ANSWERS AND EXPLANATIONS

EXERCISE 1

1. (e) In 60 gms mixture proportion of water
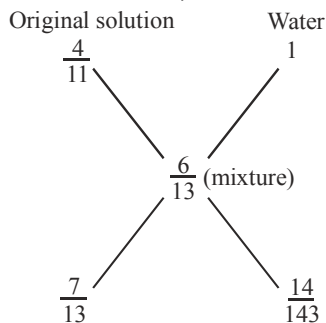
   $= 60 \times \dfrac{75}{100} = 45$ gms

   Total proportion of water in new mixture
   = 45 + 15 = 60 gms.

   ∴ Percentage of water

   $= \dfrac{60}{60 + 15} \times 100 = 80\%$

2. (b) By the rule of alligation,
   water concentration,

   Original solution　　　　　Water
   $\dfrac{4}{11}$　　　　　　　　　　1

   $\dfrac{6}{13}$ (mixture)

   $\dfrac{7}{13}$　　　　　　　$\dfrac{14}{143}$

   ∴ water must be added to the mixture in the ratio

   $\dfrac{14}{143} : \dfrac{7}{13}$ i.e. 2 : 11

   Quantity of water to be added

   $= \dfrac{2}{11} \times 55 = 10$ litres

3. (c)

	Gold	**Copper**
Type A	14	4
Type B	7	11
Type C	21	15

   ∴ The ratio of the Gold and Copper in the type C alloy = 7 : 5.

4. (b) The first type of alloy does not contain tin. Second type alloy contains tin. Therefore, quantity of tin in 2 units of the resulting alloy

   $= \dfrac{5}{13}$

   ⇒ Quantity of tin in 1 unit of the resulting alloy

   $= \dfrac{\frac{5}{13}}{2} = \dfrac{5}{26}$

5. (d) Let the capacity of the jar be of x bottles.
   since 6 bottles were taken out from jar and 4 bottles of oil poured into it ∴ 2 bottles were taken out

   Therefore, we have

   $\Rightarrow \dfrac{4}{5}x - 2 = \dfrac{3}{4}x$

   $\Rightarrow \dfrac{4}{5}x - \dfrac{3}{4}x = 2 \quad \Rightarrow \quad x = 40$

6. (c) Let the quantity of milk and water be 40 litres and 60 litres, respectively.
   (∵ Ratio of milk to water = 2 : 3)
   After removing 50% of solution
   Quantity of milk = 20 litres and
   Quantity of water = 30 litres
   Therefore, the concentration of the solution is reduced from 40 to 20 i.e. a reduction of 50%.

7. (c) Let the third type of tea is priced at Rs x per kg. Also suppose that the three types of tea mixed together are 1, 1 and 2 kg, respectively.

   Now, $\dfrac{126 \times 1 + 135 \times 1 + 2x}{1 + 1 + 2} = 153$

   $\Rightarrow \dfrac{261 + 2x}{4} = 153 \quad \Rightarrow \quad 261 + 2x = 612$

   $\Rightarrow x = \dfrac{351}{2} = $ Rs 175.5 per kg.

8. (b) Quantity of milk $= \dfrac{3}{5} \times 45 = 27$ litres

   Quantity of water $= \dfrac{2}{5} \times 45 = 18$ litres

   Let x litres of water be added to make the ratio 9 : 11.

   ∴ $\dfrac{18 + x}{27} = \dfrac{11}{9} \quad \Rightarrow \quad 18 + x = 33 \Rightarrow x = 15l$

9. (b) Let the no. of one rupee, 50 paise and 25 paise coins be 2x, 3x and 4x respectively.
   According to question,

   Rs. $\left(2x + \dfrac{3x}{2} + \dfrac{4x}{4} \right) = $ Rs. 216

   $\dfrac{8x + 6x + 4x}{4} = 216$

   ∴ x = 48

∴ Number of 50 paise coins = 48 × 3 = 144

10. (c) Quantity of milk = $45 \times \dfrac{4}{5}$ = 36 litres

Quantity of water = $45 \times \dfrac{1}{5}$ = 9 litres

Let x litres of water be added to make the ratio 3 : 2

Then, $\dfrac{36}{9+x} = \dfrac{3}{2}$

⇒ 72 = 27 + 3x ⇒ x = 15 litres

11. (b)

	Water	Milk	Total.
1st vessel	6	7	13
2nd vessel	5	9	14
3rd vessel	8	7	15

LCM of 13, 14 & 15 = 2730
Increase value of total to 2730 as follows.

1st vessel	1260	1470	2730
2nd vessel	975	1755	2730
3rd vessel	1456	1274	2730
Total	3691	4499	8190

∴ Required ratio $= \dfrac{3691}{4499}$

Alternate method is dividing options by 13, 14 & 15.

12. (d) Tonic = 30 litres, Water = 10 litres

Let x litres of water be added, then $\dfrac{10+x}{40+x} = \dfrac{2}{7}$

⇒ 70 + 7x = 80 + 2x ⇒ 5x = 10 ⇒ x = 2 litres.

13. (c) Let the weight of tea worth ₹ 25 per kg = x kg.
According to question

∴ 110% of $\left[\dfrac{x \times 25 + 30 \times 30}{x + 30}\right] = 30$

⇒ $\dfrac{110}{100}\left[\dfrac{25x + 900}{x + 30}\right] = 30$

⇒ 11 (25x + 900) = 300 (x+30)

⇒ 275x + 9900 = 300 x + 9000 or 25x = 900

∴ x = 36 kg.

14. (b) Let, weight of sugar costing ₹ 5.75 per kg = x kg

x × 5.75 + 75 × 4.50 = 5.50 × (x + 75)

⇒ 5.75x + 337.50 = 5.50x + 412.50

⇒ 0.25x = 75

∴ x = 300 kg

15. (b) Let x and y be two containers.

Ratio of milk to water in container x = 5: 1
and ratio of milk to water in container y = 7 : 2

It is given that quantity of milk should be 80% in new mixture. This means that quantity of water will be 20%

that quantity of water will be 20%

∴ Ratio of milk to water in new mixture = 80 : 20 = 4:1.

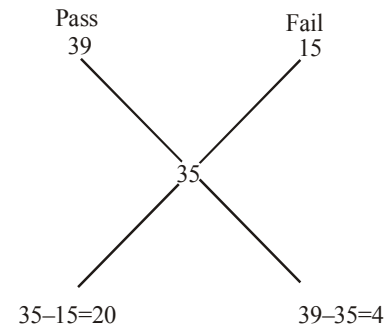∴ $\dfrac{5}{6}x + \dfrac{7}{9}y : \dfrac{1}{6}x + \dfrac{2y}{9}$ = 4 : 1

$\dfrac{\frac{5x}{6} + \frac{7y}{9}}{\frac{x}{6} + \frac{2y}{9}} = \dfrac{4}{1}$

$\dfrac{\frac{15x + 14y}{3x}}{\frac{4y}{1}} = \dfrac{4}{1}$ 15x + 14y = 12x + 16y

3x = 2y   x : y = 2 : 3
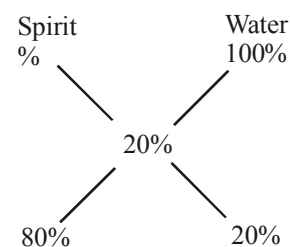
16. (c)

Pass 39   Fail 15

35

35–15=20   39–35=4

∴ Required ratio = 20 : 4 = 5 : 1
Number of passed candidates

$\dfrac{5}{5+1} \times 120 = 100$

17. (b) If spirit is sold at CP, there is % gain but if water is sold at CP, there is 100% gain.
Using the method of alligation,

Spirit %   Water 100%

20%

80%   20%

Ratio of spirit to water in the mixture should be 80 : 20 = 4 : 1

∴ Proportion of water in the mixture

$\dfrac{1}{1+4} = \dfrac{1}{5} = 1:5$

18. (a) CP = 25 × 16.50 + 35 × 24.50 = ₹ 1270

SP = 1270 × $\dfrac{125}{100}$ = ₹ 1587.50

Price per kg = $\dfrac{1587.50}{60}$ 26.50
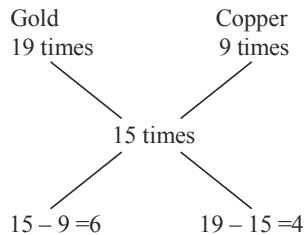
19. (a) In 1 kg mixture quantity of iron = 200 gm
Let x gm sand should be added, then
10% of (1000 + x) = 200
∴ x = 1000 gm = 1 kg

EXERCISE 2

1.   (b) By the rule of alligation, we have

Gold   Copper
19 times   9 times

15 times

15 – 9 = 6   19 – 15 = 4

∴ Required ratio $= \dfrac{6}{4} = 3:2$

2.   (c) % alcoholic strength in mixture

$\dfrac{6 \;\; 20 \;\; 4 \;\; 60}{6 \;\; 4}$ 36

3.   (a) $\dfrac{\text{Quantity lent at }8\%}{\text{Quantity lent at }10\%} = \dfrac{10-9.2}{9.2-8} = \dfrac{0.8}{1.2} = \dfrac{2}{3}$
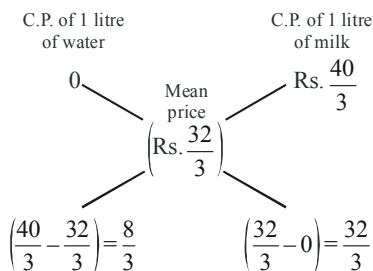
∴ Quantity of money lent at 8%

$= \dfrac{2}{2+3} \times 1000 = \text{Rs } 400$

and quantity of money lent at 10%

$= \dfrac{3}{2+3} \times 1000 = \text{Rs } 600$

4.   (c) C.P. of 1 litre of milk = $\text{Rs.}\left(20 \times \dfrac{2}{3}\right) = \text{Rs.} \dfrac{40}{3}$.

C.P. of 1 litre   C.P. of 1 litre
of water   of milk

0   Rs. $\dfrac{40}{3}$
          Mean
          price
        $\left(\text{Rs.} \dfrac{32}{3}\right)$

$\left(\dfrac{40}{3} - \dfrac{32}{3}\right) = \dfrac{8}{3}$ $\left(\dfrac{32}{3} - 0\right) = \dfrac{32}{3}$

∴ Ratio of water and milk = $\dfrac{8}{3} : \dfrac{32}{3}$ = 8 : 32 = 1 : 4.

∴ Quantity of water to be added to 60 litres of

milk = $\left(\dfrac{1}{4} \times 60\right)$ litres = 15 litres.
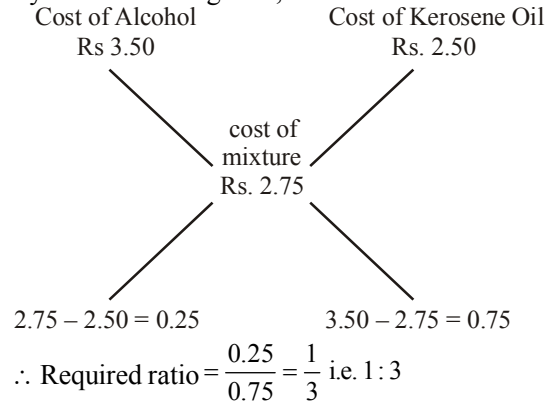
5.   (c) Here, cost price of mixture

$= 40 \times \dfrac{100}{100 + 25} = 32$ paise

∴ $\dfrac{q_1}{q_2} = \dfrac{32-24}{42-32} = \dfrac{8}{10} = \dfrac{4}{5}$

and hence $q_1 = \dfrac{4}{5} \times 25 = 20$ kg

6.   (b) By the rule of alligation, we have

Cost of Alcohol   Cost of Kerosene Oil
Rs 3.50   Rs. 2.50

cost of
mixture
Rs. 2.75

2.75 – 2.50 = 0.25   3.50 – 2.75 = 0.75

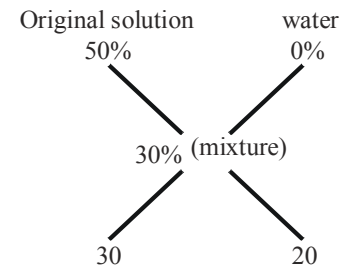∴ Required ratio $= \dfrac{0.25}{0.75} = \dfrac{1}{3}$ i.e. 1 : 3

7.   (b) In mixture,

$\dfrac{\text{Quantity of pure milk}}{\text{Quantity of water}} = \dfrac{3-0}{3.6-3} = \dfrac{3}{0.6} = \dfrac{5}{1}$

Since in every 5 litres of milk, he adds 1 litre of water.
∴ In every 25 litres of milk, he adds 5 litres of water.

8.   (d) The given solution has 50% alcohol. Water which is to be added has 0% alcohol concentration.
Alcohol concentration :

Original solution   water
50%   0%

30% (mixture)

30   20

∴ Water should be added in the ratio 2 : 3

∴ Quantity of water to be added $= \dfrac{2}{3} \times 9 = 6$ ml

9.   (d) Petrol   Petrol

	A	**B**
I:	A	0
II:	$\dfrac{A}{2}$	$\dfrac{B}{2}$
III:	$\dfrac{A}{4}+\dfrac{A}{2}$	$\dfrac{B}{4}$
IV:	$\dfrac{A}{8}+\dfrac{A}{4}$	$\dfrac{B}{8}+\dfrac{B}{2}$

Now, amount of petrol A $=\dfrac{A}{4}+\dfrac{A}{8}=\dfrac{3A}{8}$

$\therefore$ required % $=\dfrac{3A}{8\times A}\times 100 = 37.50\%$

10. **(d)** % of glycerine in new mixture

$=\dfrac{\text{Original \% of glycerine}}{\text{mixture weight + water added}}\times 100$

$=\dfrac{35}{100+25}\times 100 = 28\%$

11. **(c)** Suppose the cane initially contains 7x and 5x litres of mixtures A and B respectively.
Quantity of A in mixture left

$=\left(7x-\dfrac{7}{12}\times 9\right)$ litres $=\left(7x-\dfrac{21}{4}\right)$ litres.

Quantity of B in mixture left

$=\left(5x-\dfrac{5}{12}\times 9\right)$ litres $=\left(5x-\dfrac{15}{4}\right)$ litres.

$\therefore\ \dfrac{\left(7x-\dfrac{21}{4}\right)}{\left(5x-\dfrac{15}{4}\right)+9}=\dfrac{7}{9}\Rightarrow\dfrac{28x-21}{20x+21}=\dfrac{7}{9}$

$\Rightarrow\ 252x-189 = 140x+147$
$\Rightarrow\ 112x = 336 \Rightarrow\ x = 3.$
So, the cane contained 21 litres of A.

12. **(c)** C. P. of mixture of 18 kg $= 10\times 45 + 8\times 50 =$ Rs 850
$\therefore$ S. P. = C. P. + Profit = 850 + 32 = Rs 882
$\therefore$ S. P. = Rs 882 for 18 kg

$\therefore$ S. P. for 1 kg.   Rs $\dfrac{882}{18}$ =Rs 49
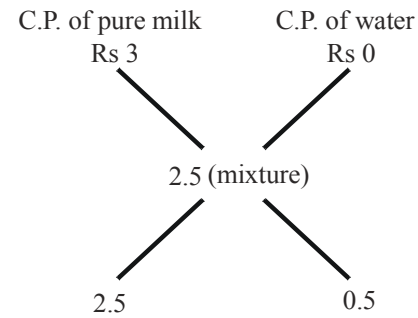
13. **(b)** Here, S. P. of mixture = C. P. of pure milk = Rs 3 per litre
Now, S. P. of mixture

$=\dfrac{100+20}{100}\times$ C.P. of mixture

$\Rightarrow$ C.P. of mixture $=\dfrac{3\times 100}{120}=$ Rs 2.5 per litre

Also, C. P of water = Rs 0
By the rule of alligation :

C.P. of pure milk   C.P. of water
    Rs 3   Rs 0

2.5 (mixture)

    2.5   0.5

$\therefore$ Ratio of pure milk and water in mixture =

$\dfrac{2.5}{0.5}=5:1$

For five litres of water, quantity of pure milk
$= 5\times 5 = 25$ litres

14. **(b)** $\because$ 10 litres are withdrawn $=\dfrac{10}{50}=\dfrac{1}{5}$ of the whole

Quantity of milk after 2nd operation

$=50\left(1-\dfrac{1}{5}\right)^{2}$

$=\dfrac{16}{25}\times 50 = 32\,\text{litres}$

15. **(c)** Let capacity of the vessel be x litres.

Therefore, $\dfrac{x-4}{4}=\dfrac{1}{2}$

$\therefore\ x = 6$

16. **(b)** Alcohol in 1st glass $=\dfrac{2}{3}$; water in 1st glass $=\dfrac{1}{3}$

Alcohol in 2nd glass $=\dfrac{1}{2}$; water in 2nd glass

$=\dfrac{1}{2}$

$\therefore$ In 3rd glass,

Alcohol $=\dfrac{2}{3}+\dfrac{1}{2}=\dfrac{7}{6}$; water $=\dfrac{1}{3}+\dfrac{1}{2}=\dfrac{5}{6}$

$\therefore$ Required ratio $=\dfrac{7}{6}:\dfrac{5}{6}=7:5$

17. **(d)** Fineness $=\dfrac{6\times 15+5\times 14+4\times\dfrac{25}{2}}{6+5+4}$

$$= \frac{210}{15} = 14 \text{ carats}$$

18. (a) C.P. of the mixture $= \frac{44 \times 100}{110} = $ Rs. 40 per kg

Using alligation rule, the required ratio

$$= \quad \begin{matrix} 31 & & 43 \\ & \searrow 40 \swarrow & \\ 3 & \nearrow \nwarrow & 9 \end{matrix} \quad = 1:3$$

If $3 \to 36$ kg

Then $1 \to ?$

$$= \frac{1 \times 36}{3} = 12 \text{ kg.}$$

19. (a) By alligation rule

$$\begin{matrix} CP_{cheaper} & & CP_{dearer} \\ 1/3 & & 2/5 \\ & \searrow 3/8 \swarrow & \\ 1/40 & & 1/24 \end{matrix}$$

∴ The ratio in which the two are to be mixed is

$$\frac{1}{40} : \frac{1}{24} = 3:5$$

20. (c) Let a container contains x units of liquid and y units of liquid is taken out from it. If this operation is repeated n times, then the final quantity of the

liquid in the container is $x\left(1 - \frac{y}{x}\right)^n$.

∴ From this equation, we have

$$24 = 54\left(1 - \frac{y}{54}\right)^2$$

(y = amount of acid initially drawn off)

$$\Rightarrow \left(1 - \frac{y}{54}\right)^2 = \frac{24}{54} = \frac{4}{9}$$

$$\Rightarrow \left(1 - \frac{y}{54}\right) = \frac{2}{3} \Rightarrow \frac{y}{54} = \frac{1}{3} \Rightarrow y = 18 \text{ litres}$$

21. (d) Let x litres of 37.85% alcoholic solution and (35 − x) litres of 92% alcoholic solution are required to get 35 litres of 89% solution. Thus,

we have $\frac{37.85}{100}x \quad \frac{92}{100}(35 \quad x) \quad \frac{89}{100} \quad 35$

$$x \quad \frac{105}{54.15} \quad 1.94$$

∴ 1.94 litres of Ist solution and 33.06 litres of IInd solution should be there in the new mixture.

22. (d) Let the weight of the filled bottle be 100 g. Then, the weight of the empty bottle is 20 g.

Let x gm liquid removed

Now, $100 - x = \frac{100}{2} \Rightarrow x = 50$

Required ratio $= \frac{50}{100} = \frac{1}{2}$

23. (c) Ratio of milk in the containers are,

$$5 \times \frac{1}{6} : 4 \times \frac{3}{8} : 5 \times \frac{5}{12} = \frac{5}{6} : \frac{3}{2} : \frac{25}{12}$$

and the ratio of water in the containers are,

$$5 \times \frac{5}{6} : 4 \times \frac{5}{8} : 5 \times \frac{7}{12} = \frac{25}{6} : \frac{5}{2} : \frac{35}{12}$$

Ratio of mixture of milk and water in the containers

$$= \left(\frac{1}{6} \times 5 + \frac{3}{8} \times 4 + \frac{5}{12} \times 5\right) : \left(\frac{5}{6} \times 5 + \frac{5}{8} \times 4 + \frac{7}{12} \times 5\right)$$

$$= 106 : 230 = 53 : 115$$

24. (a) 10% of 10 litre is 1 litre.

Nitric Acid	Water
1 ltr.	9 ltr.

1 ltr. is 4% of 25 litre. So final solution will have

Nitric Acid	Water
1 ltr.	24 ltr.

Hence 15 litres of water needs to be added.

25. (a)

	Iron		Copper	
Alloy I	8	:	6	14 kg.
Alloy II	36	:	6	42 kg.
	44	:	12	56 kg

EXERCISE 3

1. (c) C.P. of mixture $= \frac{80 \times 15 + 20 \times 20}{80 + 20} = $ Rs 16

∴ S.P. $= \frac{(100 + 25)}{100} \times 16 = $ Rs 20
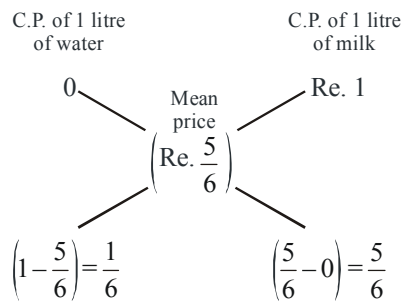
2. (c) Let the quantity of two varieties of tea be 5x kg and 4x kg, respectively.
Now, SP = 23 × 9x = 207x
and CP = 20 × 5x + 25 × 4x = 200x

Profit % = $\dfrac{7x}{200x} \times 100 = 3.5\%$

3. (b) Let C.P. of milk be Re. 1 per litre.
Then, S.P. of 1 litre of mixture = Re. 1.
Gain = 20%
∴ C.P. of 1 litre of mixture = Rs. $\left(\dfrac{100}{120} \times 1\right) = $ Re. $\dfrac{5}{6}$.

By the rule of alligation, we have :

C.P. of 1 litre of water $\quad$ C.P. of 1 litre of milk

0 $\qquad$ Mean price $\left(\text{Re. } \dfrac{5}{6}\right)$ $\qquad$ Re. 1

$\left(1 - \dfrac{5}{6}\right) = \dfrac{1}{6}$ $\qquad$ $\left(\dfrac{5}{6} - 0\right) = \dfrac{5}{6}$

∴ Ratio of water and milk = $\dfrac{1}{6} : \dfrac{5}{6} = 1 : 5$.

4. (d) C.P. of mixture $= \dfrac{100}{100+10} \times 11 = $ Rs 10
Let the cost of second liquid be Rs x.
Then, cost of first liquid be Rs (x + 2).

∴ $10 = \dfrac{(x+2) \times 3 + 2x}{5}$

⇒ 5x + 6 = 50 ⇒ x = Rs 8.8
∴ cost of first liquid = Rs (8.8 + 2) = Rs 10.80

5. (b) Let x gallons of first mixture be mixed with y gallons of second mixture.

	Milk	Water
x gallons (1st)	$\dfrac{8}{9}x$	$\dfrac{1}{9}x$
y gallons (2nd)	$\dfrac{1}{6}y$	$\dfrac{5}{6}y$
Third vessel	$\dfrac{8}{9}x \quad \dfrac{1}{6}y$	$\dfrac{1}{9}x \quad \dfrac{5}{6}y$

Since the third vessel contains half milk and half water,

$\dfrac{8}{9}x \quad \dfrac{1}{6}y \quad \dfrac{1}{9}x \quad \dfrac{5}{6}y$ ⇒ 16x + 3y = 2x + 15y
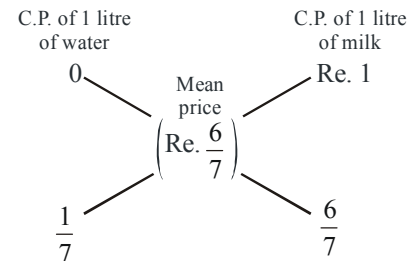
⇒ 16x − 2x = 15y − 3y $\quad \dfrac{x}{y} \quad \dfrac{12}{14} \quad \dfrac{6}{7}$.

Hence $y = \dfrac{7}{13} \times 26 = 14$ gallons

6. (a) Let C.P. of 1 litre milk be Re. 1.

S.P. of 1 litre of mixture = Re. 1, Gain = $\dfrac{50}{3}\%$.

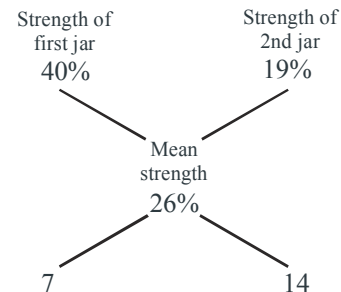∴ C.P. of 1 litre of mixture = Re. $\dfrac{6}{7}$.

By the rule of alligation, we have :

C.P. of 1 litre of water $\quad$ C.P. of 1 litre of milk

0 $\qquad$ Mean price $\left(\text{Re. } \dfrac{6}{7}\right)$ $\qquad$ Re. 1

$\dfrac{1}{7}$ $\qquad$ $\dfrac{6}{7}$

∴ Ratio of water and milk = $\dfrac{1}{7} : \dfrac{6}{7} = 1 : 6$.

7. (b) By the rule of alligation, we have :

Strength of first jar 40% $\quad$ Strength of 2nd jar 19%

Mean strength 26%

7 $\qquad$ 14

So, ratio of 1st and 2nd quantities = 7 : 14 = 1 : 2.

∴ Required quantity replaced = $\dfrac{2}{3}$.

8. (c) C. P. of mixture $= \dfrac{2.10 \times 15 + 0.98 \times 1}{15 + 1}$
= Rs 2.03 per kg
Profit on 1 kg of mixture = Rs (2.25 − 2.03)
= Rs 0.22
∴ Profit on 5 quintals mixture = 0.22 × 500
(∵ 1 quintal = 100 kg)
= Rs 110

9. (d) By the rule of alligation,
Alcohol concentration :

Original mixture   Pure alcohol
     15%   100%

                  25%

     75%   10%
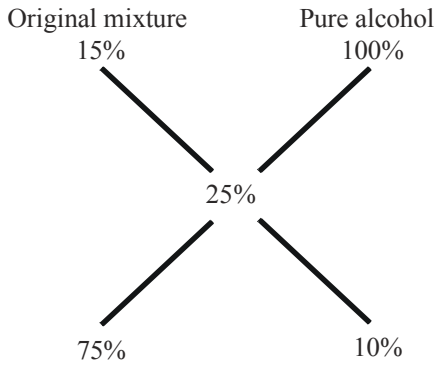
∴ Alcohol must be added in the ratio of 10 : 75
or 2 : 15

∴ Quantity of alcohol to be added in 10 litres
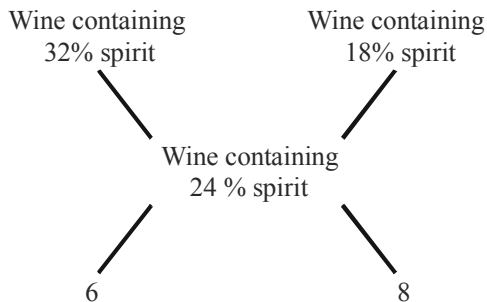
$$= \frac{2}{15} \times 10 = \frac{4}{3}$$

10. (b) C. P. of mixture $= \frac{100 \times 60}{(100 + 25)} = $ Rs 48

Let x kg be mixed. Then,

$$48 = \frac{40 \times x + 55 \times 16}{16 + x}$$

$$\Rightarrow 8x = 16[55 - 48] \Rightarrow x = 14 \text{ kg}$$

11. (c) By the rule of alligation,

Wine containing   Wine containing
   32% spirit   18% spirit

          Wine containing
           24 % spirit

     6   8

$$\frac{\text{Quantity of 32\% spirit}}{\text{Quantity of 18\% spirit}} = \frac{6}{8} = \frac{3}{4}$$

Now, wine of 32% spirit $= \frac{3}{7}$ of the butt

∴ The rest part i.e $1 - \frac{3}{7} = \frac{4}{7}$ of the butt has been stolen.

12. (c) Let a container contains x units of liquid and y units of liquid is taken out from it. If this operation is repeated n times, then the final quantity of the liquid in the container is $40 \left(1 - \frac{4}{40}\right)^3$

= 29.16 litres

13. (c) Let the third type of tea is priced at Rs x per kg. Also suppose that the three types of tea mixed together are m, m and 2m kg, respectively.

Now, $\frac{126m + 135m + 2mx}{m + m + 2m} = 153$

or $\frac{261 + 2x}{4} = 153$

or   261 + 2x = 612

or $x = \frac{351}{2} = $ Rs 175.5 per kg.