Simple Interest

Simple Interest (SI) = $\dfrac{P \times R \times T}{100}$

Amount: Amount is total sum of Principal and simple Interest.

where P = principal,

R(%) = rate of interest per annum,()

T = time period (in years)

So, $P = \dfrac{SI \times 100}{R \times T}$; $R = \dfrac{SI \times 100}{P \times T}$; $T = \dfrac{SI \times 100}{P \times R}$

Example 1: What will be the rate of interest if the principal is Rs. 2500 and simple interest for 3 years is Rs 375?

Solution: Given, Principal = 2500, T= 3yrs, SI = 375

So, $R = \dfrac{SI \times 100}{P \times T}$

$R = \dfrac{375 \times 100}{2500 \times 3} = 5\%$

Without formula: Simple interest for 3 years is 375, Interest for 1 year is Rs. 125

Now we can calculate rate of interest = $\dfrac{Interst\ for\ 1\ year}{Principal} \times 100$

$$= \frac{125}{2500} \times 100 = 5\%$$

Example 2: If the principal is 100 Rs. The difference of Simple Interest for 4yrs and 6yrs is Rs 8. Calculate the rate of simple interest.

Solution: In simple interest questions, interest always remains same for a year if the principal, rate of interest is constant for the same.

Let Interest for 4 yrs is I then interest for 6 yrs is (I+8)

interest for 2 yrs is Rs. 8

interest for 1 yr = 4

rate of interest = (4/100) × 100 = 4%

Example 3: If the amount is (10/9) times of Principal and rate of interest and time both are numerically equal. Then, what is the rate of interest per annum?

Solution: Let Principal is P. Given, numerically R = T

Interest = Amount – principal

I = (10/9)P – P

I = P/9 (Interest is in the multiples of Principal)

Now, I =[(P×R×T)/100]

P/9 = (P× R× T)/100

R^2 = 100/9 (using, R=T)

R = (10/3)%
We can also say the time period is (10/3)years.

Short approach: Whenever Interest is in multiple of Principal and Rate of Interest and Time period is equal.

Then, $R = T = \sqrt{100 \times multiple\ of\ P}$

$R = T = \sqrt{100 \times (1/9)} = 10/3$

Annual Instalments for Simple Interest:

Let's discuss a real example to understand instalments concept:

A person deposit Rs.140 to the bank every year up to 5 years . The bank gives him 5% rate of interest simple annually. And at the end of 5 years he get total amount of Rs.770

So, 140 is the instalment, time is 5 years rate of interest is 5% and the amount or debt is Rs.770
This Instalment is also known as the annual payment. Debt is total amount, so don't confuse between these two terms.

Installment =   where A = debt, r = rate of interest and t = time period

$$Installment = \frac{100A}{100t + rt\frac{(t-1)}{2}}\ where\ A = debt,\ r = rate\ of\ interest\ and\ t = time\ period$$

Example 4: What annual payment will discharge a debt of Rs.848 in 4yrs at 4% per annum simple interest?

Solution: Given, A = 848, r = 4% and t = 4yrs

Using formula: Annual payment $= \dfrac{100 \times 848}{100 \times 4 + 4 \times 4 \frac{(4-1)}{2}}$

Annual payment $= \dfrac{100 \times 848}{400 + 24} = 200$

In case if you forget formula then how to approach this question.
Let installment is X. There are 4 installments and rate of interest is also 4%
Debt (A) = four installments + (r%) × installments × (0+1+2+… (t-1))
So, 848 = 4X + (4%)(X)(0+1+2+3)
    848 = 4X+
    848 = 4X+
    848 = 424X/100
    X = 200

Some Important examples based on Simple Interest.

Example 5: A sum amounts to Rs. 702 in 2 years and Rs. 783 in 3 years. Calculate the sum, rate of interest and the amount after 5 years?

Solution:
Amount for 2 years(A_2) = 702
Amount for 3 years (A_3)= 783
Interest for 1 year (I) = 783-702 = 81
So Sum = A_2 – 2I = 702 – 2×81
        = 702-162 = 540
rate of interest = (81/540)×100
                = 15%

Amount after 5 years = Sum+5I
= 540+ 5×81
= 945

Example 6: A sum of money doubles itself in 3 yrs at a simple interest. In how many yrs will it amount to 8 times itself?

Solution: Doubles in 3 yrs
3 times in 3× 2 = 6yrs
4 times in 3× 3 = 9yrs
8 times in 3× 7 = 21yrs

Example 7: Atul and Vijay are friends. Atul borrowed a sum of Rs.400 at 5% per annum simple interest from Vijay. He returns the amount with interest after 2 yrs. Vijay returns to Atul 2% of the total amount returned. How much did Atul receive?

Solution: After 2 yrs, amount returned to Vijay = 400+ (400*5*2)/100 = Rs 440
Amount returned to Atul = 2% of 440 = 8.8

Example 8: Rs.4000 is divided into two parts such that if one part be invested at 3% and the other at 5%, the annual interest from both the investments is Rs. 144. Find each part.

Solution: Let the amount lent at 3% rate be Rs. X, then amount lent at 5% rate is 4000-X

So, 3% of X + 5% of (4000-X) = 144
  5% of 4000 – 2% of X = 144
  200 – 2% of X = 144
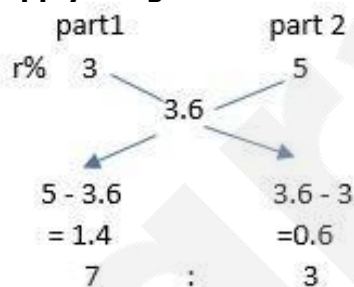 2% of X = 56
  X = (56/2)×100
  X = 2800
and 4000 -X = 1200.

How to solve this Question by Alligation Method:

First, we will calculate the net rate of interest for Rs. 144 on 4000
So, net rate = (144/4000)× 100 = 3.6%

Apply allegation:

So part 1 : part2 = 7:3
part1 = (7/10)×4000 = 2800
part2 = (3/10)×4000 = 1200

Compound Interest

Now, Let's discuss the basic difference between Simple Interest and Compound Interest.
Principal = 1000, rate of interest (r) = 10%, time = 3yrs

Simple Interest
SI for 1st yr = (1000×10×1)/100 = 100,
SI for 2nd yr = 100 (In SI it will be the same as 1st yr)
SI for 3rd yr = 100

Compound Interest:
CI for 1st yr = 100
CI for 2nd yr will not be same as 1st yr because principal for 2nd yr is the amount of 1st yr.
So, CI (2nd yr) = (1100×10×1)/100 = 110
CI for 3rd yr will also not be the same as 1st yr and 2nd yr because principal for 3rd yr is the amount of 2nd yr.
principal (3rd yr) = Amount (2nd yr) = Principal (2nd yr) + Interest (2nd yr) = 1100+110 = 1210
CI (3rd yr) = (1210×10×1)/100 = 121
Hence total CI for 3yrs = 100+110+121 = 331
Amount after 3 yrs = 1331

Interest is always calculated on the Principal. But in case of CI, Principal is get changed every year.
If we calculate it by net rate concept then the Principal will remain same.

Concept 1 : How to calculate net CI rate for 2 years?
Let rate is r% per annum for 2 years
Net CI rate for 2yrs can be calculated by = $2r+(r^2/100)$
If rate is 1%, net CI rate for 2yrs = $2×1+(1^2/100)$ = 2.01%
If rate is 3%, net CI rate for 2yrs = $2×3+(3^2/100)$ = 6.09%
If rate is 14%, net CI rate for 2yrs = $2×14+(14^2/100)$ = 29.96%
We suggest you to learn the table given below:

% Rate per annum	Net CI rate for 2 yrs	% Rate per annum	Net CI rate for 2 yrs
2%	4.04%	9%	18.81%
3%	6.09%	10%	21%
4%	8.16%	11%	23.21%
5%	10.25%	12%	25.44%
6%	12.36%	13%	27.69%
7%	14.49%	14%	29.96%
8%	16.64%	15%	32.25%

Concept 2 : How to calculate net CI rate for 3 years?

Let rate is r% per annum for 3 years
Net CI rate for 3yrs can be calculated = $3r+3(r^2/100)+\mathbf{1}(r^3/10000)$
If rate is 3% p.a., net CI rate for 3 yrs
= $\mathbf{3}\times3+\mathbf{3}(9/100)+\mathbf{1}(27/10000)$
= $9+.27+.0027 = 9.2727$
If rate is 12% p.a., net CI rate for 3 yrs
= $3\times12+3(144/100)+1(1728/10000)$
= $36+4.32+.1728$
= 40.4928
Representation while calculating net rate %.
Let's calculate it for the rate 3% p.a.
write, $r/r^2/r^3 = 3/9/27$
then, $3r/3r^2/1r^3 = 9/27/27$
 = 9.2727

We suggest you learn the table given below:

% Rate per annum	Net CI rate for 3 yrs	% Rate per annum	Net CI rate for 3 yrs
1%	3.31%	6%	19.1016%
2%	6.1208%	7%	22.5043%
3%	9.2727%	8%	25.9712%
4%	12.4864%	9%	29.5029%
5%	15.7625%	10%	33.10%

Concept 3 : If the r% p.a. is in fraction:
Example: if the rate is 16(2/3) % and the principal is 216, then calculate CI for 2yrs and 3yrs.
Solution: We can write 16(2/3)% = 1/6 (Discussed in percentage study notes)
For 2 years
216×(1/6)= 36, Now multiply 36 by 2 = 72
36× (1/6) = 6 , multiply 6 by 1 = 6
Add both the above value = 72+6 = 78
CI for 2yrs = 78
For 3 years
216×(1/6) = 36, Now multiply 36 by 3 = 108
36× (1/6) = 6, multiply 6 by 3 = 18
6× (1/6) = 1, multiply 1 by 1 = 1
Add all the above values = (108+18+1)= 127
CI for 3yrs = 127

Concept 4 : When r% is given p.a. and CI has to be calculated half-yearly or quarterly basis.

Yearly	factor	r% (per annum)	Time (n yrs)
Half yearly	6months = (6/12) =1/2	Factor× r% = (r/2) %	2n
Quarterly	3months= (3/12) =1/4	(1/4) × r% = (r/4) %	4n
9 months	9months= (9/12) = 3/4	(3/4) × r% = (3r/4) %	4n/3
8 months	8months= (8/12) = 2/3	(2/3) × r% = (2r/3) %	3n/2

Example: If r% = 10% per annum. Find the CI on 5000 for 2 years if it is compounded half-yearly.
Solution: Rate is calculated half yearly so new r% = (10/2)% = 5%
Given time is 2 yrs, acc.to half yearly, it will be 2×2 = 4
Now we have to calculate CI for 4yrs @ 5%
We know 5% = (1/20)
So, 5000×(1/20) = 250, multiply 250 by 4 = 1000
250× (1/20) = 12.5, multiply 12.5 by 6 = 75
12.5× (1/20) = 0.625, multiply 0.625 by 4 = 2.5
0.625× (1/20)= .03125 multiply .03125 by 1 = .03125
Add all the above values
(1000+75+2.5+0.03125) = 1077.53125

Concept 5 : When different rates are given for 2 years.
If a% is given for 1st year and b% is given for 2nd year.
Net rate of CI for 2 yrs = (a+b+ab/100) % (discussed in percentage study notes)
Note: The net CI rate will be the same if b% is given for 1st year and a% is given for 2nd year.
Example: If principal is 1000 Rs and r(1st yr) = 4% and r(2nd yr) = 6%. Calculate the CI after 2yrs.
Solution:
Net CI rate = 4+6+(4×6)/100
= 10.24%
Now CI = 1000×10.24% = Rs. 102.4

Concept 6: When difference between CI and SI is given.
We know, net CI for 2yrs = 2r+(r^2/100) %,
net SI for 2 yrs = 2r%
So, difference = (r^2/100)%

Example: If the difference between CI and SI is Rs.10 and the principal is Rs.1000. Calculate the rate % per annum.
Solution: difference = 10 Rs.
So difference% = (10/1000)×100 = 1%
We know that, if rate of interest is 10%
then, net CI rate (2yrs) = 21%
net SI rate (2yrs) = 20%
difference = 1%
Definitely we can say r% per annum is 10%.

Example: Calculate the difference between CI and SI for 3 yrs if Principal = 8000 and r = 6% p.a.

Solution: Net rate CI(3yrs) = 19.1016%

Net rate SI (3yrs) = 18%

Difference = 1.1016%

So, difference = 1.1016% of 8000 = 88.128

Example: If difference between CI and SI is Rs.64 and r = 8% p.a. Calculate the Principal and Amount?

Solution: If r = 8% p.a.

then, net rate CI (2yrs) – net rate SI (2yrs)

= 16.64% -16% = 0.64%

Given, difference is Rs. 64

So, 0.64% = 64

100% = 10000

Hence, Principal is 10000 Rs.

Amount = principal× (116.64%)= 10000× 116.64% = Rs.11664

Concept 7 : Calculation of Instalment

For 2 yrs: If r% is given, convert it into fraction (a/b)

then, **Instalment** $\times \dfrac{b}{a+b} \times \dfrac{b+a+b}{a+b}$ = **Principal**

Example: A man borrowed Rs.8,400 at 10% p.a. CI. He pays equal annual repayment of X rs and clear off his debts in 2 yrs. What is the value of X?

Solution: Given r=10% = (1/10)

Instalment $\times \dfrac{10}{11} \times \dfrac{10+11}{11} = 8400$

$X \times \dfrac{10}{11} \times \dfrac{21}{11} = 8400$

X = 4840 Rs.

For 3 yrs: If r% p.a. is given, convert it into fraction(a/b)

Instalment $\times \dfrac{b}{a+b} \left[\dfrac{b^2+(a+b)^2+b(a+b)}{(a+b)^2} \right]$ = **Principal**

Example: A man borrowed Rs.1820 at 20% p.a. CI. He pays equal annual repayment of X rs and clear off his debts in 3 yrs. What is the value of X?

Solution: Given r = 20% = (1/5)

Instalment $\times \dfrac{5}{5+1} \left[\dfrac{5^2+(1+5)^2+5(1+5)}{(1+5)^2} \right] = 1820$

$X \times \dfrac{5}{6} \times \dfrac{5^2+6^2+5 \times 6}{6^2} = 8400$

$X \times \dfrac{5}{6} \times \dfrac{91}{36} = 8400$

X = 864

Formulas:

Amount $= P \left(1 + \dfrac{r}{100}\right)^n$

Difference between CI and SI for 2 yrs $= P \times \left(\dfrac{r}{100}\right)^2$

Difference between CI and SI for 3 yrs $= P \times \left(\dfrac{r}{100}\right)^2 \times \left(\dfrac{300+r}{100}\right)$

Where P = Principal, r = rate of interest and n = no. of yrs

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