Alligation or Mixture 15

INTRODUCTION

Alligation literally means 'linking'. It is a rule to find:
 (a) the ratio in which two or more ingredients at their respective prices should be mixed to give a mixture at a given price.
 (b) The mean or average price of a mixture when the prices of two or more ingredients which may be mixed together and the proportion in which they are mixed are given.

Here, cost price of a unit quantity of a mixture is called the 'mean price'.

Alligation Rule

Suppose, ₹d per unit be the price of first ingredient (superior quality) mixed with another ingredient (cheaper quality) of price ₹c per unit to form a mixture whose mean price is ₹m per unit, then the two ingredients must be mixed in the ratio:

$$\frac{\text{Quantity of cheaper}}{\text{Quantity of superior}} = \frac{\text{C.P. superior} - \text{Mean price}}{\text{Mean price} - \text{C.P. of cheaper}}$$

i.e., the two ingredients are to be mixed in the inverse ratio of the differences of their prices and the mean price.

The above rule may be represented schematically as under:
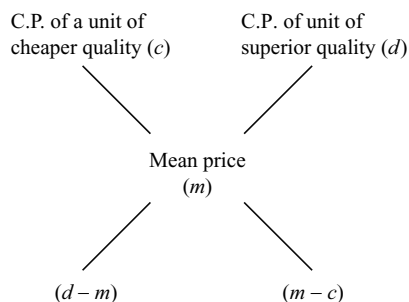
$$\frac{\text{Quantity of cheaper quality}}{\text{Quantity of superior quality}} = \frac{d-m}{m-c}$$

Explanation: Suppose, x Kg of cheaper quality is mixed with y Kg of superior quality.

Price of cheaper ingredient = ₹cx
Price of superior ingredient = ₹dy
∴ Price of mixture = ₹$(cx + dy)$
and quantity of mixture = $(x + y)$ Kg.

∴ Price of mixture/Kg = ₹$\left(\dfrac{cx+dy}{x+y}\right)$

∴ $\dfrac{cx+dy}{x+y} = m$ ⇒ $cx + dy = mx + my$

⇒ $dy - my = mx - cx$

⇒ $y(d - m) = x(m - c)$

⇒ $\dfrac{x}{y} = \dfrac{d-m}{m-c}$.

Illustration 1: In what ratio two varieties of tea, one costing ₹27 per Kg and the other costing ₹32 per Kg, should be blended to produce a blended variety of tea worth ₹30 per Kg. How much should be the quantity of second variety of tea, if the first variety is 60 Kg.

Solution:
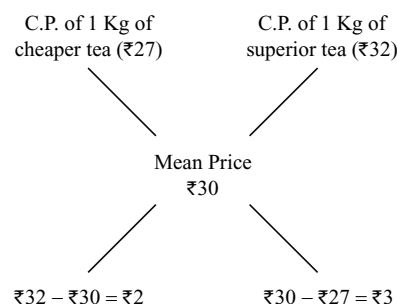
The required ratio of the two varieties of tea is 2:3, i.e.,

$$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of superior tea}} = \frac{2}{3}$$

∴ Quantity of superior tea = $\dfrac{60 \times 3}{2}$ = 90 Kg

Thus, the second variety of tea is 90 Kg.

Illustration 2: Sugar at ₹15 per Kg is mixed with sugar at ₹20 per Kg in the ratio 2:3. Find the per Kg price of the mixture.

Solution: Let, the mean price of the mixture be ₹x

C.P. of 1 Kg of cheaper sugar (₹15) C.P. of 1 Kg of superior sugar (₹20)

Mean Price ₹x
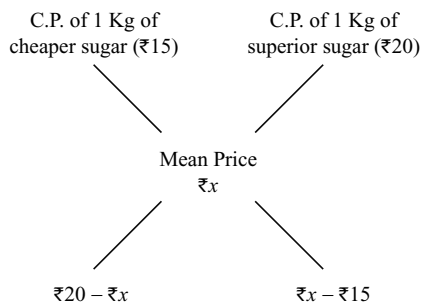
₹20 – ₹x ₹x – ₹15

$$\frac{\text{Quantity of cheaper sugar}}{\text{Quantity of dearer sugar}} = \frac{20-x}{x-15}$$

$\therefore \quad \dfrac{20-x}{x-15} = \dfrac{2}{3}$

$\Rightarrow \quad 60 - 3x = 2x - 30$

$\Rightarrow \quad 5x = 90$ or, $x = 18$.

Thus, the per Kg price of the mixture is ₹18.

SOME USEFUL SHORTCUT METHODS

1. A vessel, full of wine, contains a litres of it of which b litres are withdrawn. The vessel is then filled with water. Next, b litres of the mixture are withdrawn and, again the vessel is filled with water. This process is repeated n times. Then

$$\frac{\text{Wine left in the vessel after } n\text{th operation}}{\text{Original quantity of wine in the vessel}} = \left(\frac{a-b}{a}\right)^n$$

Explanation

Amount of wine after the first operation

$$= a - b = \left(1 - \frac{b}{a}\right) \times c$$

Ratio of wine and water after the first operation is $(a - b):b$.

$\therefore$ In b litres of mixture withdrawn in the second operation, amount of wine withdrawn

$$= \frac{a-b}{(a-b)+b} \times b = (a - b)\frac{b}{a}$$

$\therefore$ Amount of wine left after the second operation

$$= (a - b) - (a - b) \times \frac{b}{a} = \left(1 - \frac{b}{a}\right)^2 a$$

In general, quantity of wine left after nth operation

$$= \left(1 - \frac{b}{a}\right)^n a$$

$\therefore \quad \dfrac{\text{Wine left after } n\text{th operation}}{\text{Original quantity of wine}} = \left(1 - \dfrac{b}{a}\right)^n.$

Illustration 3: A vessel contains 125 litres of wine. 25 litres of wine was taken out of the vessel and replaced by water. Then, 25 litres of mixture was withdrawn and again replaced by water. The operation was repeated for the third time. How much wine is now left in the vessel?

Solution: Amount of wine left in the vessel

$$= \left(1 - \frac{25}{125}\right)^3 \times 125 = \frac{100 \times 100 \times 100 \times 125}{125 \times 125 \times 125} = 64 \text{ litres.}$$

2. There are n vessels of equal size filled with mixtures of liquids A and B in the ratio $a_1:b_1:a_2, b_2...,a_n:b_n$, respectively. If the contents of all the vessels are poured into a single large vessel, then

$$\frac{\text{Quantity of liquid } A}{\text{Quantity of liquid } B} = \frac{\left(\dfrac{a_1}{a_1+b_1} + \dfrac{a_2}{a_2+b_2} + \cdots + \dfrac{a_n}{a_n+b_n}\right)}{\left(\dfrac{b_1}{a_1+b_1} + \dfrac{b_2}{a_2+b_2} + \cdots \dfrac{b_n}{a_n+b_n}\right)}$$

Explanation Let the capacity of each vessel be c litres. Amount of liquid A in different vessels

$$= \frac{a_1 c}{a_1+b_1}, \frac{a_2 c}{a_2+b_2}, \frac{a_3 c}{a_3+b_3}, \cdots, \frac{a_n c}{a_n+b_n}$$

Amount of liquid B in different vessels

$$= \frac{b_1 c}{a_1+b_1}, \frac{b_2 c}{a_2+b_2}, \frac{b_3 c}{a_3+b_3}, \cdots \frac{b_n c}{a_n+b_n}$$

So, in the resulting mixture, amount of liquid A

$$= \left(\frac{a_1}{a_1+b_1} + \frac{a_2}{a_2+b_2} + \cdots + \frac{a_n}{a_n+b_n}\right) \times c$$

Amount of liquid B

$$= \left(\frac{b_1}{a_1+b_1} + \frac{b_2}{a_2+b_2} + \cdots + \frac{b_n}{a_n+b_n}\right) \times c$$

$$\frac{\text{Quantity of liquid } A}{\text{Quantity of liquid } B} = \frac{\left(\dfrac{a_1}{a_1+b_1} + \dfrac{a_2}{a_2+b_2} + \cdots + \dfrac{a_n}{a_n+b_n}\right)}{\left(\dfrac{b_1}{a_1+b_1} + \dfrac{b_2}{a_2+b_2} + \cdots + \dfrac{b_n}{a_n+b_n}\right)}.$$

Illustration 4: Three equal glasses are filled with mixture of milk and water. The proportion of milk and water in each glass is as follows: In the first glass as 3:1, in the second glass as 5:3 and in the third as 9:7. The contents of the three glasses are emptied into a single vessel. What is the proportion of milk and water in it?

Solution:

$$\frac{\text{Quantity of milk}}{\text{Quantity of water}} = \frac{\dfrac{3}{3+1} + \dfrac{5}{5+3} + \dfrac{9}{9+7}}{\dfrac{1}{3+1} + \dfrac{3}{5+3} + \dfrac{7}{9+7}} = \frac{31/16}{17/16}$$

$$= 31{:}17.$$

> 3. There are n vessels of sizes c_1, c_2, $\cdots$, c_n filled with mixtures of liquids A and B in the ratio $a_1:b_1$, $a_2:b_2$, $\cdots$, $a_n:b_n$, respectively. If the contents of all the vessels are poured into a single large vessel, then
>
> $$\frac{\text{Quantity of Liquid } A}{\text{Quantity of liquid } B} = \frac{\dfrac{a_1c_1}{a_1+b_1} + \dfrac{a_2c_2}{a_2+b_2} + \cdots + \dfrac{a_nc_n}{a_n+b_n}}{\dfrac{b_1c_1}{a_1+b_1} + \dfrac{b_2c_2}{a_2+b_2} + \cdots + \dfrac{b_nc_n}{a_n+b_n}}$$

Illustration 5: Three glasses of sizes 3 litres, 4 litres and 5 litres, contain mixture of milk and water in the ratio 2:3, 3:7 and 4:11, respectively. The contents of all the three glasses are poured into a single vessel. Find out ratio of milk to water in the resulting mixture.

Solution: $\dfrac{\text{Quantity of milk}}{\text{Quantity of water}}$

$$= \frac{\left(\dfrac{2\times3}{2+3} + \dfrac{3\times4}{3+7} + \dfrac{4\times5}{4+11}\right)}{\left(\dfrac{3\times3}{2+3} + \dfrac{7\times4}{3+7} + \dfrac{11\times5}{4+11}\right)}$$

$$= \frac{\dfrac{6}{5} + \dfrac{12}{10} + \dfrac{20}{15}}{\dfrac{9}{5} + \dfrac{28}{10} + \dfrac{55}{15}} = 56.124$$

or, 14:31

EXERCISE-1

1. How many Kg of tea, worth ₹25 per Kg, must be blended with 30 Kg of tea worth ₹30 per Kg, so that by selling the blended variety at ₹30 per Kg there should be a gain of 10%?

(a) 36 Kg   (b) 40 Kg
(c) 32 Kg   (d) 42 Kg

2. How much water be added to 14 litres of milk worth ₹5.40 a litre so that the value of the mixture may be ₹4.20 a litre?

(a) 7 litres   (b) 6 litres
(c) 5 litres   (d) 4 litres

3. In what ratio two varieties of tea, one costing ₹25 per Kg and the other costing ₹30 per Kg should be blended to produce blended variety of tea worth ₹28 per Kg?

(a) 3:4   (b) 4:3
(c) 2:3   (d) 3:5

4. In an examination out of 80 students 85% of the girls and 70% of the boys passed. How many boys appeared in the examination if total pass percentage was 75%?

(a) 370   (b) 340
(c) 320   (d) 360

5. In what proportion must tea worth 75 paise per packet be mixed with tea worth ₹5.50 per packet so that the mixture may cost ₹4.50 per packet?

(a) 3:11   (b) 4:15
(c) 15:11   (d) 4:5

6. How many Kg of sugar costing ₹5.50 per Kg must be mixed with 60 Kg of sugar costing ₹4.80 per Kg so that the mixture is worth ₹5.25 per Kg?

(a) 90 Kg   (b) 95 Kg
(c) 108 Kg   (e) 106 Kg

7. How many Kg of sugar costing ₹5.75 per Kg should be mixed with 75 Kg of cheaper sugar costing ₹4.50 per Kg, so that the mixture is worth ₹5.50 per Kg?

(a) 250 Kg   (b) 300 Kg
(c) 350 Kg   (d) 325 Kg

8. In what ratio must water be added to spirit to gain 10% by selling it at the cost price?

(a) 1:11   (b) 1:5
(c) 1:10   (d) 1:9

9. 300 gm of salt solution has 40% salt in it. How much salt should be added to make it 50% in the solution?
   (a) 40 gm
   (b) 60 gm
   (c) 70 gm
   (d) 80 gm

10. A man buys two cows for ₹1350 and sells one, so as to lose 6%, and the other so as to gain 7.5% and on the whole he neither gains nor loses. What does each cow cost?
    (a) 750, 500
    (b) 750, 600
    (c) 600, 500
    (d) 700, 650

11. There are 65 students in a class, 39 rupees are distributed among them so that each boy gets 80 Paise and girl gets 30 Paise. Find out the number of boys and girls in that class.
    (a) 43, 40
    (b) 36, 33
    (c) 39, 26
    (d) 45, 42

12. A trader has 50 Kg of sugar, a part of which he sells at 10% profit and the rest at 5% loss. He gains 7% on the whole. What is the quantity sold at 10% gain and 5% loss?
    (a) 40 Kg, 10 Kg
    (b) 10 Kg, 35 Kg
    (c) 25 Kg, 15 Kg
    (d) 30 Kg, 20 Kg

13. A person has ₹5000. He invests a part of it at 3% per annum and the remainder at 8% per annum simple interest. His total income in 3 years is ₹750. Find the sum invested at different rates of interest.
    (a) ₹2000, ₹1000
    (b) ₹3000, ₹1000
    (c) ₹1000, ₹4000
    (d) ₹3000, ₹2000

14. Some amount out of ₹7000 was lent at 6% p.a. and the remaining at 4% p.a. If the total simple interest from both the fractions in 5 years was ₹1600, the sum lent at 6% p.a. was
    (a) ₹3000
    (b) ₹4000
    (c) ₹5000
    (d) ₹2000

15. 729 ml of a mixture contains milk and water in the ratio 7:2. How much more water is to be added to get a new mixture containing milk and water in the ratio 7:3?
    (a) 600 ml
    (b) 710 ml
    (c) 520 ml
    (d) None of these

16. In what proportion water must be added to spirit to gain 20% by selling it at the cost price?
    (a) 1:5
    (b) 2:5
    (c) 3:5
    (d) 4:5

17. The average monthly salary of employees, consisting of officers and workers of an organization is ₹3000. The average salary of an officer is ₹10000 while that of a worker is ₹2000 per month. If there are total 400 employees in the organization, find out the number of officers and workers separately.
    (a) 50, 275
    (b) 350, 450
    (c) 50, 350
    (d) 325, 350

18. A person covers a distance 100 Kms in 10 hours, partly by walking at 7 Km/h and rest by running at 12 Km/h. Find out the distance covered in each part.
    (a) 28 Km, 72 Km
    (b) 32 Km, 82 Km
    (c) 24 Km, 68 Km
    (d) 26 Km, 70 Km

19. The average weekly salary per head of all employees (supervisors and labourers) is ₹100. The average weekly salary per head of all the supervisors is ₹600, while the average weekly salary per head of all the labourers is ₹75. Find out the number of supervisors in the factory if there are 840 labourers in it.
    (a) 46
    (b) 42
    (c) 44
    (d) 48

20. A person has a chemical of ₹25 per litre. In what ratio should water be mixed in that chemical, so that after selling the mixture at ₹20/litre he may get a profit of 25%?
    (a) 13:16
    (b) 16:9
    (c) 12:15
    (d) 19:22

21. A person travels 285 Km in 6 hours in two stages. In the first part of the journey, he travels by bus at the speed of 40 Km/h. In the second part of the journey, he travels by train at the speed of 55 Km/h. How much distance did he travel by train?
    (a) 205 Km
    (b) 145 Km
    (c) 165 Km
    (d) 185 Km

22. A trader has 50 Kg of pulses, part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. What is the quantity sold at 18% profit?
    (a) 30 Kg
    (b) 25 Kg
    (c) 20 Kg
    (d) 40 Kg

23. A trader has 50 Kg of rice, a part of which he sells at 10% profit and the rest at 5% loss. He gains 7% on the whole. What is the quantity sold at 10% gain and 5% loss?
    (a) 30 Kg, 10 Kg
    (b) 40 Kg, 15 Kg
    (c) 35 Kg, 40 Kg
    (d) 40 Kg, 10 Kg

24. Mira's expenditure and savings are in the ratio 3:2. Her income increases by 10%. Her expenditure also increases by 12%. By how many % does her saving increase?
    (a) 7%
    (b) 10%
    (c) 9%
    (d) 13%

EXERCISE-2
(BASED ON MEMORY)

1. 40 litres of mixture of milk and water contains 10% of water. The water to be added to make the water content 20% in the new mixture is:

(a) 6 litres   (b) 6.5 litres

(c) 5.5 litres   (d) 5 litres

[SSC (GL) Prel. Examination, 2003]

2. 1 litre of water is added to 5 litres of alcohol–water solution containing 40% alcohol strength. The strength of alcohol in the new solution will be:

(a) 30%   (b) 33%

(c) $33\frac{2}{3}\%$ (d) $33\frac{1}{3}\%$

[SSC (GL) Prel. Examination, 2007]

3. Two types of steel are available. Type A contains 5% of nickel and type B contains 40% of nickel. How much of each type be mixed to obtain 140 tonnes of steel containing 30% of nickel?

(a) 40, 100 tonnes   (b) 50, 125 tonnes

(c) 30, 75 tonnes   (d) 60, 180 tonnes

[SSC (GL) Asstt. Grade Main Examination, 2000]

4. Two alloys, A and B, contain silver and copper in the ratio 5:1 and 7:2, respectively. Find the ratio in which they be mixed such that there be 80% of silver.

(a) 3:2   (b) 2:3

(c) 1:3   (d) 3:4

[SSC Asstt. Grade Main Examination, 1998]

5. In what ratio water should be mixed with a liquid at ₹12 per litre so that by selling the mixture at ₹13.75 per litre, the seller gains 25%?

(a) 1:11   (b) 1:15

(c) 1:17   (d) 1:13

[SSC Assistant Grade Main Examination, 1992]

6. A tea seller mixes two kinds of tea one at ₹15 Kg and other at ₹20 per Kg. In what ratio should he mix them to get the price of mixture at ₹16.50 per Kg?

(a) 8:3   (b) 5:7

(c) 7:3   (d) 7:5

[SSC UDC Examination, 1996]

7. A tea producer mixes two categories of tea from two gardens is the ratio 5:3. The cost price of one category is ₹27 per Kg and that of other is ₹30 per Kg. The mixture is sold at ₹30.25 a Kg. Find his gain per cent.

(a) $8\frac{5}{3}$ (b) $7\frac{5}{9}$

(c) $9\frac{5}{9}$ (d) $11\frac{5}{9}$

[SSC Auditor's Examination, 1994]

8. A jar full of whisky contains 40% of alcohol. A part of this whisky is replaced by another containing 19% alcohol and, now the percentage of alcohol was found to be 26. The quantity of whisky replaced is:

(a) $\frac{2}{5}$ (b) $\frac{1}{3}$

(c) $\frac{2}{3}$ (d) $\frac{3}{5}$

[Hotel Management Examination, 1991]

9. In a mixture of 60 litres, the ratio of milk and water is 2:1. If the ratio of the milk and water is to be 1:2, then the amount of water to be further added is:

(a) 20 litres   (b) 30 litres

(c) 40 litres   (d) 60 litres

[NDA Examination, 1990]

10. A solution of sugar syrup has 15% sugar. Another solution has 5% sugar. How many litres of the second solution must be added to 20 litres of the first solution to make a solution of 10% sugar?

(a) 10   (b) 5

(c) 15   (d) 20

[LIC AAO Examination, 1988]

11. A part of sum of ₹10000 is lent at 8% and the remaining sum at 10% per annum. If the average rate of interest is 9.2%, then the two parts are:

(a) ₹4000, ₹6000

(b) ₹5500, ₹4500

(c) ₹5000, ₹5000

(d) ₹5500, ₹4500

[SSC (GL) Prel. Examination, 1993]

12. Zinc and copper are in the ratio of 5:3 in 200 gm of an alloy. How much gm of copper be added to make the ratio of 3:5?

(a) $133\frac{1}{3}$ (b) $\frac{1}{200}$

(c) 72   (d) 66

[SSC (GL) Prel. Examination, 2002]

13. The wheat sold by a grocer contained 10% low quantity wheat. What quantity of good quality wheat should be added to 150 Kg of wheat so that the percentage of low quality wheat become 5%?
    (a) 150 Kg   (b) 135 Kg
    (c) 50 Kg   (d) 85 Kg
    (e) None of these
    [SBI Associate Banks PO Examination, 2002]

14. Tea at ₹126 per Kg and at ₹135 per Kg are mixed with a third variety in the ratio 1:1:2.
    If the mixture is worth ₹153 per Kg, the price of the third variety per Kg is:
    (a) ₹169.50   (b) ₹175.50
    (c) ₹175   (d) ₹185
    [SSC CPO (SI) Examination, 2003]

15. A shopkeeper sells milk which contains 5% water. What quantity of pure milk should be added to 2 litres of milk (containing 5% water) so that proportions of water become 4%?
    (a) 1 litre   (b) 2 litres
    (c) 0.5 litre   (d) None of these
    [SBI Mumbai Bank PO Examination, 2000]

16. What quantity of water should be added to 3 litres of 10% solution of salt, so that it becomes 5% salt solution?
    (a) 1.5 litres   (b) 2.7 litres
    (c) 3 litres   (d) Cannot be determined
    (e) None of these
    [ECGC of India Ltd, Bank PO Examination, 2001]

17. A container contains 10 litres mixture in which there is 10% sulphuric acid. How much sulphuric acid is to be added to make the solution to contain 25% sulphuric acid?
    (a) 2 litres   (b) 1 litre
    (c) 4 litres   (e) Data inadequate
    (e) None of these
    [BSRB Baroda Bank Clerical Examination, 2000]

18. A painter mixes colour paint with white colour so that the mixture contains 10% blue colour. In a mixture of 40 litres colour, how many litres blue colour should be added so that the mixture contains 20% of blue colour?
    (a) 2.5 litres   (b) 4 litres
    (c) 5 litres   (d) 2 litres
    (e) None of these
    [BSRB Lucknow Bank Clerical Examination, 2000]

19. A mixture of 66 litres of milk and water are in the ratio of 5:1, water is added to make the ratio 3:5. Find the quantity of water added.

    (a) 20 litres   (b) 18 litres
    (c) 22 litres   (d) 24 litres
    [LIC AAO Examination, 1998]

20. A petrol pump owner mixed leaded and unleaded petrol in such a way that the mixture contains 10% unleaded petrol. What quantity of leaded petrol should be added to 1 litre mixture, so that the percentage of unleaded petrol becomes 5%?
    (a) 1000 ml   (b) 900 ml
    (c) 1900 ml   (d) 1800 ml
    [SBI Associates PO, Examinatin, 1999]

21. Kantilal mixes 80 Kg of sugar worth of ₹6.75 per Kg with 120 Kg worth of ₹8 per Kg. At what rate shall he sell the mixture to gain 20%?
    (a) ₹7.50   (b) ₹9
    (c) ₹8.20   (d) ₹8.85
    [BSRB Bhopal Examination, 1998]

22. Jaydeep purchased 25 Kg of rice at the rate of ₹16.80 per Kg and 35 Kg of rice at the rate of ₹25.50 per Kg. He mixed the two and sold the mixture. Approximately, at what price per Kg did he sell the mixture to make 25 per cent profit?
    (a) ₹26.50   (b) ₹27.50
    (c) ₹28.50   (d) ₹30.00
    [BSRB Mumbai PO Examination, 1998]

23. Jagtap purchases 30 Kg of wheat at the rate of ₹11.50 per Kg and 20 Kg of wheat at the rate of ₹14.25 per Kg. He mixed the two and sold the mixture. Approximately at what price per Kg should he sell the mixture to make 30 percent profit?
    (a) ₹16.30   (b) ₹18.20
    (c) ₹15.60   (d) ₹14.80
    [BSRB Calcutta PO Examination, 1999]

24. Prabha purchased 30 Kg of rice at the rate of ₹17.50 per Kg and another 30 Kg rice at a certain rate. He mixed the two and sold the entire quantity at the rate of ₹18.60 per Kg and made 20 per cent overall profit. At what price per Kg did he purchase the lot of another 30 Kg rice?
    (a) ₹14.50   (b) ₹12.50
    (c) ₹15.50   (d) ₹13.50
    [BSRB Chennai PO Examination, 2000]

25. A grocer purchased 20 Kg of rice at the rate of ₹15 per Kg and 30 Kg of rice at the rate of 13 per Kg. At what price per Kg should he sell the mixture to earn $33\frac{1}{3}$% profit on the cost price?

(a) ₹28.00   (b) ₹20.00

(c) ₹18.40   (d) ₹17.40

[BSRB Delhi PO Examination, 2000]

26. The ratio of milk and water in mixtures of four containers are 5:3, 2:1, 3:2 and 7:4, respectively. In which container the quantity of milk, relative to water is minimum?

(a) First   (b) Second

(c) Third   (d) Fourth

[SSC (GL) Examination, 2010]

27. *A* can contains a mixture of two liquids *A* and *B* in the ratio 7:5. When 9 litres of mixture are drawn of and the can is filled with *B*, the ratio of *A* and *B* becomes 7:9. Litres of liquid *A* contained by the can initially was:

(a) 10   (b) 20

(c) 21   (d) 25

[SSC (GL) Examination, 2011]

28. In a mixture of milk and water, the proportion of water by weight was 75%. If in the 60 gm mixture, 15 gm water was added, what would be the percentage of water? (Weight in gm)

(a) 75%   (b) 88%

(c) 90%   (d) None of these

[IOB PO Examination, 2009]

29. The ratio of the quantities of an acid and water in a mixture is 1:3. If 5 litres of acid is further added to the mixture, the new ratio becomes 1:2. The quantity of new mixture in litres is:

(a) 32   (b) 40

(c) 42   (d) 45

[SSC (GL) Examination, 2011]

30. An alloy contains copper, zinc and nickel in the ratio of 5:3:2. The quantity of nickel in Kg that must be added to 100 Kg of this alloy to have the new ratio 5:3:3 is:

(a) 8   (b) 10

(c) 12   (d) 15

[SSC (GL) Examination, 2011]

31. In three vessels, the ratio of water and milk is 6:7, 5:9 and 8:7, respectively. If the mixture of the three vessels is mixed, then what will be the ratio of water and milk?

(a) 2431:3781   (b) 3691:4499

(c) 4381:5469   (d) None of these

[UPPCS Examination, 2012]

32. 20 litres of a mixture contains 20% alcohol and the rest is water. If 4 litres of water be mixed in it, the percentage of alcohol in the new mixture will be:

(a) $33\frac{1}{3}\%$ (b) $16\frac{2}{3}\%$

(c) 25%   (d) $12\frac{1}{2}\%$

[SSC Examination, 2014]

33. There are two containers of equal capacity. The ratio of milk to water in the first container is 3:1, in the second container 5:2. If they are mixed up, the ratio of milk to water in the mixture will be:

(a) 28:41   (b) 41:28

(c) 15:41   (d) 41:15

[SSC Examination, 2014]

34. Sourav purchased 30 Kg of rice at the rate of ₹10 per Kg and 35 Kg at the rate of ₹11 per Kg. He mixed the two. At what price per Kg should he sell the mixture to make a 30% profit in the transaction?

(a) 12.5   (b) 13

(c) 13.7   (d) 14.25

[SSC Examination, 2013]

35. The ratio of alcohol and water in 40 litres of mixture is 5:3. Then 8 litres of the mixture is removed and replaced with water. Now, the ratio of the alcohol and water in the resultant mixture is:

(a) 1:2   (b) 1:1

(c) 2:1   (d) 1:3

[SSC Assistant Grade III Examination, 2012]

36. Two vessels contain milk and water in the ratio 3:2 and 7:3. Find the ratio in which the contents of the two vessels have to be mixed to get a new mixture in which the ratio of milk and water is 2:1.

(a) 2:1   (b) 1:2

(c) 4:1   (d) 1:4

[SSC Examination, 2012]

37. A mixture contains 80% acid and rest water. Part of the mixture that should be removed and replaced by same amount of water to make the ratio of acid and water 4:3 is:

(a) $\frac{1}{3}$rd   (b) $\frac{3}{7}$th

(c) $\frac{2}{3}$rd   (d) $\frac{2}{7}$th

[SSC Examination, 2011]

38. A and B are two alloys of gold and copper prepared by mixing metals in the ratio 7:2 and 7:11 respectively. If equal quantities of the alloys are melted to form a third alloy C, the ratio of gold and copper in C will be:

(a) 5:7　　　　　　(b) 5:9
(c) 7:5　　　　　　(d) 9:5

[SSC Examination, 2011]

39. In a laboratory, two bottles contain mixture of acid and water in the ratio 2:5 in the first bottle and 7:3 in the second. The ratio in which the contents of these two bottles be mixed such that the new mixture has acid and water in the ratio 2:3 is:

(a) 4:15　　　　　　(b) 9:8
(c) 21:8　　　　　　(d) 1:2

[SSC Examination, 2011]

40. There are two vessels A and B. Vessel A is containing 40 litres of pure milk and vessel B is containing 22 litres of pure water. From vessel A, 8 litres of milk is taken out and poured into vessel B. Then 6 litres of mixture (milk and water) is taken out and from vessel B poured into vessel A. What is the ratio of the quantity of pure milk in vessel A to the quantity of pure water in vessel B?

(a) 14:9　　　　　　(b) 21:11
(c) 24:13　　　　　　(d) 14:5
(e) 21:13

[IBPS PO/MT Examination, 2014]

ANSWER KEYS												
EXERCISE-1												
1. (a)	**2.** (d)	**3.** (c)	**4.** (c)	**5.** (b)	**6.** (c)	**7.** (b)	**8.** (c)	**9.** (b)	**10.** (b)	**11.** (c)	**12.** (a)	**13.** (d)
14. (d)	**15.** (d)	**16.** (a)	**17.** (c)	**18.** (a)	**19.** (b)	**20.** (b)	**21.** (c)	**22.** (a)	**23.** (d)	**24.** (a)		
EXERCISE-2												
1. (d)	**2.** (d)	**3.** (a)	**4.** (b)	**5.** (a)	**6.** (c)	**7.** (b)	**8.** (c)	**9.** (d)	**10.** (d)	**11.** (a)	**12.** (a)	**13.** (a)
14. (b)	**15.** (c)	**16.** (c)	**17.** (a)	**18.** (c)	**19.** (c)	**20.** (a)	**21.** (b)	**22.** (a)	**23.** (a)	**24.** (d)	**25.** (c)	**26.** (c)
27. (c)	**28.** (d)	**29.** (d)	**30.** (b)	**31.** (b)	**32.** (b)	**33.** (d)	**34.** (c)	**35.** (b)	**36.** (b)	**37.** (d)	**38.** (c)	**39.** (c)
40. (b)												

EXPLANATORY ANSWERS

EXERCISE-1

1. (a) S.P. = ₹30 per Kg

Gain = 10 %

C.P. = ₹$\frac{30 \times 100}{110}$ = ₹$\frac{300}{11}$

The required ratio of the two varieties of tea

= $\frac{30}{11} : \frac{25}{11}$ = 6:5

$\frac{\text{Quantity of cheaper tea}}{\text{Quantity of superior tea}} = \frac{6}{5}$

C.P. of 1 Kg of cheaper tea (₹25) C.P. of 1 Kg of superior tea (₹30)

Mean Price ₹$\frac{300}{11}$

₹30 − ₹$\frac{300}{11}$ = ₹$\frac{30}{11}$ ₹$\frac{300}{11}$ − ₹25 = ₹$\frac{25}{11}$
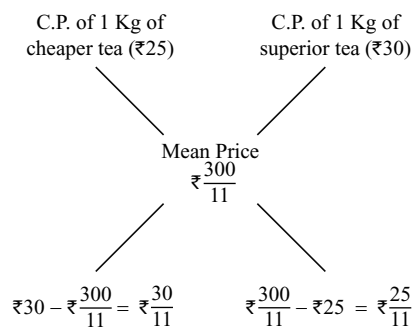
Quantity of cheaper tea = $\frac{6}{5} \times 30 = 36$ Kg.

2. (d)

Water 0   Milk 540

420

120 ⋮ 420

2 ⋮ 7
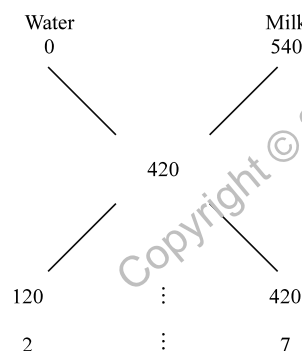
Water is free, its cost can be taken as 0 paisa per litre. By method of alligation the ratio of water and milk is 2:7, i.e., with 7 litres of milk, 2 litres of water is added, with 14 litres, water added is 4 litres.

3. (c)

C.P. of 1 Kg of cheaper tea (₹25)   C.P. of 1 Kg of superior tea (₹30)

Mean Price ₹28

₹30 − ₹28 = ₹2   ₹28 − ₹25 = ₹3
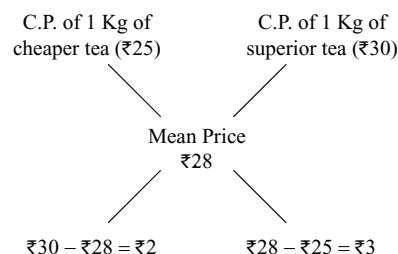
∴ The required ratio of two varieties of tea is 2:3.

4. (c)

Pass % of boys (70%)   Pass % of girls (85%)

Average 75%

10   5
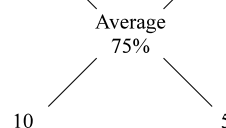
By Alligation rule:

$\frac{\text{Number of boys}}{\text{Number of girls}} = \frac{10}{5} = \frac{2}{1}$

Total number of students = 480

Number of boys = $\frac{480 \times 2}{3}$ = 320.

5. (b) By method of alligation the required ratio is 4:15.

75 P   550 P

450 P

550 − 450 ⋮ 450 − 75

100 ⋮ 375

4 ⋮ 15

6. (c)

4.80   5.50

5.25

₹(5.50 − 5.25) = ₹0.25   ₹(5.25 − 4.80) = ₹0.45
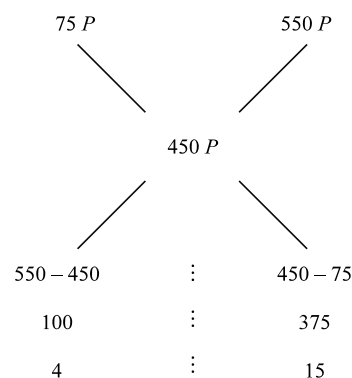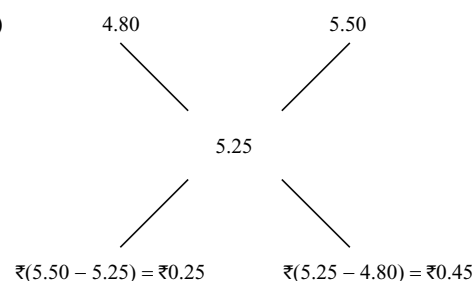
Now, $\frac{.25}{.45} = \frac{5}{9}$

∴ $\frac{5}{9} = \frac{60}{\text{superior sugar}}$

∴ Quantity of superior sugar = $\frac{60 \times 9}{5}$ = 108 Kg.

7. (b)

| C.P. of 1 Kg of cheaper sugar (₹4.50) | | C.P. of 1 Kg of superior sugar (₹5.75) |

Mean Price (₹5.50)

₹5.75 – ₹5.50 = ₹0.25   ₹5.50 – ₹4.50 = ₹1.00
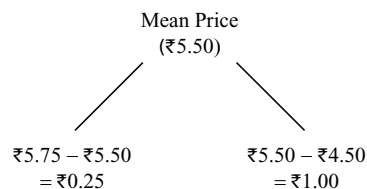
Quantity of cheaper sugar:Quantity of superior sugar = 0.25:1

or, $\dfrac{\text{Quantity of cheaper sugar}}{\text{Quantity of superior sugar}} = \dfrac{0.25}{1} = \dfrac{1}{4}$

$\Rightarrow \dfrac{75}{\text{Quantity of dearer sugar}} = \dfrac{1}{4}$

∴ Quantity of dearer sugar = 75×4 = 300 Kg.

8. (c) Let the C.P. of spirit = ₹10 per litre

S.P. of the mixture = ₹10 per litre

Profit = 10%

∴ C.P. of the mixture = $\dfrac{10 \times 100}{110}$

$= ₹\dfrac{100}{11}$ per litre

C.P. of water per litre ₹0   C.P. of pure spirit per litre (₹10)

Mean Price ₹$\dfrac{100}{11}$

$₹10 - ₹\dfrac{100}{11} = ₹\dfrac{10}{11}$ $₹\dfrac{100}{11} - 0 = ₹\dfrac{100}{11}$
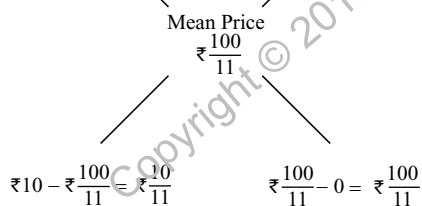
∴ $\dfrac{\text{Quantity of water}}{\text{Quantity of spirit}} = \dfrac{10/11}{100/11} = 1:10.$

9. (b) The existing solution has 40% salt. More salt is to be mixed to make 100% salt solution. So, by alligation method:

40%   100%

50%

50%   10%
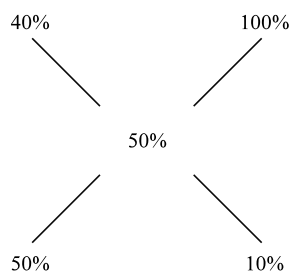
∴ The two mixtures should be added in the ratio 5:1.

∴ Required salt = $\dfrac{300}{5} \times 1 = 60$ gm.

10. (b)

1st cow −6%   2nd cow 7.5%

0

7.5   6
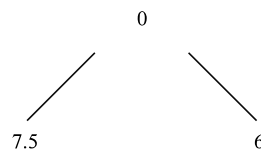
Thus, we see that the ratio of the cost of two cows is 5:4.

∴ Cost of 1st cow = $\dfrac{1350}{5+4} \times 5 = ₹750$

and, cost of 2nd cow = $\dfrac{1350}{5+4} \times 4 = ₹600.$

11. (c) Here, alligation is applicable for 'money per boy or girl'.

Mean value of money per student = $\dfrac{65}{3+2} = 60P.$

Boys 80   Girls 30

60

30   20
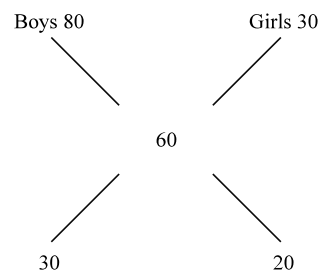
∴ Boys:Girl = 3:2.

∴ Number of boys = $\dfrac{65}{3+2} \times 3 = 39.$

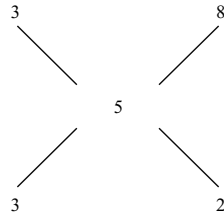number of girls = 65 − 39 = 26.

12. (a)

I part 10   II part (−) 5
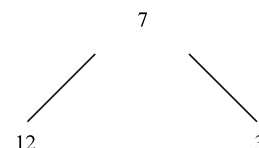
7

12   3

∴ Ratio of quantities sold at 10% profit and 5% loss = 12:3 = 4:1

∴ The quantity sold at 10% profit = $\dfrac{50}{4+1} \times 4$

$= 40$ Kg

and, the quantity sold at 5% loss = 50 − 40 = 10 Kg.

13. **(d)** Average rate of interest

$= \dfrac{100 \times 750}{5000 \times 3} = 5\%$ per annum
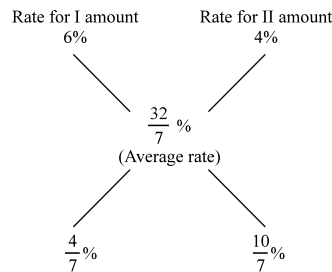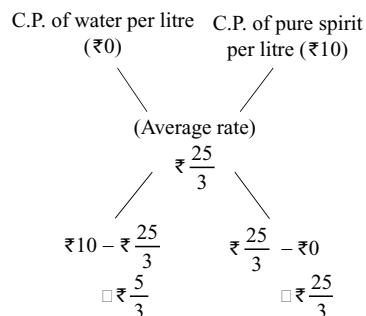

Investment at 3% per annum

$= \dfrac{3}{3+2} \times 5000 = ₹3000$

Investment at 8% per annum

$= \dfrac{2}{3+2} \times 5000 = ₹2000.$

14. **(d)** Overall rate of interest $= \dfrac{1600 \times 100}{5 \times 7000} = \dfrac{32}{7}\%$

$\therefore$ Ratio of two amounts = 2:5.

$\therefore$ Amount lent at 6% $= \dfrac{2}{7} \times 7000 = ₹2000$

15. **(d)** Milk $= \left(729 \times \dfrac{7}{9}\right) = 567$ ml

Water $= 729 - 567 = 162$ ml

Now, $\dfrac{567}{162+x} = \dfrac{7}{3} \Rightarrow x = 81$ ml.

16. **(a)** Let, the C.P. of the spirit = ₹10 per litre.

S.P. of the mixture = ₹10 per litre.

Profit = 20%

$\therefore$ C.P. of the mixture $= ₹\dfrac{10 \times 100}{120}$

$= ₹\dfrac{25}{3}$ per litre

$\dfrac{\text{Quantity of water}}{\text{Quantity of spirit}} = \dfrac{5/3}{25/3} = \dfrac{1}{5}$
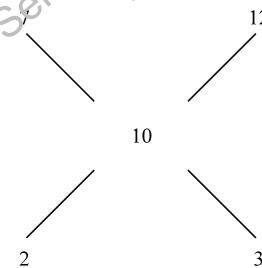
Ratio of water and spirit = 1:5.

17. **(c)**
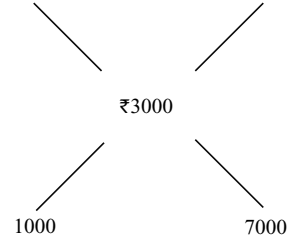
$\dfrac{\text{Number of officers}}{\text{Number of workers}} = \dfrac{1000}{7000} = \dfrac{1}{7}.$

Number of officers $= \dfrac{1}{1+7} \times 400 = 50.$

Numbers of worker $= 400 - 50 = 350.$

18. **(a)** Average speed $= \dfrac{100}{10} = 10$ Km/h

Ratio of time taken at 7 Km/h to 12 Km/h = 2:3.

Time taken at 7 Km/h

$= \dfrac{2}{2+3} \times 10 = 4$ hours.

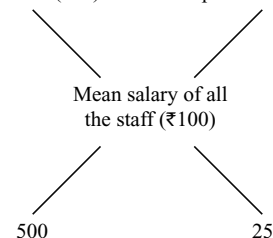Distance covered at 7 Km/h

$= 7 \times 4 = 28$ Km.

Distance covered at 12 Km/h

$= 100 - 28 = 72$ Km.

19. **(b)**

The required ratio is 500:25, or 20:1

$\dfrac{\text{Number of labourers}}{\text{Number of supervisors}} = \dfrac{20}{1}$

$\Rightarrow \dfrac{840}{\text{Number of supervisors}} = \dfrac{20}{1}$
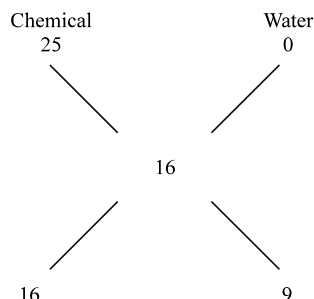
$\therefore$ Number of supervisors $= \dfrac{840}{20} = 42.$

20. (b) In this question, the alligation method is applicable on prices, so we should get the average price of mixture.

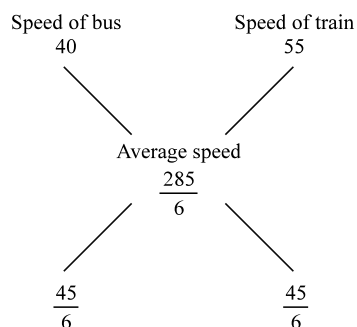S.P. of mixture = ₹20/litre, profit = 25%.

$\therefore$ Average price = $20 \times \dfrac{100}{125}$ = ₹16/litre

```
   Chemical            Water
     25                  0
        \              /
             16
        /              \
     16                  9
```

$\therefore$ Chemical:water = 16:9.

21. (c) In this question, the alligation method is applicable for the speed.

```
  Speed of bus      Speed of train
      40                 55
        \              /
       Average speed
          285
           6
        /              \
      45                 45
       6                  6
```
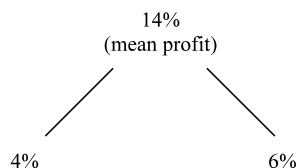
$\therefore$ Time spent in bus:time spent in train

= $\dfrac{45}{6} : \dfrac{45}{6}$ = 1:1.

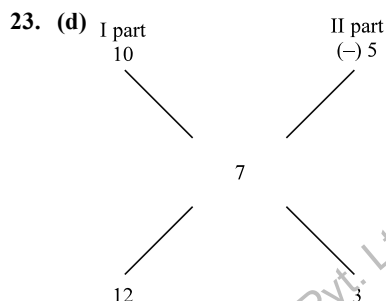$\therefore$ Distance travelled by train = 55 × 3 = 165 Km.

22. (a)
```
   I part            2nd part
  8% profit          18% profit
        \          /
        14%
     (mean profit)
        /          \
      4%              6%
```

$\therefore$ Ratio of quantities sold at 8% profit and 18% profit
= 4:6 = 2:3

Therefore, the quantity sold at 18% profit

= $\dfrac{50}{2+3} \times 3$ = 30 Kg.

23. (d)
```
   I part            II part
    10               (−) 5
        \          /
          7
        /          \
      12              3
```
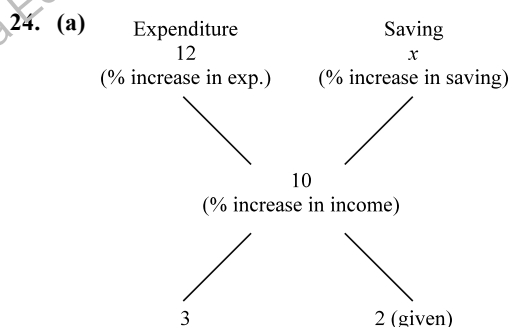
$\therefore$ Ratio of quantities sold at 10% profit and 5% loss
= 12:3 = 4:1

$\therefore$ The quantity sold at 10% profit

= $\dfrac{50}{4+1} \times 4$ = 40 Kg

and, the quantity sold at 5% loss = 50 − 40 = 10 Kg.

24. (a)
```
  Expenditure          Saving
     12                   x
(% increase in exp.)  (% increase in saving)
        \              /
           10
     (% increase in income)
        /              \
       3              2 (given)
```

We get two values of x, 7 and 13. But, to get a viable answer, we must keep in mind that the central value (10) must lie between x and 12. Thus, the value of x should be 7 and not 13.

$\therefore$ Required % increase = 7%.

EXERCISE-2
(BASED ON MEMORY)

1. (d) Amount of milk and water in the mixture is 36 litres and 4 litres, respectively.

Now, let x litres of water be added

20% of $(40 + x) = 4 + x$

or, $40 + x = 20 + 5x$

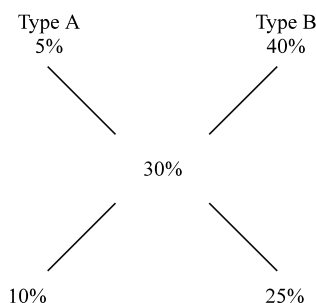or, $4x = 20$ or, $x = 5$ litres

3. (a) Nickel in Type A = 5%

Nickel in Type B = 40%

Nickel in resulting steel = 30%.

By Alligation rule

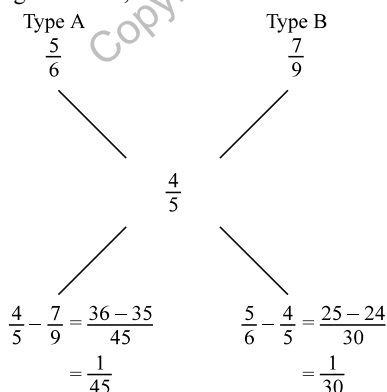Type A:Type B = 10:25 = 2:5

We have to obtain 140 tonnes of steel

Type A
5%

Type B
40%

30%

10%   25%

∴   Steel of type A = $\dfrac{2}{7}$ × 140 = 40 tonnes

Steel of type B = $\dfrac{5}{7}$ × 140 = 100 tonnes.

4. (b) Resulting alloy has 80% of silver and hence, 20% of copper.

∴   Silver:Copper = 80:20 = 4:1.

By Alligation rule,

Type A
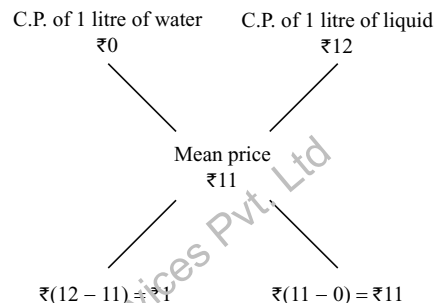$\dfrac{5}{6}$

Type B
$\dfrac{7}{9}$

$\dfrac{4}{5}$

$\dfrac{4}{5} - \dfrac{7}{9} = \dfrac{36 - 35}{45}$ $\dfrac{5}{6} - \dfrac{4}{5} = \dfrac{25 - 24}{30}$

$= \dfrac{1}{45}$ $= \dfrac{1}{30}$

∴   Required ratio = $\dfrac{1}{45} : \dfrac{1}{30}$

i.e., Type A:Type B = $\dfrac{1}{3} : \dfrac{1}{2}$ = 2:3.

5. (a) Gain = 25%, S.P. = ₹13.75 per litre

∴   C.P. of mixture = $\dfrac{100 \times 13.75}{100 + 25}$ = ₹11 per litre

C.P. of 1 litre of water
₹0

C.P. of 1 litre of liquid
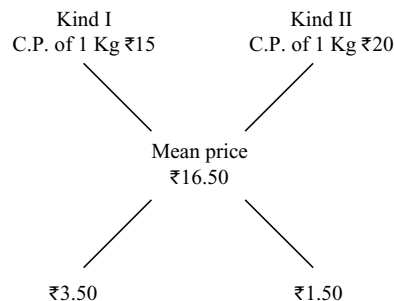₹12

Mean price
₹11

₹(12 − 11) = ₹1   ₹(11 − 0) = ₹11

C.P. of water may be assumed as ₹0 per litre

C.P. of liquid = ₹12 per litre

By the rule of alligation, we have

∴   Water:Liquid = 1:11.

6. (c) By Alligation Rule

Kind I
C.P. of 1 Kg ₹15

Kind II
C.P. of 1 Kg ₹20

Mean price
₹16.50

₹3.50   ₹1.50

∴   Kind I:Kind II = 3.5:1.5 = 7:3.

7. (b) Given ratio = 5:3

If the tea producer mixed $5x$ Kg of the category of tea to that of $3x$ Kg of the second category of tea.

C.P. of category I tea = ₹27 per Kg

C.P. of $5x$ Kg tea = $5x$ × 27 = ₹135x

C.P. of category II tea = ₹30 per Kg

∴   C.P. of $3x$ Kg tea = $3x$ × 30 = ₹90x

Total mixture = $5x + 3x = 8x$ Kg

Total cost price = $135x + 90x$ = ₹225x

Selling price of 1 Kg of mixture = ₹30.25

Total S.P. = $8x$ × 30.25 = ₹242x

Gain = ₹$(242x − 225x)$ = ₹17x

Gain % = $\dfrac{17x}{225x}$ × 100 = $\dfrac{68}{9} = 7\dfrac{5}{9}$%.

8. (c) Ratio of alcohol to whisky in the jar = 40:60 = 2:3.

Ratio of alcohol to whisky in the new mixture

= 26:74 = 13:37

Now, applying the given alligation method, we have

$$\frac{2}{5} \qquad \frac{19}{100}$$

$$\frac{13}{50}$$
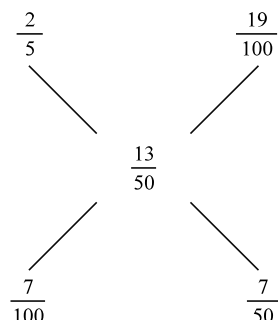
$$\frac{7}{100} \qquad \frac{7}{50}$$

∴ Ratio of alcohol to whisky in the replaced mixture
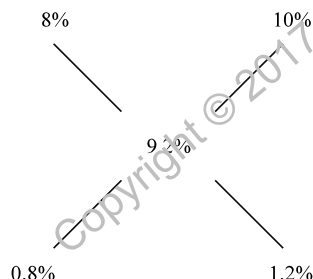
$$= \frac{7}{100} : \frac{7}{50} = 1:2$$

∴ Quantity of whisky replaced $= \dfrac{2}{1+2} = \dfrac{2}{3}$.

9. (d) $60 \left[\dfrac{\dfrac{200}{3} - \dfrac{100}{3}}{100 - \dfrac{200}{3}} \right] = 60$ litres.

10. (d) $\dfrac{0.8}{2} = 10$

∴ $m = 20$ litres.

11. (a) By the rule of alligation

$$8\% \qquad\qquad 10\%$$

$$9\dfrac{2}{5}\%$$

$$0.8\% \qquad\qquad 1.2\%$$

∴ First part $= \dfrac{0.8}{2} \times 1000 = ₹4000$

Second part = (10000 − 4000) = ₹6000.

12. (a) Weight of zinc $= 200 \times \dfrac{5}{8} = 125$ gm

Weight of copper $= 200 \times \dfrac{3}{8} = 75$ gm

Let the ratio of 125 gm zinc and x gm copper be 3:5

∴ $\dfrac{125}{x} = \dfrac{3}{5}$ ∴ $x = \dfrac{125 \times 5}{3} = \dfrac{625}{3}$ gm

∴ Addition of copper in mixture

$\dfrac{625}{3} - 75 = \dfrac{625 - 225}{3} = \dfrac{400}{3} = 133\dfrac{1}{3}$ gm.

13. (a) Good quality content in 150 Kg of

wheat = 90% of 150 = 135 Kg

∴ 5% of the new mixture = 15 Kg

∴ New mixture $= \dfrac{15 \times 100}{5} = 300$ Kg

∴ Good quality of wheat added = (300 − 150) Kg

= 150 Kg.

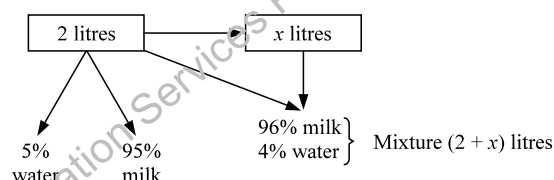**14. (b)** Let, the price of the third variety be

₹x per Kg

∴ $126 \times 1 + 135 \times 1 + 2 \times x = 153 \times 4$

or, $261 + 2x = 612$ or, $2x = 612 − 261 = 351$

∴ $x = \dfrac{351}{2} = 175.50$
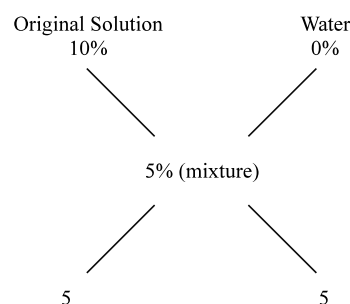
∴ The required price = ₹175.50 per Kg.

15. (c)

| 2 litres | → | x litres |

5% water   95% milk   96% milk
                           4% water } Mixture (2 + x) litres

∴ $\dfrac{95}{100} + 2 + x = \dfrac{96}{100}(2 + x)$

or, $190 + 100x = 192 + 96x$ or, $4x = 2$

or, $x = 0.5$ litres.

16. (c) The given solution has 10% salt. Water which is to be added has 0% salt concentration.

$$\text{Original Solution} \qquad \text{Water}$$
$$10\% \qquad\qquad\qquad 0\%$$

$$5\% \text{ (mixture)}$$

$$5 \qquad\qquad\qquad 5$$

Final concentration of solution is 5%.

Salt concentration:

So, water should be added to the given solution in the ratio 5:5 = 1:1.

∴ Quantity of water to be added $= \dfrac{1}{1} \times 3 = 3$ litres.

18. (c) Quantity of blue paint in the mixture = 10% of 40 = 4 litres

Quantity of white paint in the mixture

= 40 − 4 = 36 litres

Let, x litres blue paint be added

∴ According to the question, in the final mixture

$\dfrac{\text{Quantity of blue paint}}{\text{Quantity of white paint}} = \dfrac{4+x}{36} = \dfrac{20}{80}$

$4 + x = \dfrac{20 \times 36}{80}$ $\therefore$ $x = 9 - 4 = 5$ litres.

20. (a) Here, we have to find out the quantity of leaded petrol. Hence, we have to make certain changes in the given data.

% of leaded petrol in the mixture = 100 − 10 = 90%.

After addition of leaded petrol (that has to be calculated), percentage of leaded petrol becomes (100 − 5) = 95%.

The required answer $= \left(\dfrac{95-90}{100-95}\right)$ 1000 ml = 1000 ml.

21. (b) $120\left[\dfrac{100Z - 8(100+20)}{675(100+20) - 100Z}\right] = 80$ $\therefore$ Z = ₹9 per Kg.

22. (a) $35\left[\dfrac{100Z - 24.50(100+25)}{16.50(100+25) - 100Z}\right] = 25$

or, $\dfrac{100Z - 3062.5}{2062.5 - 100Z} = \dfrac{5}{7}$

or, $700Z - 21437.5 = 10312 - 500Z$

or, $1200Z = 31750$

$\therefore$ Z = ₹26.458 per Kg ≈ Rs.26.50 per Kg.

23. (a) $203\left[\dfrac{100Z - 14.25(100+30)}{11.50(100+30) - 100Z}\right] = 30$

or, $\dfrac{100Z - 1852.3}{1495 - 100Z} = \dfrac{3}{2}$ or, $500Z = 8190$

$\therefore$ Z = $\dfrac{8190}{500}$ = ₹16.38 ≈ ₹16.30

24. (d) $30\left[\dfrac{100 \times 18.60 - y \times 120}{17.50 \times 120 - 100 \times 18.60}\right] = 30$

or, $1860 - 120y = 2100 - 1860 = 240$

or, $120y = 1620$ $\therefore$ $y = \dfrac{1620}{120}$ = ₹13.50.

25. (c) $\left[\dfrac{100 \times Z - 13\left(100 + \dfrac{100}{3}\right)}{15 \times \left(100\dfrac{100}{3}\right) - 100Z}\right] \times 30 = 20$

$\therefore$ Z = ₹18.40.

26. (c) Milk in the first vessel

$= \dfrac{5}{8} = 0.625$

Milk in the second vessel

$= \dfrac{2}{3} = 0.66$

Milk in the third vessel

$= \dfrac{3}{5} = 0.6$

Milk in the fourth vessel

$= \dfrac{7}{11} = 0.636$

27. (c) Let, the quantity initially of liquid A be 7x litre.

$\therefore$ Let, the quantity initially of liquid B be 5x litre.

Quantity of A after 9 litres mixture drawn

$= 7x - \dfrac{21}{4} = \dfrac{28x - 21}{4}$ litres

Quantity of B after 9 litres mixture drawn and adding 9 litres of $B = 5x + \dfrac{21}{4} = \dfrac{20x + 21}{4}$

$\therefore$ $\dfrac{(28x-21)}{4} : \dfrac{20x+21}{4} = \dfrac{7}{9}$

$\Rightarrow$ $(252 - 140)x = 189 + 147$

$\Rightarrow$ $x = \dfrac{336}{112} = 3$

The required quantity of A = 7x = 21 litres.

28. (d) Weight of water in the mixture of 60 g water

$= 60 \times \dfrac{75}{100} = 45$ g

Weight of water in the mixture of 45 g water

$= 45 + 15 = 60$ g

$\therefore$ Percentage of water = $\dfrac{60 \times 100}{75} = 80\%$

29. (d) Let, the quantity of acid in the original mixture be x litre and quantity of water in the original mixture be 3x litre.

Therefore, $\dfrac{x+5}{3x} = -$

$2(x + 5) = 3x$

$\Rightarrow$ $2x + 10 = 3x$

$\Rightarrow$ $3x - 2x = 10$

$\Rightarrow$ $x = 10$

Therefore, quantity of new mixture

$= 4x + 5 = 4(10) + 5$

$= 45$ litres

30. (b) Let, the quantity of nickel mixel be x Kg

Therefore,

$\dfrac{20 + x}{100 + x} = \dfrac{3}{11}$

$\Rightarrow$ $11(20 + x) = 3(100 + x)$

$\Rightarrow$ $220 + 11x = 300 + 3x$

$\Rightarrow$ $11x - 3x = 300 - 220$

$\Rightarrow$ $8x = 80$

$\Rightarrow$ $x = \dfrac{80}{8} = 10$ Kg

31. (b) Quantity of milk in the mixture

$= \dfrac{6}{13} + \dfrac{5}{14} + \dfrac{8}{15}$

$$= \frac{1260 + 975 + 1456}{2730}$$

$$= \frac{3691}{2730}$$

Quantity of milk in the mixture

$$= \frac{7}{13} + \frac{9}{14} \times \frac{7}{15}$$

$$= \frac{1470 + 1755 + 1274}{2730}$$

$$= \frac{4499}{2730}$$

∴ The required ratio = 3691:4499.

32. (b) In 20 litres of mixture,

Alcohol $= \frac{20 \times 20}{100} = 4$ litres

Water = 20 − 4 = 16 litres

On adding 4 litres of water,

Quantity of water = 16 + 4 = 20 litres

Quantity of mixture = 24 litres

Required per cent

$$= \frac{4}{24} \times 100 = \frac{50}{3} = 16\frac{2}{3}\%$$

33. (d) Let the capacity of each container be x litres.

In first container,

Milk $= \frac{3x}{4}$ litres

Water $= \frac{x}{4}$ litres

In second container

Milk $= \frac{5x}{7}$ litres

Water $= \frac{2x}{7}$ litres

On mixing both, we have,

Quantity of milk $= \frac{3x}{4} + \frac{5x}{7}$

$$= \frac{21x + 20x}{28} = \frac{41x}{7} \text{ litres}$$

Quantity of water $= \frac{x}{4} + \frac{2x}{7} = \frac{7x + 8x}{28}$ litres

$$= \frac{15x}{28} \text{ litres}$$

∴ Required ratio $= \frac{41x}{28} : \frac{15x}{28} = 41:15$

34. (c) Total cost = ₹(3 × 10 + 35 × 11)

= ₹(300 + 385) = ₹685

Required S.P. $= ₹\left(\frac{685 \times 130}{100}\right)$

Rate per Kg $= \frac{685 \times 130}{65 \times 100} = ₹13.7$

35. (b) In 32 litres of mixture

Alcohol $= \left(\frac{5}{8} \times 32\right) = 20$ litres

Water $= \left(\frac{3}{8} \times 32\right) = 12$ litres

∴ Required ratio = 20:20 = 1:1

36. (b) Let the ratio of contents (milk and water) of two vessels be $x:y$

Amount of milk in first vessel $= \frac{3x}{5}$

Amount of water in first vessel $= \frac{2x}{5}$

Amount of milk in second vessel $= \frac{7y}{10}$

Amount of water in second vessel $= \frac{3y}{10}$

Now, according to the question,

$$\frac{3x}{5} + \frac{7y}{10} : \frac{2x}{5} + \frac{3y}{10} = 2:1$$

$$\Rightarrow \frac{3x}{5} = \frac{7y}{10} = 2 \times \left(\frac{2x}{5} + \frac{3y}{10}\right)$$

$\Rightarrow$ 6x + 7y = 8x + 6y

$\Rightarrow$ 2x = y

$$\Rightarrow \frac{x}{y} = \frac{1}{2}$$

Therefore, required ratio = 1:2

By Method of Alligation:

Milk-I   Milk-II

$\frac{3}{5}$ $\frac{7}{10}$

$\frac{2}{3}$

$\frac{7}{10} - \frac{2}{3}$ $\frac{3}{5} - \frac{2}{3}$

$$= \frac{21 - 20}{30} = \frac{10 - 9}{15}$$

$$= \frac{1}{30} = \frac{1}{15}$$

∴ Required ratio $= \frac{1}{30} : \frac{1}{15} = 1:2$

37. (d) In the beginning, Acid:Water = 4:1

Let x part of mixture be replaced by x part of water.

∴ In x part of mixture, milk $= \frac{4x}{5}$ part and, water $= \frac{x}{5}$ part

Now, according to the question,

$$\frac{4 - \frac{4x}{5}}{1 - \frac{x}{5} + x} = \frac{4}{3}$$

$$\Rightarrow \quad \frac{20 - 4x}{5 - x + 5x} = \frac{4}{3}$$

$$\Rightarrow \quad 60 - 12x = 20 + 16x$$

$$\Rightarrow \quad 28x = 40$$

$$\Rightarrow \quad x = \frac{40}{28} = \frac{10}{7} = 2\frac{2}{7}$$

38. (c) Let the weight of alloy A be 1 Kg.

∴ Gold in $A = \frac{7}{9}$ Kg and copper $= \frac{2}{9}$ Kg.

In 1 Kg of alloy B, Gold $= \frac{7}{18}$ Kg and copper $= \frac{11}{18}$ Kg.

∴ Required ratio $= \left(\frac{7}{9} + \frac{7}{18} \right) : \left(\frac{2}{9} + \frac{11}{18} \right)$

$$= \frac{21}{18} : \frac{15}{18} = 21:15 = 7:5$$

39. (c) Let the required ratio be x:y

Now, according to the question,

$$\frac{\frac{2x}{7} + \frac{7y}{10}}{\frac{5x}{7} + \frac{3y}{10}} = \frac{2}{3}$$

$$\Rightarrow \quad \frac{20x + 49y}{50x + 21y} = \frac{2}{3}$$

$$\Rightarrow \quad 60x + 147y = 100x + 42y$$

$$\Rightarrow \quad 100x - 60x = 147y - 42y$$

$$\Rightarrow \quad 40x = 105y$$

$$\Rightarrow \quad \frac{x}{y} = \frac{105}{40} = \frac{21}{8}$$

40. (b) Initially

Milk in Vessel A = 40 litres

Water in Vessel B = 22 litres

After first operation:

Milk in Vessel A = 40 − 8 = 32 litres

Water in Vessel B = 22 litres

Milk in Vessel B = 8 litres

Mixture in Vessel B = 22 + 8 = 30 litres

After second operation (when 6 litres or $\frac{6}{30} = \frac{1}{5}$ of the

mixture is taken out from B, it means $\frac{22}{5}$ litres of water

and $\frac{8}{5}$ litres of milk is taken out):

Milk in Vessel A $= 32 + \frac{8}{5} = \frac{168}{5}$ litres

Water in Vessel B $= 22 - \frac{22}{5} = \frac{88}{5}$ litres

∴ Required ratio $= \frac{168}{5} : \frac{88}{5} = 21:11$