

KERALA HIGH COURT
OFFICE ATTENDANT EXAM

Numerical Ability

Mixtures and Alligation

Key Concepts • Shortcuts • 25 Practice Questions • Answer Key with Solutions

1. Key Concepts

- A **mixture** is formed by combining two or more ingredients (milk and water, two grades of rice, etc.).
- **Mean price (m)** of a mixture = Total cost of all ingredients / Total quantity.
- **Mean price of two ingredients:** $m = (q_1 \times p_1 + q_2 \times p_2) / (q_1 + q_2)$.
- Water, when added to milk, is treated as an ingredient with price **Rs 0**.
- In a mixture with ratio $a : b$, ingredient A = $a/(a + b) \times \text{Total}$, ingredient B = $b/(a + b) \times \text{Total}$.

2. Rule of Alligation

Let the cheaper ingredient cost **c** per unit, the dearer cost **d** per unit and the mean price be **m**.

Ingredient	Quantity (in ratio)
Cheaper (c)	$d - m$
Dearer (d)	$m - c$

- **Cheaper quantity : Dearer quantity = $(d - m) : (m - c)$**
- The mean price m must always lie between c and d .
- Alligation can be used for any quantity that averages out: price per kg, concentration (%), speed, profit %, and so on.

3. Replacement Formula

- A vessel holds x litres of pure liquid. y litres are drawn off and replaced by water. After n such operations, the pure liquid left = $x (1 - y/x)^n$ litres.
- Ratio of pure liquid left to total (after n operations) = $(1 - y/x)^n$.
- To find the starting quantity, set up the ratio equation with the initial total as x .

Quick tip: For ratio-of-mixture problems, assume the total quantity as the sum of ratio parts times k , then solve for k .

4. Practice Questions (25)

Q1. In what ratio should rice at Rs 20/kg be mixed with rice at Rs 30/kg to get a mixture worth Rs 24/kg?

- (a) 2 : 3
- (b) 3 : 2
- (c) 3 : 1
- (d) 1 : 2

Q2. In what ratio should sugar at Rs 36/kg be mixed with sugar at Rs 42/kg to get a mixture worth Rs 38/kg?

- (a) 1 : 2
- (b) 1 : 1
- (c) 2 : 1
- (d) 3 : 1

Q3. 20 kg of rice at Rs 15/kg is mixed with 30 kg of rice at Rs 20/kg. The mean price per kg is:

- (a) Rs 18
- (b) Rs 17
- (c) Rs 19
- (d) Rs 20

Q4. A mixture of 40 litres contains milk and water in the ratio 3 : 1. How much water should be added to make the ratio 3 : 2?

- (a) 5 L
- (b) 8 L
- (c) 15 L
- (d) 10 L

Q5. A mixture of 60 litres contains milk and water in the ratio 2 : 1. Water to be added to make the ratio 1 : 1 is:

- (a) 10 L
- (b) 20 L
- (c) 30 L
- (d) 40 L

Q6. A 25 litre mixture has milk and water in the ratio 4 : 1. The quantity of milk is:

- (a) 15 L
- (b) 18 L
- (c) 20 L
- (d) 22 L

Q7. Wheat at Rs 12/kg and Rs 15/kg are mixed in the ratio 2 : 3. The mean price per kg is:

- (a) Rs 13.80
- (b) Rs 13.50
- (c) Rs 14
- (d) Rs 14.20

Q8. A vessel contains 40 litres of milk. 4 litres are removed and replaced by water, and this is repeated once more. The milk left is:

- (a) 30.4 L
- (b) 34 L
- (c) 36 L
- (d) 32.4 L

Q9. Tea at Rs 100/kg and Rs 150/kg are mixed in the ratio 2 : 3. The mean price per kg is:

- (a) Rs 125
- (b) Rs 130
- (c) Rs 135
- (d) Rs 140

Q10. 4 kg of sugar at Rs 30/kg is mixed with 6 kg of sugar at Rs 40/kg. The mean price per kg is:

- (a) Rs 34
- (b) Rs 35
- (c) Rs 36
- (d) Rs 38

Q11. A 32 litre mixture contains milk and water in the ratio 5 : 3. The quantity of water is:

- (a) 12 L
- (b) 10 L
- (c) 15 L
- (d) 20 L

Q12. How much water must be added to 20 litres of pure milk to make the ratio of milk to water 4 : 1?

- (a) 2 L
- (b) 3 L
- (c) 4 L
- (d) 5 L

Q13. The ratio of milk and water in a mixture is 3 : 2. After adding 10 litres of water, the ratio becomes 3 : 4. The initial quantity of the mixture is:

- (a) 20 L
- (b) 25 L
- (c) 30 L
- (d) 35 L

Q14. In what ratio should tea at Rs 80/kg be mixed with tea at Rs 100/kg to get a mixture worth Rs 90/kg?

- (a) 1 : 2
- (b) 2 : 1
- (c) 1 : 1
- (d) 3 : 1

Q15. 15 kg of rice at Rs 50/kg is mixed with 10 kg of rice at Rs 75/kg. The mean price per kg is:

- (a) Rs 60
- (b) Rs 58
- (c) Rs 62
- (d) Rs 65

Q16. In what ratio should water be mixed with milk costing Rs 60/litre to get a mixture worth Rs 48/litre?

- (a) 4 : 1
- (b) 1 : 2
- (c) 2 : 3
- (d) 1 : 4

Q17. Vessel A has milk and water in the ratio 3 : 1 and vessel B has 1 : 1. Equal quantities from both are mixed. The ratio of milk to water in the new mixture is:

- (a) 3 : 5
- (b) 5 : 3
- (c) 4 : 3
- (d) 1 : 1

Q18. 25 kg of wheat at Rs 30/kg is mixed with 15 kg at Rs 18/kg. The mean price per kg is:

- (a) Rs 24
- (b) Rs 25
- (c) Rs 25.50
- (d) Rs 26

Q19. A container has 50 litres of milk. 10 litres are removed and replaced with water, and this is repeated once more. The milk left is:

- (a) 32 L
- (b) 36 L
- (c) 40 L
- (d) 28 L

Q20. In what ratio should goods at Rs 30/kg be mixed with goods at Rs 50/kg to get a mixture worth Rs 38/kg?

- (a) 2 : 3
- (b) 5 : 3
- (c) 1 : 1
- (d) 3 : 2

Q21. A mixture has 15 litres of milk and 5 litres of water. The percentage of water is:

- (a) 20%
- (b) 25%
- (c) 30%
- (d) $33 \frac{1}{3} \%$

Q22. Milk costs Rs 50 per litre. Water is added to make a mixture that is 20% water. The cost of the mixture per litre is:

- (a) Rs 35
- (b) Rs 45
- (c) Rs 40
- (d) Rs 42

Q23. 20 kg of sugar at Rs 18/kg is mixed with how many kg of sugar at Rs 24/kg to get a mixture worth Rs 20/kg?

- (a) 10 kg
- (b) 12 kg
- (c) 15 kg
- (d) 20 kg

Q24. A 40 litre mixture has milk and water in the ratio 7 : 1. The quantity of water is:

- (a) 4 L
- (b) 6 L
- (c) 8 L
- (d) 5 L

Q25. A can contains a mixture of liquids A and B in the ratio 7 : 5. When 9 litres are drawn off and the can is filled with B, the ratio becomes 7 : 9. The quantity of A initially in the can was:

- (a) 18 L
- (b) 21 L
- (c) 24 L
- (d) 27 L

5. Answer Key

1-b | 2-c | 3-a | 4-d | 5-b | 6-c | 7-a | 8-d | 9-b | 10-c | 11-a | 12-d | 13-b | 14-c | 15-a | 16-d | 17-b | 18-c | 19-a | 20-d | 21-b | 22-c | 23-a | 24-d | 25-b

6. Solutions

Q1. (b) 3 : 2 - Cheaper : Dearer = $(30 - 24) : (24 - 20) = 6 : 4 = 3 : 2$.

Q2. (c) 2 : 1 - Cheaper : Dearer = $(42 - 38) : (38 - 36) = 4 : 2 = 2 : 1$.

Q3. (a) Rs 18 - $(300 + 600)/50 = 900/50 = \text{Rs } 18$.

Q4. (d) 10 L - Milk = 30 L, water = 10 L. $30/(10 + x) = 3/2$ gives $10 + x = 20$, so $x = 10$ L.

Q5. (b) 20 L - Milk = 40 L, water = 20 L. For 1 : 1, water must be 40 L, so add 20 L.

Q6. (c) 20 L - Milk = $4/5 \times 25 = 20$ L.

Q7. (a) Rs 13.80 - $(2 \times 12 + 3 \times 15)/5 = (24 + 45)/5 = 69/5 = \text{Rs } 13.80$.

Q8. (d) 32.4 L - Milk left = $40 \times (1 - 4/40)^2 = 40 \times 0.81 = 32.4$ L.

Q9. (b) Rs 130 - $(200 + 450)/5 = 650/5 = \text{Rs } 130$.

Q10. (c) Rs 36 - $(120 + 240)/10 = \text{Rs } 36$.

Q11. (a) 12 L - Water = $3/8 \times 32 = 12$ L.

Q12. (d) 5 L - Water needed = $20/4 = 5$ L.

Q13. (b) 25 L - Let milk = $3k$, water = $2k$. $3k/(2k + 10) = 3/4$ gives $k = 5$. Initial = $5k \times 5 = 25$ L.

Q14. (c) 1 : 1 - $(100 - 90) : (90 - 80) = 10 : 10 = 1 : 1$.

Q15. (a) Rs 60 - $(750 + 750)/25 = 1500/25 = \text{Rs } 60$.

Q16. (d) 1 : 4 - Water (Rs 0) : Milk (Rs 60) = $(60 - 48) : (48 - 0) = 12 : 48 = 1 : 4$.

Q17. (b) 5 : 3 - Milk fraction: $A = 3/4$, $B = 1/2$; average = $5/8$. Milk : Water = 5 : 3.

Q18. (c) Rs 25.50 - $(750 + 270)/40 = 1020/40 = \text{Rs } 25.50$.

Q19. (a) 32 L - Milk left = $50 \times (1 - 10/50)^2 = 50 \times 0.64 = 32$ L.

Q20. (d) 3 : 2 - Cheaper : Dearer = $(50 - 38) : (38 - 30) = 12 : 8 = 3 : 2$.

Q21. (b) 25% - $5/20 \times 100 = 25\%$.

Q22. (c) Rs 40 - 80% milk: $0.8 \times 50 = \text{Rs } 40$ per litre.

Q23. (a) 10 kg - Cheaper : Dearer = $(24 - 20) : (20 - 18) = 2 : 1$. So $20 : x = 2 : 1$, $x = 10$ kg.

Q24. (d) 5 L - Water = $1/8 \times 40 = 5$ L.

Q25. (b) 21 L - Let total = x . A left = $7x/12 - 21/4$; $B = 5x/12 + 21/4$. Ratio 7 : 9 gives $x = 36$. $A = 7/12 \times 36 = 21$ L.