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## **Aptitude Made Simple**

### **Compound Interest**

Compound Interest is one of the most common topics across all competitive and academic exams. Many people face challenges while solving Compound Interest.

Most of student thinks that Simple interest is Simple and Compound Interest id difficult.

If you know Simple Interest you already know compound interest. There is only minute difference you need to understand and you will feel it easy.

Terms/ Terminologies in Simple Interest Calculation:

Terms	Symbol	Meaning
Principal	P	Original amount given to / taken from someone.
Number of Years	N	Number of years for which amount given
Rate of Interest	R	Rate of Interest in %
Simple Interest	I or SI	Simple Interest (Extra amount over original amount)
Amount	A	Original Amount + Simple Interest
Compound Interest	I or CI	Compound Interest(Extra amount over Original amount)

#### **What is difference in Simple Interest and Compound Interest?**

**Let us assume you took 100 Rs from your friend at rate of 10%. (Simple Interest)**

Simple Interest after 1 year : 10 Rs [Amount will become 110, Principal: 100]

Simple Interest after 2 years:  $10 + 10 = 20$  Rs [Amount will become 120, Principal: 100]

Simple Interest after 3 years:  $10 + 10 + 10 = 30$  Rs [Amount will become 130, Principal: 100]

As you can see Interest is always constant for each year.

This is because only Original Principal is always considered while calculating Simple Interest on any year.

**Let us assume you took 100 Rs from your friend at rate of 10%. (Compound Interest)**

Simple Interest after 1 year : 10 Rs [Amount will become 110, Principal: 110]

[Please note here Principal is Revised to Amount]

Simple Interest for 2<sup>nd</sup> year =

$$\frac{P * N * R}{100} = \frac{110 * 1 * 10}{100}$$

= 11 Rs

Simple Interest after 2<sup>nd</sup> year: 11 + 10 = 21 Rs [Amount will become 121, Principal: 121]

Simple Interest for 3<sup>rd</sup> year =

$$\frac{P * N * R}{100} = \frac{121 * 1 * 10}{100}$$

= 12.1 Rs

Simple Interest after 2<sup>nd</sup> year: 11 + 10 + 12.1 = 33.1 Rs **[Amount will become 133.1, Principal: 133.1]**

**So basically in order to find compound interest we find simple interest only and we just keep Principal updating with Amount.**

Now same example we will solve directly with formula for Compound Interest

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

$$A = 100 \left[1 + \frac{10}{100}\right]^3 = 100 * 1.1^3$$

$$= 100 * 1.21 * 1.1$$

$$= 121 * 1.1$$

$$\mathbf{A = 133.1}$$

Compound Interest = Amount – Principal

$$= 133.1 - 100$$

$$= 33.1$$

Compound Interest will be 33.1 Rs and Amount will be 133.1 Rs

*So by chance, during exam if you forget Compound Interest formula and you need to calculate Compound Interest for 2 or 3 years, you can use Simple Interest formula 2 or 3 times to get you answer.*

**Formulae:**

**Formula 1:**

$$\text{Simple Interest} = \frac{P * N * R}{100}$$

**Formula 2:**

$$A = P + SI$$

**Formula 3:**

Compound Interest

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

**Formula 4:**

$$\text{Compound Interest (CI)} = A - P$$

We will look at type of problems asked on Compound Interest and then we will solve problems for each type.

**Note:**

Principal	P
Number of Years	N
Rate of Interest	R
Simple Interest	I or SI
Amount	A
Compound Interest	I or SI

Type	Given	To find
Type 1	P, N, R given and interest compound annually	CI or A?
Type 2	P, N, R given and interest half yearly/ Quarterly	CI or A?
Type 3	Any 3 values out of 5 [P, N, R, CI, A] given	Any of other 2?
Type 4	Amount given for 2 different period	Original Sum/Principal?
Type 5	Simple Interest / compound interest or difference between them given	P or R or SI or CI?

**Type 1:****Problem 1:**

Find Compound Interest on 7500 Rs at 4% per annum for 2 years, compounded annually?

**Solution :**

$$P = 7500 \text{ Rs}$$

$$R = 4 \%$$

$$N = 2 \text{ Years}$$

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

$$A = 7500 \left[ 1 + \frac{4}{100} \right]^2$$

$$= 7500 * \left[ \frac{100 + 4}{100} \right]^2$$

$$= 7500 * \left[ \frac{104}{100} \right]^2$$

$$= 7500 * \frac{26}{25} * \frac{26}{25}$$

$$= \frac{300 * 26 * 26}{25}$$

$$= 12 * 676 = 8112$$

$$\text{Amount} = 8112 \text{ Rs}$$

$$CI = A - P$$

$$CI = 8112 - 7500$$

$$= 612 \text{ Rs}$$

**Answer is Compound Interest 612 Rs and Amount will be 8112 Rs**

**Problem 2:**

Amrut invested amount of 8000 Rs on fixed deposit scheme for 2 years at compound interest rate 5 p.c.p.a. How much Compound Interest and total amount Amrut will get at maturity of fixed deposit?

$$P = 8000 \text{ Rs}$$

$$R = 5 \%$$

$$N = 2 \text{ Years}$$

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

$$A = 8000 \left[ 1 + \frac{5}{100} \right]^2$$

$$= 8000 * \left[ \frac{100 + 5}{100} \right]^2$$

$$= 8000 * \left[ \frac{105}{100} \right]^2$$

$$= 8000 * \frac{21}{20} * \frac{21}{20}$$

$$= \frac{400 * 21 * 21}{20}$$

$$= 20 * 441 = 8820$$

$$\text{Amount} = 8820 \text{ Rs}$$

$$\text{CI} = A - P$$

$$\text{CI} = 8820 - 8000$$

$$= 820 \text{ Rs}$$

**Answer is Compound Interest 820 Rs and Amount will be 8820 Rs**

**Problem 3:**

What will be Compound Interest and Total amount on sum of 25000 Rs after 3 years at rate of 12 p.c.p. a.

**Solution :**

$$P = 25000 \text{ Rs}$$

$$R = 12 \%$$

$$N = 3 \text{ Years}$$

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

$$A = 25000 \left[ 1 + \frac{12}{100} \right]^3$$

$$= 25000 * \left[ \frac{100 + 12}{100} \right]^3$$



$$= 25000 * \left[ \frac{112}{100} \right]^2$$

$$= 25000 * \frac{28}{25} * \frac{28}{25} * \frac{28}{25}$$

$$= \frac{1000 * 28 * 28 * 28}{25 * 25} = \frac{40 * 28 * 28 * 28}{25}$$

$$= \frac{8 * 28 * 784}{5}$$

$$= 1.6 * 21952 = 35123.2$$

Amount = 35123.2 Rs

$$CI = A - P$$

$$CI = 35123.2 - 25000$$

$$= 10123.2 \text{ Rs}$$

**Answer is Compound Interest 10123.2 Rs and Amount will be 35123.2 Rs**

## **Type 2:**

### **Problem 1**

Find compound Interest on 10000 Rs in 2 years at 4% per annum, the interest being compounded half yearly.

### **Solution :**

Before going at actual solution of this problem we will understand difference of compound interest calculated annually, half yearly and Quarterly

Compound Interest	Months in Year	Number of Times in year Interest calculated
Annually (12 Months)	12	$12 / 12 = 1 \text{ Times}$
Half yearly Annually (6 Months)	12	$12 / 6 = 2 \text{ Times}$
Quarterly (3 Months)	12	$12 / 3 = 4 \text{ Times}$

We will use same formula for Compound Interest only small changes will happen according to half yearly, quarterly etc.

### **Original formula for Compound Interest (Annually):**

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

As you can imagine R means  $\frac{R}{1}$

And n means  $n * 1$

So for **Half yearly** we use **2** instead of 1 and for **Quarterly** we will use **4** instead of 1

[ Refer to above table]

**Formula for Compound Interest (Annually):**

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

**Formula for Compound Interest (Half Yearly):**

$$A = P \left[ 1 + \frac{R/2}{100} \right]^{2n}$$

**Formula for Compound Interest (Quarterly):**

$$A = P \left[ 1 + \frac{R/4}{100} \right]^{4n}$$

Now we will solve Problem.

$$P = 10000 \text{ Rs}$$

$$N = 2 \text{ years}$$

$$R = 4\% \quad [\text{Note: Half Yearly interest calculated}]$$

As you can see here, we have to find Compound interest and calculated half yearly.

$$\begin{aligned} A &= P \left[ 1 + \frac{R/2}{100} \right]^{2n} \\ &= 10000 \left[ 1 + \frac{4/2}{100} \right]^{(2*2)} \\ &= 10000 \left[ 1 + \frac{2}{100} \right]^{(4)} \\ &= 10000 * \left[ \frac{102}{100} \right]^4 \\ &= 10000 * \frac{102}{100} * \frac{102}{100} * \frac{102}{100} * \frac{102}{100} \\ &= \frac{102 * 102 * 102 * 102}{100 * 100} \end{aligned}$$

Let us do some trick here to solve  $102 * 102 * 102 * 102$

$102 * 102$  means multiply 102 by 100 and then add  $102 * 2$

$$102 * 102 = (102 * 100) + (102 * 2)$$

$$= 10200 + 204$$

$$= 10404$$

***[ I will create separate document to calculate Square in 1 step and orally as well]***

$$\text{So } 102 * 102 * 102 * 102 = 10404 * 10404$$

Let us calculate this square

$$(a + b)^2 = a^2 + 2ab + b^2$$

$$= (10400 + 4)^2$$

$$= 10400^2 + (2 * 10400 * 4) + 4^2$$

$$= 108160000 + 83200 + 16$$

$$= 108243216$$

$$A = \frac{102 * 102 * 102 * 102}{100 * 100} = = \frac{108243216}{10000}$$

$$\text{Amount} = 10824.32 \text{ Rs}$$

$$CI = A - P$$

$$= 10824.32 - 10000$$

$$CI = 824.32 \text{ Rs}$$

**Answer is Compound Interest 824.32 Rs and Amount will be 10824.32 Rs**

## Problem 2

Find compound interest on 16000 Rs at 20% per annum for 9 months. Compound interest is calculated quarterly.

### Solution:

$$P = 16000 \text{ Rs}$$

$$R = 20 \% \text{ [Calculated quarterly that is 4 times in year]}$$

$$N = 9 \text{ months} = \frac{9}{12} = \frac{3}{4} \text{ Years}$$

$$CI = ?$$

$$A = P \left[1 + \frac{R/4}{100}\right]^4 n$$

$$A = 16000 \left[1 + \frac{20/4}{100}\right]^4 \times \frac{3}{4}$$

$$= 16000 \left[1 + \frac{5}{100}\right]^3$$

$$= 16000 \left[\frac{105}{100}\right]^3$$

$$= 16000 * \frac{105}{100} * \frac{105}{100} * \frac{105}{100}$$

$$= \frac{16 * 105 * 105 * 105}{1000}$$

$$= \frac{16 * 21 * 21 * 105}{40} = \frac{16 * 21 * 21 * 105}{40} = \frac{16 * 21 * 21 * 21}{8}$$

$$= 2 * 21 * 441$$

$$= 42 * 441 = 18522$$

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

$$CI = A - P$$

$$= 18522 - 16000$$

$$= 2522$$

**Answer is Compound Interest 2522 Rs and Amount will be 18522 Rs**

**Type 3:****Problem 1:**

If 500 Rs amounts to 583.20 Rs in 2 years compounded annually, find the rate of Interest per annum.

**Solution:**

$$P = 500 \text{ Rs}$$

$$N = 2 \text{ Years}$$

$$A = 583.20 \text{ Rs}$$

$$R = ?$$

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

$$583.20 = 500 \left[1 + \frac{R}{100}\right]^2$$

$$\frac{11664}{10000} = \left[1 + \frac{R}{100}\right]^2$$

Get square root on both sides

$$\frac{108}{100} = \left[1 + \frac{R}{100}\right]$$

$$\frac{108}{100} = \frac{100 + R}{100}$$

$$100 + R = 108$$

$$R = 8\%$$

**Answer is Rate of Interest is 8% per annum**

**Problem 2:**

In how many years will sum of 800 Rs at 10% annum compounded semi annually become 926.10 Rs?

**Solution:**

$$P = 800 \text{ Rs}$$

$$R = 10\% \text{ [ Semi/ half yearly]}$$

$$A = 926.10$$

$$N = ?$$

**As Compound Interest is Half Yearly:**

$$A = P \left[ 1 + \frac{R/2}{100} \right] ^{2n}$$

$$926.10 = 800 \left[ 1 + \frac{10/2}{100} \right] ^{2n}$$

$$926.10 = 800 \left[ 1 + \frac{5}{100} \right] ^{2n}$$

$$\frac{9261}{8000} = \left[ \frac{21}{20} \right] ^{2n}$$

As you can see 8000 is perfect cube of 20 and 9261 is also perfect cube of 21

$$\left[ \frac{21}{20} \right] ^3 = \left[ \frac{21}{20} \right] ^{2n}$$

$$2n = 3$$

$$N = 3/2$$

**Answer is 1.5 years**



**Problem 3:**

Compound interest on 30000 Rs at 7% per annum is 4347 Rs. The period in years?

**Solution:**

$$P = 30000$$

$$R = 7\%$$

$$CI = 4347 \text{ Rs}$$

$$N = ?$$

As compound Interest given we will find Amount first.

$$CI = A - P$$

$$4347 = A - 30000$$

$$A = 34347 \text{ Rs}$$

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

$$34347 = 30000 \left[1 + \frac{7}{100}\right]^n$$

$$\frac{34347}{30000} = \left[\frac{107}{100}\right]^n$$

$$\frac{11449}{10000} = \left[\frac{107}{100}\right]^n$$

$$100^2 = 10000$$

$$107^2 = 11449$$

$$n = 2 \text{ Years}$$

**Answer is 2 Years**

#### Type 4

##### Problem 1:

A sum of money amounts to 6690 after 3 years and to 1000 Rs after 6 years on compound Interest. Find the sum.

##### Solution

$$A = 6690 \text{ ( when N is 3 years)}$$

$$A = 10000 \text{ (when A is 6 years)}$$

$$P = ?$$

We have 2 different amounts given So we will get 2 equations with this and then we can solve them.

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

$$\text{When } N = 3$$

$$6690 = P \left[ 1 + \frac{R}{100} \right]^3 \quad [\text{Equation 1}]$$

$$\text{When } N = 6$$

$$10000 = P \left[ 1 + \frac{R}{100} \right]^6 \quad [\text{Equation 2}]$$

We will divide Equation2 by Equation 1

$$[\text{index formula } \frac{a^m}{a^n} = a^{m-n}]$$

$$\frac{10035}{6690} = \left[ 1 + \frac{R}{100} \right]^3$$

$$\frac{3345}{2230} = \left[ 1 + \frac{R}{100} \right]^3$$

$$\frac{669}{446} = \left[1 + \frac{R}{100}\right]^3$$

$$\left[1 + \frac{R}{100}\right]^3 = \frac{3}{2}$$

Putting this value in Equation 1

$$6690 = P * \frac{3}{2}$$

$$P = \frac{6690 * 2}{3} = 2230 * 2$$

$$= 4460 \text{ Rs}$$

**Answer is Sum is 4460 Rs**

### **Problem 2:**

A sum of money invested at compound interest amounts to Rs 800 in 3 years and to 840 Rs in 4 Years. The rate of interest is ?

### **Solution:**

*We have already discussed earlier that Compound Interest is similar to Simple Interest only Principal gets updated after every year.*

Here we have amount after 3 years : 800 Rs

While calculating Interest on 4<sup>th</sup> year it is same as good as simple interest on Principal after 3 years

$$\begin{aligned}
 \text{Simple Interest on 4}^{\text{th}} \text{ year} &= 4^{\text{th}} \text{ year amount} - 3^{\text{rd}} \text{ Year amount} \\
 &= 840 - 800 \\
 &= 40 \text{ Rs}
 \end{aligned}$$

$$\text{Simple Interest} = \frac{P * N * R}{100}$$

$$40 = \frac{800 * 1 * R}{100}$$

$$R = \frac{40 * 100}{800} = 5$$

**Answer is Rate of Interest is 5%**

**Type 5:**

**Problem 1:**

If the simple interest of a sum of money at 5% per annum for 3 year is 1200 Rs. Find the compound Interest on same sum for same period at same rate.

**Solution:**

$$SI = 1200 \text{ Rs}$$

$$N = 3 \text{ years}$$

$$R = 5\%$$

$$CI = ?$$

As we have simple interest given we will first find Principal so that we can find compound Interest

$$\text{Simple Interest} = \frac{P * N * R}{100}$$

$$1200 = \frac{P * 3 * 5}{100}$$

$$15 P = 120000$$

$$P = \frac{120000}{15}$$

$$P = 8000 \text{ Rs}$$

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

$$A = 8000 \left[1 + \frac{5}{100}\right]^3$$

$$A = 8000 \left[\frac{105}{100}\right]^3$$

$$= 8000 * \frac{105}{100} * \frac{105}{100} * \frac{105}{100}$$

$$= \frac{8*105*105*105}{1000} = \frac{8*21*21*105}{40} = \frac{21*21*105}{5}$$

$$= 21 * 21 * 21$$

$$= 9261 \text{ Rs}$$

$$CI = A - P$$

$$= 9261 - 8000$$

$$\text{Compound Interest} = 1261 \text{ Rs}$$

**Answer is Compound Interest is 1261 Rs**

## Problem 2

Difference between Compound Interest and Simple Interest on an amount of 15000 Rs for 2 years is 96Rs. What is rate of Interest?

### Solution:

When you take any similar period and similar rate of interest and Principal:

1<sup>st</sup> Year Compound interest and simple Interest will be always same if compounded annually.

2<sup>nd</sup> year onwards compound interest will be always greater than what you achieved in 2 years with simple Interest.

Here we have given difference between Compound Interest and Simple Interest.

$$\text{Simple Interest} = \frac{15000 * 2 * R}{100}$$

$$\text{Simple Interest} = 300 R$$

### For Compound Interest:

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

$$A = 15000 \left[1 + \frac{R}{100}\right]^2$$

$$= 15000 \left[\frac{100+R}{100}\right]^2$$

$$= 15000 \left[\frac{10000 + R^2 + 200R}{10000}\right]$$

$$A = \frac{3}{2} * [10000 + R^2 + 200R]$$

$$A = \frac{30000 + 3R^2 + 600R}{2}$$

$$CI = A - P$$

$$= \frac{30000 + 3R^2 + 600R}{2} - 15000$$

$$= \frac{30000 + 3R^2 + 600R - 30000}{2}$$

$$CI = \frac{3R^2 + 600R}{2}$$

$$CI - SI = 96$$

$$\left[ \frac{3R^2 + 600R}{2} \right] - 300R = 96$$

$$\left[ \frac{3R^2 + 600R - 600R}{2} \right] = 96$$

$$\frac{3R^2}{2} = 96$$

$$R^2 = \frac{192}{3}$$

$$R^2 = 64$$

$$R = 8$$

**Answer is Rate of Interest is 8%**