Lecture Notes For 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 profit and loss of a product.

The basic concept of 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 = 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 = Loss.

Positive profit is a negative loss and negative profit is a positive loss.
For example :
If CP = 20 and And SP = 18. Then, 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 for Profit and loss :

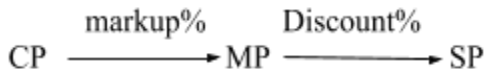
1. Profit = SP – CP
2. SP = Profit + CP
3. CP = SP – Profit
4. Percentage Profit = (Profit/CP) × 100
5. SP = CP + Gain
   = CP + (Gain%/100) × CP
   = (1 + Gain%/100) × CP
6. Loss = CP – SP
7. SP = CP – Loss
8. CP = SP + Loss
9. Loss% = (Loss/CP) × 100

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

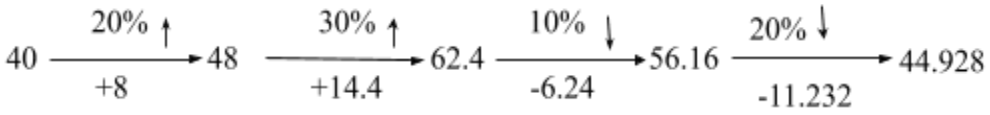
Marked Price: The price that is marked on the article in shops is called as the Marked Price of that article, abbreviated as M.P.

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 – discount
Or, Discount = M.P – S.P
You have cost price and has markup% on that, and you get the marked price from there. Based on mark price, you offered a discount as a shopkeeper, which is in % or absolute value. And you get a selling price.



In some situations, MP, as well as discounts, can be successive in nature.
Let us say, a shopkeeper bought an item of 40Rs and successively marked up by 20% and 30%. He offers successive discounts of 10% and 20%. What is the selling price of that item?
Solution :
Using the PCG structure;

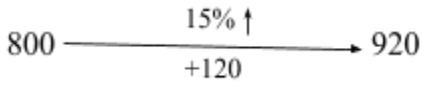


Problem :
A shopkeeper bought 10 mangoes for 80Rs and sold 8 mangoes for 96 Rs. What is the percentage profit?
Solution :
In such a situation when the number of units bought and sell are different, then the first thing you will have to think is profit % can only be calculated when;
Number of units bought = 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 = $(4/8) \times 100 = 50\%$ or
CP of 10 mangoes = 80 Rs

SP of 10 mangoes = 120 Rs
Profit = 120 - 80 = 40 Rs
% Profit = (40/80) × 100 = 50%.

Problems in Profit & Loss :

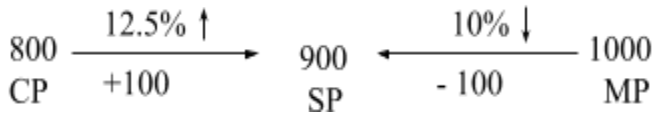
Type 1: Simple question based on profit and loss
Problem 1:
You bought an item of 800 Rs and you sold the item at a profit of 10%. What are the selling price and absolute profit?
Solution :
CP = 800Rs
% profit = 15. 15% of 800 = 800 × 15/100 = 120.



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

Problem 2:
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 *100
CP = SP × 100/125. CP = 2000 × 100/125 = 1600Rs.

Type 2: Problem on markup price and Discount
Problem 1:
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;



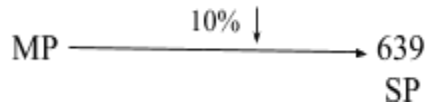
CP = 800 , %Profit = 12.5, SP = CP + CP × % Profit , SP = 800 + 800 × 12.5/100 = 900.
Let Mark price = x , Discount = 10% , SP = MP - MP × Discount%
SP = x - x × 10/100 = 0.9x and we have SP = 900.

Hence 900 = 0.9x , x = 1000.

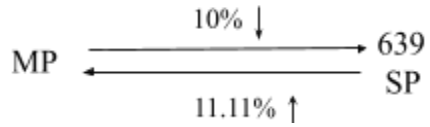
Problem 2:

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

Solution :



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 1/9. So, 1/9 of 639 = 71.

Hence mark price = 639 +71 = 710.

Type 3:

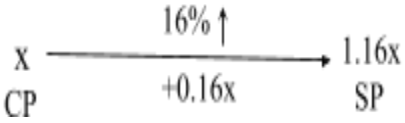
Problem 1:

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 :

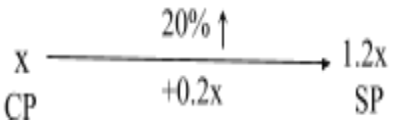
Let original cost price = x.

% profit = 16%.



New SP = 1.16x + 20

New profit = 20%

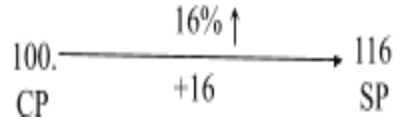


Hence 1.16x + 20 = 1.2x , x = 500.

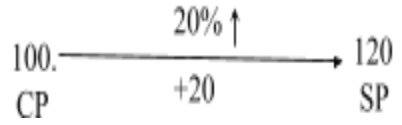
2nd method;

Let CP = 100.

SP in 1st case when profit = 16%



P in 2nd case when profit = 20%.



Difference between two SP = 120 - 116 = 4.

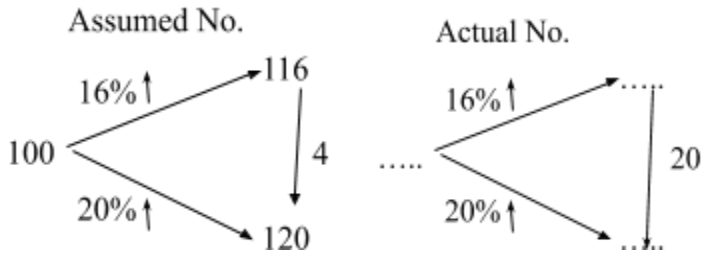
These problems always have a parallel actual set of numbers.

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 × 5 = 500.

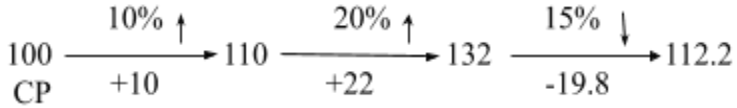
Type 4: Multiple transaction question

Problem 1:

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 × 500 = 50000.

Type 5: Dishonest shopkeeper question

Problem 1:

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) × 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) × 100 = 11.11%.

Problem 2:

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.

Some Questions for Practice :

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1. A shopkeeper incurs a loss of 10%, by selling a watch for 495. Find the C.P. of the watch for the shopkeeper.
   Ans: 550.
2. By selling a cap for 34.40, a man gains a profit of 7.5%. What will be the cost price of the cap?
   Ans: 32.

3. A cellular phone when sold for 4600 gains a profit of 15%. Find the CP of the cellular phone.
   Ans: 4000.
4. A machine costs 375. If it is sold at a loss of 20%, what will be its cost price as a percentage of its selling price?
   Ans: 125%.
5. A shopkeeper sold goods for ` 2400 and made a profit of 25% in the process. Find his profit percent if he had sold his goods for 2040.
   Ans: 6.25%.

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 short-term i.e duration of less than one year.
2. Compound interest is used for a longer period.

Some important terms :

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.

Problem 1:

You are investing 100 Rs @ 10% per annum. What is the simple interest for 3 years?

Solution :

Here P = 100, r = 10%, t = 3 years

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

$= 100 \times 10 \times 3/100 = 30$ Rs.

Another simpler way to solve this problem without using formula.

You can simply solve inside your mind, you can simply think that on 100 Rs, 10% means 10Rs for 1 year. In simple interest for every time period interest will be constant.

So,you can simply do interest calculation = $10 \times 3 = 30$ Rs.

Problem 2:

You are investing 90 Rs @ 6% per half-year, then after 3.5 years what will be the total amount?

Solution :

Here P = 90, r =6% , t = 1/2 year , For one year rate will be $6 \times 2 = 12\%$.

I = $P \times r \times t/100$, I = $90 \times 12 \times 1/100 = 10.8$

Interest for 3.5 year = $10.8 \times 3.5 = 37.8$ Rs.

Total amount = P +total interest = 90 + 37.8 = 127.8 Rs

OR

12% of 90 = $90 \times 12/100 = 10.8$.

Total interest for 3.5 year = $10.8 \times 3.5 = 37.8$.

Total amount = P +total interest = 90 + 37.8 = 127.8 Rs

Problems on Simple interest :

Some standard problems on simple interest are;

Problem 1:

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?

Solution :

Total amount = Principal + total interest.

5920 = 4000 + total interest

Total interest = 5920 - 4000 = 1920 Rs.

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

No of time period = total interest / annual interest

Total time period = 1920 / 320 = 6 years.

Hence time period = 6 years.

Problem 2:

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?

Solution :

Let 'i' be the interest for 1 year.

Sum of money after 2 years;

Sum = P + total interest after 2 years

2394 = P + i + i, 2394 = P +2i …….(1).

And sum after another 3 years;

Here P = 2394 Rs

Sum = P + 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 × 147, P = 2394 - 294 = 2100.

Annual rate = (interest / Principal) × 100

= (147 / 2100) × 100 = 7%.

Total sum = P + interest after 5 years

= 2100 + 5i

= 2100 + 5 × 147 = 4185 Rs.

Problem 3:

An amount becomes 1240 Rs after 4 years and the same amount after 10 years will be 1600 Rs. Money is invested at a simple interest at a certain rate per annum. What are the annual interest and a rate of interest?

Solution :

Let 'i' be the interest for 1 year.

Sum of money after 4 years;

Sum = P + total interest after 4 years

1240 = P + i + i+i+i, 1240 = P +4i …….(1).

Sum of money after 10 years;

Sum = P + total interest after 10 years

1600 = P + 10i …….(2)

Subtract (1) from (2)

6i = 360 , i = 60 Rs.

Hence annual interest = 60 Rs.

Put the value of i in (1).

1240 = P + 4 × 60, P = 1000.

Annual rate = (interest / Principal) × 100

= (60 /1000) × 100 = 6%

Hence annual rate = 6%.

Problem 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?

Solution :

Mathematically;

A lent B Rs 6000 for 2 years. So;

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

A lent C Rs 1500 for 4 years. So;

I' = 1500 × r × 4/100 = 60r ……....(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 ≡ 12000 for 1 year ……..(1)

1500for 4 years ≡ 6000 for 1 year ……..(2)

Form (1) and (2);

18000 for 1 year and total interest earned is 900.

Hence annual rate of interest = (900/18000) × 100 = 5%.

Problem 5:

A certain sum of money doubles in 10 years at simple interest.what is the rate of interest per annum?

Solution :

Let if money was 100 it has become 200 after 10 years.

So; interest earned in 10 years is 100%.

Hence interest earned in 1 year = 100/10 = 10%.

Problem 6:

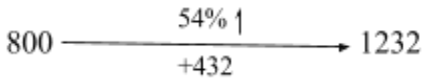
Shubham invested 800 Rs at a rate of 6% per annum for 9 years at simple interest. What is the interest he earned in 9 years?

Solution :

Here 6% interest for one year. So; interest for 9 years = 6 × 9 = 54%.

Thus; using PCG structure;

54% of 800 = 54 × 800/100 = 432.



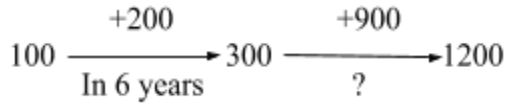
Hence interest he earned = 432.
And total amount = 1232

Problem 7:

Sum of money at simple interest tripled in 6 years. In how many years would it become 12 times itself?

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.



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.

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

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

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 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

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

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?

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

Rate = 6% half-yearly, t = 2 years means 4 half years. Hence t = 4.

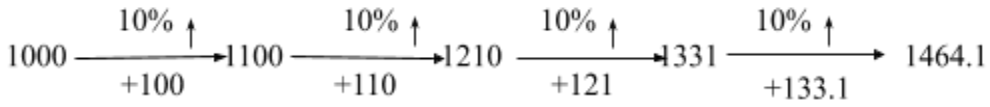
$A = 1000 \times (1 + 10/100)^4 = 1000 \times (1.1)^4 = 1000 \times 1.4641$

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.

Problems On CI :

Problem 1:

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

Solution :

As we know;

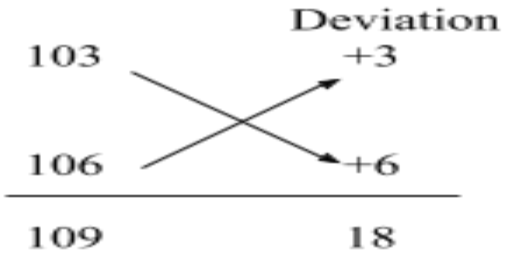
$A = P \times (1 + r/100)^t$

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

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

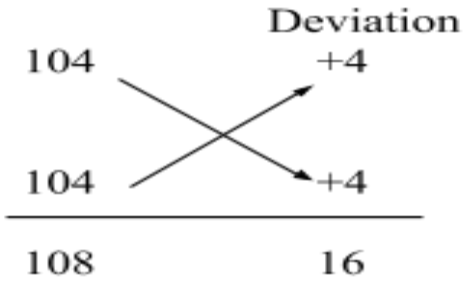
Method of multiplying 2 numbers when they are close to 100, that is very useful in CI.
For example :
You multiply 103 and 106.
In this method, you have to take the base value as 100.
103 is a deviation of +3 from 100.
106 is a deviation of +6 from 100.
Answer to multiplication will consist of two parts; 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 × 106 =10918

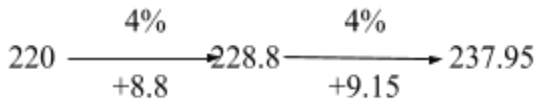
In this question, we have 104 × 104



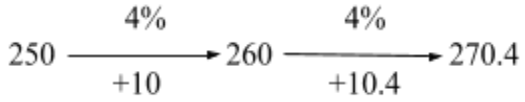
Hence 104 × 104 = 10816.
$270.40 = P \times (1.04)^2 = P \times 1.0816$
P = 270.40/1.0816 = 250 Rs.
Here the calculation of P is not easy. So; solve these type of problems from the options given to you.
Let us say the options for this problem are

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.



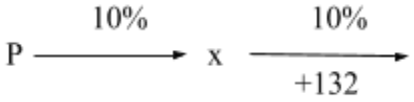
This is exactly what was required.

Problem 2:

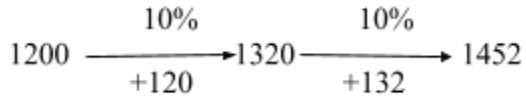
On a certain principal, the compound interest is Rs 132 for the 2nd year and rate of interest 10% per annum. What was the principal?

Solution :

Solve by PCG structure; let say P is the principal



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;



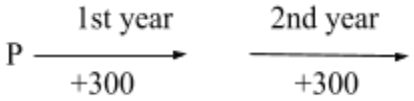
Problems On SI & CI :

Problem 1:

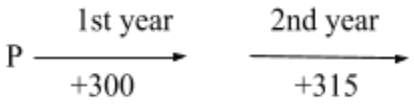
Compound interest on a sum of money for 2 years is 615. While the SI for the same period is Rs 600. Find the principal and rate of interest.

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 :



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.

Problem 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?

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

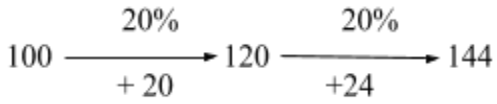
$$0.44x - 0.4x = 48$$
$$x = 1200.$$

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 :



A = 144. CI = 144 - 100 = 44.

Difference between CI & SI = 48

44 - 40 = 48

4 ≡ 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 × 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".

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

48 = p × 1/25

P = 1200.

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

Some Questions for Practice :

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1. The Simple Interest on a sum of money is 25% of the principal amount, and the rate per annum is equal to the number of years. Find the rate %.
   Ans: 5%
2. The rate of interest for the first 3 years is 6% per annum and for the next 4 years it is 7 per cent per annum and for the period beyond 7 years, 7.5 per cent per annum. If a man lent out 1200 for 11 years, then, find the total interest earned by him?
   Ans: 912.
3. A sum of money doubles itself in 12 years. Find the rate of % per annum.
   Ans: 8.33%
4. A certain sum of money amounts to 704 in 2 years and 800 in 5 years. Find the principal.
   Ans: 640.
5. A sum of money was invested at simple interest at a certain rate for 3 years. Had it been invested at a 4% higher rate, it would have gained 480 more. Find the principal.
   Ans: 4000.