

## CHAPTER 5 SIMPLE INTEREST COMPOUND INTEREST

The lending and borrowing of money has been happening since thousands of years. Any sum of money, borrowed for a certain period, will invite an extra cost to be paid on the money borrowed; this extra cost at a fixed rate is called the interest. The money borrowed is called the principal. The sum of interest and principal is called the amount. The time for which money is borrowed is called the period.

**Amount = Principal + Interest**

The interest paid per hundred (or percent) for a year is called the rate percent per annum. The rate of interest is almost always taken as per annum; in calculations we will always consider it per annum unless indicated.

The interest is of two types; one is simple, the other is compound.

### **5.1 Simple Interest (S.I)**

It is the interest paid as it falls due, at the end of decided period (yearly, half yearly or quarterly), the principal is said to be lent or borrowed at simple interest.

Simple Interest,  $SI = PRT / 100$

Here  $P$  = Principal,  $R$  = Rate per annum,  $T$  = Time in years.

$$\text{Therefore Amount, } A = P + \frac{PRT}{100} = P \left[ 1 + \frac{RT}{100} \right]$$

If  $T$  is given in months, since rate is per annum, the time has to be converted in years, so the period in months has to be divided by 12. If  $T = 2$  months  $= 2/12$  years

**E.g. 1:** Find the amount on S.I., when Rs. 4000 is lent at 5 % p.a. for 5 years.

By the formula,  $A = P (1 + RT/100) = 4000(1 + 5 \times 5/100) = \text{Rs. 5000}$

### **5.2 Compound Interest (C.I)**

The compound interest is essentially interest over interest. The interest due is added to the principal and that becomes the new principal for the interest to be levied. This method of interest calculation is called compound interest. This can be for any period (yearly, half yearly or quarterly) and will be called "Period compounded" like yearly compounded or quarterly compounded and so on.

First period's principal + first period's interest = second period's principal

$$\text{Compound interest} = \text{principal} \left(1 + \frac{\text{Rate}}{100}\right)^{\text{time}} - \text{Principal}$$

$$CI = P \left\{ 1 + \frac{R}{100} \right\}^T - P$$

$$\text{Here Amount} = \text{principal} \left(1 + \frac{\text{Rate}}{100}\right)^{\text{time}}$$

**E.g. 2:** Find the compound interest on Rs. 4500 for 3 years at 6 % per annum  
Using the formula,  $A = P (1 + R/100)^T = 4500(1 + 6/100)^3 = 4500 (1.06)^3 = 5360$   
Compound Interest =  $5360 - 4500 = \text{Rs } 860$

### 5.3 THE RULE OF 72

The rule of 72 is a quick way to show how long it will take to double your money. The equation for the rule of 72 is:

Number of years for money to double =  $(72/\text{Annual Interest Rate})$  interest rate  
At 8% interest, it will take  $72/8 = 9$  years for your money to double.

Here are more examples:  
At 6%, it will take 12 years ( $72/6 = 12$ ).  
At 12%, it will take 6 years ( $72/12 = 6$ ).

The rule of 72 is a shortcut to estimate the magic of compound interest that makes your money grow.

- Remember that the rule of 72 is an approximation and its accuracy reduces as the interest rate becomes high.

### Important notes

1. In case interest is paid half yearly, then the interest is divided by 2, and used as  $(R/2)$  in the formula and the time is multiplied by 2, and used as  $2T$  in the formula, given by

$$A = P \left[1 + \frac{R}{200}\right]^{2T}$$

**E.g.3:** Find the compound interest on Rs. 5000 for 3 years at 6 % per annum compounded half yearly.

$$\begin{aligned} \text{Using the formula, } A &= P [1 + (R / 200)]^{2T} \\ &= 5000(1 + 6/200)^{3 \times 2} \\ &= 5000 (1.03)^6 = 5971 \\ \text{Compound interest} &= 5971 - 5000 = \text{Rs } 971 \end{aligned}$$

2. In case, interest is paid quarterly, then the interest is divided by 4, and used as  $(R/4)$  in the formula and the time is multiplied by 4, and used as  $4T$  in the formula, given by

$$A = P \left[ 1 + \frac{R}{400} \right]^{4T} \text{ payable quarterly (rate} = R/4, \text{time} = 4T)$$

E.g.4: Find the compound interest on Rs. 5000 for 3 years at 6 % per annum compounded quarterly.

Using the formula,  $A = P \left[ 1 + (R / 400) \right]^{4T}$

$$= 5000(1 + 6/400)^{3 \times 4}$$

$$= 5000 (1.015)^{12} = 5978$$

$$\text{Compound interest} = 5978 - 5000 = \text{Rs } 978$$

3. In case the rates are different ( $R_1, R_2, R_3\dots$ ) for different years, the amount is given by  $P (1 + R_1/100)(1 + R_2/100)(1 + R_3/100)$ .

E.g.5: Find the compound interest on Rs. 5000 for 3 years at 6 % per annum for first year, 7% for the second year and 8% for the third year.

Using the formula,  $P \{1 + R_1/100\} \{1 + R_2/100\} \{1 + R_3/100\}$

$$= 5000(1 + 6/100) (1 + 8/100) (1 + 9/100)$$

$$= 6125$$

$$\text{Compound interest} = 6125 - 5000 = \text{Rs. } 1125.$$

4. For population increase the formula to be used is  $P \{1 + R/100\}^T$ , and for decrease  $P \{1 - R/100\}^T$ . It can also be used for the depreciation factor.

E.g.6: The death rate of a town with population of 100000 is 5 %, considering there are no new births, what is the population of town in next three years?

Using the formula,  $P \{1 - R/100\}^T$

$$= 100000(1-5/100)^3$$

$$= 100000(0.857) = 8573$$

5. The SI and CI earned during the first period remains the same.

E.g.7: The compound interest on a certain sum of money in 2 years is 210 and the simple interest on the same amount is 200, what are the principle and the rate of interest?

Since SI and CI for first year is the same, and SI for each year is the same, so SI for the first year  $= 200/2 = 100$ , CI for year I  $= 100$ , that means CI for the year II  $= 210 - 100 = 110$ . Here the excess of interest over year I  $= 10$ . Since the excess of interest in CI is interest over first years interest, assuming I is the interest,  $I/100 \times 100 = 10$ , so  $I = 10$ , and the principal is obviously 1000.(Try calculating it yourself)

**E.g.8:** A sum of money placed at Compound Interest doubles in every 5 years, then in how many years it will become 16 times?

Now, it is given that the principle gets doubled in every 5 years. So, if we start from initial amount P, then in first 5 years it will become 2P. In the next 5 years 2P will become 4P, next 5 years 4P will become 8P and finally in the next 5 years 8P will become 16P.  
So, it will take  $(5+5+5+5) = 20$  years

#### 5.4 Net Present Value (NPV)

Money received or paid today is not the same as money received or paid after a period. This is because the money has an opportunity cost of interest in the same period. What it simply means is that you can earn interest on money if you have it now, and if you get the money later, you lose the opportunity to make interest on that. For example, if the going interest rate in the market is 10%, and someone has to pay me Rs. 1000, and he pays after a year, so he should pay, 1100 (100 has the interest). Here 1100 is called the future value and 1000 is called the present value.

Here the Future value (FV) = Present value (PV)  $\{1 + \text{Rate}/100\}^{\text{time}}$ , which is the basic formula for amount in the case for compound interest, this is the formula to be used for calculating present value. From here,

$$PV = FV / \{1 + \text{Rate}/100\}^{\text{time}}$$

This is the same formula as of the compound interest; herein we are calculating principal from the amount, which's it.

#### 5.5 Equal annual installment to pay the debt amount

Let the borrowed (debt) amount = Rs. B, rate of interest per annum = R, amount of each installment = Rs. A, and time = t yrs. Then,

$$A[\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2 + \dots + \left(\frac{100}{100+R}\right)^t] = \text{Borrowed amount B}$$

**E.g.9:** What annual payment will discharge a debt of Rs. 50,440 due in 3 years at 5% per annum compounded annually?

Let each annual installment = Rs. A. Then, by the formula,

$$A[\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2 + \dots + \left(\frac{100}{100+R}\right)^t] = \text{Borrowed amount B}$$

$$A[\left(\frac{100}{105}\right) + \left(\frac{100}{105}\right)^2 + \left(\frac{100}{105}\right)^3] = 50,440$$

$$A = \text{Rs. } 18522$$

## LEVEL 1

1. The SI on a sum of money is 25% of the principal, and the rate per annum is equal to the number of years. Find the rate per cent.  
(a) 4.5%      (b) 6%      (c) 5%      (d) 8%
  
2. The rate of interest for first 3 years is 6% per annum, for the next 4 years, 7 per cent per annum and for the period beyond 7 years, 7.5 percentages per annum. If a man lent out Rs 1200 for 11 years, find the total interest earned by him?  
(a) 1002      (b) 912      (c) 864      (d) 948
  
3. A sum of money doubles itself in 12 years. Find the rate percentage per annum if interest is calculated at simple interest.  
(a) 12.5%      (b) 8.33%      (c) 10%      (d) 7.51%
  
4. A certain sum of money amounts to Rs 704 in 2 years and Rs 800 in 5 years. Find the principal.  
(a) Rs 580      (b) Rs 600      (c) Rs 660      (d) Rs 640
  
5. A sum of money was invested at SI at a certain rate for 3 years. Had it been invested at a 4% higher rate, it would have fetched Rs 480 more. Find the principal.  
(a) Rs 4000      (b) Rs 4400      (c) Rs 5000      (d) Rs 3500
  
6. A certain sum of money trebles itself in 8 years. In how many years it will be five times?  
(a) 22 years      (b) 16 years      (c) 20 years      (d) 24 years
  
7. If CI is charged on a certain sum for 2 years at 10% the amount becomes 605. Find the principal?  
(a) Rs 550      (b) Rs 450      (c) Rs 480      (d) Rs 500
  
8. If the difference between the CI and SI on a certain sum of money is Rs 72 at 12 per cent per annum for 2 years, then find the amount.  
(a) Rs 6000      (b) Rs 5000      (c) Rs 5500      (d) Rs 6500
  
9. The population of Pune increases by 10% in the first year, it increases by 20% in the second year and due to mass exodus, it decreases by 5% in the third year. What will be its population after 3 years, if today it is 10,000?  
(a) 11,540      (b) 13,860      (c) 12,860      (d) 12,540
  
10. David borrows a sum of Rs 1200 at the beginning of a year. After 4 months, Rs 1800 more is borrowed at a rate of interest double the previous one. At the end of the year, the sum of interest on both the loans is Rs 216. What is the first rate of interest per annum?  
(a) 9%      (b) 6%      (c) 8%      (d) 12%

## LEVEL 2

- 1) A sum of money invested at simple interest triples itself in 8 years at simple interest. Find in how many years will it become 8 times itself at the same rate?  
(a) 24 years   (b) 28 years   (c) 30 years   (d) 21 years
- 2) A sum of money invested at simple interest triples itself in 8 years. How many times will it become in 20 years' time?  
(a) 8 times   (b) 7 times   (c) 6 times   (d) 9 times
- 3) If Rs. 1100 is obtained after lending out Rs.  $x$  at 5% per annum for 2 years and Rs. 1800 is obtained after lending out Rs  $y$  at 10% per annum for 2 years, find  $x + y$ ?  
(a) Rs 2500   (b) Rs 3000   (c) Rs 2000   (d) Rs 2200
- 4) Peter borrows Rs 10000 at 20 % p. a. for 5 years at simple interest. From fourth year onwards, on the entire amount due at the end of three years, the lender begins to charge 20% p. a. compounded annually. What is the amount repaid by Peter after five years from the beginning?  
(a) 23040   (b) 22500   (c) 21000   (d) 19900
- 5) Raj takes a loan at 100% p. a. interest. When he was repaying it after three years, he had to pay Rs 952000 more because the loan was compounded every moment, instead of annually. What was the loan amount? [Take  $e=2.71$  and  $(2.71)^3=19.9$ ]  
(a) 78000   (b) 80000   (c) 80500   (d) 79500
- 6) A sum of money when kept at simple interest doubled in 8 years & 4 months. If rate of interest is doubled and interest is calculated under compound interest in which year same sum will become twice?  
(a) 3<sup>rd</sup> Year   (b) 4<sup>th</sup> Year   (c) 5<sup>th</sup> Year   (d) 6<sup>th</sup> Year
- 7) The population of a city is 200,000. If the annual birth rate and the annual death rate are 6% and 3% respectively, then calculate the population of the city after 2 years?  
(a) 2, 12,090   (b) 2, 06,090   (c) 2, 12,000   (d) 2, 12,180
- 8) A part of Rs 38,800 is lent out at 6% per six months. The rest of the amount is lent out at 5% per annum after one year. The ratio of interest after 3 years from the time when first amount was lent out is 5 : 4. Find the second part that was lent out at 5%?  
(a) 26,600   (b) 28,800   (c) 27,500   (d) 28,000
- 9) If the simple interest is 10.5 % annual and compound interest is 10% annual, find the difference between the interests after 3 years on a sum of 1000?  
(a) 15   (b) 12   (c) 16   (d) 11

- 10) A sum of 1000 after 3 years at compound interest becomes a certain amount that is equal to the amount that is the result of 3 year depreciation from 1728. Find the difference between the rates of CI and depreciation. (Given CI is 10% p.a.)?
- (a) 3.33%      (b) 0.66%      (c) 3%      (d) 2%
- 11) The Value of a machine depreciates 10% annually. If the present value of the machine is Rs 1, 00, 000/- then the total depreciation during 2 years hence will be?
- (a) Rs 81, 000      (b) 21, 000      (c) Rs 19, 000      (d) Rs 72, 000
- 12) The present population of a village is 9, 261. If the annual birth rate is  $8\frac{1}{2}\%$  and the annual death rate is 3.5%, then calculate the population 3 years ago.
- (a) 10, 721      (b) 11, 363      (c) 11, 391      (d) 8, 000
- 13) A certain sum amounts to Rs 1, 452 in 2 years and to Rs 1, 597.20 in 3 years at compound interest, then rate percent is?
- (a) 10      (b) 11      (c) 13      (d) 9
- 14) The bacteria in a culture grows by 10% in first two hours, decreases by 10% in next one hour and again increases by 5% in next two hours. If the original count of the bacteria in the sample is 40, 000, find the bacteria count at the end of 5 hours?
- (a) 48, 000      (b) 48, 025      (c) 48, 050      (d) 48, 075
- 15) The population of a town was 2, 50,000 three years ago. If it has increased by 3%, 4% and 6% in the last three years, find the present population of the town?
- (a) 2,83,868      (b) 2,81,686      (c) 2,82,868      (d) 2,80,168

### COMPANY SPECIFIC QUESTIONS

- What will Rs. 1500 amount to in three years if it is invested in 20% p.a. compound interest, interest being compound annually? [ACCENTURE]  
  
(A) 2592      (B) 2569      (C) 2540      (D) 2678
- The difference between the compound interest and the simple interest earned at the end of 3<sup>rd</sup> year on a sum of money at a rate of 10% per annum is Rs. 77.5. What is the sum? [ACCENTURE]  
  
(A) Rs. 3500      (B) Rs. 3000      (C) Rs. 2000      (D) Rs. 2500
- At a certain rate of simple interest a certain sum doubles itself in ten years. It will become four times of itself in how many years? [PERSISTENT]  
  
(A) 20 years      (B) 15 years      (C) 10 years      (D) 5 years

4. Ajit invested Rs 35000 for 8 months and Manjit invested Rs 42000 for 10 months. On a profit of Rs 31570 Ajit share is [VEDANTA]
- (A) Rs.13548      (B) Rs.14234      (C) Rs.12628      (D) None of these
5. Anuj started a business by investing Rs.20, 000. Six months later, Pankaj joined him with a capital of Rs.15,000. After another three months Puneet joined the team by investing Rs.50, 0000. Find the ratio in which the profit at the end of two years should be divided by the three.  
[ORACLE]
- (A) 8:3:5      (B) 3:2:1      (C) 16:9:25      (D) 4:2:1
6. Mr. A lends 40% of a sum at 15% pa, 50% of the rest sum at 10% pa and the rest at 18% pa rate of interest. What would be the rate of interest if the interest is calculated on the whole sum?  
[Tech Mahindra]
- (A) 13.4% pa      (B) 14.33% pa      (C) 14.4% pa      (D) 13.33% pa
7. In simple interest what sum amounts of Rs.1120/- in 4 years and Rs.1200/- in 5 years?  
[Tech Mahindra]
- (A) 500      (B) 600      (C) 800      (D) 900
8. If a sum of money compound annually amounts of thrice itself in 3 years.  
In how many years will it become 9 times itself?  
[Tech Mahindra]
- (A) 6      (B) 8      (C) 10      (D) 12
9. In a partnership, A invests  $\frac{1}{6}$  of the capital for  $\frac{1}{6}$  of the time, B invests  $\frac{1}{3}$  of the capital for  $\frac{1}{3}$  of the time and C, the rest of the capital for the whole time. Out of a profit of Rs 4600, B's share will be?  
[L & T]
- (A) Rs. 650      (B) Rs. 800      (C) Rs. 960      (D) Rs. 700
10. A sum of Rs. 370 is to be divided among A, B and C such that:  $\frac{A's\ share}{B's\ share} = \frac{B's\ share}{C's\ share} = \frac{3}{4}$   
Then A's share is [TCS]
- (A) Rs. 240      (B) Rs. 120      (C) Rs. 100      (D) Rs. 90

**ANSWER KEY LEVEL 1:**

|     |     |     |     |     |     |     |     |     |      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1 C | 2 B | 3 B | 4 D | 5 A | 6 B | 7 D | 8 B | 9 D | 10 B |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|

**ANSWER KEY LEVEL 2:**

|      |      |      |      |      |     |     |     |     |      |
|------|------|------|------|------|-----|-----|-----|-----|------|
| 1 B  | 2 C  | 3 A  | 4 A  | 5 B  | 6 B | 7 D | 8 B | 9 C | 10 D |
| 11 C | 12 D | 13 A | 14 B | 15 A |     |     |     |     |      |

**ANSWER KEY COMPANY SPECIFIC QUESTIONS:**

|     |     |     |     |     |     |     |     |     |      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1 A | 2 D | 3 A | 4 C | 5 C | 6 C | 7 D | 8 B | 9 A | 10 D |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|