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Today in our blog, we are going to learn questions related to mixtures with the use of alligation in the Quantitative Aptitude Section.

Mixture: The new product obtained by mixing two or more ingredients in a certain ratio is called a mixture or combination of two or more quantities is known as a mixture. A mixture has two types: When two different ingredients are mixed together it is called a simple mixture and when two or more simple mixtures are mixed together, it is called a compound mixture.

Let's discuss some examples of mixture: Water and milk, water and pure spirit, the weight of boys and girls in a classroom, Kerosene and petrol, etc.

Mean price: The cost price of a unit quantity of the mixture is called the mean price. It will always be higher than the cost price of cheaper quantity and lower than the cost price of dearer quantity.

Weighted average mothod

E.g. The average weight of a class of 40 students is 30 and the average weight of the class of 20 students is 15. Find the average weight of both the combined classes? Sol: By the concepts of averages, The required average = (40 × 30 + 20 × 15)/(40 + 20) = (1200 + 300)/60 = 1500/60 = 25 (Ans.)

E.g. 16 liters of kerosene is mixed with 5 liters of petrol. The price of kerosene is rs.12 per liter and the price of petrol is rs. 33 per liter. The average price of the mixture per liter is? Sol: By the concepts of average, The required average = (16 × 12 + 5 × 33) / (16 + 5) = (192 + 165) / 21 = 357 / 21 = 17 (Ans.)

Alligations

The literal meaning of alligation is 'linking'. The **Alligation rule** states that "When different quantities of same or different ingredients, of different cost(value), are mixed together to produce a mean cost(value), the ratio of their quantities are inversely proportional to the difference of their cost from the mean(cost) price."

(Quantity of cheaper cost ingredient) / (Quantity of dearer cost ingredient) = (dearer cost - Mean cost) / (Mean cost - cheaper cost)

or $\mathbf{q_1 / q_2 = (C_2 - C_m) / (C_m - C_1)}$

Where, q_1 = Quantity of cheaper cost ingredient q_2 = Quantity of dearer cost ingredient C_1 = Cost price of cheaper cost ingredient C_2 =Cost price of dearer cost ingredient C_m = Cost price of the mixture(mean price)

Diagram Representation:

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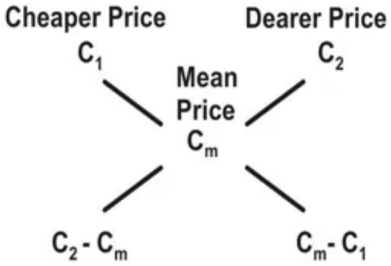
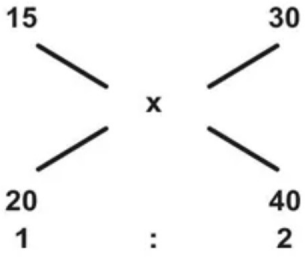


E.g. The average weight of the class of 40 students is 30 and the average weight of the clas s of 20 students is 15. Find the average weight of both the combined classes?

Sol: Alligation method:



In the graphical representation of the solution, x is the weighted average where 15 and 30 are the averages of different classes. Now, the difference between the two averages is divided in the inverse ratio of the quantities written below, so according to the problem difference (15) will be divided in the ratio 2 : 1 = 40 : 20 So, the value of x = 15 + 2/3 × (30 - 15) = 25 (Ans.)

E.g. 16 Litres of kerosene is mixed with 5 liters of petrol. The price of kerosene is Rs.12 per liter and the price of petrol is Rs.33 per liter. The average price of the mixture per liter is: Sol: Alligation method:

The difference of 33 and 12 be divided in the ratio of 16 : 5 ⇒ 33 - 12 = 21 Again, on dividing 21 in the ratio 16 : 5, we get first part = 5 and second part = 16. The average price 12 + 5 = 17 (Ans.)

E.g. In what proportion must a grocer mix teas of Rs.1.02 per kg and Rs.1.44 per kg so as to make a mixture worth Rs.1.26 per kg? Sol: As per alligation rule: ⇒ q_1 / q_2 = (1.44 - 1.26)/(1.26 - 1.02) (As per alligation) ⇒ (0.18)/(0.24) = 3/4 (Ans.)

E.g. A container contains 40 L of milk. From this container, 4 L of milk was taken out and replaced by water. This process was further repeated two times. How much milk is now there in the container? Sol: Original quantity of milk = 40L Since 4L of milk is taken out Quantity of the new mixture would be 40 - 4 = 36L Now, when 4L of the mixture is taken out, Quantity of milk taken out = 4 × 36 / 40 = 3.6L Quantity of milk left = 36 - 3.6 = 32.4L Similarly taken out in the third step: 4 × 32.4 / 40 = 3.24L Quantity of milk left = 32.40 - 3.24 = 29.16L (Ans.)

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This was a really long method. Let's discuss a short trick, If a container initially contains 'a' unit of liquid and 'b' unit of liquid is taken out and it is filled with 'b' unit of another liquid, then after n operations, the final quantity of the original liquid in the container is given as:

$[a(1 - b/a)^n]$ Units

E.g. A container contains 40 L of milk. From this container, 4 L of milk was taken out and replaced by water. This process was further repeated two times. How much milk is now there in the container? Sol: a = 40, b = 4, n = 3 So according to the formula, $40(1 - 4/40)3 = 40(1 - 1/10)^3 = 40(9/10)3 = 40 \times 729/1000 = 29.16$ L (Ans.)

Alligation rule for a mixture of three ingredients:

When three ingredients of quantity q_1 , q_2 and q_3 and cost prices C_1 , C_2 and C_3 are mixed, and the mean cost price (mean price) is C_m then $q_1 : q_2 : q_3 = (C_2 - C_m)\times(C_3 - C_m):(C_m - C_1)\times(C_3 - C_m):(C_2 - C_m) \times (Cm - C_1)$

We learned the concept of alligation which is a surgical strike for mixtures questions, so practice questions by alligation method because it is quick and precise too. Stay in touch for more.

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