# Alligation and mixture concepts

It improves logical reasoning, problem-solving, and proportional analysis, useful in business and scientific contexts. Commonly asked in Accenture, TCS, DXC, IBM, Cognizant, HCL, Infosys, Capgemini, Wipro, etc

Alligation is a rule that helps us solve problems related to mixtures. Alligation rule helps in finding out the ratio in which two items or ingredients, having a certain cost must be mixed to obtain a final mixture having ingredients in a known ratio.

Mixture refers to the mix that is derived as a result of mixing two or more items or substances in a certain ratio or proportion.

## Types of problems

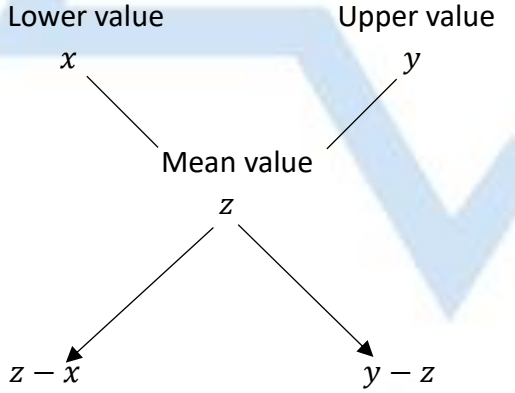
1. Concept of alligation – it can be further classified into 3 problems such as, mixture of two different things, Two mixtures are mixed to form a new mixture and Selling of Mixtures after mixing.
2. Percentage change in mixture by adding any one unit of the mixture.
3. Problem based on replacement in mixture.

**Key trick to remember for alligation**

If 2 ingredients are mixed in a ratio and the value of the unit quantities of the mixture, and the mean value is given then,

Trick 1 = $\frac{Lower\ value}{Upper\ value} = \frac{upper\ value - mean\ value}{mean\ value - lower\ value}$

Trick 2 =




## 1. Alligation problem

**Question1**: A grocer mixes two varieties of sugar type I and type II. The price of type I sugar is 20/kg and that of type II is 30/kg. If the mean price of the mixture is Rs. 24/kg. in what ratio did he mix the two?

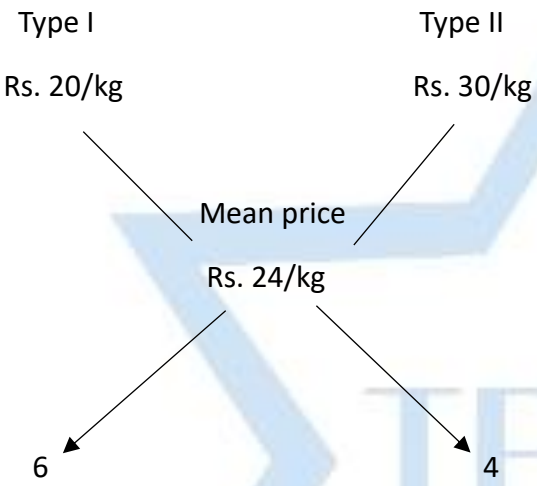
**Solution**: Lower value = Rs. 20/kg

Upper value = Rs. 30/kg

Mean Value = Rs. 24/kg

To find the ratio = $\frac{Lower\ value}{Upper\ value} = \frac{upper\ value - mean\ value}{mean\ value - lower\ value} = \frac{20}{30} = \frac{30-24}{24-20} = \frac{6}{4}$ = 3 : 2

The same problem can be solved by another trick of alligation diagram.




Therefore, the answer is 3 : 2

**Question2:** A vessel contains a mixture of $x$ and $y$ in the ratio of 5 : 3. 16 liters of this mixture is taken out and 5 liters of $x$ is poured in. The new mixture has a ratio of $x$ to $y$ as 11 : 6. Find the total original quantity of mixture.

**Solution**: $x$ = 5k, $y$ = 3k

The quantity of $x$ and $y$ in 16 liters of the mixture: Quantity of $x$ = (16 × 5k)/8k = 10 litres

Quantity of $y$ = (16 × 3k)/8k = 6 litres

Now, 5 liters of $x$ poured in and then the ratio becomes 11 : 6 (5k – 10 + 5) / (3k – 6) = 11/6

(5k – 5) / (3k – 6) = 11/6

Therefore, k = 12

So total mixture originally = 8x = 8 × 12 = 96 litres.

**Question3**. The ratio of alcohol and water in a solution is 20 : 7 and after adding 5 litres of water in it the ratio of alcohol and water becomes 5 : 3, then find the final amount of water in the final solution.

**Solution**: Let the initial amount of alcohol be 20x and of water 7x.

Ratio of alcohol and water after adding 5 litres = 20x/ (7x + 5) = 5/3

⇒ 60x = 35x + 25

⇒ 25x = 25

⇒ x = 1.

Final amount of water in solution = 7x + 5 = 7 + 5 = 12 litres.

We can solve it by another logical method:

Initial ratio of alcohol and water = 20 : 7

Final ratio of alcohol and water = 5 : 3

Multiplying 2nd with 4 to make amount of alcohol equal, we get new ratio of alcohol and water = 20 : 12

Therefore, Amount of water in final solution = 12 litres.

## 2. Percentage change in mixture by adding any unit of the mixture.

**Question1:** In a mixture of 20 litres of milk and water containing 20% water. If 5 litres of milk is added to the mixture, what will be the new concentration of the milk in the mixture?

**Solution:** Quantity of water in the initial mixture = $\frac{20}{100}$x20 = 4 litres.

Quantity of milk in the initial mixture = 20-4 = 16 litres.

When 5 liters of milk is added to the mixture, the quantity of milk becomes = 16+5 = 21 litres.

Total quantity of the new mixture = 20+5 = 25 litres.

The percentage of milk in new mixture = $\frac{21}{25}$x100 = 84%

**Question2:** Milk contains 5% water. What quantity of pure milk should be added to 10 liters of milk to reduce this to 2%?

**Solution:** Quantity of water in the initial mixture = $\frac{5}{100}$ x 10 = 0.5 litre

Now, if talking about new mixture, the quantity of water will remain the same but concentration of water in the new mixture is 2%.

Let the quantity of new mixture = $x$

Then 2% of $x$ = 0.5 litre

$x$ = $\frac{0.5}{2}$ x 100 = 25 litres

So, the quantity of water added = 25 - 10 litres = 15 litres.

## 3. **Replacement in mixture**

**Question1:** From a container having pure milk, 20% of the milk is withdrawn and replaced by water and the process repeated thrice. At the end of the third operation, the concentration of milk is:

**Solution:** Let the initial quantity of the milk is 100 ml,

While solving questions of replacement, if we are withdrawing milk and replacing it with water means milk will be the quantity which will be constantly decreasing.

After the first operation the quantity of milk will be = $\frac{80}{100}$ x100 = 80 ml

After the second operation the quantity of milk will be = $\frac{80}{100}$ x 80 = 64 ml

After the third operation the quantity of milk will be = $\frac{80}{100}$ x 64 = 51.2 ml

So, the percentage of milk after third operation = $\frac{51.2}{100}$ x 100 = 51.2%

**Question2:** A can contains 200 liters of pure milk. From this can, 20 liters of milk is removed and replaced with water. This process is repeated two more times. Find the concentration of milk in the resultant solution?

**Solution:** if 20 litres of mixture is to be drawn from 200 litres of milk, then the concentration of quantity with drawn = $\frac{20}{200}$ x 100 = 10%

After the first operation the quantity of milk will be = 200 – 20 = 180 litres.

After the second operation the quantity of milk will be = $\frac{90}{100}$ x 180 = 162 litres.

After the third operation the quantity of milk will be = $\frac{90}{100}$ x 162 = 145.8 litres

So, the concentration of milk after third operation = $\frac{145.8}{200}$ x 100 = 72.9%