 years

25. The least number of complete years in which a sum of money put out at 20% compound interest will be more than doubled is:

(a) 3 (b) 4 (c) 5 (d) 6

26. What annual payment will discharge a debt of Rs. 1025 due in 2 years at the rate of 5% compound interest?

(a) Rs. 550 (b) Rs. 551.25 (c) Rs. 560 (d) Rs. 560.75

27. A sum of money is borrowed and paid back in two annual installments of Rs. 882 each allowing 5% compound interest. The sum borrowed was:

(a) Rs. 1620 (b) Rs. 1640 (c) Rs. 1680 (d) Rs. 1700

Answers:

Chapter – 7

Exercise – 1

Exercise – 1

1. (b), 2. (c), 3. (c), 4. (b), 5. (e), 6. (d), 7. (c), 8. (a), 9. (c), 10. (d), 11. (d), 12. (c), 13. (a), 14. (b), 15. (b), 16. (a), 17. (a), 18. (c), 19. (b), 20. (b), 21. (c), 22. (d), 23. (c), 24. (c), 25. (d), 26. (a), 27. (c), 28. (d), 29. (d), 30. (a).

Chapter – 11

Exercise – 1

1. (d), 2. (d), 3. (a), 4. (d), 5. (b), 6. (c), 7. (b), 8. (c), 9. (b), 10. (c), 11. (b), 12. (a), 13. (d), 14. (b), 15. (a), 16. (b), 17. (b), 18. (a), 19. (b), 20. (d), 21. (b), 22. (b), 23. (d), 24. (e), 25. (b), 26. (d), 27. (a), 28. (c), 29. (a), 30. (c), 31. (d), 32. (d), 33. (a), 34. (b), 35. (a), 36. (b), 37. (b), 38. (d), 39. (a), 40. (b).

Chapter – 12

Exercise – 1

1. (d), 2. (b), 3. (c), 4. (c), 5. (c), 6. (d), 7. (c), 8. (c), 9. (b), 10. (c), 11. (a), 12. (d), 13. (b), 14. (c), 15. (e), 16. (d), 17. (b), 18. (b), 19. (b), 20. (a), 21. (c), 22. (a), 23. (b), 24. (c), 25. (d), 26. (c), 27. (d), 28. (d), 29. (a), 30. (d), 31. (c), 32. (b), 33. (c), 34. (b),35. (b),36. (d),37. (b), 38. (c), 39. (a), 40. (d)

Chapter – 13

Exercise – 1

(a), 2. (b), 3. (e), 4. (b), 5. (c), 6. (c), 7. (d), 8. (c), 9. (d), 10. (c), 11. (c), 12. (c), 13. (a), 14. (b), 15. (c), 16. (b), 17. (c), 18. (b), 19. (a), 20. (a), 21. (a), 22. (d), 23. (b), 24. (d), 25. (e), 26. (c), 27. (a), 28. (b), 29. (c), 30. (d).

Chapter – 14

Exercise – 1

1. (e), 2. (c), 3. (c), 4. (c), 5. (b), 6. (a), 7. (c), 8. (a), 9. (d), 10. (b), 11. (a), 12. (d), 13. (b), 14. (d), 15. (b), 16. (c), 17. (c), 18. (a), 19. (a), 20. (b), 21. (d), 22. (a), 23. (c), 24. (c), 25. (b), 26. (b), 27. (b).