STAFF SELECTION COMMISSION – Solved Papers

ALLIGATION (Some Important Exercises)

1. A shopkeeper mixes 12 kgs of rice at Rs. 8 per kg with 6 kgs of rice at Rs. 10 per kg. Find the cost per kg of the mixture.

(1) Rs. 8.67 (2) Rs. 8.50

(3) Rs. 7.67 (4) Rs. 7.50

Ans : 1

Total quantity of the mixture

= 12 + 6 = 18 kgs

Cost of 12 kgs of rice @ Rs. 8 per kg = Rs. (12 x 8) = Rs. 96
Cost of 6 kgs of rice @ Rs. 10 per kg.

= Rs. (6 x 10) = Rs. 60

Total cost of 18kgs of the mixture

= Rs. (96 + 60) = Rs. 156

$\therefore$ Cost per kg of the mixture

$$= \frac{\text{Rs.}156}{18\text{kgs}} = \text{Rs.}8.67\,\text{per kg}$$

Because cost of the mixture lies somewhere in the middle of Rs. 8 and Rs. 10, so this type of problem is known as 'Alligation medial'.

2. In what ratio a trader should mix two varieties of tea one at Rs. 62 per kg and other at Rs. 72 per kg in order to obtain the mixture worth Rs. 65 per kg?

(1) 4 : 3 (2) 7 : 3

(3) 8 : 3 (4) 3 : 8

Ans : 2

C.P. of 1 kg tea of cheaper quality = Rs. 62

C.P. of 1 kg tea of dearer quality = Rs. 72.

Mean Price = Rs. 65

1st kind of tea Rs. 62 per kg (c) 2nd kind of tea Rs. 72 per kg (d)

Mean Price per kg Rs. 65

(d-m) = Rs. (72-65) = Rs.7 (m-c) = Rs. (65-62) = Rs.3

Using Alligation Rule.

$$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of dearer tea}} = \frac{d-m}{m-c} = \frac{7}{3}$$

Therefore, they must be mixed in the ratio of 7 : 3.

Since this problem is the inverse of above type problem, it is called 'Alligation alternate'.

3. In a zero there are some pigeons and some rabbits. If their heads are counted these are 300 and if their legs are counted these are 750. Find the number of pigeons in the zoo.

(1) 215 (2) 220

(3) 225 (4) 230

Ans : 3

This problem can be solved in two ways :

1. by Algebra
2. by Alligation Rule

Method I : Let the number of rabbits in the zoo = x

and number of pigeons in the zoo = y

Heads are 300

$\Rightarrow x + y = 300$ .....(i)

(as each one has one head)

As a rabbit has four legs and a pigeon has two legs, total number of legs

$4x + 2y = 750$ .....(ii)

Multiplying equation (i) by 4 and subtracting equation (ii) from it.

We have

$4x + 4y = 1200$

$4x + 2y = 750$

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$2y = 450$

$$\Rightarrow y = \frac{450}{2} = 225$$

$\therefore$ The number of pigeons in the zoo = 225

Method II :

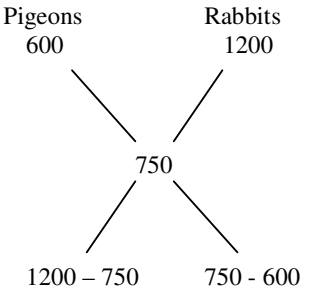
By Alligation Rule

Since there are 300 heads. It means that the number of pigeons and rabbits is 300. A pigeon has two legs and a rabbit has four legs.

If all are pigeons, number of legs = 2 x 300 = 600

If all are rabbits, number of legs = 4 x 300 = 1200

Actual number of legs = 750



Ratio of pigeons and rabbits

$$= \frac{450}{150} = \frac{3}{1} = 3:1$$

Sum of the ratios = 3 + 1 = 4

Their total number = 300.

$\therefore$ Number of pigeons

$$= \frac{3}{4} \times 300 = 225$$

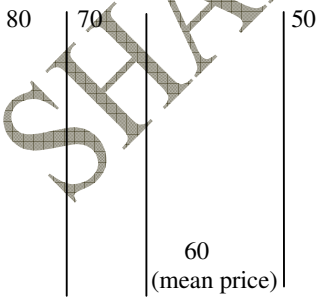
4. In what proportion may three kinds of tea prices @ Rs. 80, Rs. 70 and Rs. 50 per kg be mixed to produce a mixture worth Rs. 60 per kg?

(1) 2 : 2 : 3 (2) 2 : 1 : 3

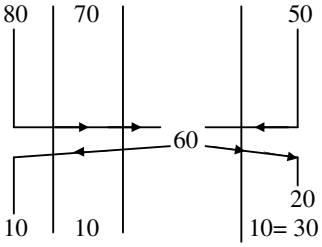
(3) 1 : 2 : 3 (4) 1 : 1 : 3

Ans : 4

Write the prices in ascending or descending order as shown below :



Make pairs by choosing one from each side of the mean price and apply Alligation Rule. Then add the quantity obtained under each price. This will give the ratio in which the ingredients should be mixed.



So, Required ratio

= 10 : 10 : 30 or 1 : 1 : 3.

5. In what proportion may three kinds of rice bought @ Rs. 6, Rs. 10 and Rs. 14 be mixed to produce a mixture which would earn 40% on selling it at Rs. 11.20 per kg?

(1) 4 : 1 : 1 (2) 3 : 1 : 1

(3) 2 : 1 : 1 (4) 2 : 2 : 1

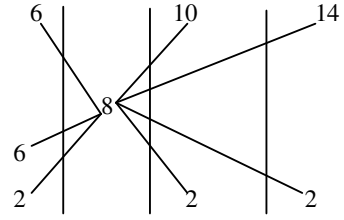
Ans : 1

SP of mixture = Rs. 11.20 per kg.

Profit = 40%

CP of mixture

$$= 11.20 \times \frac{100}{140} = \text{Rs. } 8 \text{ per kg}$$



= 8

Required ratio

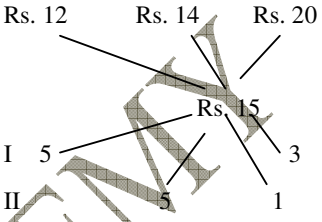
= 8 : 2 : 2 or 4 : 1 : 1.

6. Find the proportion in which three types of sugar at Rs. 12, Rs. 14 and Rs. 20 may be mixed so as to obtain a mixture worth Rs. 15 per kg?

(1) 15 : 5 : 6 (2) 5 : 15 : 6

(3) 3 : 12 : 16 (4) 4 : 12 : 15

Ans : 2



Required proportion

= 5 : 5 : (3 + 1) or 5 : 5 : 4.

Note : We can find other alternatives too by adding multiples of the quantities obtained at I and II. This will give us infinite number of alternatives. Care must be taken not to mix up quantities of one pair with another.

For example,

(i) I 5 | 3
II | (5 x 2) | (1 x 2)
5 | 10 | 5

= 5 : 10 : 5 = 1 : 2 : 1

(ii) I 5 x 2 | 3 x 2
II | 5 | 1
10 | 5 | 7

= 10 : 5 : 7

(iii) I 5 3
II 5 x 3 1 x 3
5 15 6

= 5 : 15 : 6

7. Two vessels A and B contain milk and water in the ratios 7 : 5 and 17 : 7 respectively. In what ratio mixture from two vessels should be mixed to get

a new mixture containing milk and water in the ratio 5 : 3?

(1) 1 : 3 (2) 2 : 3

(3) 2 : 1 (4) 3 : 2

Ans : 3

First of all we write the fraction of milk present in three mixtures.

Mixture A.

Ratio of milk and water = 7 : 5

Sum of the ratios = 7 + 5 = 12

$\therefore$ Fraction of milk $= \frac{7}{12}$

Similarly,

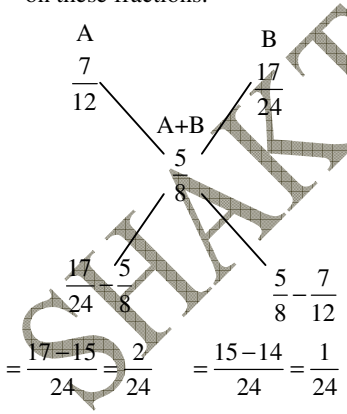
In mixture B,

Fraction of milk $= \frac{17}{24}$

In combination of A and B.

Fraction of milk $= \frac{5}{8}$

We now apply Alligation Rule on these fractions.



$\therefore$ Ratio of A & B

$= \frac{2}{24} : \frac{1}{24} = 2:1$

8. Two vessels A and B contain mixtures of milk and water in the ratios 4 : 1 and 9 : 11 respectively. They are mixed in the ratio of 3 : 2. Find the ratio of milk and water in the resulting mixture.

(1) 12 : 25 (2) 15 : 37

(3) 17 : 19 (4) 33 : 17

Ans : 4

First of all we write the fraction of milk and water in each mixture.

	Milk	Water
A	$\frac{4}{5}$	$\frac{1}{5}$
B	$\frac{9}{20}$	$\frac{11}{20}$

Both A and B are mixed in the ratio 3 : 2

$\therefore$ (3A + 2B) will have ratio of milk and water as follows :

Milk : Water $= \left(3\times\frac{4}{5}+\frac{2\times9}{20}\right) : \left(3\times\frac{1}{5}+\frac{2\times11}{20}\right)$

$= \left(\frac{12}{5}+\frac{9}{10}\right) : \left(\frac{3}{5}+\frac{11}{10}\right)$

$= \frac{33}{10} : \frac{17}{10} = 33:17$

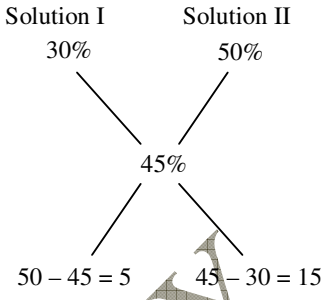
So, ratio of milk and water in the resulting mixture = 33 : 17

9. A person has two solutions of sugar with 30% and 50% concentration respectively. In what ratio should be mix two solutions to get 45% concentration in the resulting mixture?

(1) 1 : 3 (2) 2 : 3

(3) 2 : 5 (4) 5 : 2

Ans : 1



$\therefore$ $\frac{\text{30\% Concentrated Solution}}{\text{50\% Concentrated Solution}}$

$= \frac{5}{15} = \frac{1}{3}$

Hence, the required ratio

= 1 : 3

10. 49 litres of milk has 80% milk concentration. How much water be added to make its concentration 70%?

(1) 6 litres (2) 7 litres

(3) 6.5 litres (4) 7.5 litres

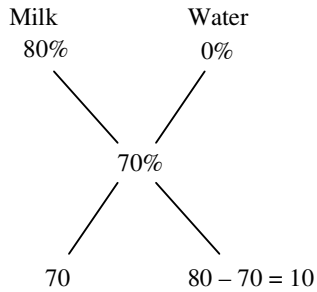
Ans : 2

The given milk has 80% concentration of milk.

Water to be added has 0% milk concentration.

Final concentration of solution is 70%.

By Alligation Rule.



So, water should be added to the given milk in the ratio 10 : 70 or 1 : 7.

$\therefore$ Quantity of water to be added $= \frac{1}{7} \times 49 = 7$ litres

11. 6 litres of milk and water mixture has 75% milk in it. How much milk should be added to the mixture to make it 90% pure?

(1) 10 litres (2) 8 litres

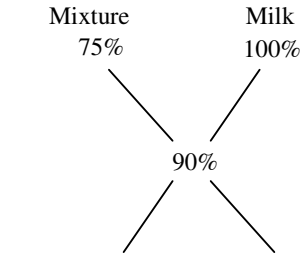
(3) 9 litres (4) 12 litres

Ans : 3

The given solution has 75% milk.

Milk to be added has 100% milk.

By Alligation Rule



Ratio = 10 : 15 = 2 : 3

$\therefore$ Milk should be added to the given mixture in the ratio 3 : 2.

$\therefore$ Quantity of milk to be added

$= \frac{3}{2} \times 6 = 9$ litres

12. 12 litres of a mixture has wine and water in the ratio 2 : 3. How much water must be added to get wine to water ratio of 3 : 7 in the resultant mixture?

(1) 16 litres (2) 15 litres

(3) 12 litres (4) 10 litres

Ans : 4

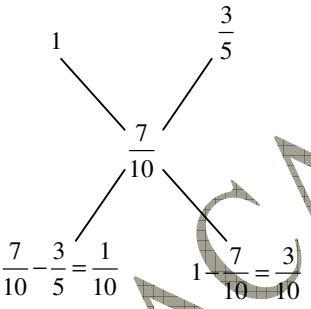
In the given mixture, wine : water = 2 : 3

Fraction of water in the given mixture $= \frac{3}{5}$

For water to be added, fraction = 1

Fraction of water in the resultant mixture $= \frac{7}{10}$

Water Given mixture



So, water must added to the mixture in the ratio 1 : 3.

Quantity of water to be added

$= \frac{1}{3} \times 12 = 4$ litres

13. 55 litres of a mixture has milk and water in the ratio 7 : 4. How much water must be added to get milk and water in the ratio 7 : 6 in the resulting mixture.

(1) 16 litres (2) 15 litres

(3) 12 litres (4) 10 litres

Ans : 4

Milk : Water = 7 : 4

Sum of the ratios = 7 + 4 = 11

$\therefore$ Fraction of water in the given mixture $= \frac{4}{11}$

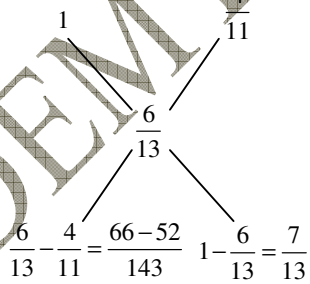
For water to be added, fraction = 1

Similarly,

Fraction of water in the resulting mixture $= \frac{6}{13}$

By Alligation Rule:

Water Mixture



So, water must be added to the mixture in the ratio $= \frac{14}{143} : \frac{7}{13}$

or, $\frac{2}{11} : 1 = 2 : 11$

$\therefore$ Quantity of water to be added

$= \frac{2}{11} \times 55 = 10$ litres.