

# **SIMPLE INTEREST**

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### 3.1.1 Simple Interest

#### 3.1.1.1 Basic Definitions and Concepts

**Principal:** The initial amount of money borrowed or lent for a certain period is called principal.

**Interest:** The money paid for using other's money for a certain period is called interest or we say that extra money paid for using other's money is called interest. The interest is usually paid yearly, half-yearly or quarterly as agreed upon.

**Simple Interest (S.I):** If the interest is paid on a certain sum, borrowed for a certain period, and is reckoned at a uniform rate, then it is called simple interest. Thus, the rate of simple interest will be the same for the period. Simple interest is calculated only on the principal amount, or on that portion of the principal amount which remains unpaid.

Let Principal = P, Rate = R% per annum (p.a.) and Time = T years. Then,

- $S.I = \frac{P \times R \times T}{100}$
- $P = \frac{S.I \times 100}{R \times T}$  ;  $R = \frac{S.I \times 100}{P \times T}$  and  $T = \frac{S.I \times 100}{R \times P}$
- The sum of the principal and interest is called the amount.

Amount (A) = Principal (P) + Simple Interest (S.I)

**Example:** Find the simple interest on Rs 68,000 at  $16\frac{2}{3}\%$  per annum for 9 months.

**Solution:** P = Rs. 68000, R =  $\frac{50}{3}\%$  p.a and T =  $\frac{9}{12}$  years =  $\frac{3}{4}$  years.

$$\therefore S.I. = \left(\frac{P \times R \times T}{100}\right) = \text{Rs. } (68000 \times \frac{50}{3} \times \frac{3}{4} \times \frac{1}{100}) = \text{Rs. } 8500.$$

**Example:** Calculate the simple interest on Rs. 7200 at  $12\frac{3}{4}\%$  per annum for 9 months.

**Solution:**  $S.I = \frac{P \times R \times T}{100} = \frac{7200 \times 51 \times 9}{4 \times 100 \times 12} = \text{Rs. } 688.50$

**Example:** Find the simple interest on Rs 400 for 5 years at 6%.

**Solution:**  $S.I = \frac{400 \times 5 \times 6}{100} = \text{Rs } 120$

**Example:** At what rate percent per annum will a sum of money double in 16 years?

**Solution:** Let principal = P. Then, S.I. = P and T = 16 yrs.

$$\therefore \text{Rate} = \left(\frac{100 \times P}{P \times 16}\right) \% = 6\frac{1}{4}\% \text{ p.a.}$$

**Example:** Find the simple interest on Rs. 306.25 from March 3<sup>rd</sup> to July 27<sup>th</sup> at  $3\frac{3}{4}\%$  per annum.

**Solution:**  $S. I = \text{Rs. } 306\frac{1}{4} \times \frac{146}{365} \times \frac{15}{4} \times \frac{1}{100}$   
 $= \text{Rs. } \frac{1225}{4} \times \frac{2}{5} \times \frac{15}{4} \times \frac{1}{100} = \text{Rs } \frac{147}{32} = \text{Rs. } 4.59 \text{ nearly.}$

**Example:** What sum of money will produce Rs 143 interest in  $3\frac{1}{4}$  years at  $2\frac{1}{2}\%$  simple interest?

**Solution:** Let the required sum be Rs P. Then

$$P = \text{Rs.} \frac{100 \times 143}{3 \frac{1}{4} \times 2 \frac{1}{2}} = \text{Rs.} \frac{100 \times 143 \times 4 \times 2}{13 \times 5} = \text{Rs.} 1760.$$

**Example:** A sum of Rs 468.75 was lent out at simple interest and at the end of 1 year 8 months the total amount was Rs 500. Find the rate of interest per cent per annum.

**Solution :** Here  $P = \text{Rs.} 468.75$ ,  $T = 1 \frac{2}{3}$  or  $\frac{5}{3}$  years.

$$S.I = \text{Rs} (500 - 468.75) = \text{Rs} 31.25.$$

$$\text{Rate \%} = \frac{100 \times 31.25}{468.75 \times \frac{5}{3}} = 100 \times \frac{3125}{46875} \times \frac{3}{5} = 4\%$$

**Example:** A lent Rs 600 to B for 2 years, and Rs 150 to C for 4 years and received altogether from both Rs 90 as interest. Find the rate of interest, simple interest being calculated.

**Solution:** Rs 600 for 2 years = Rs 1200 for 1 year and Rs 150 for 4 years = Rs 600 for 1 year.

Interest = Rs 90

$$\therefore \text{Rate} = \frac{90 \times 100}{1800 \times 1} = 5\%.$$

**Example :** In what time will Rs 8500 amount to Rs 15767.50 at  $4 \frac{1}{2}$  % annum?

**Solution:** Here interest = Rs 15767.50 - Rs 8500 = Rs 7267.50.

$$T = \frac{7267.50 \times 100}{8500 \times 4.5} = 19 \text{ years.}$$

**Example:** The simple interest on a sum of money is  $\frac{1}{9}$  of the principal, and the number of years is equal to the rate per cent per annum. Find the rate%.

**Solution :**  $\text{Rate} = \text{Time} = \sqrt{100 \times \frac{1}{9}} = \frac{10}{3} = 3 \frac{1}{3} \%$

### 3.1.1.2 Some Specific Cases

- The difference in amounts for two different time periods is equal to the simple interest.

**Example:** Rs. 800 amounts to Rs. 920 in 3 years at simple interest. If the interest is increased by 3%, it would amount to how much?

**Solution:**  $S.I = (920 - 800) = \text{Rs.} 120$

$$120 = \frac{800 \times R \times 3}{100}$$

$$\therefore R = 5\%$$

$$\text{Interest at 8\% interest} = \frac{800 \times 8 \times 3}{100} = \text{Rs.} 192$$

$$\text{Amount} = (800 + 192) = \text{Rs.} 992$$

- The annual payment that will discharge a debt of Rs A due in T years at R% rate of interest per annum is

$$\frac{100A}{\left[100T + \frac{RT(T-1)}{2}\right]}$$

**Example:** What annual installment will discharge a debt of Rs. 1092 due in 3 years at 12% simple interest?

**Solution:** Annual installment

$$= \left( \frac{100 \times 1092}{100 \times 3 + \frac{3 \times 12(3-1)}{2}} \right) = \frac{109200}{336} = \text{Rs. } 325$$

- If a sum of money becomes 'x' times in 'T' years at SI, the rate of interest is given by  $\frac{100(x-1)}{T} \%$

**Example:** A sum of money doubles itself in 10 years at simple interest. What is the rate of interest?

**Solution:** Rate =  $\frac{100(2-1)}{10} = 10\%$

- A sum of Rs X is lent out in n parts in such a way that the interest on first part at  $R_1\%$  for  $T_1$  yrs, the interest on second part at  $R_2\%$  for  $T_2$  years the interest on third part at  $R_3\%$  for  $T_3$  years, and so on, are equal, the ratio in which the sum was divided in n parts is given by

$$\frac{1}{R_1 T_1} : \frac{1}{R_2 T_2} : \frac{1}{R_3 T_3} : \dots : \frac{1}{R_n T_n}$$

**Example:** A sum of Rs 2600 is lent out in two parts in such a way that the interest on one part at 10% for 5 years is equal to that on another part at 9% for 6 years. Find the two sums.

**Solution:**  $S_1 : S_2 = \frac{1}{50} : \frac{1}{54} = 54 : 50 = 27 : 25$

$$\therefore 1^{\text{st}} \text{ Part} = \frac{2600}{27+25} = \text{Rs } 1350$$

$$\text{and } 2^{\text{nd}} \text{ part} = 2600 - 1350 = \text{Rs } 1250$$

- There is a direct relationship between the principal and the amount and is given by

$$\text{Sum} = \frac{100 \times \text{Amount}}{100 + RT}$$

**Example:** A certain sum of money amounted to Rs 575 at 5% in a time in which Rs 750 amounted to Rs 840 at 4%. If the rate of interest is simple, find the sum.

**Solution:** S.I = Rs. 840 - Rs. 750 = Rs. 90

$$\text{Time} = \frac{90 \times 100}{750 \times 4} = 3 \text{ yrs}$$

$$\text{Sum} = \frac{100 \times \text{Amount}}{100 + RT} = \frac{100 \times 575}{100 + 3 \times 5} = \text{Rs } 500$$

- When different amounts mature to the same amount at simple rate of interest, the ratio of the amounts invested is in inverse ratio of  $(100 + \text{time} \times \text{rate})$ . That is, the ratio in which the amounts are invested is

$$\frac{1}{100+R_1 T_1} : \frac{1}{100+R_2 T_2} : \frac{1}{100+R_3 T_3} : \dots : \frac{1}{100+R_n T_n}$$

**Example:** A man invests an amount of Rs 15,860 in the names of his three sons P, Q, and R in such a way that they get the same amount after 2, 3 and 4 years respectively. If the rate of simple interest is 5% then find the ratio in which the amount was invested for P, Q and R?

**Solution:** The required ratio is

$$\frac{1}{100+2 \times 5} : \frac{1}{100+3 \times 5} : \frac{1}{100+4 \times 5} = \frac{1}{110} : \frac{1}{115} : \frac{1}{120}$$

- Two equal amounts of money are deposited at  $R_1\%$  and  $R_2\%$  for  $T_1$  and  $T_2$  yrs respectively. If the difference between their interest is  $I_d$  then

$$\text{Sum} = \frac{I_d \times 100}{R_1 T_1 - R_2 T_2}$$

**Example:** Two equal amounts of money are deposited in two banks each at 15% per annum for 3.5 yrs and 5 yrs respectively. If the different between their interests is Rs 144, find each sum.

**Solution:**  $\text{Sum} = \frac{144 \times 100}{15 \times 5 - 15 \times 3.5} = \frac{144 \times 100}{22.5} = \text{Rs. } 640$

**Example:** The difference between the interests received from two different banks on Rs 500 for 2 yrs is Rs 2.5. Find the difference between their rates.

**Solution:** When  $T_1 = T_2$ , then

$$(R_1 - R_2) = \frac{I_d \times 100}{\text{Sum} \times T} = \frac{2.5 \times 100}{500 \times 2} = 0.25\%$$

**Example:** The simple interest on a certain sum of money at 4% per annum for 4 yrs is Rs 80 more than the interest on the same sum for 3 yrs at 5% per annum. Find the sum.

**Solution:**  $\text{Sum} = \frac{\text{Difference} \times 100}{|R_1 T_1 - R_2 T_2|} = \frac{80 \times 100}{4 \times 4 - 3 \times 5} = \text{Rs. } 8000$

- If a sum amounts to Rs.  $A_1$  in  $T_1$  years and Rs.  $A_2$  and  $T_2$  years at simple rate of interest,

$$\text{Then rate per annum} = \frac{100[A_2 - A_1]}{(A_1 T_2 - A_2 T_1)}$$

**Example:** A sum of money at simple interest amounts to Rs 600 in 4 years and Rs 650 in 6 years. Find the rate of interest per annum.

**Solution:**  $\text{Rate} = \frac{100[650 - 600]}{6 \times 600 - 4 \times 650} = \frac{100 \times 50}{1000} = 5\%$

### Some More Examples:

**Example:** A certain sum of money at simple interest amount to Rs. 1260 in 2 years and to Rs. 1350 in 5 years find the rate percent per annum.

**Solution :**  $\text{Rate per annum} = \frac{100[A_2 - A_1]}{(A_1 T_2 - A_2 T_1)}$

Here  $A_1 = 1260$ ,  $T_1 = 2$ ,  $A_2 = 1350$  and  $T_2 = 5$

$$\begin{aligned} &= \frac{(1350 - 1260) \times 100}{1260 \times 5 - 1350 \times 2} = \frac{90 \times 100}{6300 - 2700} \\ &= \frac{90 \times 100}{3600} \\ &= 2.5\% \end{aligned}$$

**Example:** If a certain sum on simple interest is doubled in 8 years, in how many years will it be four times?

**Solution:**  $\text{Reqd. time} = \frac{(n-1) \times T}{m-1}$

**(Tip)**

Here  $n = 4$ ,  $m = 2$ , and  $T = 8$

$$\begin{aligned} &= \frac{(4 - 1) \times 8}{(2 - 1)} \\ &= 24 \text{ years} \end{aligned}$$

**Example:** In how many years a sum will be doubled if it is lent out at 5% simple interest?

**Solution:** Required time =  $\frac{100 \times P}{P \times R} = \frac{100}{5} = 20$  Years

**Example:** I gave some money at simple interest. At the end of 16 years, I got three times of my loan. Find the rate of interest.

**Solution:** Rate =  $\frac{(n-1) \times 100}{T}$  **(Tip)**

Here  $n = 3$  and  $T = 16$

$$= \frac{(3-1) \times 8}{16}$$

$$= 12 \frac{1}{2}\%$$

**Example:** If a sum of money amounts to 2300 in 3 years at 5% per annum at simple interest, find the sum.

**Solution:** Principal =  $\frac{100A}{100+RT}$  **(Tip)**

Here  $A = 2300$ ,  $R = 5\%$  and  $T = 3$  years

$$\begin{aligned} P &= \frac{100 \times 2300}{100 + 5 \times 3} \\ &= \frac{230000}{115} \\ &= \text{Rs. } 2000 \end{aligned}$$

**Example:** The rate of interest for the first 2 yrs is 3% per annum, for the next 3 years is 8% per annum and for the period beyond 5 years 10% per annum. If a man gets Rs. 1520 as a simple interest for 6 years, how much money did he deposit?

**Solution:** Principal =  $\frac{\text{Interest} \times 100}{T_1 R_1 + T_2 R_2 + T_3 R_3 + \dots}$  **(Tip)**

$$= \frac{1520 \times 100}{2 \times 3 + 3 \times 8 + 1 \times 10}$$

$$= \frac{1520 \times 100}{40} = \text{Rs } 3800$$

**Example:** In what time does a sum of money become four times at the simple interest rate of 5% per annum?

**Solution:** Time =  $\frac{100(\text{Multiple number of principal}-1)}{\text{Rate}}$  **(Tip)**

$$= \frac{100(4-1)}{5} = 60 \text{ yrs}$$

**Example:** A sum is put at SI at a certain rate for 2 yrs. Had it been put at 3% higher rate, it would have fetched Rs 300 more. Find the sum.

**Solution:** Sum =  $\frac{\text{More Interest} \times 100}{\text{Time} \times \text{More rate}}$  **(Tip)**

$$= \frac{300 \times 100}{2 \times 3} = \text{Rs. } 5000$$

**Example:** A sum of money doubles itself in 4 yrs at a simple interest. In how many yrs will it amount to 8 times itself?

**Solution:**  $n$  times in: No. of yrs to double ( $n - 1$ ) **(Tip)**

$$\therefore 8 \text{ times in} = 4(8 - 1) = 4 \times 7 = 28 \text{ yrs.}$$