

# Profit and Loss

---

## Introduction to profit and loss

Profit and loss is an important topic of the arithmetic section of quantitative aptitude. You will find this chapter's application in certain DI questions as well. It is used to determine the price of a commodity in the market and understand how to profit an organization. Every product has a cost price and selling price. Based on these values we can calculate the profit and loss of a product.

## Basic terms related to profit and loss

- **Cost price:** The price at which an item is purchased is called its cost price (C.P).
- **Selling price:** The price at which an item is sold is called its selling price (S.P).
- **Profit:** If the selling price of an item is more than its cost price, then there is a profit/gain on that item. i.e  $SP - CP = \text{Profit/Gain}$ .
- **Loss:** If the cost price of an item is more than its selling price, then there is a loss on that item. i.e  $CP - SP = \text{Loss}$ .
- **Marked Price:** The price that is marked on the article in shops is called as the Marked Price of that article, abbreviated as M.P.  
Between cost price and selling price, there is a % markup or markup % is defined.  
If  $CP = 100$  and markup by 30% then MP should be 130. But when you sell you might also give a discount while selling.
- **Discount:** Discount is the amount given on the marked price by lowering the price.  
 $S.P = M.P - \text{discount}$   
Or,  $\text{Discount} = M.P - S.P$

Positive profit is a negative loss and negative profit is a positive loss.

For example :

If  $CP = 20$  and  $SP = 18$ . Then,  $\text{Profit} = 18 - 20 = -2$ . i.e negative profit is a positive loss.

NOTE: If the cost price and selling price of an item is equal then there is no loss and no profit on that item.

## Basic formulas related to profit and loss

1. Profit = SP – CP
2. SP = Profit + CP
3. CP = SP – Profit
4. Percentage Profit = (Profit/CP)×100
5. SP = CP + Gain  
= CP + (Gain%/100) × CP  
= (1 + Gain%/100) × CP
6. Loss = CP – SP
7. SP = CP – Loss
8. CP = SP + Loss
9. Loss% = (Loss/CP) × 100

NOTE: Profit percent and Loss percent are always calculated on the basis of cost price (CP).

**Example:** A shopkeeper bought 10 mangoes for 80Rs and sold 8 mangoes for 96 Rs. What is the percentage profit?

**Answer:** 50%

**Solution:** In such a situation when the number of units bought and sell are different, then the first thing you will have to think is profit % can only be calculated when;  
Number of units bought = number of units sold

For calculating profit % either calculate the selling price of 10 mangoes or you would have to look at the cost price of 8 mangoes.

10 mangoes bought for 80 Rs and 8 mangoes sell for 96 Rs.

CP of 1 mango = 8 Rs

SP of 1 mango = 12 Rs

Profit = 12 - 8 = 4 Rs/mango

% Profit = (4/8)×100 = 50%      or

CP of 10 mangoes = 80 Rs

SP of 10 mangoes = 120 Rs

Profit = 120 - 80 = 40 Rs

% Profit = (40/80)×100 = 50%.

## Types of questions asked in profit and loss

### Type 1: Simple question based on profit and loss

**Example:** You bought an item of 800 Rs and you sold the item at a profit of 10%. What are the selling price and absolute profit?

**Solution :**

CP = 800Rs

% profit = 15. 15% of 800 =  $800 \times 15/100 = 120$ .

$$\begin{array}{ccc} 800 & \xrightarrow[+120]{15\% \uparrow} & 920 \end{array}$$

Hence SP = 920Rs. And absolute profit =  $920 - 800 = 120$ Rs.

Example: A shopkeeper sold goods for 2000 at a profit of 25%. Find the cost price for the shopkeeper.

**Solution :**

SP = 2000Rs

%profit = 25.

% Profit =  $(SP - CP)/CP \times 100$

CP =  $SP \times 100/125$ . CP =  $2000 \times 100/125 = 1600$ Rs.

**Type 2: Problem on markup price and Discount**

**Example:** The cost price of an article was 800 and it is sold at a discount of 10% and at a profit of 12.5%. What is the selling price and mark price?

**Solution :**

Using the PCG structure;

$$\begin{array}{ccccc} 800 & \xrightarrow[+100]{12.5\% \uparrow} & 900 & \xleftarrow[-100]{10\% \downarrow} & 1000 \\ \text{CP} & & \text{SP} & & \text{MP} \end{array}$$

CP = 800 , %Profit = 12.5,  $SP = CP + CP \times \% \text{ Profit}$  ,  $SP = 800 + 800 \times 12.5/100 = 900$ .

Let Mark price = x , Discount = 10% ,  $SP = MP - MP \times \text{Discount}\%$

$SP = x - x \times 10/100 = 0.9x$  and we have SP = 900.

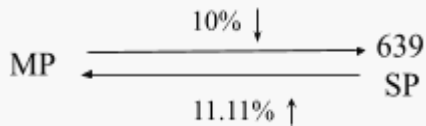
Hence  $900 = 0.9x$  ,  $x = 1000$ .

**Example:** An item was sold at 639 after giving a discount of 10%. What is the original mark price of the item?

**Solution :**

$$\begin{array}{ccc} \text{MP} & \xrightarrow{10\% \downarrow} & 639 \\ & & \text{SP} \end{array}$$

This type of situation we have seen in % chapter. In PCG structure going from one side to the other side between 2 numbers. Here drop of 10% going from left to right side then there is an increment of 11.11% going from right to left.



11.11% equivalent to  $\frac{1}{9}$ . So,  $\frac{1}{9}$  of 639 = 71.

Hence mark price = 639 + 71 = 710.

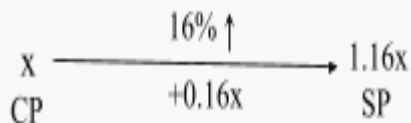
### Type 3:

**Example:** An item is sold at a profit of 16%. If it was sold at 20Rs more. The net profit would have been 20%. Find the cost price of the item?

**Solution :**

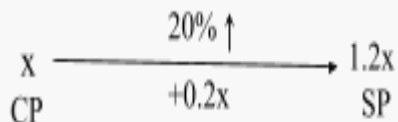
Let original cost price = x.

% profit = 16%.



New SP =  $1.16x + 20$

New profit = 20%

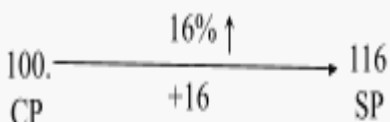


Hence  $1.16x + 20 = 1.2x$ ,  $x = 500$ .

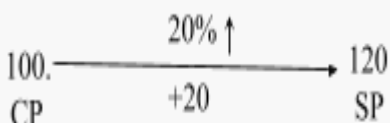
**2nd method;**

Let CP = 100.

SP in 1st case when profit = 16%



P in 2nd case when profit = 20%.



Difference between two SP =  $120 - 116 = 4$ .

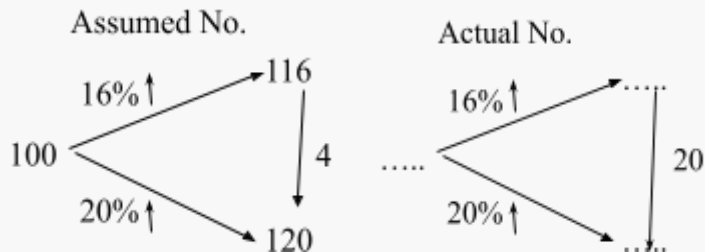
These problems always have a parallel actual set of numbers.

Parallel number to 100 which is not known.

Parallel number to 116 which is not known.

Parallel number to 120 which is also not known.

There is a parallel number to 4 which is 20.



Between 4 & 20 there is a multiplier of 5. You can apply a multiplier of 5 to any of these numbers to find which is asked.

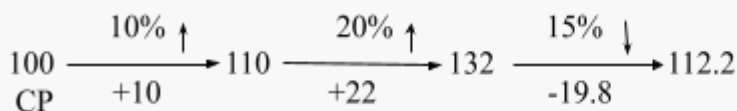
Hence  $CP = 100 \times 5 = 500$ .

#### Type 4: Multiple transaction question

Example: A manufacturer who sells his items to a wholesaler at a profit of 20% and wholesaler sells it to a shopkeeper at a profit of 20% and shopkeeper sells it to a customer at a loss of 15%. What % above the manufacturer cost were the items sold at?

**Solution :**

Let manufacturer CP = 100.



Hence, items sold 12.2% more than the manufacturer cost.

If in this question it is given that the customer bought the items for 56100.

112.2 would correspond to 56100 then, the multiplier will be  $56100/112.2 = 500$ .

The multiplier would be constant between assumed value and actual value.

CP of manufacturer =  $100 \times 500 = 50000$ .

#### Type 5: Dishonest shopkeeper question

**Example:** A shopkeeper professes to sell at CP and he cheats the customer by 10% (on weight) while selling. What is % profit to the shopkeeper?

**Solution :**

Assume that he sells 1kg = 1000gm and the price of each gm is 1Rs. CP of 1000gm = 1000Rs. His SP for 1000gm is also 1000 Rs.

But the only problem is while selling 1000gm, he only gives 900gm because he cheats the customer by 10%.

SP of 900gm is 1000Rs.

In profit and loss problem if money is equated, Money got = Money given, **then you can use the formula for % profit;**

**% Profit = (Goods left / Goods sold) × 100.**

Hence % profit to shopkeeper =  $(100/900) \times 100 = 11.11\%$ . OR

CP for 1000 gm = 1000 Rs

SP for 900 gm = 1000 Rs

So, CP for 900 gm = 900 Rs.

Hence % profit to shopkeeper =  $(100/900) \times 100 = 11.11\%$ .

**Example:** A man sells 2 items 1 at a profit of 20% and other at a loss of 20% and SP of both the items are equal. What is his % profit or loss?

**Solution :**

If a man sells two items at the same price in which he sells one at a profit of x% and the other one at a loss of x%, then **the result will always be a loss percent of  $[x/10]^2 \%$**

Here x is 20. Hence, the answer =  $(20/10)^2 = 4\%$  Loss.

## Introduction to Interest

Chapter of interest is an application of percentages. Interest is calculated as a percentage of a loan (or deposit) balance, paid to the lender periodically for the advantage of using their money. Interest can be calculated for periods that are longer or shorter than one year.

**Interest is of two types:**

1. Simple interest
2. Compound interest

The basic difference between simple interest and compound interest is the compounding factor that is often talked about in all economic and finance.

**Simple interest :**

Simple interest is the interest that is paid only on the amount borrowed (or invested), and not on past interest.

**Compound interest :**

Compound interest is the interest on capital invested as well as interest on the interest.

For example :

If you invested 100Rs @ 10% per annum on simple interest for 3 years.

Interest after 1st year = 10, after 2nd year = 10 and after 3rd year also be 10.

Amount after 1st year =  $100 + 10 = 110$

Amount after 2nd year =  $110 + 10 = 120$

Amount after 3rd year =  $120 + 10 = 130$

In the case of compound interest

Let say you invested 100 Rs @ 10% per annum on compound interest for 3 years.

Interest after 1st year = 10, Amount after 1st year =  $100 + 10 = 110$

Interest after 2nd year on 110 @ 10% = 11, Amount after 2nd year =  $110 + 11 = 121$

Interest after 2nd year on 121 @ 10% = 12.1, Amount after 3rd year =  $121 + 12.1 = 133.1$

Difference between compound interest and simple interest starts from 2nd year not from 1st year (after 1st year CI & SI both are same) it is illustrated as;

A sum of 100 at 10% per annum will have

Simple interest		Compound interest
10	After First year	10
10	After Second year	11
10	After Third year	12.1

NOTE: 1. Simple interest is generally used only on the short-term i.e duration of less than one year.

2. Compound interest is used for a longer period.

## Basic terms related to interest

1. The man who borrows the money is **Debtor** and the man who lends money is the **Creditor**
2. The initially borrowed amount of money is known as the **Capital or Principal money**.
3. The extra money that will be paid or received for the use of the principal after a certain period is called the **Total interest on the capital**.
4. The sum of the principal and the interest at the end of any time is called the **Amount**.
5. The period for which money is deposited or borrowed is called **Time**.

Hence, **Amount = Principal + Total Interest.**

**Rate of Interest** is the rate at which the interest is calculated and it is always specified in terms of percentage.

## Concept of Simple Interest

Simple interest is the interest that is paid only on the amount borrowed (or invested), and not on past interest.

**The formula for simple interest:**

$$I = P \times r \times t/100.$$

Here I = total interest, P = Principal amount, r = rate%, t = time period

Since the Amount = Principal + Total interest

NOTE: The half-yearly rate of interest is half the annual rate of interest.

**Example:** An amount of 4000 Rs is invested at a rate of 8% per annum simple interest and after a certain time period, it becomes 5920 Rs. What is the time period?

**Answer:** 6 years

**Solution:** Total amount = Principal + total interest.

$$5920 = 4000 + \text{total interest}$$

$$\text{Total interest} = 5920 - 4000 = 1920 \text{ Rs.}$$

$$\text{Annual interest} = 8\% \text{ of } 4000 = 4000 \times 8/100 = 320.$$

$$\text{No of time period} = \text{total interest} / \text{annual interest}$$

$$\text{Total time period} = 1920 / 320 = 6 \text{ years.}$$

$$\text{Hence time period} = 6 \text{ years.}$$

**Example:** A sum of money lends a simple interest. Sum of money after 2 years is 2394 Rs and after another 3 years is 2835 Rs. What is the sum, annual interest and the rate of interest?

**Answer:** Rs. 4185

**Solution:** Let 'i' be the interest for 1 year.

Sum of money after 2 years;

$$\text{Sum} = P + \text{total interest after 2 years}$$

$$2394 = P + i + i, 2394 = P + 2i \dots\dots\dots(1).$$

And sum after another 3 years;

$$\text{Here } P = 2394 \text{ Rs}$$

$$\text{Sum} = P + \text{total interest after 3 years}$$

$$2835 = 2394 + 3i$$



$$3i = 2835 - 2394 = 441, i = 441/3 = 147.$$

Hence annual interest = 147.

Put  $i = 147$  in equation (1).

$$2394 = P + 2 \times 147, P = 2394 - 294 = 2100.$$

$$\begin{aligned} \text{Annual rate} &= (\text{interest} / \text{Principal}) \times 100 \\ &= (147 / 2100) \times 100 = 7\%. \end{aligned}$$

$$\begin{aligned} \text{Total sum} &= P + \text{interest after 5 years} \\ &= 2100 + 5i \\ &= 2100 + 5 \times 147 = 4185 \text{ Rs.} \end{aligned}$$

## Concept of Compound Interest

Compound interest is the interest on capital invested as well as interest on the interest.

Let say you invested 100 Rs @ 10% per annum on compound interest for 3 years.

In compound interest every year you will get the interest on the amount.

Interest after 1st year = 10, Amount after 1st year =  $100 + 10 = 110$

Interest after 2nd year on 110 @ 10% = 11, Amount after 2nd year =  $110 + 11 = 121$

Interest after 2nd year on 121 @ 10% = 12.1, Amount after 3rd year =  $121 + 12.1 = 133.1$

### Formula :

**Case 1:** Let principal = P, time = 'n' years and rate = r% per annum and let A be the total amount at the end of n years, then

$$A = P \times (1 + r/100)^t$$

Let say a man invested 1000 Rs @ 20% per annum. What will be the amount in 3 years?

$P = 1000$  Rs,  $r = 20\%$ ,  $t = 3$  years.

$$A = P \times (1 + r/100)^t$$

$$A = 1000 \times (1 + 20/100)^3 = 1000 \times (1.2)^3 = 1000 \times 1.728$$

$$A = 1728 \text{ Rs.}$$

**Case 2:** When compound interest is half-yearly then,

If the annual rate is r% per annum and is to be calculated for n years.

Here, rate =  $r/2$  % half-yearly and time =  $(2n)$  half-years.

From the above we get

$$A = P \times (1 + (r/2)/100)^t$$

In case of quarterly, rate =  $r/4$  % and time =  $(4n)$  quarter years.

Let say a man invested 1000 Rs @ 10% per 6 months. What will be the amount after 2 years?

$$A = P \times (1 + (r/2)/100)^t$$

Rate = 10% half-yearly, t = 2 years means 4 half years. Hence t = 4.

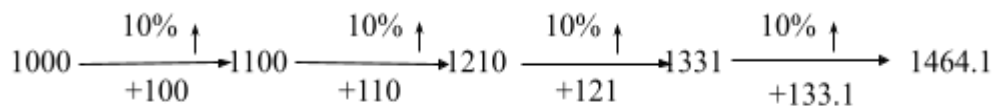
$$A = 1000 \times (1 + 10/100)^4 = 1000 \times (1.1)^4 = 1000 \times 1.4641$$

Hence amount = 1464.1 Rs.

In the given formula what you notice is that the power in the formula, if it goes to 4 or 5 it becomes slightly complex to calculate the amount because you might not know the value.

To solve this question think about PCG structure.

invested 1000 Rs @ 10% per 6 months for 2years.



You should solve all compound interest questions through PCG structure.

**Example:** What principal amounts to 270.40 Rs in 2 years at the 4% compound interest per annum?

**Solution:** As we know;

$$A = P \times (1 + r/100)^t$$

$$270.40 = P \times (1 + 4/100)^2$$

$$270.40 = P \times (104/100)^2$$

Method of multiplying 2 numbers when they are close to 100, that is very useful in CI.

For example :

You multiply 103 and 106.

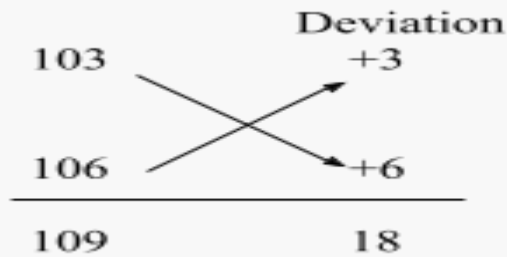
In this method, you have to take the base value as 100.

103 is a deviation of +3 from 100.

106 is a deviation of +6 from 100.

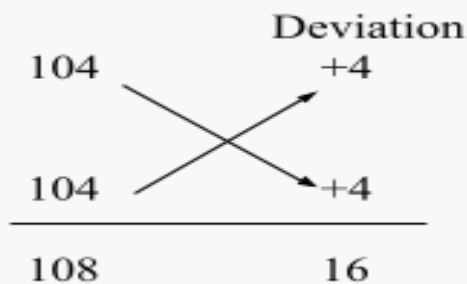
Answer to multiplication will consist of two parts; the last two digits and the starting digit.

1. The value of two digits of this multiplication is obtained by multiplying the deviation +3 and +6.
2. And across the diagonal, you will have to get the initial digits. Whether you do 103+6 or 106+3, you will get the same number in both additions.



Hence  $103 \times 106 = 10918$

In this question, we have  $104 \times 104$



Hence  $104 \times 104 = 10816$ .

$$270.40 = P \times (1.04)^2 = P \times 1.0816$$

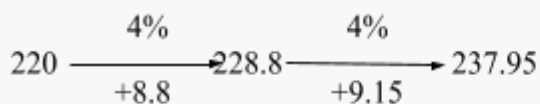
$$P = 270.40 / 1.0816 = 250 \text{ Rs.}$$

Here the calculation of P is not easy. So; solve these type of problems from the options given to you.

Let us say the options for this problem are

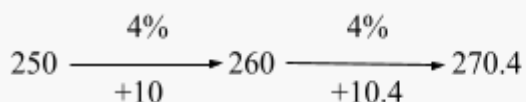
- a) 220 b) 200 c) 250 d) 225

Let's say you try from 220.



Hence 220 gets rejected. 200 & 225 are also rejected because 200 is less than 220 and 225 is not far away from 220.

Now try for 250.



This is exactly what was required.

**Example:** On a certain principal, the compound interest is Rs 132 for the 2nd year and rate of interest 10% per annum. What was the principal?

**Solution :**

Solve by PCG structure; let say P is the principal

$$P \xrightarrow[+132]{10\%} x \xrightarrow[+132]{10\%}$$

After one year the amount not given to us. Let say it is x. The interest for 2nd year is 132.

It is obvious interest on x at a rate of interest is 132 that means x must be 1320.

So the starting principal is ;

$$P \times 1.1 = 1320, \quad P = 1200.$$

Hence principal amount = 1200 and the amount after two years is;

$$1200 \xrightarrow[+120]{10\%} 1320 \xrightarrow[+132]{10\%} 1452$$

## Problems for practice

1. Compound interest on a sum of money for 2 years is 615. While the SI for the same period is Rs 600. Find the principal and rate of interest. (capgemini recruiting 2019)
  - a. Rs 6000
  - b. Rs 5000
  - c. Rs 1200
  - d. Rs 4000

Answer: 6000 rs

Solution: Let's say P is the principal. Here IS for 2 years is 600 that means annual interest is 300.

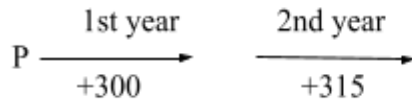
In the case of SI :

$$P \xrightarrow[+300]{1st\ year} \xrightarrow[+300]{2nd\ year}$$

In the case of CI :

CI is 615 for 2 years. As we know CI in the 1st year is the same as the SI in the 1st year.

CI for 1st year = 300. And for 2nd year = 600 - 300 = 315.



Let the annual rate of interest is x%.

x% of P = 300 .....(1)

In case of CI :

x% of (P + 300) = 315

x% of P + x% of 300 = 315

300 + x% of 300 = 315 .....(2)

So; from this equation x% of 300 should be equal to 15 to satisfy the equation.

x% of 300 = 315. Hence x = 5%.

For calculation of Principal from eq (1)

5% of P = 300.

Hence P = 6000 Rs.

2. Difference between CI and SI of a certain sum of money for 2 years at 20% per annum is Rs 48. What is the sum of money? ( Infosys 2018)

- a. 1200
- b. 1300
- c. 1600
- d. 1700

Answer: 1200

Solution: Let say x is the original amount.

SI @ 20% for 2 year on x =  $0.2x + 0.2x = 0.4x$

CI @ 20% for 2 year on x;

$A = x \times (1 + 20/100)^2 = 1.44x$

CI =  $1.44x - x = 0.44x$ .

Difference between CI & SI = 48

$$0.44x - 0.4x = 48$$

$$x = 1200.$$

**2nd method :**

Assume principal= 100 Rs.

In the case of SI :

SI on 100 @ 20% for 2 year is;

$$I = 20 + 20 = 40.$$

In the case of CI :

$$100 \xrightarrow[\substack{20\% \\ +20}]{\quad} 120 \xrightarrow[\substack{20\% \\ +24}]{\quad} 144$$

$$A = 144. \quad CI = 144 - 100 = 44.$$

Difference between CI & SI = 48

$$44 - 40 = 48$$

$$4 \equiv 48.$$

Using the multiplier logic, 4 to 48 the multiplier is 12. Multiply all the assumed values by 12 you will get the actual value.

Hence Principal amount =  $100 \times 12 = 1200$ .

### 3rd method :

The difference can also be calculated by a formula which is  $p \times (r/100)^2$ . This gives you the difference between CI & SI for 2 years for a principal amount P @ a rate "r".

$$\text{Difference between CI \& SI} = 48 = p \times (20/100)^2$$

$$48 = p \times 1/25$$

$$P = 1200.$$

NOTE :  $p \times (r/100)^2$  This work on the difference between CI & SI for 2 year.

3. Sum of money at simple interest tripled in 6 years. In how many years would it become 12 times itself? ( AWS hiring 2020)

- a. 33 years
- b. 31 years
- c. 35 years
- d. 42 years

Answer: 33 years

Solution: Let if money was 100 it has become 300 after 6 years. That means an addition of 200 in 6 years and money became 12 times itself i.e 1200.

$$100 \xrightarrow[\substack{+200 \\ \text{In 6 years}}]{\quad} 300 \xrightarrow[\substack{+900 \\ ?}]{\quad} 1200$$

6 years interest is 200 and for another 6 years interest would be again 200 because annual interest is the same. Hence in every 6 years, you will add 200.

So; after 12 years the amount will become =  $300 + 200 = 500$ .

After 18 years the amount will become =  $500+200 = 700$ .

After 24 years the amount will become =  $700+200 = 900$ .

After 30 years the amount will become =  $900+200 = 1100$ .

Now you need 100 Rs interest more.

200 Rs interest in 6 years. So; 100 Rs Interest in 3years.

So; after 33 years the amount will become =  $1100+100 = 1200$

Hence 1200 will become in 33 years.

4. A lent B Rs 6000 for 2 years and to C he lent Rs 1500 for 4 years. Together he earned a total interest of Rs 900. What is the rate of interest? (Goldman Sachs campus hiring 2019)

a. 5%

b. 3%

c. 6%

d. 10%

Answer: 5%

Solution: Mathematically;

A lent B Rs 6000 for 2 years. So;

$$I = P \times r \times t/100, I = 6000 \times r \times 2/100 = 120r \dots\dots\dots(1)$$

A lent C Rs 1500 for 4 years. So;

$$I' = 1500 \times r \times 4/100 = 60r \dots\dots\dots(2)$$

And total interest = 900 i.e  $I + I' = 900$

$$120r + 60r = 900, 180r = 900$$

$$r = 5\%$$

Hence rate of interest = 5%.

**Another way to do this question;**

i.e; 6000 for 2 years  $\equiv$  12000 for 1 year  $\dots\dots\dots(1)$

1500 for 4 years  $\equiv$  6000 for 1 year  $\dots\dots\dots(2)$

Form (1) and (2);

18000 for 1 year and total interest earned is 900.

$$\text{Hence annual rate of interest} = (900/18000) \times 100 = 5\%.$$