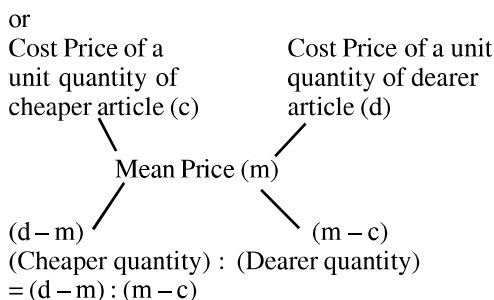# ALLIGATION OR MIXTURE

**Alligation Rule :** When two or more quantities of different values are mixed together to produce a mixture of a mean value, the ratios of their amounts are inversely proportional to the differences of their values from the mean value. Thus,

$$\frac{\text{Amount of Quantity of Smaller value}}{\text{Amount of Quantity of Larger value}}$$

$$= \frac{\text{Larger value} - \text{Mean value}}{\text{Mean value} - \text{Smaller value}}$$

Similarly, if two ingredients (one cheeper and the other dearer) are mixed in a ratio, then

$$\frac{\text{Quantity of Cheaper Article}}{\text{Quantity of Dearer Article}}$$

$$= \frac{\text{CP of Dearer Article} - \text{Mean price}}{\text{Mean price} - \text{CP of Cheaper Article}}$$

or

Cost Price of a unit quantity of cheaper article (c)          Cost Price of a unit quantity of dearer article (d)

Mean Price (m)

(d – m)          (m – c)
(Cheaper quantity) : (Dearer quantity)
= (d – m) : (m – c)

The Alligation Rule has its application in the following situations :

1. When we have to find the proportion in which different ingredients of known values are to be mixed to produce a mixture of a given mean value.
2. When we have to find the mean value of a mixture when the proportion and value of its ingredients are known.
3. When we have to find the mean or average price of a mixture when the proportion and value of its ingredients are known.

## EXERCISE

1. If goods be purchased for ₹ 450 and one - third be sold at loss of 10%, what per cent of profit should be taken on the remainder so as to gain 20% on the whole transaction?
   (a)   35%          (b)   30%
   (c)   40%          (d)   45%
   (e)   None of these

2. Kamal mixes 80 kg sugar worth ₹ 6.75 per kg with 120 kg sugar worth of ₹ 8 per kg. At what rate should he sell the mixture to gain 20%?
   (a)   ₹ 7.50          (b)   ₹ 9

   (c)   ₹ 8.20          (d)   ₹ 8.85
   (e)   None of these

3. A merchant has 50 kg of sugar, part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. The quantity sold at 18% profit is :
   (a)   20 kg          (b)   30 kg
   (c)   15 kg          (d)   35 kg
   (e)   None of these

4. A man travelled a distance of 60 km in 7 hours partly on foot at the rate of 8 km per hour and

partly on bicycle at 16 km per hour. Distance travelled by foot is :

(*a*)   52 km               (*b*)   48 km
(*c*)   36 km               (*d*)   44 km
(*e*)   None of these

**5.** In what ratio should water and wine be mixed so that after selling the mixture at the cost price a profit of 20% is made?

(*a*)   1 : 5               (*b*)   1 : 6
(*c*)   1 : 7               (*d*)   1 : 9
(*e*)   None of these

**6.** Find the quantity of rice @ ₹ 10 per kg which should be mixed with 25 kg of rice @ ₹ 8 per kg, so that on selling the mixture @ ₹ 15 per kg there is 80% profit.

(*a*)   6 kg               (*b*)   7 kg
(*c*)   3 kg               (*d*)   5 kg
(*e*)   None of these

**7.** A trader has 50 kg of rice, a part of which he sells at 14% profit and the rest at 6% loss. On the whole his loss is 4 %. What are the quantities sold at 14% profit and that at 6% loss?

(*a*)   5 kg and 45 kg   (*b*)   5 kg and 55 kg
(*c*)   5 kg and 50 kg   (*d*)   5 kg and 40 kg

(*e*)   None of these

**8.** A sum of rupees 210 made up of coins consisting of rupee, 50 P and 25 P, of which the numbers are proportional to 5, 6 and 8. How many of rupee coins are there?

(*a*)   63               (*b*)   168
(*c*)   105               (*d*)   100
(*e*)   None of these

**9.** A vessel of 80 litre is filled with milk and water. 70% of milk and 30 % of water is taken out of the vessel. It is found that the vessel is vacated by 55% . The initial quantity of milk and water was :
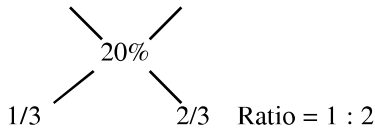
(*a*)   50 litres and 35 litres
(*b*)   50 litres and 30 litres
(*c*)   50 litres and 40 litres
(*d*)   50 litres and 45 litres
(*e*)   None of these

**10.** Two equal glasses are respectively 1/4 and 1/3 full of milk. They are then filled up with water and contents mixed in a tumbler. The ratio of milk and water in the tumbler is :

(*a*)   3 : 11               (*b*)   7 : 17
(*c*)   9 : 23               (*d*)   11 : 23
(*e*)   None of these

## EXPLANATORY ANSWERS

**1. (*a*) :** 1st Part                   2nd Part
– 10%               *x*%
20%
1/3               2/3   Ratio = 1 : 2
We see that 20 – (–10) = 20 + 10 = 30.
As 2 is written in place of 30, there should be 15 in place of 1.
Therefore, $x = 20 + 15 = 35\%$.

**2. (*b*) :** Total CP $= 80 \times 6.75 + 120 \times 8 = ₹\ 1500$

SP per kg $= \dfrac{120 \times 1500}{100 \times 200} = ₹\ 9$.

**3. (*b*) :** 8          18
14
4          6   Ratio = 4 : 6 = 2 : 3

Quantity sold on 18% profit $= \dfrac{50}{5} \times 3$
$= 30$ kg.

**4. (*a*) :** Let the distance travelled by bicycle be *x* km. ∴ The distance travelled on foot will be $(60 - x)$ km.

According to question, $\dfrac{60 - x}{8} + \dfrac{x}{16} = 7$

⇒                   $\dfrac{120 - 2x + x}{16} = 7$

⇒                   $x = 8$
Distance travelled on foot $= 60 - 8 = 52$ km

**5. (*a*) :** Water : Wine = 20 : 100 = 1 : 5.

**6. (*a*) :**   8                   10
$\dfrac{25}{3}$
$\dfrac{1}{5}$               $\dfrac{1}{3}$

CP of the mixture $= 15 \times \dfrac{100}{180} = ₹\ \dfrac{25}{3}$ per kg

$$\frac{\text{Quantity of rice @ ₹ 8 per kg}}{\text{Quantity of rice @ ₹ 10 per kg}} = \frac{5/3}{1/3} = \frac{5}{1}$$

$$\text{Quantity of rice @ ₹ 10 per kg} = 25 \times \frac{1}{5}$$
$$= 5 \text{ kg}$$

**7. (a) :** I Part    II Part

14       (−) 6

(−) 4 (as there is loss on whole)

2       18

So, ratio of quantities sold at 14% profit and 6% loss = 2 : 18 = 1 : 9

So, quantity sold at 14% profit $= \dfrac{50}{10} \times 1$

= 5 kg and sold at 6% loss = 50 − 5 = 45 kg

**8. (c) :** Ratio = 5 : 6 : 8, Value = 5 : 3 : 2

Number of rupee coins $= \dfrac{210}{10} \times 5 = 105.$

**9. (b) :** Here, the % values of milk and water that is taken from the vessel should be taken into consideration.

(Milk) 70%           (Water) 30%

55%

25%         15% $\Rightarrow$ 5 : 3

Ratio of milk to water = 5 : 3

So, quantity of milk $= \dfrac{80}{8} \times 5 = 50$ litres

and quantity of water $= \dfrac{80}{8} \times 3 = 30$ litres

**10. (b) :** Quantity of milk in tumbler = 1/4 + 1/3
$$= 7/12$$

Quantity of water in tumbler
= (1 − 1/4) + (1 − 1/3) = 3/4 + 2/3 = 17/12

So, ratio of milk and water = 7/12 : 17/12
$$= 7 : 17.$$