

MIXTURE & ALLIGATION

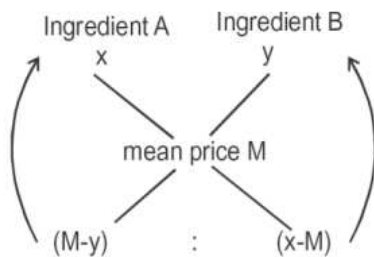
Alligation: It enables us to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of a desired price.

Mean price: The cost price of a unit quantity of the mixture is called the mean price.

Basic Formula: If two ingredients A and B are mixed of price x and y respectively, then the price of resultant mixture is M mean price. The ratio in which ingredients are mixed is given by rule of allegation

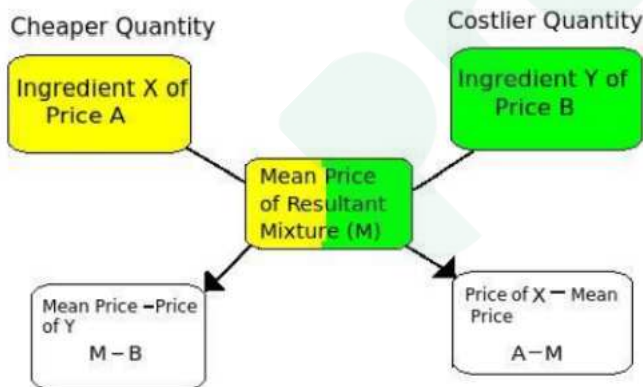
$$R = \frac{M - Y}{X - M}$$

The above formula can be represented as

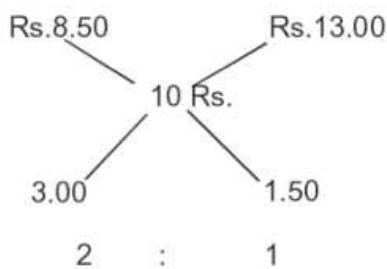


Thus, the required ratio is R

$$R = \frac{M - Y}{X - M} = \frac{Y - M}{M - X}$$

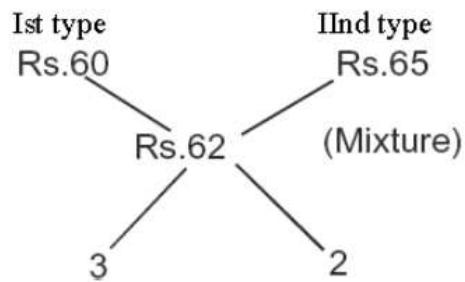


Example 1. In what ratio must rice costing Rs.8.50 per kg be mixed with rice costing Rs.13 per kg so that the mixture be worth Rs.10 per kg?



Example 2. In what ratio must a grocer mix two varieties of sugar costing Rs.60 per kg and Rs.65 per kg, so that on selling the mixture at Rs.68.20 per kg he may gain 10%?

Solution: Cost price of 1 kg of mixture



Required Ratio = 3 : 2

Example 3. 729 Litres of mixtures containing milk and water in the ratio 7 : 2. How much more water should be added so that the new mixture contains milk and water in the ratio 7 : 3 ?.

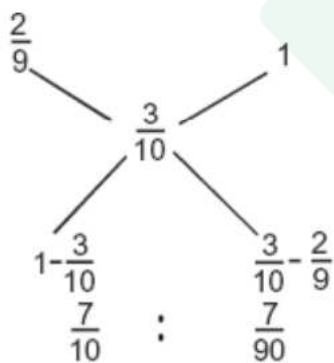
Solution:

729 litre quantity of water = $\frac{2}{9}$

Pure water = 1

Quantity of water in mixture = $\frac{3}{10}$

APPLYING ALLIGATION:



Required Ratio = 9: 1

9 = 729 litre

1 = $\frac{729}{9} \times 1 = 81 \text{ Litres}$

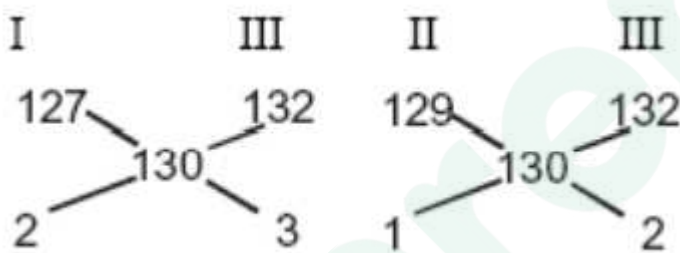
Mixture of more than two elements:

These questions may seem to be a little tricky at first, but a similar concept is applied repeatedly in order to calculate the final ratio of ingredients when a mixture contains more than two ingredients.

1. Take two ingredients in such a way that the first ingredient is lower than the mean value and the other one is higher than mean value.
2. Calculate the ratio of ingredients.
3. Repeat for all possible pairs.
4. Final ratio is the ratio obtained from step 2 (if an ingredient is common in the ratios, add value for this particular ingredient)

Example 4. Three types of Rice of Rs. 1.27, Rs. 1.29 and Rs. 1.32 per kg are mixed together to be sold at Rs. 1.30 per kg. in what ratio should this rice be mixed.

Solution:

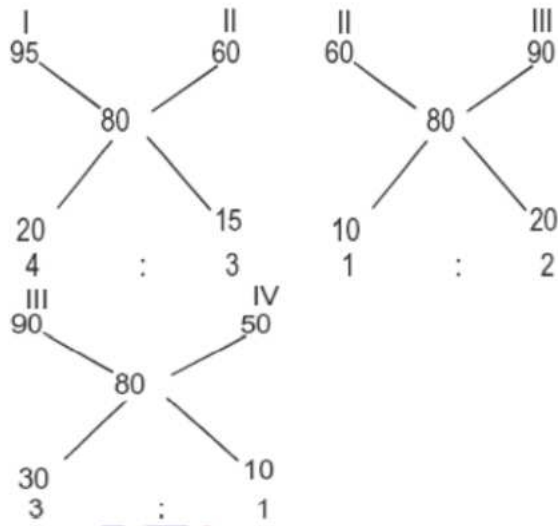


Hence final ratio is 2: 1: 3 + 2 = 2: 1: 5

Mixture containing 4 ingredients:

Example 5. How much does a shop owner mix 4 types of rice worth Rs. 95, Rs. 60, Rs. 90 & Rs. 50 per kg so that he can make the mixture of these rice worth Rs. 80 per kg.

Solution:



I: II: III: IV = 4: 4: 5: 1

Concept of replacement:

Suppose a container contains a - units of liquid from which b -units are taken out and replaced by water- after k-operations, the quantity of pure liquid

$$= \left[a \left(1 - \frac{b}{a} \right)^k \right] \text{ units.}$$

Example 6. 8 litres are drawn from a cask full of wine and is then filled with water. This operation is performed three more times. The ratio of the quantity of wine now left in cask to that of the water is 16 :65. How much wine did the cask hold originally?

Solution. Let initial quantity of wine in a cask = x lit So, After 4 process,

$$4 = \left[x \left(1 - \frac{8}{x} \right)^4 \right] \text{ lit.}$$

$$\therefore \frac{x \left(1 - \frac{8}{x} \right)^4}{x} = \frac{16}{81} \Rightarrow \left(1 - \frac{8}{x} \right)^4 = \left(\frac{2}{3} \right)^4 \Rightarrow \left(\frac{x-8}{x} \right) = \frac{2}{3}$$

$$\Rightarrow 3x - 24$$

$$= 2x \Rightarrow x$$

$$= 24 \text{ lit.}$$

Practice Questions:

Q1. In 330 litres of mixtures of milk and water, water is only 24%. The milkman sold 80 litres of this mixture and then he added 60 litres of pure milk and 26 litres of pure water in the remaining mixture. What is the percentage of water in the final mixture?

- A.39.70%
- B.25.59%
- C.34.68%
- D.37.34%
- E.16.89%

Ans: (B)

Q2. A paint maker has three different qualities of paint. 806 barrels of 1st quality, 930 barrels of 2nd quality and 992 barrels of 3rd quality. Find the least possible number of buckets of equal size in which different paint of different qualities can be filled without mixing?

- (A) 34
- (B) 46
- (C) 26
- (D) 44
- (E) None of these

Ans.(D)

Q3. Two vessels A and B contain milk and water mixed in the ratio 4: 3 and 2: 3. The ratio in which these mixtures be mixed to form a new mixture containing half milk and half water is

- (A) 7: 5
- (B) 6: 5
- (C) 5: 6
- (D) 4: 3

Ans.(A)

Q4. A milkman makes 20% profit by selling milk mixed with water at Rs. 9 per litre. If the cost price of 1 litre pure milk is Rs. 10, then the ratio of milk and water in the said mixture is

- (A) 3: 1
- (B) 4: 1
- (C) 3: 2
- (D) 4: 3

Ans.(A)

Q5. In two types of stainless steel, the ratio of chromium and steel are 2: 11 and 5: 21 respectively. In what proportion should the two types be mixed so that the ratio of chromium to steel in the mixed type becomes 7: 32?

- (A) 2: 3
- (B) 3: 4
- (C) 1: 2
- (D) 1: 3

Ans.(C)

Q6. A vessel has 60 litres of solution of acid and water having 80% acid. How much water can be added to make it a solution in which acid forms 60%?

- (A) 48 litres
- (B) 20 litres
- (C) 36 litres
- (D) None of these

Ans.(B)

Q7. A mixture contains alcohol and water in the ratio 4: 3. If 5 litres of water is added to the mixture, the ratio becomes 4: 5. The quantity of alcohol in the given mixture is

- (A) 3 litres
- (B) 4 litres
- (C) 15 litres
- (D) 10 litres

Ans.(D)

Q8. A Can contains a mixture of two liquids A and B in the ratio 7:5. When 9 litres of mixture are drained off and the Can is filled with B, the ratio of A and B becomes 7: 9. How many litres of liquid A was contained by the Can initially?

(A) 10

(B) 20

(C) 21

(D) 25

Ans.(C)

