CHAPTER – 4

SIMPLE INTEREST AND COMPOUND INTEREST

INTEREST

Interest is money paid to the lender by the borrower for using his money for a specified period of time. Various terms and their general representation are as follows:

(a) INTEREST
Money paid by borrower for using the lender's money. Denoted by I.

(b) PRINCIPAL
The original sum borrowed. Denoted by P.

(c) TIME
Time for which money is borrowed. Denoted by n. (n is expressed in number of periods, which is normally one year)

(d) RATE OF INTEREST
Rate at which interest is calculated on the original sum. Denoted by r and is expressed as a percentage or decimal fraction.

(e) AMOUNT
Sum of Principal and Interest. Denoted by A.

SIMPLE INTEREST

When interest is calculated every year (or every time period) on the original principal, i.e., the sum at the beginning of first year, such interest is called Simple Interest.

Here, year after year, even though the interest gets accumulated and is due to the lender, this accumulated interest is not taken into account for the purpose of calculating interest for latter years.

Simple Interest = $\frac{Pnr}{100}$

where P, n, r are as explained above.

Total Amount A = $P + \frac{Pnr}{100}$

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

COMPOUND INTEREST

Under Compound Interest, the interest is added to the principal at the end of each period to arrive at the new principal for the next period.

In other words, the amount at the end of first year (or period) will become the principal for the second year (or period); the amount at the end of second year (or period) becomes the principal for the third year (or period) and so on.

If P denotes the principal at the beginning of Period 1, then, principal at the beginning of Period 2

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

= PR = Amount at the end of Period 1, where

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

P at the beginning of Period 3

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

= PR^2 = Amount at the end of Period 2

P at the beginning of Period (n + 1)

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

= Amount at the end of Period n

Hence the amount after n years (periods)

= $PR^n = A$

Interest = $I = A - P = P[R^n - 1]$

The following table gives an example of how simple interest and compound interest operate, i.e., how the Principal is for various years under simple interest and compound interest. A principal at the beginning of 1st year, of ₹100 and a rate of 10% p.a. are considered. The details are worked out for three years and shown below.

(All figures pertaining to Principal, interest and amount are in Rupees)

	Under **Simple Interest**				Under **Compound Interest**			
Year	Principal at the beginn. of the year	Interest for the year	Interest till the end of the year	Amount at the end of the year	Principal at the beginn. of the year	Interest for the year	Interest till the end of the year	Amount at the end of the year
1	100	10	10	110	100	10	10	110
2	100	10	20	120	110	11	21	121
3	100	10	30	130	121	12.1	33.1	133.1

As can be seen from the table,

In case of Simple Interest,

- The principal remains the same every year
- The interest for any year is the same as that for any other year.

In case of Compound Interest,

- The amount at the end of an year is the Principal for the next year
- The interest for different years is not the same

The compound interest for the first year (where compounding is done every year) is the same as the simple interest for one year.

COMPOUNDING MORE THAN ONCE A YEAR

We just looked at calculating the amount and interest when the compounding is done once a year. But, compounding can also be done more frequently than once a year. For example, the interest can be added to the principal every six months or every four months and so on.

If the interest is added to the principal every six months, we say that compounding is done twice a year. If the interest is added to the principal every four months, we say that compounding is done thrice a year. If the interest is added to the principal every three months, we say that compounding is done four times a year.

The formula that we discussed above for calculating the amount will essentially be the same,

i.e., Amount = $P\left(1+\frac{r}{100}\right)^{n}$

where r = rate % per annum and n = number of years, but the rate will not be for ONE YEAR but for the time period over which compounding is done and the power to which the term inside the bracket is raised (n in the above case) will not be the number of years but the number of years multiplied by the number of times compounding is done per year (this product is referred to as the total number of time periods).

For example, if a sum of ₹10000 is lent at the rate of 10% per annum and the compounding is done for every four months (thrice a year), then the amount will be equal to

$$10000\left(1+\frac{10}{3}\times\frac{1}{100}\right)^{2\times3}$$

Here, the dividing factor of 3 in the rate and the multiplying factor of 3 in the power (multiplying the number of years) - both shown by arrow marks - are nothing but the NUMBER OF TIMES compounding is done in a year.

> If compounding is done k times a year (i.e., once every 12/k months), at the rate of r% p.a. then in n years, the principal of P will amount to
> $= P\left(1+\frac{r}{k\cdot100}\right)^{kn}$

When compounding is done more than once a year, the rate of interest given in the problem is called NOMINAL RATE OF INTEREST.

We can also calculate a rate of interest which will yield simple interest in one year equal to the interest obtained under the compound interest at the given nominal rate of interest. The rate of interest so calculated is called EFFECTIVE RATE OF INTEREST.

> If the number of times compounding is done in a year is increased to infinity, we say that the compounding is done EVERY MOMENT and then the amount is given by $P.e^{nr/100}$, where r is the rate% p.a. and n is the number of years

The following points should also be noted which are helpful in solving problems.

> The difference between the Compound Interest and Simple Interest on a certain sum for two years is equal to the interest calculated for one year on one year's Simple Interest.

In mathematical terms, the difference between Compound Interest and Simple Interest for two years will be equal to $P(r/100)^2$, which can be written as P (r/100) (r/100). In this Pr/100 is the simple interest for one year and when this is multiplied by r/100 again, it gives interest for one year on Pr/100 i.e., interest for one year on one year's simple interest.

> The difference between the Compound Interest for k years and the Compound Interest for (k + 1) years is the interest for one year on the amount at the end of k^{th} year.
> This can also be expressed in terms of the amount as follows:
> The difference between the amount for k years and the amount for (k + 1) years under compound interest is the interest for one year on the amount at the end of the k^{th} year.

> The difference between the Compound Interest for the k^{th} year and the Compound Interest for the $(k + 1)^{th}$ year is equal to the interest for one year on the compound interest for the k^{th} year.

PRESENT VALUE

Consider a given sum P and a rate of interest r.

We have seen that interest is cost of using the money over a period of time. That means a sum at the beginning of a period is always higher than the same amount after a period greater than or equal to 1.

Let the sum P that is being considered at a rate of interest r% p.a., becomes Y at the end of Year 1 and Z at the end of Year 2 (i.e., Y and Z are the amounts at the end of first and second years respectively on a principal of P).

Then we can say that what is P today is equal to Y at the end of one year and equal to Z at the end of the second year. In other words, if an amount of Y were to come at the end of one year from now, its value today is equal to P. Similarly, if an amount of Z were to come at the end of two years from now, its value today is equal to P.

So, P is the PRESENT VALUE of Y coming at the end of one year and P is the PRESENT VALUE of Z coming at the end of two years.

Similarly, if we consider n years (or n periods in general), and X is the amount that P will become in n periods, then we say that P is the PRESENT VALUE of X coming at the end of n periods.

If we consider a series of payments Y_1 at the end of first year, Y_2 at the end of second year and so on, the present value of the series of payments will then be equal to the sum of the present values of each of the payments calculated separately. If Z_1 is the present value of Y_1, Z_2 is the present value of Y_2 and so on, then the present value of the series of payments Y_1, Y_2, ... is equal to $Z_1 + Z_2 + ...$

Present Value can be looked at both under Simple Interest and Compound Interest.

If an amount of Y whose present value is P_1 comes at the end of Year 1, and an amount of Z whose present value is P_2 comes at the end of Year 2, then the present value of both the amounts together will be equal to $(P_1 + P_2)$, i.e., the present value of the stream of payments that come at different points of time is equal to the sum of the present values of the individual amounts coming in at various points of time.

Present Value Under Simple Interest

The principal P is amounting to X in n periods. From this we know that

$$X = P\left(1+\frac{nr}{100}\right) \Rightarrow P = \frac{X}{\left(1+\frac{nr}{100}\right)}$$

Hence, in general, the present value P of an amount X coming (or due) after n periods is given by

$$P = \frac{X}{\left(1+\frac{nr}{100}\right)}$$

where r is the rate percent per time period.

Present Value Under Compound Interest

The principal P is amounting to X in n periods. From this we know that

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

Hence, in general, the present value P of an amount X coming (or due) after n periods is given by

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

where r is the rate percent per time period.

REPAYMENT IN EQUAL INSTALMENTS – COMPOUND INTEREST

If a sum P borrowed, is repaid in n equal instalments compound interest being calculated at r% per period of instalment, we can find out the value of each instalment. Let us consider the case of n equal ANNUAL instalments (Even if the instalments are not annual, but monthly, the approach will remain the same except that the rate of interest taken should then be the rate per month and not rate per annum).

Let each instalment (i.e., the amount paid at the end of each year) be X.

Instalment X paid after year 1 gives a present value of $\frac{X}{\left(1+{}^{r}/_{100}\right)}$.

Instalment X, paid at the end of year 2 gives a present value of $\frac{X}{\left(1+{}^{r}/_{100}\right)^2}$

Similarly, instalment X paid for nth period (at the end of year n) gives a present value of $\frac{X}{\left(1+{}^{r}/_{100}\right)^n}$.

The sum of all these present values would be equal to the loan amount P (because only if the amount borrowed is equal to the amount repaid can we say that the loan is repaid).

$$\frac{X}{\left(1+{}^{r}/_{100}\right)} + \frac{X}{\left(1+{}^{r}/_{100}\right)^2} + \ldots\ldots + \frac{X}{\left(1+{}^{r}/_{100}\right)^n} = P$$

Call $\frac{1}{\left(1+{}^{r}/_{100}\right)} = k \quad \Rightarrow k = \frac{100}{100+r}$

The above equation can then be rewritten as
$X\{k + k^2 + ... + k^n\} = P$

The terms within the brackets form a G.P with first term k and common ratio k.

The sum of this G.P. = $\frac{k(k^n - 1)}{(k - 1)}$;

Thus $\frac{X \bullet k(k^n - 1)}{(k - 1)} = P \Rightarrow X = \frac{P(k-1)}{k(k^n - 1)}$

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

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

$$\text{Each Instalment} = \frac{P \bullet r}{100\left[1 - \left\{{}^{100}/_{(100+r)}\right\}^n\right]}$$

Examples

4.01. Find the simple interest on a sum of ₹1000 at 10% p.a. for 4 years.

Sol: Simple interest = $\frac{PNR}{100}$

Interest = $\frac{(1000)(4)(10)}{100}$ = ₹ 400

4.02. A sum of ₹4000 becomes ₹4500 in 2 years under simple interest. In how many years will ₹5000 become ₹5625 under simple interest at the same rate of interest?

Sol: Let the rate of interest be R% p.a.
Interest on ₹4000 = ₹500

$500 = (4000)\left(\frac{R}{100}\right)(2)$

R = 6·25
Interest on ₹5000 = ₹625
Let the required time be T years.

$625 = (5000)\left(\frac{6\cdot 25}{100}\right) T \Rightarrow T = 2$

4.03. Find the value that ₹1000 would amount to under compound interest at 20% p.a., interest being compounded annually in 3 years.

Sol: Amount = $P\left(1+\frac{R}{100}\right)^N$

$= 1000\left(1+\frac{20}{100}\right)^3$ = ₹1728

4.04. Find the sum that would amount to ₹6600 under simple interest in 4 years at 8% p.a.

Sol: Let the sum be ₹P.

Given that $P\left(1+4\left(\frac{8}{100}\right)\right) = 6600$

P = 5000

4.05. If a sum triples in 4 years under simple interest, find the time that it would take to become 5 times itself at the same rate of interest.

Sol: If the sum triples, the interest obtained will be twice the sum. This takes 4 years. If the sum becomes 5 times, the interest must be four times the sum.
∴ This takes a total of 8 years.

4.06. A sum triples in 4 years under compound interest at a certain rate of interest, interest being compounded annually. Find the time it would take to become 9 times itself.

Sol: The sum triples in 4 years. If it becomes 9 times itself, it has tripled twice.
∴ This takes 8 years.
Let the sum of ₹P, triple in 4 years at R% p.a.

$\Rightarrow P\left(1+\frac{R}{100}\right)^4 = 3P$

$\Rightarrow \left(1+\frac{R}{100}\right)^4 = 3$ ——— (1)

Let it take K years to become 9 times.

$P\left(1+\frac{R}{100}\right)^K = 9P \Rightarrow \left(1+\frac{R}{100}\right)^K = 9$

$\Rightarrow \left[\left(1+\frac{R}{100}\right)^4\right]^{\frac{K}{4}} = 3^2$

from (1),

$3^{\frac{K}{4}} = 3^2 \Rightarrow \frac{K}{4} = 2$

∴ K = 8

4.07. If ₹4000 is lent at 10%p.a, interest being compounded annually, find the interest for the fourth year.

Sol: Interest for the fourth year = Amount at the end of the first 4 years – Amount at the end of the first 3 years

$= 4000\left(1+\frac{10}{100}\right)^4 - 4000\left(1+\frac{10}{100}\right)^3$

= 4000 (1.4641 – 1.3310)
= 4000 (0.1331) i.e. ₹ 532.40

4.08. Find the value that ₹8000 will amount to in 2 years at 20% p.a., interest being compounded half yearly.

Sol: Rate of interest = 10% per half year
Number of time periods (i.e. half years) = 4

Amount = $8000\left(1+\frac{10}{100}\right)^4$ = 8000 (1.4641) i.e. ₹11712.80

4.09. The interest on a sum is compounded every 3 months. If the rate of interest is 40% p.a., find the effective rate of interest per annum.

Sol: Let the sum be ₹100
Amount at the end of a year

$= 100\left(1+\frac{40}{4(100)}\right)^4$ = ₹146·41

∴ effective rate of interest = 46·41%

4.10. A sum amounts to ₹28800 in two years and to ₹34560 in three years under compound interest, interest being compounded annually. Find the sum and the rate of interest.

Sol: Let the sum be ₹P and the rate of interest be R% p.a.

$P\left(1+\frac{R}{100}\right)^2 = 28800$ ——— (1)

$P\left(1+\frac{R}{100}\right)^3 = 34560$ ——— (2)

Dividing (2) by (1),

$1+\frac{R}{100} = 1\cdot 2 \Rightarrow R = 20$

Substituting R = 20 in (1) or (2),
P = 20000

4.11. The compound interest and the simple interest on a sum at certain rate of interest for 2 years are ₹2760 and ₹2400 respectively. Find the sum and the rate of interest.

Sol: Let the sum be ₹P and let the rate of interest be R% p.a.
Difference between the compound interest and the simple interest = ₹360

$\therefore P\left(\frac{R}{100}\right)^2 = 360$ ———— (1)

$P(2)\left(\frac{R}{100}\right) = 2400 \Rightarrow \frac{PR}{100} = 1200$ ——— (2)

$\therefore \frac{PR}{100}\left(\frac{R}{100}\right) = 1200\left(\frac{R}{100}\right) = 360$

R = 30
Substituting R in (1) or (2),
P = 4000

4.12. The compound interest on a certain sum for the 2nd year and the 3rd year are ₹3300 and ₹3630 respectively. Find the sum and the rate of interest.

Sol: Let the sum be ₹P
Let the rate of interest be R% p.a.
Interest for the 2nd year

$= P\left(1+\frac{R}{100}\right)^2 - P\left(1+\frac{R}{100}\right) = 3300$

$P\left(\frac{R}{100}\right)\left(1+\frac{R}{100}\right) = 3300$ ———— (1)

Interest for the 3rd year

$= P\left(1+\frac{R}{100}\right)^3 - P\left(1+\frac{R}{100}\right)^2 = 3630$

$P\left(\frac{R}{100}\right)\left(1+\frac{R}{100}\right)^2 = 3630$ ———— (2)

Dividing (2) by (1),

$1+\frac{R}{100} = 1{\cdot}1 \Rightarrow R = 10$

Substituting R in (1) or (2),
P = 30000.

4.13. Sanjay borrowed ₹15000 at 20% p.a. under compound interest, interest being compound annually. He repaid ₹12000 at the end of the first year. Find the amount he must repay at the end of the second year to clear the loan.

Sol: Value of ₹15000 at the end of the first year = ₹18000
As Sanjay repaid ₹12000, he has to repay the value of the balance of ₹6000 at the end of the second year. He has to repay 6000×1.2
i.e., ₹7200.

4.14. Praveen borrowed ₹26400 at 20% p.a. under compound interest, interest being compounded annually. If he has to repay this in two equal annual instalments, find the value of each instalment.

Sol: Let each instalment be ₹x
Value of ₹26400 at the end of the first year = 26400×1.2 i.e. ₹31680
As Praveen repaid ₹x at the end of the first year, he has to repay the value of the balance of ₹(31680 – x) at the end of the second year.
$\Rightarrow 1{\cdot}2\ (31680 - x) = x$
$\therefore x = 17280$

4.15. Find the sum of the present values of the payments received at 10% p.a. under compound interest, interest being compounded annually, if ₹7700 and ₹7260 are received at the end of the first year and second year respectively.

Sol: Sum of the present values of the payments received

$= \frac{7700}{1+\frac{10}{100}} + \frac{7260}{\left(1+\frac{10}{100}\right)^2} =$ ₹13000

Concept Review Questions

Directions for questions 1 to 25: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. ₹5000 is invested for two years under simple interest at 10% p.a. Find the interest earned (in ₹)
(A) 1000 (B) 2000
(C) 500 (D) 1050

2. The simple interest for the second year on a certain sum at a certain rate of interest is ₹1000. Find the sum of the interests accrued on it for the 6^{th}, 7^{th} and 8^{th} years. (in ₹)

3. What sum will yield an interest of ₹306 in six years at 5% p.a. simple interest?
(A) ₹840 (B) ₹765
(C) ₹1,210 (D) ₹1,020

4. What sum will fetch a simple interest of ₹25,410 in five and a half years at 6% p.a. rate of interest?
(A) ₹55,000
(B) ₹88,000
(C) ₹77,000
(D) ₹70,000

5. In how many months will a sum of ₹15,000 at 5% p.a. rate of simple interest yield an interest of ₹4,000?

6. A sum yields ₹54 more interest when lent at 37% p.a. simple interest than when lent at 33% p.a. simple interest in six years. Find the sum.
(A) ₹225 (B) ₹250
(C) ₹450 (D) ₹255

7. If ₹3000 amounts to ₹3600 in two years under simple interest. What is the rate of interest?
(A) 20% p.a (B) 10% p.a
(C) 5% p.a (D) None of these

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

9. In how many years will a sum of money become sixteen times itself at 30% p.a. simple interest?
(A) 25 (B) 40 (C) 30 (D) 50

10. A sum becomes 84% more in seven years when invested at simple interest. Find the annual rate of interest.
(A) 28% (B) 24%
(C) 12% (D) 18%

11. A sum of money becomes ten times itself at simple interest. If the time period (in years) is numerically equal to the rate of interest, find the annual rate of interest.
(A) 25% (B) 20%
(C) 30% (D) 90%

12. Bhavan invested two equal amounts at simple interest. He invested one amount at 15% p.a. and the other at 20% p.a. The total interest earned at the end of a year was ₹1400. Find the total amount invested (in ₹).

13. An amount of ₹2400 is due after six years under simple interest at 10% p.a. Find its present value (in ₹)
(A) 2000 (B) 1600
(C) 1800 (D) 1500

14. If ₹3000 amounts to ₹3630 in two years under compound interest, interest being compounded annually, what is the annual rate of interest?
(A) 10% (B) 21%
(C) 11% (D) 10.5%

15. ₹5000 is invested for two years under compound interest at 10% p.a, interest being compounded annually. Find the interest earned (in ₹).

16. A sum under compound interest, interest being compounded annually amounts to ₹6000 in two years and ₹7200 in three years. Find the rate of interest.
(A) 10% p.a. (B) 20% p.a.
(C) 18% p.a (D) 15% p.a

17. The compound interest on a sum for the third year is ₹2420, interest being compounded annually. The interest on it for the fourth year is ₹2662. Find the rate of interest.
% p.a

18. A sum of money becomes four times itself in eight years at compound interest. In how many years will the same sum become sixteen times itself?
(A) 64 (B) 32
(C) 44 (D) 16

19. A sum becomes 2.197 times of itself in three years at compound interest. Find the annual rate of interest.
%.

20. A sum becomes 33.1% more in three years when invested under compound interest, interest being compounded annually. Find the annual rate of interest.
(A) 10.5% (B) 11.03%
(C) 10% (D) 16.55%

21. Find the interest (in ₹) earned in the first year on ₹200 at 20% p.a. compound interest, interest compounded every six months.

22. Which of the following schemes of computing interest yields the maximum interest for a year?
(A) Interest compounded monthly at 2% per month.
(B) Interest compounded per quarter 6% per quarter.
(C) Interest compounded every six months at 12% for every 6 months.
(D) Interest compounded every year at 24% p.a.

23. If the interest on a sum is compounded quarterly, which of the following is necessarily true regarding the effective rate of interest per annum?
(A) It is the same for each year.
(B) It quadruples every year.
(C) Neither (A) nor (B)
(D) Both (A) and (B)

24. Find the effective rate of interest if the rate of interest is 40% p.a., and the interest is compounded quarterly.
(A) 42% p.a (B) 40% p.a.
(C) 44% p.a (D) 46.41% p.a.

25. The interests earned on a sum under a certain rate of compound interest, interest being compounded annually, for the xth year and the (x + 1)th year differ by ₹I_1. The difference in the interests earned on it for the yth year and the (y + 1)th year differ by ₹I_2. If $I_1 > I_2$, which of the following can be concluded?
(A) x > y
(B) x < y
(C) Neither (A) nor (B)

Exercise – 4(a)

Directions for questions 1 to 25: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. What is the principal, if after five years at 11% p.a. simple interest, it amounts to ₹18600? (in ₹)

2. Given that a principal amounts to ₹10080 at 10% p.a simple interest after two years what is the compound interest for two years on this principal at the same rate?
(A) ₹10164 (B) ₹1764
(C) ₹1640 (D) ₹3764

3. Prashanth borrows a sum at compound interest and it amounts to ₹1,38,240 at the end of three years and to ₹1,99,065.60 at the end of five years. What is the sum borrowed?
(A) ₹76,000 (B) ₹80,000
(C) ₹90,000 (D) ₹96,000

4. ₹10000 was lent at compound interest, interest being compounded annually for 3 years. The annual rates of interest for the first, second and third years were 10%, 20% and 30% respectively. If it was instead, lent at 20% p.a. simple interest for the same time, how much more / less interest would be realized?
(A) ₹ 530 more (B) ₹530 less
(C) ₹1160 more (D) ₹1160 less

5. The compound interest on a certain sum for the third and the fourth years is ₹1815 and ₹1996.50 respectively. What is the annual rate of interest?
(A) 5% (B) 8% (C) 10% (D) 12%

6. Prakash invested a certain amount in a six-year fixed deposit scheme, interest being compounded annually. The interests accrued on this deposit for the fourth and fifth years, respectively, are ₹1331 are ₹1464.10. If George deposited ₹12000 in the same scheme, how much interest would be accrued on this deposit for the first two years?
(A) ₹1320 (B) ₹1452 (C) ₹2520 (D) ₹1440

7. Mr. Patel borrows ₹10000 at 20% p.a. for five years at simple interest. But, from the fourth year onwards, on the entire amount due at the end of three years, the lender begins to charge 20% p.a interest compounded annually. What is the amount repaid by Mr. Patel after five years from the beginning?
(A) ₹15342 (B) ₹18432
(C) ₹17324 (D) ₹23040

8. Krishna takes a loan of ₹8000 at simple interest. After four years he takes an additional loan of ₹14440. From that point, compound interest at 10% per annum is calculated on the total amount repayable on the first loan as well as the second loan. He repays a total of ₹30250 after two more years to clear the entire loan amount. What is the annual rate of simple interest?

%

9. Prasad invests ₹34000, part of it in scheme A at 20% p.a. and the rest of it in scheme B at 60% p.a., both at compound interest. If, after two years, the amount in scheme A is nine times that in scheme B, how much was invested in scheme B? (in ₹)

10. A sum was lent for a year, another sum was lent for 2 years and another sum was lent for 3 years. Each sum was lent at 5% p.a compound interest. If each sum amounted to the same value, the ratio of the first, second and third sums is _____.
(A) 400 : 420 : 441 (B) 20 : 21 : 22
(C) 22 : 21 : 20 (D) 441 : 420 : 400

11. Suhaas borrowed a certain amount at 28% p.a. compound interest and repays it in one year. Bhanu borrows a certain amount at a certain interest rate under simple interest and returns it after four years. If the amounts repaid by Suhaas and Bhanu are the same and that is equal to ₹38400 and the sum of their principals borrowed is ₹54000, at what rate Bhanu paid the interest?
(A) 10 % p.a (B) 12% p.a
(C) 15% p.a (D) 18% p.a

12. Puneet borrows ₹32000 from Jalpesh at 10% simple interest. He lends it to Govinda at 20% compound interest. How much more would Puneet have gained, if Govinda had returned the amount in three years instead of two years?
(A) ₹5016 (B) ₹7016 (C) ₹6016 (D) ₹4016

13. The difference between the amounts to be repaid by a man at the end of two years, at 20% per annum compounded annually and half yearly, is ₹1084.50. What is the principal? (in ₹)

14. Venkat lends a sum P at r% compound interest, compounded every moment for ten years. It becomes "a" times P after ten years. What is the annual interest rate? (Assume that $a = e^2$)
(A) 100% (B) 20% (C) 40% (D) 200%

15. ₹2.4 crores invested at a certain rate of compound interest becomes ₹19.2 crores in 18 years. The value that ₹4 crores invested at the same rate of compound interest would amount to in 24 years is (in ₹ crores) .

16. The compound interest and the simple interest on a certain sum for two years are ₹1230 and ₹1200 respectively. The rate of interest is same for both compound interest and simple interest. What is the principal?
(A) ₹10000 (B) ₹12000
(C) ₹12500 (D) ₹16000

17. The difference between the compound and simple interests on a sum for three years at 20% p.a. is ₹3200. Find the sum.
(A) ₹5000 (B) ₹10000 (C) ₹15000 (D) ₹25000

18. Sourabh borrows ₹2500000 at 12% compound interest from a bank and invests in shares. The investment gives him a return of 20% per annum and he repays ₹500000 at the end of first year. How much does he make for himself after paying all the outstanding amount at the end of the second year?
(A) ₹424000 (B) ₹356241.50
(C) ₹525000 (D) ₹484241.80

19. Karthik borrows ₹24000 from a bank at 12% p.a simple interest. He repays 20% of the principal at the end of every year. What is the simple interest that has accrued for the first four years? (in ₹)

20. What annual instalment will discharge a debt of ₹1450 due after five years at 8% p.a simple interest?
(A) ₹320 (B) ₹450
(C) ₹250 (D) ₹400

21. What is the present worth of ₹20000 due after three years at 10% p.a. compound interest? (Given (1/1.1) = 0.90)
(A) ₹13970 (B) ₹14120
(C) ₹14580 (D) ₹15730

22. A man took a loan of ₹100000 at 8% per annum compound interest. He repays ₹10000 per annum. What is the amount due from him at the beginning of the third year?
(A) ₹91917 (B) ₹81917
(C) ₹93970 (D) ₹95840

23. The difference between the compound interests on a certain sum for the second and the third years at 5% p.a. is ₹42. Find the sum (in ₹).

24. Srikanth buys a car worth ₹525000. He pays ₹125000 as down payment and agrees to pay the remaining amount in instalments. What is the approximate yearly instalment amount to be paid by him, if at 12% p.a. compounded annually, he repays the remaining amount in three more years? Given that $(1/1.12)^3 = 0.71$
(A) ₹160000 (B) ₹165000
(C) ₹180000 (D) ₹183000

25. A sum was borrowed at 20% p.a. compound interest. It was repaid in three annual instalments with each instalment being paid at the end of an year. The first, second and third instalments were ₹1200, ₹1152 and ₹2592 respectively. Find the sum borrowed. (in ₹)

Exercise – 4(b)

Directions for questions 1 to 40: For the Multiple Choice Questions, select the correct alternative from the given choices. For the Non-Multiple Choice Questions, write your answer in the box provided.

1. A sum of money invested at simple interest amounts to ₹2832 at the end of three years and ₹3120 at the end of five years. Find the principal.
(A) ₹2400 (B) ₹2000
(C) ₹3500 (D) ₹2500

2. If the annual rate of simple interest at which a sum is lent for two years increases by 10 percentage points, the interest realized would be ₹4000 more. Find the sum (in ₹).

3. If a sum was ₹10000 more it would fetch ₹4000 extra as simple interest, if it was lent at a certain rate of interest for two years. Find the annual rate of interest.
(A) 5% (B) 10%
(C) 20% (D) 25%

4. If a sum invested at simple interest doubles itself in ten years, how long will it take to become five times itself?
(A) 20 (B) 40
(C) 25 (D) 30

5. A sum was invested at simple interest. At the end of four years, the total interest was equal to the sum. At the end of five years the total interest was ₹12500. Find the interest on the sum at the end of three years (in ₹).
(A) 6000 (B) 7500 (C) 9000 (D) 4500

6. Rohan lent a total of ₹1,00,000 to two people. He lent a certain amount to P at 10% p.a. simple interest and lent the remaining amount to Q at 20% p.a. simple interest. He lent each amount for two years and received ₹32000 as the total interest. Find the sum he lent to P (in ₹).

7. In question 6 find the effective annual rate of simple interest at which he lent the total sum.
(A) 12% (B) 14% (C) 16% (D) 18%

8. Rajesh, a money lender, lends in the following manner. For the first year, he charges 2% p.a., for the second year, he charges 4% p.a for the third year, he charges 6% p.a. and so on. If he lends a sum in this way at simple interest, find the least integral number of years in which it will fetch an interest at least equal to itself.
(A) 9 (B) 10 (C) 11 (D) 12

9. A sum was split into four parts (P_1, P_2, P_3, P_4) where $P_1 : P_2 : P_3 : P_4 = 1 : 4 : 5 : 2$. Each part was lent at simple interest. P_1 was lent at 10% p.a. for a year. P_2 was lent at 20% p.a. for 5 years. P_3 was lent at 2% p.a. for 4 years. P_4 was lent at 6% p.a. for 10 years. The greatest of the interests on the parts exceeds the least of the interests on the parts by ₹7800. Find the total interest fetched by the parts (in ₹).

10. Ajay borrowed ₹20,000 from Balu at 10% p.a. simple interest and twice that amount from Chetan at 20% p.a. simple interest. He then added an amount of his own and lent the entire sum at 18% p.a. simple interest. All the deals were for a year. At the end of the year, he earned ₹4400. Find the amount that he added.
(A) 15000 (B) 26000 (C) 24000 (D) 20000

11. Find the present value of ₹17280 due 3 years from now at 20% p.a. simple interest (in ₹).

12. A sum amounts to ₹266,200 in three years and ₹292,820 in four years under compound interest, interest being compounded annually. Find the annual rate of interest.
(A) 8% (B) 10% (C) 12% (D) 15%

13. A sum was invested under compound interest, interest being compounded annually. It fetches ₹14400 as interest in the second year and ₹17280 as interest in the third year. Find the annual rate of interest.
(A) 10% (B) 15% (C) 20% (D) 25%

14. The interest on a sum under compound interest when interest is compounded annually for the sixth year and the seventh year are ₹1,256 and ₹1,413 respectively. Find the rate of interest.
(A) 10% p.a (B) 15% p.a
(C) $7^1/_2$% p.a (D) $12^1/_2$% p.a

15. A loan has to be repaid after three years under compound interest, interest being compounded annually at 30% p.a. Find the amount borrowed if the amount to be repaid is ₹87880 (in ₹).

16. In how many years will a sum of ₹1875 amount to ₹2187 at 8% p.a. compound interest?
(A) 1 (B) 2 (C) 3 (D) 4

17. If a sum of ₹12000 is lent at 5% p.a compound interest, what is the interest for the third year?
(A) ₹441 (B) ₹661.50
(C) ₹531.20 (D) ₹742.75

18. A sum was lent at 20% p.a. compound interest, interest being compounded annually. The interest for the first year was ₹4000. Find the total interest for the second and third years (in ₹).

19. A sum when lent at a certain rate compounded annually amounts to ₹1200 in two years and when lent at twice the previous rate amounts to ₹1323 in the same time. What is the rate at which it was initially lent?
(A) 4% p.a (B) $4\frac{3}{7}$% p.a
(C) $5\frac{5}{19}$% p.a (D) $6\frac{1}{4\%}$ p.a

20. Akshay deposits a sum P in a bank at r% compound interest. The amount becomes 27P after three years by compounding annually. Instead, if the bank had compounded half yearly, what is the additional amount Akshay would have received in terms of P?
(A) 54P (B) 37P
(C) 18P (D) 5P

21. The excess interest (in ₹) realised when ₹10000 is lent at compound interest at 20% p.a for 3 years than when it is lent at 10% p.a, 20%p.a, 30%p.a for the first, second and third years respectively, is

22. If a sum is lent at 20% p.a. compound interest, interest being compounded annually, for a year it would fetch an interest which is ₹400 less than it would fetch if it is lent at the same rate of interest, interest being compounded half yearly. Find the sum (in ₹).
(A) 48000 (B) 40000
(C) 36000 (D) 50000

23. A man invested ₹40,000 in a bond which gives 10% p.a. interest, compounded half yearly. If the annual rate of interest is increased by 20 percentage points at the end of every half year, what will be the interest for the first one and half years?
(A) ₹15875 (B) ₹16750
(C) ₹20375 (D) ₹19875

24. A sum becomes ₹60,000 in five years at 20% p.a. compound interest, interest being compounded continuously. Find the sum to the nearest thousand (e = 2.718). (in ₹)

25. Sunil takes a loan from a financier at 100% p.a. interest. When he was repaying it after three years, he had to pay ₹952000 more because the loan was compounded every moment, instead of annually. What was the loan taken? [Take e = 2.71 and $(2.71)^3 = 19.9$]
(A) ₹70000 (B) ₹75000
(C) ₹80000 (D) ₹85000

26. Srikar saves ₹20000 at the beginning of each year in a savings bank account that pays 5% p.a, interest being compounded annually. If, at the beginning of the third year, instead of depositing ₹20000, he withdraws ₹10000, how much would be the total savings of the man at the end of three years?
(A) ₹28124.24 (B) ₹29324.20
(C) ₹31349.75 (D) ₹34702.50

27. Anwar borrowed ₹72000 at 20% p.a. compound interest, interest being compounded annually. He repaid ₹x at the end of the first year. He repaid ₹57600 at the end of the second year and thereby cleared the loan. Find x.

28. Aswin borrowed ₹3,20,320 at 20% p.a. compound interest, interest being compounded annually. He planned to repay it in two equal annual instalments. But he actually repaid it in three equal annual instalments. Find the difference between the value of each instalment he had planned to pay and each instalment that he actually paid (in ₹).
(A) 48000 (B) 54000
(C) 29952 (D) 57600

29. Ashok borrowed a total of ₹84000 from two banks at compound interest, interest being compounded annually. One of the banks charged interest at 10% p.a. while the other charged interest at 20% p.a. If Ashok paid ₹13200 as the total interest after a year, find the difference of the sums he borrowed (in ₹).

30. A sum takes T_1 years to double at R_1% p.a. simple interest. If it is lent at R_2% p.a. compound interest, interest being compounded annually, it would take the same time to double. Which of the following is always true if $T_1 > 1$?
(A) $R_1 > R_2$ (B) $0.5R_2 < R_1 < R_2$
(C) $R_1 = R_2$ (D) $R_2/3 < R_1 < R_2$

31. Anil gave a certain sum to Bala. Bala lent 75% of the sum he received at 10% p.a. compound interest for 3 years. He received ₹3993 at the end of 3 years. Find the sum that Anil gave Bala (in ₹).

32. The difference between the interest under compound interest, interest being compounded annually and simple interest, for two years, for the same sum and at the same rate of interest is ₹112.5. Find the sum if the rate of interest is 15%p.a.
(A) ₹3500 (B) ₹5000
(C) ₹7500 (D) ₹10000

33. The difference between the simple interest and the compound interest, interest being compounded annually, on a sum of ₹8000 for two years is ₹320. Find the annual rate of interest, if it is the same for both types of interest.
%

34. A sum takes two years to become 40% more under simple interest at a certain rate of interest. If it was lent at the same interest rate for the same time under compound interest, interest being compounded annually, it would amount to x% more than itself. Find x.
(A) 36 (B) 48 (C) 40 (D) 44

35. A certain sum becomes twice itself in exactly five years at r% p.a. simple interest. In which year does the sum amount to twice itself, under r% p.a compound interest?

36. A sum of money when kept at simple interest doubled in eight years four months. If the rate of interest is doubled, in which year the same sum becomes twice of itself under compound interest?
(A) 4th year (B) 5th year
(C) 3rd year (D) 6th year

37. A sum was divided into two equal parts. One part was lent at 20% p.a. simple interest. The other part was lent at 20% p.a. compound interest, interest being compounded annually. The difference in the interests fetched by the parts in the second year is ₹400. Find the difference in the interests fetched by the parts in the fourth year (in ₹).
(A) 1414 (B) 1442
(C) 1456 (D) 1484

38. A sum of ₹4000 was split into two parts in the ratio 1 : 3. The smaller part was lent at 10% p.a. simple interest for two years. The greater part was lent at 30% p.a. simple interest for two years. If the total sum of ₹4000 was instead lent at 20% p.a. simple interest for two years, how much more / less interest would be realized? (in ₹)?
(A) 1200 less (B) 1200 more
(C) 400 less (D) 400 more

39. In the above question, if all the interests considered had been compound interest, interest being compounded annually, how much more/less interest would be realized? (in ₹)
(A) 1632 more (B) 1632 less
(C) 2014.40 more (D) None of these

40. The value of a machine depreciates at the rate of 10% p.a. every year. What was the value of the machine two years ago, if its present value is ₹24,300? (in ₹)

Directions for questions 41 to 45: Each question is followed by two statements I and II. Indicate your responses based on the following directives:

Mark (A) if the question can be answered using one of the statements alone, but cannot be answered using the other statement alone.
Mark (B) if the question can be answered using either statement alone.
Mark (C) if the question can be answered using I and II together but not using I or II alone
Mark (D) if the question cannot be answered even using I and II together.

41. What is the rate of interest per annum?
I. The interest is ₹500 for two years.
II. At twice the rate of interest, the interest for four years is ₹2000.

42. What is the rate of simple interest on the deposit?
I. The interest earned on the deposit for 8 years is ₹3600.
II. The amount at the end of 8 years is double the principal.

43. A man invests a total of ₹x on the names of his three sons A, B and C in such a way that they get the same amount after 2, 3 and 4 years respectively. What is the ratio of amounts invested on A, B and C?
I. x = 15,860.
II. The man invested at the rate of 5%.p.a. simple interest.

44. What is the rate of compound interest per annum?
I. ₹100 becomes ₹125 in three years compounded annually.
II. ₹x becomes ₹1.5x in 3 years compounded annually.

45. What is the total compound interest accrued on a sum of money after five years?
I. Rate of interest is 6% per annum.
II. The total simple interest on the same amount after 5 years at the same rate will be ₹600.

Key

Concept Review Questions

1. A	6. A	11. C	16. B	21. 42
2. 3000	7. A	12. 8000	17. 10	22. A
3. D	8. 45600	13. D	18. D	23. A
4. C	9. D	14. A	19. 30	24. D
5. 64	10. C	15. 1050	20. C	25. A

Exercise – 4(a)

1. 12000	6. C	11. C	16. B	21. C
2. B	7. D	12. C	17. D	22. D
3. B	8. 8	13. 45000	18. A	23. 16000
4. D	9. 2000	14. B	19. 8064	24. B
5. C	10. D	15. 64	20. C	25. 3300

Exercise – 4(b)

1. A	10. D	19. C	28. D	37. C
2. 20000	11. 10800	20. B	29. 12000	38. C
3. C	12. B	21. 120	30. A	39. D
4. B	13. C	22. B	31. 4000	40. 30000
5. B	14. D	23. C	32. B	41. D
6. 40000	15. 40000	24. 22000	33. 20	42. A
7. C	16. B	25. C	34. D	43. A
8. B	17. B	26. D	35. 4	44. B
9. 11400	18. 10560	27. 38400	36. A	45. C