Simple Interest & Compound Interest

Interest

When a person or firm borrows money (loan) from a bank, banker or any other person, then at the time of returning the amount (borrowed money), the borrowed amount has to paid with some extra amount. This extra amount is known as **interest**.

Some terms related to interest are as follows.

Principal

The borrowed money (loan) is known as **principal**. It is denoted by *P*.

Time

The time period for which the principal (loan) is borrowed is known as **time** and it is denoted by *T* or *t*.

Rate of Interest

The rate at which interest is calculated on borrowed money is known as **rate of interest**. Rate of interest is denoted by *r* or *R*.

Amount

The sum of interest and principal is known as **amount**.

Simple Interest (SI)

When interest is calculated on borrowed money, the obtained interest is known as **simple interest**. Simple interest is denoted by SI.

$$\therefore \text{SI} = \frac{\text{Principal} \times \text{Rate} \times \text{Time}}{100} = \frac{\text{P} \times \text{R} \times \text{T}}{100}$$

and Amount = SI + P

Example 1 The simple interest of ₹6500 for $1\frac{1}{2}$ yr at 10% is

(a) ₹945 (b) ₹975
(c) ₹950 (d) ₹960

Sol. (*b*) We have, $P = ₹6500, R = 10\%$

$$T = 1\frac{1}{2} = \frac{3}{2}\text{ yr}$$

$$\therefore \text{SI} = \frac{P \times R \times T}{100} = \frac{6500 \times 10 \times 3}{100 \times 2} = ₹975$$

Compound Interest (CI)

If the borrower and the lender agree to fix up a certain interval of time (say, a year or a half year or a quarter of 2 yrs, etc.), so that the amount at the end of an interval becomes the principal for the next interval, then the total interest over all

the intervals calculated in this way is called the compound interest.

Also, CI = Amount – Principal

$$\therefore \quad CI = P\left[\left(1+\frac{R}{100}\right)^{n} - 1\right]$$

where, P = Principal

R = Rate of interest

n = Number of year/month

1. For the one year SI and CI both are equal, for the same R, P and T.
2. In compound interest, amount at the end of the 1st year will become the principal for the 2nd year and amount of the end of 2nd year will become the principal of third year, and so on.

Important Formulae

1. When interest is compounded annually. Then

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

2. When interest is compounded half-yearly or semi-annually. Then, interest would be calculated after every six months.

   Therefore, time = $2n$ and rate = $\frac{R}{2}$

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

3. When interest is compounded quarterly.
   Then, interest would be calculated after every three months,
   Therefore, time = $4n$ and rate = $R/4$

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

4. When time is given in fraction of a year *i.e.*, $\frac{11}{3}$ yr, $\frac{7}{3}$ yr etc.

   Let the time be a fraction of a year say $4\frac{2}{3}$ yr and is compounded annually.

   $$\therefore \text{Amount} = P\left(1+\frac{R}{100}\right)^{4}\left(1+\frac{\frac{2}{3}R}{100}\right)$$

5. When rates are different for different years say $R_1\%$, $R_2\%$, $R_3\%$ for first, second and third year, respectively.
   Then, combined can be determined by the formula

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

6. Difference between CI and SI for 2 yr, for the same rate of interest, time and principal is given by

   $$D = \frac{P \times r^2}{(100)^2}.$$

Example 2 The compound interest on ₹24000 compounded annually for 2yr at the rate of 10% per annum, is

(a) ₹ 5040 (b) ₹ 5240 (c) ₹ 5340 (d) ₹ 5440

Sol. (a) Here, P = ₹ 24000, R = 10% per annum

$n = 2$ yr

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

$$= 24000\left(1+\frac{10}{100}\right)^{2}$$

$$= 24000\left(\frac{110}{100}\right)^{2} = 24000 \times \frac{110}{100} \times \frac{110}{100} = ₹29040$$

$\therefore$ Compound interest = Amount – Principal

= ₹ (29040 – 24000) = ₹ 5040

Example 3 The amount on ₹ 24000 compounded semi-annually for $1\frac{1}{2}$ yr at the rate of 10% per annum is.

(a) ₹ 27783 (b) ₹ 37832
(c) ₹ 27813 (d) ₹ 31212

Sol (a) Here P = ₹ 24000

R = 10% per annum

Here, $n = 1\frac{1}{2}\text{ yr} = \frac{3}{2}\text{ yrs}$

Since, interest is compounded half yearly then,

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

$$\therefore \quad A = 24000\left(1+\frac{\frac{10}{2}}{100}\right)^{3}$$

$$= 24000\left(1+\frac{1}{20}\right)^3 = 24000\left(\frac{21}{20}\right)^3$$

$$= 24000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} = ₹\ 27783$$

Example 4 What sum of mondy at compound interest will amount to ₹ 5400 in 2 yrs. if the rate of interest in 4% for the Ist year, and 6% for the 2nd year?

(a) ₹4950.00 (b) ₹4889.40
(c) ₹5000.00 (d) None of these

Sol. (*b*) Here $A = ₹\ 5400, R_1 = 4\%, R_2 = 6\%$

$$\because \quad A = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)$$

$$\therefore \quad 5400 = P\left(1+\frac{4}{100}\right)\left(1+\frac{6}{100}\right)$$

$$\Rightarrow \quad 5400 = P\left(\frac{26}{25}\right)\left(\frac{53}{50}\right)$$

$$\Rightarrow \quad P = \frac{5400 \times 25 \times 50}{26 \times 53} = ₹\ 4898.40$$

Example 5 The difference between the simple interest and the compound interest (compounded annually) on ₹ 1250 for 2 yr at the rate of 8% per annum will be

(a) ₹ 18 (b) ₹ 2 (c) ₹ 8 (d) ₹ 4

Sol. (*c*) $\text{Difference} = \frac{\text{Principal} \times r^2}{100^2}$

$$= \frac{1250 \times 8 \times 8}{100 \times 100} = \frac{1000 \times 8}{10 \times 100} = ₹\ 8$$

Depreciation

The decrease in the value of things (items population etc) is called its **depreciation**. Depreciation per unit time is called the rate of depreciation.

Let the present value of things be P and depreciation at the rate of R% per annum.

1. When the rate of growth = R%. Then

   (a) Value of article after n yr $= P\left(1-\frac{R}{100}\right)^n$

   (b) Value of article n yr ago $= \frac{P}{\left(1-\frac{R}{100}\right)^n}$

2. When rate of depreciation is $R_1\%$ during first year and $R_2\%$ during the next year. Then

   Value after 2 yr $= P\left(1-\frac{R_1}{100}\right)\left(1-\frac{R_2}{100}\right)$

Example 6 The price of product *A* is 5000. Its price decreases by 10% in the first year and 5% in the second year because of some reason. In the end of the second year, the price of product A will be

(a) ₹4225 (b) ₹4275
(c) ₹4375 (d) ₹4315

Sol. (*b*) We have, $P = 5000$, $R_1 = 10\%$ and $R_2 = 5\%$

∴Price at the end of 2nd year

$$= P\left(1-\frac{R_1}{100}\right)\left(1-\frac{R_2}{100}\right)$$

$$= 5000\left(1-\frac{10}{100}\right)\left(1-\frac{5}{100}\right)$$

$$= 5000 \times \frac{90}{100} \times \frac{95}{100}$$

$$= 5 \times 9 \times 95$$

$$= ₹\ 4275$$

Growth

Growth of certain things like the height of tree, population, the weight and height of child etc, increase over a period of time. This increment in the things is known as growth while the growth per unit of time is known as the rate of growth.

Let the present population be P.

New,

1. When rate of growth = R% per annum

   (a) Population after n yr $= P\left(1+\frac{R}{100}\right)^n$

   (b) Population n yr ago $= \frac{P}{\left(1+\frac{R}{100}\right)^n}$

2. When rate of growth is $R_1\%$ during first year and $R_2\%$ during the next year.

   ∴ Population after 2 yr

   $$= P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)$$

Example 7 The population of a city increases at the rates of 15% per annum. If its population was 4000 at the end of the year 2013, then the population at the end of the year 2015 will be

(a) 5290 (b) 6330
(c) 4500 (d) 6100

Sol. (*a*) We have, $R=15\%$, $n=2$ yr and $P=4000$

$\therefore$ Population after 2 yr $= P\left(1+\frac{R}{100}\right)^n$

$= 4000\left(1+\frac{15}{100}\right)^2 = 4000 \times \frac{23}{20} \times \frac{23}{20}$

$= 10 \times 529 = 5290$

Practice Exercise

1. Simple interest of ₹6250 for 4yr at the rate of 5% per annum must be
(a) ₹1250 (b) ₹7500 (c) ₹5000 (d) 3250

2. The simple interest on ₹ 2000 for 6 months at the rate of $4\frac{1}{2}\%$ per annum is
(a) ₹ 55 (b) ₹ 105 (c) ₹ 45 (d) ₹ 35

3. The simple interest on ₹ 1300 at the rate of 5% per annum for 146 days is
(a) ₹ 38 (b) ₹ 26
(c) ₹ 48 (d) ₹ 39

4. A farmer borrowed ₹ 5300 at 8% per annum (on simple interest), at the end of $2\frac{1}{2}$ yr , he cleared his account by paying ₹ 4600 and a watch. The cost of watch is
(a) ₹1760 (b) ₹1860
(c) ₹1960 (d) ₹1660

5. The simple interest at x % for x years will be ₹ x on a sum of
(a) ₹ x (b) ₹ 100x
(c) ₹$\left(\frac{100}{x}\right)$ (d) ₹$\left(\frac{100}{x^2}\right)$

6. In how much time an amount becomes double at the rate 10% per annum?
(a) 5yr (b) 4yr
(c) 10yr (d) 2yr

7. The Compound Interest on ₹12600 for 2 yr at 10% per annum compounded annually?
(a) ₹ 2646 (b) ₹ 3646
(c) ₹ 5646 (d) ₹ 4146

8. In how much time would the SI on a certain sum be 0.5 times of the principal at 8% per annum?
(a) $6\frac{1}{4}$ yr (b) $5\frac{1}{4}$ yr (c) $6\frac{1}{3}$ yr (d) $5\frac{1}{3}$ yr

9. The amount of a certain sum at compound interest for 2 yr at 5% is ₹ 4410. The sum is
(a) ₹ 3800 (b) ₹ 4200 (c) ₹ 3900 (d) ₹ 4000

10. In how many years a sum of ₹ 6400 compounded quarterly at the rate of 5% per annum will amount to ₹ 6561?
(a) 1/3 (b) 1/2 (c) 1/4 (d) 1/12

11. A sum of money amounts to ₹8820 in 2yr and ₹12005 in 4yr at the compound interest. The principal amount is
(a) ₹ 6480 (b) ₹ 6980 (c) ₹ 1125 (d) ₹ 8120

12. If ₹3000 amount to ₹4320 at compound interest in a certain time, then ₹3000 amount to what in half of the time?
(a) ₹3600 (b) ₹4300 (c) ₹4200 (d) ₹3500

13. The compound interest on ₹ 2000 for 2 yr at the rate of 8% per annum, when the interest is compounded annually, is
(a) ₹ 1832.80 (b) ₹ 2132.80
(c) ₹ 332.80 (d) ₹ 2332.80

14. A sum compounded annually becomes $\frac{25}{16}$ times of itself in 2 yr. Then, the rate of interest per annum is
(a) 25% (b) 20% (c) 15% (d) $7\frac{1}{2}\%$

15. I borrowed ₹12000 from Jamshed at 6% per annum SI for 2 yrs. Had I borrowed this sum at 6% per annum CI, what extra amount would I have to pay?
(a) ₹144 (b) ₹1440 (c) ₹72 (d) ₹43.20

16. ₹ 16000 invested at 10% per annum compounded semi-annually amounts to ₹ 18522. Then, the period of investment is
(a) $1\frac{1}{2}$ yr (b) 3 yr
(c) 2 yr (d) $\frac{5}{2}$ yr

17. Nagma invested ₹ 6000 in a company at compound interest compounded semi-annually. She receives ₹ 7986 after 18 months from the company, the rate of interest per annum is
(a) 10% (b) 20%
(c) 30% (d) 15%

18. A sum amount to ₹ 9680 in 2 yr and to ₹ 10648 in 3 yr compounded annually. Then, the sum and rate of interest respectively are
(a) ₹ 8000, 10%
(b) ₹ 8500, 10%
(c) ₹ 8500, 9%
(d) ₹ 8000, 9%

19. The amount on ₹ 24000 compounded semi-annually for $1\frac{1}{2}$ yr at the rate of 10% per annum, are
(a) ₹ 3783 (b) ₹ 3814
(c) ₹ 3788 (d) ₹ 3871

20. The compound interest on ₹ 5000 for 3 yr at 8% for first year, 10% for second year and 12% for third year will be
(a) ₹ 1560.40
(b) ₹ 1500
(c) ₹ 1565.60
(d) ₹ 1652.80

21. The difference between simple and compound interest on a sum of money put for 2 yr at the rate of 10% is ₹ 40. The sum is
(a) ₹ 4000 (b) ₹ 5000
(c) ₹ 6000 (d) ₹ 7000

22. The difference between the compound interest and the simple interest on a certain sum at 12% per annum for 2 yr is ₹ 90. Find the sum is.
(a) ₹ 6250 (b) ₹ 6255 (c) ₹ 6252 (d) ₹ 6358

23. The population of a town is 10000 now and was 8000 two years ago. If it grows at the same rate, what will it be 2 yr hence ?
(a) 12000 (b) 12500 (c) 12750 (d) 12755

24. In a laboratory,the count of bacteria in a certain experiment was increasing at the rate of 2.5% per hour. Find the bacteria at the ends of 2h, if the count was initially 506000.
(a) 531616 (b) 531818 (c) 531717 (d) 531515

25. A scooter was bought at ₹42000. Its value depreciated at the rate of 8% per annum. Its value after one year is
(a) 38640 (b) 41326 (c) 74630 (d) 38119

26. If the value of a machine depreciates by 10% of its value at the beginning of the year and its present value is estimated as ₹ 10935, what was its value 3 yr back?
(a) ₹ 15000 (b) ₹ 7000
(c) ₹ 8050 (d) None of these

27. The population of a city increases each year by 4% of what it had been at the beginning of each year. If the population in 1997 had been 6760000, find the population of the city in
(i) 1999 and (ii) 1995.
(a) 7311616, 6230016 (b) 7321414, 6410013
(c) 7321131, 6123161 (d) 7311632, 6122463

Answers

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

Hints & Solutions

1. (a) We have, P = ₹6250, T = 4 yr and R = 5%

$\therefore SI = \frac{P \times R \times T}{100} = \frac{6250 \times 5 \times 4}{100} = ₹1250$

2. (c) We have, P = ₹2000, $R = 4\frac{1}{2}\% = \frac{9}{2}\%$

and T = 6 months $= \frac{6}{12}$ yr $= \frac{1}{2}$ yr

$\therefore S.I = \frac{P \times R \times T}{100} = \frac{2000 \times 9 \times 1}{2 \times 2 \times 100} = ₹45$

3. (b) P = ₹1300, R = 5% and T = 146 days $= \frac{146}{365}$ yr

$\therefore \ SI = \frac{1300 \times 5 \times 146}{365 \times 100} = ₹\ 26$

4. (a) $SI = \frac{5300 \times 8 \times \frac{5}{2}}{100} = \frac{5300 \times 8 \times 5}{100 \times 2} = ₹1060$

$\therefore$ Amount = 5300 + 1060 = ₹ 6360

$\therefore$ Cost of watch = 6360 − 4600 = ₹1760

5. (c) $\because P = \frac{100 \times SI}{t \times r} = \frac{100 \times x}{x \times x} = ₹\frac{100}{x}$

6. (c) Here, rate (r) = 10% per annum

Suppose principal amount = ₹P

$\because$ Simple interest $= \frac{P \times r \times t}{100}$

$\because$ Amount = P + SI

$2P = P + \frac{P \times 10 \times t}{100}$

$\Rightarrow 2P - P = \frac{P \times 10 \times t}{100}$

$\Rightarrow \qquad t = \frac{P \times 100}{P \times 10}$

$\therefore \qquad t = 10$ yr

7. (a) P = ₹ 12600, n = 2 yr, r = 10%

$\therefore \ CI = P\left[\left(1 + \frac{r}{100}\right)^n - 1\right]$

$= 12600\left[\left(1 + \frac{10}{100}\right)^2 - 1\right] = 12600\left[\frac{121}{100} - 1\right]$

$= 12600 \times \frac{21}{100} = 126 \times 21 = ₹2646$

8. (a) Let principal be P and after t yr SI would be 0.5P.

$\therefore \ SI = \frac{P \times R \times T}{100} \Rightarrow 0.5P = \frac{P \times 8 \times t}{100} \Rightarrow \frac{5}{10} = \frac{8}{100} t$

$\Rightarrow \ t = \frac{5 \times 100}{10 \times 8} = \frac{25}{4} = 6\frac{1}{4}$ yr

9. (d) Let the principal be ₹ x.

$\therefore \qquad 4410 = x\left(1 + \frac{5}{100}\right)^2 \quad \left[\because A = p\left(\frac{1+r}{100}\right)\right]^n$

$\Rightarrow \qquad 4410 = x\left(\frac{21}{20}\right)^2$

$\Rightarrow \qquad x = \frac{4410 \times 400}{441} = ₹\ 4000$

10. (b) Here, P = ₹ 6400

R = 5% per annum

n = ?, A = ₹ 6561

Since, compounded interest in quarterly

$\therefore \qquad A = \left(1 + \frac{R}{4 \times 100}\right)$

$\therefore \ 6561 = 6400\left(1 + \frac{5}{400}\right)^{4n}$

$\Rightarrow \frac{6561}{6400} = \left(\frac{405}{400}\right)^{4n} \Rightarrow \left(\frac{81}{80}\right)^2 = \left(\frac{81}{80}\right)^{4n}$

On comparing, we get 4n = 2

$\therefore \qquad n = \frac{1}{2} = 6$ months

11. (a) Suppose A_1 = ₹8820 and t_1 = 2yr and

A_2 = ₹12005 and t_2 = 2yr

$\therefore \qquad 8820 = P\left(1 + \frac{r}{100}\right)^2 \qquad ...(i)$

and $\qquad 12005 = P\left(1 + \frac{r}{100}\right)^4 \qquad ...(ii)$

On dividing Eq. (ii) from Eq. (i), we get

$\frac{12005}{8820} = \left(1 + \frac{r}{100}\right)^2$

$\Rightarrow \qquad \frac{2401}{1764} = \left(1 + \frac{r}{100}\right)^2 \Rightarrow \left(\frac{49}{42}\right)^2 = \left(1 + \frac{r}{100}\right)^2$

$$\Rightarrow 1+\frac{r}{100}=\frac{49}{42} \Rightarrow \frac{r}{100}=\frac{49}{42}-1$$

$$\Rightarrow \quad \frac{r}{100}=\frac{49-42}{42} \Rightarrow \frac{r}{100}=\frac{7}{42}$$

$$\Rightarrow \quad r=\frac{7\times 100}{42}=16\frac{2}{3}\%$$

On putting value of r in Eq. (i), we get

$$8820=P\left(1+\frac{50}{300}\right)^2 \Rightarrow 8820=P\times\left(\frac{350}{300}\right)^2$$

$$\Rightarrow \quad P=\frac{8820\times 300\times 300}{350\times 350}$$

$$\therefore \quad P=₹6480$$

12. (a) Let rate = R% and time = n yr

Then, $4320=3000\left(1+\frac{R}{100}\right)^n$

$$\Rightarrow \left(1+\frac{R}{100}\right)^{n/2}=\sqrt{1.44}=1.2 \text{ [taking square root]}$$

$$\therefore \text{ Required amount for } \frac{n}{2}\text{ yr } = 3000\left(1+\frac{R}{100}\right)^{n/2}$$

$$= 3000\times 1.2 = ₹3600$$

13. (c) Principal = ₹ 2000, rate = 8% per annum and time = 2 yr

$$\therefore \quad CI = 2000\left[\left(1+\frac{8}{100}\right)^2-1\right]$$

$$= 2000\left[\left(\frac{27}{25}\right)^2-1\right]$$

$$= 2000\left(\frac{729-625}{625}\right)=₹\ 332.80$$

14. (a) Let sum = ₹ x and rate = R % per annum

Then, amount $=\frac{25}{16}x$

$$\therefore \quad \frac{25}{16}x=x\left(1+\frac{R}{100}\right)^2$$

$$\Rightarrow \left(\frac{5}{4}\right)^2=\left(1+\frac{R}{100}\right)^2$$

On comparing, we get

$$\frac{5}{4}=\left(1+\frac{R}{100}\right) \Rightarrow \frac{R}{100}=\frac{1}{4}$$

$$\therefore \quad R = 25\%$$

15. (a) ∴ Required extra amount

$$=12000\left(1+\frac{6}{100}\right)^2-12000-\frac{12000\times 6\times 2}{100}$$

$$=12000\left[\frac{53\times 53}{50\times 50}-1-\frac{6}{50}\right]$$

$$=12000\left[\frac{2809-2500-300}{2500}\right]=\frac{12000\times 9}{2500}$$

$$=₹43.20$$

Alternate Method We know that, the difference between CI and SI for 2 yr, for the some rate of interest, time and principal is

$$D=\frac{P\times r^2}{(100)^2}$$

Here, r = 6%, P = 12000

$$\therefore \text{ Required extra amount} = \frac{P\times r^2}{(100)^2}$$

$$=\frac{P}{\left(1+\frac{R}{100}\right)^n}=12000\times\frac{(6)^2}{(100)^2}=₹43.2$$

$$=\frac{10000}{1+\frac{r}{100}}$$

16. (a) Amount invested, p = ₹ 16000

Amount received at the end of period,

$$A = ₹18522$$

Let time = t years

So, $n = 2t$

Rate = 10% per annum

Since compound interest is semi-annually.

$$\therefore \quad A=P\left(1+\frac{R}{2\times 100}\right)^{2n}$$

$$\therefore \quad 18522=16000\left(1+\frac{10}{2\times 100}\right)$$

$$\Rightarrow \quad \left(\frac{18522}{16000}\right)=\left(\frac{21}{20}\right)^{2n}$$

$$\Rightarrow \quad \left(\frac{21}{20}\right)^3=\left(\frac{21}{20}\right)^{2n}$$

On comparing, we get $n=3 \Rightarrow n=\frac{3}{2}$

$$\Rightarrow \quad n=1\frac{1}{2}\text{ yr}$$

17. (b) Amount invested = ₹ 6000

Let rate be R% per annum

$n = 18\,\text{month} = \frac{3}{2}\,\text{yr}$

Since compound interest is semi-annually.

$$\therefore \quad 7986 = 6000\left(1+\frac{R}{2\times 100}\right)^{2\times\frac{3}{2}}$$

$$\Rightarrow \quad \frac{7986}{6000} = \left(1+\frac{R}{200}\right)^3 \Rightarrow \left(\frac{11}{10}\right)^3 = \left(1+\frac{R}{100}\right)^3$$

On comparing, we get

$$1+\frac{R}{200} = \frac{11}{10} \quad \Rightarrow \quad \frac{R}{200} = \frac{11}{10} - 1$$

$$\therefore \quad R = 20\%$$

18. (a) Let principal be ₹ x.

Rate = R% per annum

Amount A_1 = ₹ 9680

$n_1 = 2\,\text{yr}$

Amount A_2 = ₹ 10648

$n_2 = 3\,\text{yr}$

$$\therefore \quad A_1 = P\left(1+\frac{R}{100}\right)^{n_1}$$

$$\Rightarrow \quad 9680 = x\left(1+\frac{R}{100}\right)^2 \qquad \ldots(i)$$

Also, $A_2 = x\left(1+\frac{R}{100}\right)^3$

$$\Rightarrow \quad 10648 = x\left(1+\frac{R}{100}\right)^3 \qquad \ldots(ii)$$

From Eqs. (i) and (ii), we get

$$9680\left(1+\frac{R}{100}\right)^{-2} = 10648\left(1+\frac{R}{100}\right)^{-3}$$

$$\Rightarrow \quad \left(1+\frac{R}{100}\right) = \frac{10648}{9680}$$

$$\Rightarrow \quad \frac{R}{100} = \frac{10648}{9680} - 1 = \frac{968}{9680}$$

$$\Rightarrow \quad \frac{R}{100} = \frac{1}{10}$$

$$\therefore \quad R = 10\%$$

From Eq. (i), we get $9680 = x\left(1+\frac{10}{100}\right)^2$

$$\Rightarrow \quad 9680 = x\left(\frac{11}{10}\right)^2 \Rightarrow x = 9680\times\frac{10}{11}\times\frac{10}{11}$$

$$\therefore \quad x = ₹\ 8000$$

19. (a) Here, P = ₹ 24000

R = 10% per annum

$n = 1\frac{1}{2}\,\text{yr} = \frac{3}{2}$

Since compound interest is semi-annually.

$$\therefore \quad A = P\left(1+\frac{R}{2\times 100}\right)^{2n}$$

$$A = 24000\left(1+\frac{10}{200}\right)^{2\times\frac{3}{2}} = 24000\left(\frac{21}{20}\right)^3$$

$$= 24000\times\frac{21}{20}\times\frac{21}{20}\times\frac{21}{20} = ₹\ 27783$$

$$\therefore \quad CI = 27783 - 24000 = ₹\ 3783$$

20. (d) $\therefore A = 5000\times\left(1+\frac{8}{100}\right)\left(1+\frac{10}{100}\right)\left(1+\frac{12}{100}\right)$

$$\left[\because A = P\times\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right)\times\left(1+\frac{R_3}{100}\right)\right]$$

$$= 5000\times\frac{27}{25}\times\frac{11}{10}\times\frac{28}{25} = ₹\ 6652.80$$

$\therefore$ CI = A − P = 6652.80 − 5000 = ₹ 1652.80

21. (a) $\text{Principal} = \frac{\text{Difference}\times 100^2}{r^2}$

$$= \frac{40\times 100\times 100}{(10)^2} = ₹\ 4000$$

22. (a) Difference between CI and SI for 2 yr is given by

$$P = \frac{D\times(100)^2}{r^2} = \frac{90\times 100\times 100}{144} = ₹\ 6250$$

Hence, the sum is ₹ 6250.

23. (b) Two years ago, $10000 = 8000\left(1+\frac{r}{100}\right)^2$

$$\Rightarrow \quad \left(1+\frac{r}{100}\right)^2 = \frac{5}{4}$$

Two years hence, $P = 10000\left(1+\frac{r}{100}\right)^2$

$$= 10000\times\frac{5}{4} = 12500$$

24. (a) Here, initial count of bacteria (P) = 506000,
time (n) = 2 h
Rate of increasing bacteria (R) = 2.5% per hour

$$= \frac{25}{10}\% \text{ per hour} = \frac{5}{2}\% \text{ per hour}$$

Bacteria count after 2 h, $(A) = P\left(1 + \frac{R}{100}\right)^n$

$$= 506000\left(1 + \frac{5}{2\times100}\right)^2 = 506000\left(\frac{200+5}{200}\right)^2$$

$$= 506000\left(\frac{205}{200}\right)^2 = 506000\left(\frac{41}{40}\right)^2$$

$$= 506000\times\frac{41}{40}\times\frac{41}{40} = \frac{5060\times41\times41}{4\times4}$$

$$= \frac{1265\times41\times41}{4} = \frac{2126465}{4}$$

$= 531616.25 = 531616$ (approx.)

Hence, the number of bacteria count at the end of 2 h are 531616.

25. (a) Here, principal (P) = ₹ 42000,
Rate of depreciation $(R_1) = 8\%$
and time (n) = 1 yr

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

$$= 42000\left(1 - \frac{8}{100}\right)^1$$

$$= 42000\left(\frac{100-8}{100}\right) = 42000\times\frac{92}{100}$$

$$= 420\times92 = ₹\ 38640$$

Hence, the value of the scooter after one year will be ₹ 38640.

26. (a) Let the value be ₹ x.

$$\therefore \quad x\left(1 - \frac{10}{100}\right)^3 = 10935$$

$$\Rightarrow \quad x\left(\frac{90}{100}\right)^3 = 10935$$

$$\therefore \quad x = \frac{10935\times10\times10\times10}{9\times9\times9}$$

$$= ₹\ 15000$$

27. (a) Population of city in 1997 = 6760000
Rate of growth = 4%
(i) Let population in 1999 = P_1 and $n = 2$ yr, then

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

$$= 6760000\left(1 + \frac{4}{100}\right)^2$$

$$= 6760000\times\left(\frac{104}{100}\right)^2$$

$$= 7311616$$

$\therefore$ Population in 1999 = 7311616

(ii) Let population in 1995 = P_2 and T = 2 yr

$$\therefore \quad P_2 = 6760000\left(1 - \frac{4}{100}\right)^2$$

$$= 6760000\left(\frac{96}{100}\right)^2$$

$$= \frac{6760000\times96\times96}{10000}$$

$$= 6230016$$

$\therefore$ Population in 1995 = 6230016