5. Simple Interest and Compound Interest

Terminology

➤ **Principal:** The amount that is given as loan is called principal

➤ **Interest:** Extra amount that is to be paid over given principal

➤ **Rate of interest:** Extra amount paid /Rs. 100 per year (Also referred as p.c.p.a percent per annum)

➤ **Time:** Time period for which loan is given

Simple Interest (S.I.)

When the interest is paid as it falls due, i.e. at the end of every period (e.g. yearly, half yearly or quarterly), the principal is said to be lent or borrowed at **Simple Interest.**

If P = Principal, R = Rateper annum, T = Time in years,

SI = Simple interest, A = Total amount

$SI = \frac{PRT}{100}$

$A = P + SI = P\left[1 + \frac{RT}{100}\right]$

Example: If Rs. 650 amounts to Rs. 790 in 4 years, then what sum of money will it amount to in 7 years at the same rate of interest?

Sol. S.I. = Rs (790 - 650) = Rs. 140,

Also, $S.I = \frac{PRT}{100}$

➔ $140 = \frac{650 \times (R) \times 4}{100}$ ➔ $R = \frac{140 \times 100}{650 \times 4} = \frac{70}{13}$

Amount $= p\left[1 + \frac{RT}{100}\right] = 650[1 + \frac{70 \times 7}{13 \times 100}]$ ➔ $650[1 + \frac{490}{1300}] = Rs. 895$

Short-cut:

You can see that Rs. 140 is earned in 4 years

➔ Rs. 35 is earned in 1 year ➔ Rs. 35 x 7

➔ Rs. 245 is earned in 7 years etc.

Note:

If the interest type is not mentioned it is consideted simple interest by default.

Compound Interest (C.I.)

When the interest, as it becomes due, is added to the principal, and the interest for the next period is calculated on the new principal, then the money is said to be lent or borrowed at Compound Interest.

First year's principal + First year's Interest = Second year's principal.

If P = Principal, A = Amount in n years, R = Rate of interest. per annum, then

- $A = p\left[1 + \dfrac{R}{100}\right]^n$, interest payable annually

- $A = p\left[1 + \dfrac{R^1}{100}\right]^{n^1}$, interest payable half-yearly $R^1 = R/2$, $n^1 = 2n$

- $A = p\left[1 + \dfrac{R}{400}\right]^{4n}$, interest payable quarterly

- $\left[1 + \dfrac{R}{100}\right]$ Is the yearly growth factor;

- $\left[1 + \dfrac{R}{100}\right]$ is the yearly decay factor or depreciation factor.

In fact in compound interest every year interest on interest gets accumulated in the total amount.

Example

Ravi gave a loan of Rs. 20000 to Santosh at an interest rate of 8% for a period of 2 years, if Ravi charges CI how much does Santosh pay at the end of 2 years?

Sol:

Total amount = 20000 + (1st yr int = 8% 20000 = 1600) + 1600 for 2nd year +

8% of 1600 = Rs. 23328

This helps us in finding sum quickly instead of using $p\left[1 + \dfrac{R}{100}\right]^n$ formula

Points to remember

A. When time is fraction of a year, say $3\frac{3}{4}$, years, then,

Amount = $p\left[1 + \dfrac{R}{100}\right]^3 \times \left[1 + \dfrac{\frac{3}{4}R}{100}\right]$

B. CI = Amount – principal = $p\left[\left(1 + \dfrac{R}{100}\right)^n - 1\right]$

C. When Rates are different for different years, say R_1, R_2, R_3% for 1st, 2nd & 3rd years respectively, then,

Amount = $p\left[1 + \dfrac{R_1}{100}\right]\left[1 + \dfrac{R_2}{100}\right]\left[1 + \dfrac{R_3}{100}\right]$

In general, interest is considered to be SIMPLE unless otherwise stated.

Example: A certain sum of money at C.I. amounts to Rs. 811.25 in 2 years and to Rs. 843.65 in 3 years. Find the sum of money.

Sol. Since A = $p\left[1 + \dfrac{R}{100}\right]^n$ ➔ 811.25 = $p\left[1 + \dfrac{R}{100}\right]^2$ … (1)

➔843.65 = $p\left[1 + \dfrac{R}{100}\right]^3$ … (2)

on dividing (2) by (1), we get: $\dfrac{843.65}{811.25} = 1 + \dfrac{R}{100}$

➔ 1.04 = 1 + $\dfrac{R}{100}$ ➔ R = 4.

Now, putting R = 4 into (1), we get

$811.25 = p \left[1 + \frac{4}{100}\right]^2$ ➔ p = 750

➔ The sum of money is Rs. 750.

Equal annual installment to pay the debt (Borrowed) amount:

Let the value of each equal annual installment = Rs. a.

Rate of Interest = R% p.a.

Number of installments per year = n.

Number of years = T.

:. Total number of installments = n x T.

Borrowed amount = B. Then,

$$a\left[\frac{100}{100 + R} + \left(\frac{100}{100 + R}\right)^2 + \dots + \left(\frac{100}{100 + R}\right)^{n \times T}\right] = B$$

Example: What annual installment will be required to repay a borrowed amount of Rs. 1, 32, 400 in 3 years at 10% compounded annually?

Sol. Let each annual installment be Rs. a. by using the formula,

➔ $132400 = a\left[\frac{100}{100 + 10} + \left(\frac{100}{100 + 10}\right)^2 + \dots + \left(\frac{100}{100 + 10}\right)^3\right]$

➔ $132400 = a \times \left[\frac{10}{11} + \left(\frac{10}{11}\right)^2 + \dots + \left(\frac{10}{11}\right)^3\right]$ ➔ $132400 = a \times \frac{10}{11}\left[1 + \frac{10}{11} + \frac{100}{121}\right]$

➔ $132400 = a \times \frac{10}{11} \times \frac{331}{121}$ ➔ $a = 132400 \times \frac{11}{10} \times \frac{121}{331}$ ➔ a = Rs. 53,240.

Example: A loan of Rs. 2000 is to be paid back in 3 equal annual installments. How much is each installment to the nearest whole rupee, if the interest is compounded annually at $12\frac{1}{2}$% p.a.?

Sol. $2000 = a\{(100/112.5) + (100/112.5)^2 + (100/112.5)^3\}$

= Rs. 840(approx)

Practice Exercise

1. Interest obtained on a sum of Rs. 5000 for 3 years is Rs. 1500. Find the rate percent.

    1) 8%   2) 9%   3) 10%   4) 11%

2. Rs. 2100 is lent at compound interest of 5% per annum for 2 years. Find the amount after two years.

    1) 2300/-   2) 2315.25/- 3) 2310/-   4) 2320/-

3. Find the difference between the simple and he compound interest at 5% per annum for 2 years on a principal of Rs. 2000.

1) 5   2) 105   3) 4.5   4) None of these

4. After how many years will a sum of Rs. 12,500 become Rs. 17, 500 at the rate of 10% per annum?

    1) 2 years   2) 3 years   3) 4 years   4) 5 years

5. What is the difference between the simple interest on a principal of Rs. 500 being calculated at 5% per annum for 3 years and 4% per annum for 4 years?

    1) 5/-   2) 10/-   3) 20/-   4) 40/-

6. What is the difference between compound interest and simple interest for the sum of Rs. 2000 over a 2 year period if the compound interest is calculated at 20% and simple interest is calculated at 23%

    1) 40/-   2) 46/-   3) 44/-   4) None of these

7. Find the compound interest on Rs. 1000 at the rate of 20% per annum for 18 months when interest is compounded half-yearly?

    1) 331/-   2) 1331/-   3) 320/-   4) None of these

8. Find the principal if compound interest is charged on the principal at the rate of 16 2/3% per annum for two years and the sum becomes Rs. 196.

    1) 140/-   2) 154/-   3) 150/-   4) None

9. The SBI lent Rs. 1331 to the Tata group at a compound interest and got Rs. 1728 after three years. What is the rate of interest charged if the interest is compounded annually?

    1) 11%   2) 9.09%   3) 12%   4) 8.33%

10. Varun purchased a Maruti van for Rs. 1,96,000 and the rate of depreciation is 14 2/7% per annum. Find the value of he van after two years.

    1) 1, 40, 000/-   2) 1, 44, 000/-   3) 1, 50, 000/-   4) None

11. Varun deposited Rs. 8000 in ICICI Bank, which pays him 12% interest per annum compounded quarterly. What is the amount that he receives after 15 months?

    1) 9274.2/-   2) 9228.8/-   3) 9314.3/-   4) 9338.8/-

12. What is he rate of simple interest for the first 4 years if the sum of Rs. 360 becomes Rs. 540 in 9 years and the rate of interest for the last 5 years is 6%?

    1) 4%   2) 5%   3) 3%   4) 6%

13. Havishma makes a fixed deposit of Rs. 20,000 with the Bank of India for a period of 3 years. If the rate of interest be 13% SI per annum charged half-yearly, what amount will he get after 42 months?

    1) 27, 800/-   2) 28, 100/-   3) 29, 100/-   4) None of these

14. Varun makes a deposit of Rs. 50,000 in the Punjab National Bank for a period of 2 ½ years. If the rate of interest is 12% per annum compounded half-yearly, find the maturity value of the money deposited by him.

    1) 66, 911.27   2) 66, 123.34 3) 67, 925.95 4) 65, 550.8

15. Varun borrows Rs. 1500 from two money lenders. He pays interest at the rate of 12% per annum for one loan and at he rate of 14% per annum for the other. The total interest he pays for the entire year is Rs. 186. How much does he borrow at he rate of 12%?

    1) 1200/-   2) 1300/-   3) 1400/-   4) 300/-

16. Two equal sums were borrowed at 8% simple interest per annum for 2 years and 3 years respectively. The difference in the interest was Rs. 56. the sum borrowed were

    1) 690/-   2) 700/-   3) 740/-   4) 780/-

17. In what time will Rs. 500 give Rs. 50 as interest at the rate of 5% per annum simple interest?

    1) 2 years   2) 5 years   3) 3 years   4) 4 years

18. Shashikant derives an annual income of Rs. 688.25 from Rs. 10,000 invested partly at 8% p.a. and partly at 5% p.a. simple interest. How much of his money is invested at 5%?

    1) 5, 000/-   2) 4225/-   3) 4, 8000/-   4) 3, 725/-

19. If the difference between the simple interest and compound interest on some principal amount at 20% per annum for 3 years is Rs. 48, then the principal amount must be

    1) 550/-   2) 500/-   3) 375/-   4) 400/-

20. Raju lent Rs. 400 to Ajay for 2 years, and Rs. 100 to Manoj for 4 years and received together from both Rs. 60 as interest. Find the rate of interest, simple interest being calculated.

    1) 6%   2) 5%   3) 10%   4) 8%

Answers:

1. 3	**2.** 2	**3.** 1	**4.** 3	**5.** 1
6. 1	**7.** 2	**8.** 4	**9.** 2	**10.** 1
11. 1	**12.** 3	**13.** 3	**14.** 1	**15.** 1
16. 2	**17.** 1	**18.** 4	**19.** 3	**20.** 2