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From an era of small farmers paying interest is everywhere. The importance of this topic from the exams point of view is high and also this will be the easiest blog you will learn in the quant section so our returns are high, then let's calculate this with interest. I will make sure to abandon the jargon and make it engaging.

When a person borrows some amount of money from another person or bank, then the borrower pays some extra money during repayment called **interest**.

Let's first deal with some terminology related to interest:

1. **Interest**: The extra money during the repayment
2. **Principal** (P): The money deposited for a certain time, is also known as capital.
3. **Time** (t/n): The duration for which money is borrowed or lent.
4. **Rate of interest** (R/r): The rate charged on principal; it is given in percentage terms.
5. **Simple Interest** (SI): For every time period, our principal is constant, on which we calculate interest.
6. **Compound Interest** (CI): The successive increase in the previous amount.
7. **Amount** (A): Principal + Interest

Simple Interest

Simple interest = (Principal × Rate × Time)/100 ⇒**SI = (P × r × t) / 100 = A - P**

E.g. Find the simple interest on Rs. 100 at 12% per annum for 5 years. Sol: SI = (P × r × t) / 100 = (1000 × 12 × 5) / 100 = 600

Let's discuss some more formulae of simple interest:

1. P = (100 × A) / (100 + r × t)
2. SI = (A × r × t) / (100 + r × t)
3. Two different cases can be compared by (A1 - N1) / (A2 - N2) = (P1 × r1 × t1) / (P2 × r2 × t2)
4. Amount (A) ⇒A = P + (P × r × t) / 100

E.g. A sum of money doubles in 10 years. In how many years will it treble at the same rate of interest? Sol: A = 2P, ⇒SI = P (given) ⇒ SI = (P × r × 10) / 100 ⇒ P = (P × r × 10) / 100 So, r = 10% For 3 years, Amount = Interest + Principal ⇒3P = Interest – P, Interest would be 2P, ⇒2P = (P × 10 × t)/100 ⇒t = 20 years

E.g. A sum was invested at simple interest at a certain rate for 4 years. Had it been put at a 2% higher rate, it would have fetched 56 rs. more. Find the sum. Sol: We know that SI = (P × r × t) / 100 A simple interest in the first case, ⇒SI = (P × r × 4) / 100 = (P × r) / 25 Simple interest in second case, ⇒SI = [P × (r + 2) × 4] / 100 = [P(r + 2)] / 25 The difference would be, ⇒P(r + 2)/25 - Pr/25 = 56 ⇒ 2P / 25 = 56 ⇒P = 700 rs. (Ans.)

Compound interest

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Interest accrued on principal as well as interest due of principal is called compound interest. Since principal increases after every year, the amount of interest in compound interest is always more than simple interest. Amount (A) = $P(1 + r / 100)^t$, Compound interest = A – P = $P\{(1 + r / 100)^t - 1\}$ Where signs have usual meanings,

E.g. What will be the amount when rs. 10000 is deposited in a bank at 10% per annum compounded annually for 3 years. Sol: Amount will be $A = P(1 + r / 100)^t = 1000(1 + 10 / 100)3 = 10000 \times (1.1)3$ = Rs.13310 (Ans.)

E.g. The difference between the compound interest and simple interest on a certain sum at 15% per annum for 3 years is Rs. 283.50. Find the sum. Sol: Simple interest for 3 years would be = $(P \times r \times t) / 100 \Rightarrow (P \times 15 \times 3) / 100 = (P \times 45) / 100$ Compound interest for 3 years would be = $P\{(1 + r / 100)t - 1\} = P\{(1 + 15 / 100)3 - 1\} = P\{0.520875\}$ According to question, $P\{0.520875\} - (P \times 45)/100 = 283.50$ □□$P\{0.520875 - 0.450\} = 283.50 \Rightarrow P = 4000$ rs. (Ans.)

Some important concepts

1. Difference between CI and SI for two years = $P(R/100)^2$
2. Difference between CI and SI for 3 years = $P(R/100)^2 \times [(R/100) + 3]$

Let's try to find out the answer to the previous question with the use of this formula for faster calculation.

According to formula, Difference = $P(R/100)^2 \times (R/100 + 3) \Rightarrow 283.50 = P(15/100)^2 \times [(15/100) + 3] \Rightarrow P = 100/315 \times 283.50 \times 10000/225$ = Rs. 4000 (Ans.)

We saw we can solve questions this way much faster than conventional methods.

3. When interest is not compounded annually, the amount is given by, $\Rightarrow A = P[1 + r/(n \times 100)]$ where n = number of conversions in a year.

E.g. Calculate the compound interest on Rs. 2000 for 3 years at 10%, when compounded half-yearly. Sol: Here n = (12/6) = 2 $A = P(1 + r/(n \times 100)]^{nt}$ by putting the values, $A = 2000[1 + 10/(2 \times 100)]^{3\times2} \Rightarrow A = 2000(21 / 20)6$ = Rs. 2680 $\Rightarrow$CI = A – P = 2680 - 2000 = CI = 680 rs. (Ans.)

4. When interest is not the same for every year.

1. A = P(1 + R/100)(1 + R/100)(1 + R/100)… Up to T terms (When the rate is the same for every year)
2. A = P(1 + R1 /100)T 1 × (1 + R2 /100)T 2 × (1 + R3 /100)T 3 …..and so on (When the rate is not same for every year)

E.g. If the rate of interest on an amount of Rs 40000 is 10% for the first 3 years and 20% for the next 2 years then find the amount for 5 years compounded annually. Sol: According to formula $A = P(1 + R_1 /100)^{T}{}_1 \times (1 + R_2 /100)^{T}{}_2$ by putting the values, $\Rightarrow A = 4000(1 + 10/100)^3 \times (1 + 20/100)^2 \Rightarrow A = 4000(11/10)3 \times (6/5)2$ = 7667 rs. (Ans.)

5. When the rate of interest is compounded half-yearly rate becomes R/2% and time becomes 2T. Similarly, when the compounded quarterly rate becomes R/4% and time becomes 4T. (Similar for simple interest calculations)

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E.g. In what time Rs. 2400 becomes Rs.2640 at 20% compounded half-yearly? Sol: Amount = $P[1 + (r/2)/100]^{2t}$ $\Rightarrow 2640 = 2400(1 + (20 / 2) / 100)^{2t}$ $\Rightarrow 2640/ 2400 = (1.1)^{2t}$ $\Rightarrow t = 1$ year (Ans.)

TIP: To calculate interest, the day on which the amount is deposited is not counted but the day on which amount is withdrawn is counted.

Simple and Compound Interest Mix problems

There are certain problems which involve concepts of both Simple Interest and Compound Interest. It is important to understand the concept involved and then we have to proceed accordingly. Let's start with an example from some Quant Questions which contain both the concepts.

E.g. On a certain principal, simple interest amounts to Rs. 1,000 in 1 year at the rate of 10% p.a. What will be the effective rate of interest if the same is compounded on a half yearly basis? Sol: Now here we see that we have both the concepts involved in a question. Let's try to solve it. **Step 1:** Take note of given values Here, Simple Interest (SI) = Rs. 1,000, Time (T) = 1 year Rate of Simple Interest (RSI) = 10% p.a. **Step 2:** See what we can find using given values Here, we can find the Principal using formula of SI, SI = (P × R × T)/100 $\Rightarrow$1000 = (P × 10 × 1)/100 [Cancelling 100 and 10 by 10] $\Rightarrow$1000 = (P × 1 × 1)/10 $\Rightarrow$1000 = (P)/10 $\Rightarrow$1000 × 10 = P $\Rightarrow$P = Rs. 10000 **Step 3:-** Change the values according to what we have to find Now for CI compounded half yearly we have, P = Rs. 10,000, RCI = R/2 % = 10/2% = 5%, TCI = T × 2 = 1 × 2 = 2 half years **Step 4:** Find the other unknown values Here, we can found amount A = P × {1 + R/100}T $\Rightarrow$A = P × {1 + R/100}T $\Rightarrow$A = 10,000 × {1 + 5/100} 2 [Cancelling 100 by 5] $\Rightarrow$A = 10,000 × {1 + 1/20}2 $\Rightarrow$A = 10,000 × {(1 × 20 + 1)/20}2 $\Rightarrow$A = 10,000 × {(1 × 20 + 1)/20}2 $\Rightarrow$A = 10,000 × {21/20}2 $\Rightarrow$A = 10,000 × 441/400 $\Rightarrow$A = 100 × 441/4 $\Rightarrow$A = 25 × 441 = 11, 025 Therefore, net effective rate of interest for 1 year = (11025 - 10000)/10000 × 100 % = 10.25% (Ans).

This question is all about two successive percentage changes of 5%. So, we could easily solve these types of questions by a b principle. We have discussed this method in Percentage and Profit and loss in depth so here let's just understand it very quickly.

Successive change principle

Successive change principle is used to get the result of two successive changes. If A% and B% are two successive percentage changes then, the equivalent percentage change = A + B + AB/100

For example, In this case initially we have a 10% rate of simple interest. But the rate has to be compounded half yearly, so we will have to divide it by 2. So the new rate of interest will be 5% per half year and time becomes 2 half years so that means, there is a need of two successive changes of 5%.

Now, let's try previous question using the 'successive change principle', The equivalent percentage change = a + b + ab/100 = 5 + 5 + (5 × 5)/100 = 10 + 25/100 = 10.25

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E.g. Raja invested Rs. 15000 at the rate of 10% per annum for 1 year. If the interest is compounded half yearly, then find the amount received by Raja at the end of the year. Sol: We have, P = Rs. 15000, R = 5% per half years, T = 2 half years. For CI, A = P × {1 + R/100}T ⇒A = 15000 × {1 + 5/100}2 ⇒A = 15000 × {1 + 1/20}2 ⇒A = 15000 × {21/20}2 ⇒A = 15000 × 441/400 ⇒A = 150 × 441/4 ⇒A = 37.5 × 441 = Rs. 16,537.5 (Ans).

E.g. Find the compound interest for a sum of Rs. 9000 in a year if the rate of interest is 10% compounded half yearly. Sol: Equivalent Percentage Change = 10 + 10 + (10 × 10)/100 = 21 % Compound Interest = 21 % of 9000 ⇒Compound Interest = 21/100 × 9000 = 21 × 90 = Rs. 1890 (Ans).

Keep practising the exercises and stay tuned with us.

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