MIXTURE AND ALLIGATION

Mixture: Mixing of two or more than two type of quantities is called a mixture.
Quantities of these elements can be expressed as percentage or ratio.
(1) Percentage: - (20% of sugar in water)
(2)Ratio:- A solution of sugar and water such that
(sugar : water = 1:4)

Alligation: Alligation is a method which is used to solve the problems related to mixture and alligation. This method is used to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture.

Mean Price

The cost price of a final mixture is called the mean price.

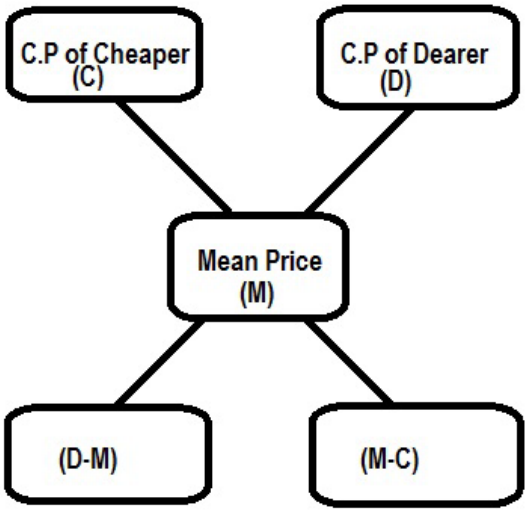
Alligation Rule:-

When two elements are mixed to make a mixture and one of the elements is cheaper and other one is costlier then

Note: Alligation method is applied to **a ratio, rate, percentage , prices, speed** etc and it is not applicable for absolute values. It means whenever per cent, per hour, per kg, per km etc are being compared, we can use alligation.

$$\frac{Quantity\ \ of\ Cheaper}{Quantity\ \ of\ Dearer} = \frac{Dearer\ -Mean}{Mean\ -Cheaper}$$

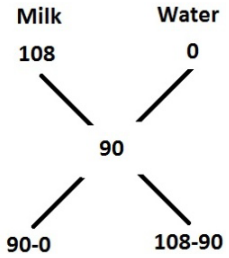
Here Mean Price is CP of mixture per unit quantity.
Above rule can be written as,



Points to Remember While Using the Rule of Alligation

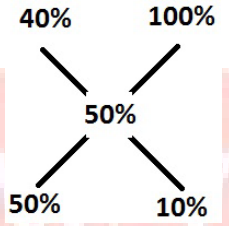
– The three values alligated should always represent the same variable and should have same units.
– Alligation of 3 values of cost gives the ratio in terms of number and vice-versa.
– If two values of cost price and selling price of the mixture are given, then in such cases first calculate the cost price of the mixture and then allegate the 3 values of cost price.
– A and B represent concentration if the numerical is based on mixing of solutions.

Ex1: A mixture of a certain quantity of milk with 16 litres of water is worth 90 P per litre. If pure milk is worth Rs1.08 per litre, how much milk is there in the mixture?
Sol:



By the alligation Rule, milk and water are in the ratio of 5: 1.
Quantity of milk in the mixture = 5 ×16 = 80 litres.

Ex2. 600 gm of sugar solution has 40% sugar in it. How much sugar should be added to make it 50% of the solution?
Sol:
The existing solution has 40% sugar, and sugar is to be mixed; so the other solution has 100% sugar. So, by alligation method;



the two mixture should be added in the ratio 5: 1
Therefore, required sugar =(600/5)*1 = 120

Questions for Practise

1. A jeweller mixes Silver and Gold in the ratio 3 : 2 in order to make a necklace. The cost of Gold is Rs. 3000 per gram. If the cost of a gram of mixture is Rs. 1950, then what is the price of Silver per gram?
(A) 1150 (B) 1250
(C) 1350 (D) 1450
(E) None of these

2. There are three different containers, first has 60% acid and rest is water. The second has 50% acid and rest is water and third has 40% acid and rest is water. If the three are mixed in ratio 3 : 4 : 3, what will be the percentage of Acid in the mixture?
(A) 40% (B) 45%
(C) 48% (D) 50%
(E) None of these

3. Two vessels contain water and milk in the ratio 2 : 3 and 1 : 2. In which ratio the contents of the two vessels have to be mixed to get a new mixture which contains the water and milk in ratio 3 : 5.
(A) 1 : 2 (B) 2 : 3
(C) 3 : 2 (D) 5 : 3
(E) None of the above

4. A jar full of whisky contains 45% alcohol. A part of this whisky is replaced by another containing 21% alcohol and now the percentage of alcohol was found to be 29%. What is the quantity of whisky replaced?
(A) $\frac{2}{3}$ (B) $\frac{1}{2}$
(C) $\frac{1}{3}$ (D) $\frac{2}{5}$
(E) None of these

5. 8 kg of a metal contains $\frac{2}{5}$ Tin and rest is Zinc. Another 6 kg of metal contains $\frac{2}{3}$ Tin and rest is Zinc. What is the ratio of Zinc and Tin in the mixture of these two metals?
(A) 18 : 17 (B) 8 : 15
(C) 17 : 18 (D) 15 : 7
(E) None of these

6. Two containers A and B, contains a mixture of water and acid in the ratio 7 : 2 and 7 : 11 respectively. If equal quantities of these two containers are pour into a third container C, the ratio of water and acid in C will be:
(A) 5 : 7 (B) 7 : 5
(C) 6 : 5 (D) 8 : 7
(E) None of these

7. Liquid X is twice as heavy as water and liquid Y is 12 times as heavy as water. In what ratio should X and Y mixed to make the mixture 4 times as heavy as water?
(A) 2 : 1 (B) 3 : 1
(C) 4 : 1 (D) 3 : 2
(E) None of these

8. Two tanks A and B contain mixtures of milk and water in the ratio 3:2 and 1:1 respectively .The volumes of two tanks are in the ratio 2:3. If contents of both the tank are mixed, the ratio of milk and water?
(A) 15 : 17 (B) 27 : 23
(C) 22 : 27 (D) 19 : 22
(E) None of these

9. A container has 30 litres of water. If 3 litres of water is replaced by 3 litres of spirit and this operation is repeated twice, what will be the quantity of water in the new mixture?
(A) 20 litres (B) 22 litres
(C) 24.3 litres (D) 26.6 litres
(E) None of these

10. In a mixture of 60 Ltr, the ratio of milk and water is 2 : 1. If this ratio is to be 1 : 2, then the quantity of water to be further added is
(A) 20 Ltr (B) 30 Ltr
(C) 40 Ltr (D) 60 Ltr
(E) None of these

11. What quantity of sugar of superior quality costing Rs.48/kg should a shopkeeper mix with 30 kg of sugar of low quality costing Rs.26 per kg so that he makes a profit of 25% on selling the mixture at Rs.45/kg?
(A) 18 (B) 20
(C) 25 (D) 32
(E) None of these

12. A vessel contains 60 litres of milk. 10 litres of this milk is taken out and replaced with water. This process is repeated twice. Find the amount of remaining milk in the mixture?
(A) $26\frac{2}{3}$ litres (B) $32\frac{2}{3}$ litres
(C) $36\frac{1}{3}$ litres (D) $41\frac{2}{3}$ litres
(E) None of these

13. Rs 14000 are lent in two parts, 1 part at 8% per annum and 2nd part at 15% per annum. At the end of a year Rs 1680 is received as simple interest. Find the part lent at 15% p.a.
(A) 5000 (B) 6000
(C) 7000 (D) 8000
(E) None of these

14. If fresh fruit contains 72 percent water and dry fruit contains 16 percent water. How much dry fruit can be obtained from 300 kg of fresh fruit?
(A) 75 (B) 90
(C) 100 (D) 120
(E) None of these

15. The ratio of chemical A and chemical B in the container is 3:2 when 10 litres of the mixture is taken out and is replaced by the Chemical B, the ratio become equal. What is the quantity of the chemical B mixture in the container?
(A) 18L (B) 24L
(C) 30L (D) 36L
(E) None of these

Solutions

1. Answer is option B
Explanation:
Let Silver and Gold
3x : 2x
Cost of Silver = S
Mixture cost = $\frac{gold \times 3000 + Silver \times S}{gold + silver}$
1950 = $\frac{(2x \times 3000 + 3x \times S)}{5x}$
1950×5 = 6000 + 3S
9750–6000 = 3S
S = $\frac{3750}{3}$
S = 1250

2. Answer is option D
Explanation:
Container Acid : Water
First 6 : 4 = 10
Second 5 : 5 = 10
Third 4 : 6 = 10
Mixed in the ratio 3 : 4 : 3.
First 6 : 4 = 10 ×3
Second 5 : 5 = 10 ×4
Third 4 : 6 = 10 ×3
After mixing
First 18 : 12 = 30
Second 20 : 20 = 40
Third 12 : 18 = 30
Total 50 : 50 = 100
Acid in the mixture = $\frac{50}{100} \times 100$ = 50%

3. Answer is option D
Explanation:
By allegation method
Water-I Water-II
$\frac{2}{5}$ $\frac{1}{3}$
\ /
$\frac{3}{8}$
/ \
$\frac{3}{8}-\frac{1}{3}$ $\frac{2}{5}-\frac{3}{8}$

= $\frac{9-8}{24} : \frac{16-15}{40}$
= $\frac{1}{24} : \frac{1}{40}$
= 5 : 3

4. Answer is option A
Explanation:
By allegation method
Strength of First Strength of second
45% 21%
29%
8 16
= 1 : 2 =3
Quantity replaced = $\frac{2}{3}$

5. Answer is option C
Explanation:
First metal = 8 kg (8000g)
Tin : Zinc
8000×$\frac{2}{5}$: 8000×$\frac{3}{5}$
3200 : 4800

Second metal = 8 kg (8000g)
Tin : Zinc
6000×$\frac{2}{3}$: 6000×$\frac{1}{3}$
4000 : 2000

In the mixture
Zinc : Tin
6800 : 7200
= 17 : 18

6. Answer is option B
Explanation:
Water : Acid
A 7 2 = 9
B 7 11 = 18
These containers hold equal quantity.
So, Multiply Container A' quantity with 2.
Water : Acid
A 14 4 = 18
B 7 11 = 18
Total 21 15

Water : Acid
7 5

7. Answer is option C
Explanation:
Water = 1
Liquid x = 2
Liquid y = 12
Mixture = 4
Liquid x Liquid y
2 12

4

8 2
Final ratio
Liquid x : Liquid y
4 1

8. Answer is option B
Explanation:
Milk : Water
Tank A 3 : 2 = 5
Tank B 1 : 1 = 2
Equate the quantities of both tanks.
Tank A 6 : 4 = 10
Tank B 5 : 5 = 10
Volume of
Tank A : Tank B
2 3
Final ratio
Milk : Water
Tank A 12 : 8
Tank B 15 : 15
27 : 23

9. Answer is option C
Explanation:
Remaining quantity = $x\left(1-\frac{y}{x}\right)^n$
Remaining water = $30\left(1-\frac{3}{30}\right)^2$
= $\frac{30\times81}{100}$
= 24.3 ltr

10. Answer is option D
Explanation:
Mixture = 60 Ltr
Milk : Water
40 : 20
Let water added = x
$\frac{40}{20+x}=\frac{1}{2}$
80 = 20+x
x = 60 Ltr

11. Answer is option C
Explanation:
S.P = 45
Profit = 25%
C.P = $45\times\frac{100}{125}$
= 36

Superior Low quality
48 26
\ /
36
/ \
10 12
Ratio
5x : 6x
6x = 30
x = 5
Then, 5x = 25 kg

12. Answer is option D
Explanation:
Total milk = 60 litres
Remove qt. = 10 litres
Remaining milk = $60\times\left(1-\frac{10}{60}\right)^2$
= $60\times\frac{25}{36}$
= $\frac{125}{3}=41\frac{2}{3}$ litres

13. Answer is option D
Explanation:
Amount = 14000
Interest = 1680
Rate = $\frac{1680}{14000}\times100=12\%$

8% 15%
\ /
12%
/ \
3 4
Ratio
3 : 4 = 7
15% amount = $14000\times\frac{4}{7}=8000$

14. Answer is option C
Explanation:
Fresh fruit
Water = 28%
Pulp = 72%

Dry fruit
Water = 16%
Pulp = 84%
Pulp remains same.
So, we can say that
28% of fresh fruit = 84% of dry fruit
Fresh fruit = 3
Dry fruit = 1
Dry fruit can be obtain = $300\times\frac{1}{3}$ = 100 kg

15. Answer is option B
Explanation:
A : B
3x : 2x
$\frac{3x-6}{2x-4+10}=\frac{1}{1}$
3x-6 = 2x+6
x = 12
Chemical B initially = 2x
= 2×12 = 24 litres