

# Mathematics

## NTSE - Foundation

### S.I. and C.I.

#### Simple interest

**Principal :** Whenever we borrow money from some lending source such as bank or a financial institution, we have to pay some extra money to the service provider, which depends upon the sum borrowed. This extra money is called the interest. The borrowed money is called principal.

- ❖ The rate of interest is taken as "percent per annum" which means "per Rs.100 per year" i.e. a rate of '10 % per annum', means Rs 10 on Rs. 100 for 1 year. Amount: When interest is calculated simply on the original principal, it is known as Simple Interest. When the interest for a specific period is added to the principal, then the sum is called the amount.

$$\text{S.I} = \frac{P \times R \times T}{100}$$

$$P = \frac{100 \times \text{S.I}}{R \times T}$$

$$R = \frac{100 \times \text{S.I.}}{P \times T}$$

$$T = \frac{100 \times \text{S.I.}}{R \times P}$$

**Ex.1** Find the rate of interest at which a sum becomes four times of itself in 15 years at S.I.

**Sol.** Let sum is P then,

$$\Rightarrow 3P = \frac{P \times R \times 15}{100}$$

$$\Rightarrow R = 20\%$$

**Ex.2** How long will it take a sum of money invested at 5% p.a.S.I. to increase its value by 40%?

**Sol** .Let sum is P then S.I. is  $\frac{2}{5} P$

$$\Rightarrow \frac{2}{5} P = \frac{P \times 5 \times T}{100}$$

$$\Rightarrow T = 8 \text{ years.}$$

**Ex.3** In what time a sum of Rs.2700 amounts to Rs.

3240 at a rate of  $6\frac{2}{3}\%$  at S.I.?

**Sol** Given.

Principal = Rs. 2700

Amount = Rs. 3240

Interest = Rs. (3240-2700) =Rs. 540

$$\text{Rate} = 6\frac{2}{3}\%$$

$$\therefore \text{Simple Interest} = \frac{PRT}{100}$$

$$\Rightarrow 540 = 2700 \times \frac{20}{3 \times 100} \times T$$

$$\Rightarrow T \times \frac{20}{300} \times 2700 = 540$$

$$\Rightarrow T = 3 \text{ years}$$

Hence, the required time is 3 years.

#### Compound Interest

- ❖ If the interest earned of a specific period is added to the principal for calculation the interest for the next period and so. On then such calculated interest is called Compound Interest (C.I).

Important Formulae: If A is the amount, P is the principal, R% is the rate of interest compounded annually and n is the number of intervals, then:

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

$$\text{and } \text{C.I.} = A - P = P \left[ \left( 1 + \frac{R}{100} \right)^n - 1 \right]$$

- ❖ If compound interest reckoned half – yearly, then

Rate =  $\frac{R}{2}\%$  per half year and Time = 2n half years.

$$\text{So, } A = P \left( 1 + \frac{R}{2 \times 100} \right)^{2n}$$

- ❖ If compound interest reckoned quarterly, then

Rate =  $\frac{R}{4}\%$  per quarter, Time = 4n quarters.

$$\text{So, } A = P \left( 1 + \frac{R}{4 \times 100} \right)^{4n}$$

- ❖ Let P be the principal and the rate of interest be R% annum. If the interest is compounded K-times in a year, then the amount A and the compound interest C.I. at the end of n years are given by:

$$A = P \left( 1 + \frac{R}{100k} \right)^{nk}, \text{ and}$$

$$\text{C.I.} = A - P = P \left\{ \left( 1 + \frac{R}{100k} \right)^{nk} - 1 \right\} \text{ respectively.}$$

- ❖ Let P be the principal and the rate of interest be R, % for first year,  $R_2\%$  for the  $R_n\%$  year. Then, the amount A and the compound interest C.I. at the end of n years are given by:

$$A = P \left( 1 + \frac{R_1}{100} \right) \left( 1 + \frac{R_2}{100} \right) \dots \left( 1 + \frac{R_n}{100} \right)$$

$$\& \text{C.I.} = A - P = P \left[ \left( 1 + \frac{R_1}{100} \right) \left( 1 + \frac{R_2}{100} \right) \dots \left( 1 + \frac{R_n}{100} \right) - 1 \right]$$

- ❖ Let P be the principal and the rate of interest be R % per annum. If the interest is compounded annually but time is the fraction of a years, say  $5\frac{1}{4}$  years, then amount A is given by:

$$A = P \left( 1 + \frac{R}{100} \right)^5 \left( 1 + \frac{\frac{R}{4}}{100} \right) \text{ and C.I.} = A - P$$

**Ex.4** Find the amount of Rs.8000 for 3 years, compounded annually at 5% per annum. Also, find the compound interest.

**Sol.** Here,  $P = \text{Rs } 8000$ ,  $R = 5\%$  per annum and  $n = 3$  years.

Using the formula  $A = P \left( 1 + \frac{R}{100} \right)^n$ , we get

$$\text{Amount at the 3 year} = \text{Rs. } \left\{ 8000 \times \left( 1 + \frac{5}{100} \right)^3 \right\}$$

$$= \text{Rs. } \left( 8000 \times \frac{21}{20} \times \frac{21}{20} \times \frac{21}{20} \right) = \text{Rs. } 9261.$$

**Ex.5** At what rate percent per annum will a sum of Rs. 2000 amount to Rs 2205 in years, compounded annually?

**Sol.** Let the required rate be  $R\%$  per annum.  
Here,  $A = \text{Rs } 2205$ ,  $P = \text{Rs } 2000$   
And  $n = 2$  years.

Using the formula  $A = P \left( 1 + \frac{R}{100} \right)^n$ . We get

$$2205 = 2000 \times \left( 1 + \frac{R}{100} \right)^2$$

$$\Rightarrow \left( 1 + \frac{R}{100} \right)^2 = \frac{2205}{2000}$$

$$\Rightarrow \left( 1 + \frac{R}{100} \right)^2 = \frac{441}{400}$$

$$\Rightarrow \left( 1 + \frac{R}{100} \right)^2 = \left( \frac{21}{20} \right)^2$$

$$\Rightarrow \left( 1 + \frac{R}{100} \right) = \frac{21}{20}$$

$$\Rightarrow \frac{R}{100} = \left( \frac{21}{20} - 1 \right) = \frac{1}{20}$$

$$\Rightarrow R = \left( 100 \times \frac{1}{20} \right) = 5$$

Hence, the required rate of interest is 5% per annum.

#### Application of Compound Interest:

❖ Let  $P$  be the population of a city or town at the beginning of a certain year and the population grows at a constant rate of  $E\%$  per annum, then

$$\text{Population after } n \text{ years} = \left( 1 + \frac{R}{100} \right)^n \times P$$

❖ Let  $P$  be the population of a city or a town at the beginning of a certain year. If the population grows

of the rate of  $R_1\%$  during first year and  $R_2\%$  during second year, then

$$\text{Population after 2 years} = P \left( 1 + \frac{R_1}{100} \right) \times \left( 1 + \frac{R_2}{100} \right)$$

This formula may be extended for more than 2 the value  $V_n$  at the end of  $n$  years is given by

❖ If  $V_0$  is the value of an article at a certain time and  $R\%$  per annum is the rate of depreciation, then the value  $V_n$  at the end of  $n$  years is given by

$$V_n = V_0 \left( 1 - \frac{R}{100} \right)^n$$

❖ If  $V_0$  is the value of an article at a certain time and the rate of depreciation is  $R_1\%$  for first  $n_1$  years,  $R_2\%$  for next  $n_2$  years and so on and  $R_k\%$  for the last  $n_k$  years, then the value at the end of  $n_1 + n_2 + \dots + n_k$  years is given by

$$V = V_0 \left( 1 + \frac{R_1}{100} \right)^{n_1} \left( 1 - \frac{R_2}{100} \right)^{n_2} \dots \left( 1 - \frac{R_k}{100} \right)^{n_k}$$

**Ex.6** The present population of a town is 25000. It grows at the rate of 4%, 5% and 8% during the first year, second year and third year respectively. Find its population after 3 years,

**Sol.** Population after 3 years.

$$= 25000 \left[ 1 + \frac{4}{100} \right] \left[ 1 + \frac{5}{100} \right] \left[ 1 + \frac{8}{100} \right]$$

$$= 25000 \times \frac{26}{25} \times \frac{21}{20} \times \frac{27}{25} = 29484$$

Hence, the population after 3 years = 29484.

## EXERCISE

- A man earns Rs. 450 as an interest in 2 yrs on a certain sum invested with company at the rate of 12% per annum. Find sum invested by the man in the company.  
(A) Rs.1875 (B) Rs.1830  
(C) Rs.1825 (D) Rs.1810
- In what time will Rs 64000 amount to Rs 68921 at 5% per annum, interest being compounded half-yearly?  
(A)  $1\frac{2}{3}$  (B)  $2\frac{1}{2}$  (C)  $1\frac{1}{2}$  (D)  $1\frac{1}{4}$
- A sum of money doubles itself and compound interest in 15 years. In how many years will it become eight times:  
(A) 35 years (B) 40 years  
(C) 42 years (D) 45 years
- A sum of money placed at compound interest doubles itself in 5 years. If it will amount to eight times itself at the same rate of interest in:  
(A) 7 years (B) 10 years  
(C) 15 years (D) 20 years

5. If the difference between the C.I and S.I at the end of 2 years is Rs. 100 what is the principal? Rate is 5% per annum in both the cases. Assume same principal for both the cases.  
 (A) Rs.50,000 (B) Rs.40,000  
 (C) Rs.10,000 (D) None of these
6. The compound interest on RS 5000 at 4% per annum for 2 years compounded annually is:  
 (A) Rs.804 (B) Rs.708  
 (C) Rs.408 (D) Rs.5408
7. Find the compound interest on Rs 15625 for 9 months, at 16% per annum, compounded quarterly.  
 (A) Rs.1250 (B) Rs.1651  
 (C) Rs.1951 (D) Rs.2651
8. Difference between C.I. & S.I in a certain amount at 10% per annum for 2yrs compound annually is Rs .282. Find the principal.  
 (A) RS.28210 (B) Rs.28120  
 (C) Rs.28200 (D) None
9. If an amount is kept at S.I, It earns an interest of Rs.600 in first two years but when kept at C.I., if earns an interest of Rs .660 in the same period. The rate of interest will be:  
 (A) 10% (B) 20%  
 (C) 30% (D) None of these
10. The population of a village in the year 2000 was 10,000. In the year 2001 & 2002 percentage increase in population was 5% & 10% respectively. The population of village in the year 2002 will be:  
 (A)  $10000 \times \left(1 + \frac{5}{100}\right) \left(1 + \frac{10}{100}\right)$   
 (B)  $1000 \times \left(1 - \frac{5}{100}\right) \left(1 - \frac{10}{100}\right)$   
 (C)  $1000 \times \left(1 - \frac{5}{100}\right) \left(1 + \frac{10}{100}\right)$   
 (D)  $1000 \times \left(1 + \frac{5}{100}\right) \left(1 - \frac{10}{100}\right)$
11. A bacteria reproduces at the rate of 50% in every 15 min. In how much time will it be  $3\frac{3}{8}$  times of itself?  
 (A) 105 min (B) 45min  
 (C) 75 min (D) 50min
12. The population of a town increases 20% annually. What is the population after two years if present population is 2500?  
 (A) 3250 (B) 3500  
 (C) 3600 (D) 4000
13. What will be the ratio of simple interest earned by certain amount at the same rate of interest for 6 years and that for 9 years?  
 (A) 1:3 (B) 1:4  
 (C) Data (D) None of these
14. Rs. 300 amounts lent out at simple interest is increased by 1% then in same time the amount will be:  
 (A) Rs.500 (B) RS.372  
 (C) Rs.312 (D) Rs. 364
15. A sum of money lent out at simple interest amounts to Rs. 720 after 2 years and to Rs. 1020 after a further period of 5years. The sum is:  
 (A) Rs. 500 (B) Rs.620  
 (C) Rs.502 (D) Rs.501
16. If the compound interest on a certain sum of money for 2 years at 4% per annum is Rs. 102, then the simple interest on the same sum of money at the same rate and for the same period is  
**(NTSE Stage-1/Raj/2007)**  
 (A) Rs.99 (B) Rs.100  
 (C) Rs.101 (D) Rs. 102
17. In what time a capital becomes five times at the interest rate of 10%.  
**(NTSE Stage-1/Raj/2007)**  
 (A) 10years (B) 30years  
 (C) 40 years (D) 50 years
18. An amount at certain rate of compound interest becomes Rs. 700 in 3 years and  
**(NTSE Stage-1/Raj/2008)**  
 (A) 7% (B) 10%  
 (C) 8% (D) 10.5%
19. A borrowed Rs. 500 at the rate of 5% annum and Rs. 1000 at the rate of 4% per annum on simple interest from B on the same day. Under conditions that the loan and interest will be paid when the amount in both cases together will be Rs. 2020. How many years will it take to repay the loans?  
**(NTSE Stage-1/Raj/2008)**  
 (A) 6 (B) 8  
 (C) 10 (D) 12
20. A borrowed a sum of money for 3 years at the rate of 5% simple interest from B. He then lent that money to C for the same time and the same rate at compound interest. If A gained Rs .122, after paying back to B, then the sum borrowed by A was:  
**(NTSE Stage-1/Raj/2008)**  
 (A) Rs.16000 (B) Rs. 12000  
 (C) Rs.8000 (D) Rs.4000
21. One third of a certain sum is invested at 3% per annum; one sixth of the sum is invested at 6% per annum and the remaining sum at 8% per annum. simple interest from all these investments is Rs .600, the original sum is: **(NTSE Stage-1/Raj/2007)**  
 (A) Rs.6000 (B) Rs.6666  
 (C) Rs.7500 (D) Rs. 10000

## ANSWER – KEY

**S.I. & C.I.**

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	C	D	C	B	C	C	C	B	A
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	B	C	D	B	C	B	C	C	B	A
Que.	21									
Ans.	D									