

# Lecture-4 : Ratio, Proportion & Mixture (Written)

## Teacher's Work

- Certain amount of money is divided among A, B, and C in such a way that A gets 3 times as much as B and B receives 2 times as much as C. If A receives Tk. 1500 more than C, what is the total amount of money? [20 Based Combined Senior Officer (General): 2023]
- In an MBA class the ratio of number of commerce graduates to the number of science graduates is 2 to 5. If 2 more commerce graduates enter the class the ratio becomes 1 to 2. How many commerce graduates are in the class? [Combined Cash 08, RAKUB 11]
- The ratio of the numbers of boys and girls in a school was 5:3. Some new boys and girls were admitted to the school, in the ratio 5:7. At this, the total number of students in the school became 1200 and the ratio of boys to girls changed to 7:5. The number of students in the school before new admissions was? [Combined 5 Banks Cash 19]
- The annual income and expenditure of a man and his wife are in the ratios 5:3 and 3:1, respectively. If they decide to save equally and find a balance of Tk. 4000 at the end of the year, what was their income? [BB Officer 15]
- Total number of men, women and children working in a factory is 18. They earn Tk. 4000 in a day. If the sum of the wages of all men, all women and all children is in ratio of 18: 10 : 12 and if the wages of an individual man, woman and child is in ratio 6 : 5 : 3, then how much a woman earns in a day?
- Coffee A normally costs 100 taka per pound. It is mixed with coffee B, which normally costs 70 taka per pound, to form a mixture which costs 80 taka per pound. If there are 12 pounds of the mix, how many pounds of coffee A are used in the mix? [NCC Bank Officer 02]
- Rahim bought 2 varieties of rice costing Tk. 5 and 6 per kg each. Then he sold the mixture at Tk. 7/kg, making profit of 20%. What was the ratio of the mixture? [Janata EO 12, Rupali bank SO 13, BB AD 14]
- A Jar contains 30 liters mixture of Milk and Water in the ratio of x:y respectively. When 10 liter of the mixture is taken out and replaced it water, then the ratio becomes 2:3. Then what is the initial quantity of Milk in the Jar?
- Three containers A, B and C having mixtures of milk and water in ratio of 1:5, 3:5 and 5:7 respectively. If the capacities of the container are in the ratio 5:4:5. Find the ratio of milk and water, if the mixtures of all the three containers are mixed together. [Sonali FF SO 19]

- Two alloys A and B are composed of two basic elements. The ratios of the compositions of the two basic elements in the two alloys are 5:3 and 1:2. A new alloy X is formed by mixing the two alloys A & B in the ratio 4:3. What is the ratio of the composition of the two basic elements in alloy X? [BB AD 12]
- In a mixture of milk and water, their ratio is 4:5 in the first container and the same mixture has ratio 5:1 in the second container. In what ratio should the mixture be extracted from each container and poured into the third container, so that the ratio of milk and water comes to 5:4 in the third container? [Combined 3 Banks SO 18, Combined 5 Banks AME/HE/AE (IT) 18]
- Two vessels contain milk and water in the ratio of 7:3 and 2:3 respectively. Find the ratio in which the contents of both the vessels must be mixed to get a new mixture containing milk and water in the ratio 3:2.

## Illustrative Questions

- A sum of Tk 1290 is divided between A, B and C such that A's share is  $1\frac{1}{2}$  times that of B and B's share is  $1\frac{3}{4}$  times that of C. What is C's share?

Sol. Let C's share = Tk x.

$$\text{Then, B's share} = \text{Tk} \left(1\frac{3}{4}x\right) = \text{Tk} \left(\frac{7x}{4}\right);$$

$$\text{A's share} = \text{Tk} \left(\frac{3}{2} \times \frac{7x}{4}\right) = \text{Tk} \left(\frac{21x}{8}\right).$$

$$\text{A} : \text{B} : \text{C} = \frac{21x}{8} : \frac{7x}{4} : x = \frac{21}{8} : \frac{7}{4} : 1 = 21 : 14 : 8.$$

$$\text{Sum of ratio terms} = (21 + 14 + 8) = 43.$$

$$\therefore \text{C's share} = \text{Tk} \left(1290 \times \frac{8}{43}\right) = \text{Tk} 240.$$

- A sum of Tk 427 is to be divided among A, B and C in such a way that 3 times A's share, 4 times B's share and 7 times C's share are all equal. Find the share of each.

Sol. Let,  $3A = 4B = 7C = k$

$$\Rightarrow A = \frac{k}{3}, B = \frac{k}{4}, C = \frac{k}{7}$$

$$\Rightarrow \text{A} : \text{B} : \text{C} = \frac{k}{3} : \frac{k}{4} : \frac{k}{7} = \frac{1}{3} : \frac{1}{4} : \frac{1}{7} = 28 : 21 : 12.$$

$$\text{Sum of ratio terms} = (28 + 21 + 12) = 61.$$

$$\therefore \text{A's share} = \text{Tk} \left(427 \times \frac{28}{61}\right) = \text{Tk} 196;$$

$$\text{B's share} = k \left(427 \times \frac{21}{61}\right) = \text{Tk} 174;$$

$$\text{C's share} = \text{Tk} \left(427 \times \frac{12}{61}\right) = \text{Tk} 84.$$

03. The salary of A, B and C together amounts to Tk 33300. If they spend 80%, 85% and 75% of their respective incomes, their savings are as 7:6:9. Find the salary of B.

Sol. Since A, B and C spend 80%, 85% and 75% of their incomes, they save 20%, 15% and 25% of their incomes. Let the salary of A, B and C be x, y and z respectively.

$$\text{Then, } 20\% \text{ of } x : 15\% \text{ of } y : 25\% \text{ of } z = 7 : 6 : 9$$

$$\Rightarrow \frac{x}{5} : \frac{3y}{20} : \frac{z}{4} = 7:6:9.$$

$$\Rightarrow \frac{x}{5} : \frac{y}{20} :: 7:6 \Rightarrow \frac{x}{5} \times 6 = \frac{3y}{20} \times 7$$

$$\Rightarrow \frac{3}{20} \times \frac{7}{6} \times 5 = \frac{7}{8}.$$

$$\frac{3y}{20} : \frac{z}{4} :: 6:9$$

$$\Rightarrow \frac{3y}{20} \times 9 = \frac{z}{4} \times 6$$

$$\Rightarrow \frac{y}{z} = \frac{1}{4} \times \frac{6}{9} \times \frac{20}{3} = \frac{10}{9}.$$

$$\text{So, } x : y = 7 : 8 \text{ and } y : z = 10 : 9$$

$$= \left(10 \times \frac{4}{5}\right) : \left(9 \times \frac{4}{5}\right) = 8 : \frac{36}{5}.$$

$$x : y : z = (7 \times 5) : (8 \times 5) : \left(\frac{36}{5} \times 5\right) = 35 : 40 : 36.$$

$$\text{Let } x = 35k, y = 40k \text{ and } z = 36k.$$

$$\therefore 35k + 40k + 36k = 33300$$

$$\Rightarrow 111k = 33300 \Rightarrow k = 300.$$

$$\text{Hence, B's salary} = \text{Tk } (40 \times 300) = \text{Tk } 12000.$$

04. Ratio of the income of A, B and C last year was 3 : 4 : 5. The ratio of their individual incomes of the last year and this year are 4:5, 2:3 and 3:4 respectively. If the sum of their present income is Tk 78800, then find the present individual incomes of A, B and C.

Sol. Let the incomes of A, B and C last year be Tk 3x, Tk 4x and Tk 5x respectively.

$$\text{Then, A's present income} = \text{Tk } \left(\frac{5}{4} \times 3x\right) = \text{Tk } \frac{15x}{4}.$$

$$\text{Then, B's present income} = \text{Tk } \left(\frac{3}{2} \times 4x\right) = \text{Tk } 6x.$$

$$\text{C's present income} = \text{Tk } \left(\frac{4}{3} \times 5x\right) = \text{Tk } \left(\frac{20x}{3}\right).$$

$$\therefore \frac{15x}{4} + 6x + \frac{20x}{3} = 78800$$

$$\Rightarrow 45x + 72x + 80x = 78800 \times 12$$

$$\Rightarrow x = \frac{78800 \times 12}{197} = 4800.$$

$$\text{Hence, A's present income} = \text{Tk } \left(\frac{15}{4} \times 4800\right) = \text{Tk } 18000.$$

$$\text{B's present income} = \text{Tk } (6 \times 4800) = \text{Tk } 28800.$$

$$\text{C's present income} = \text{Tk } \left(\frac{20}{3} \times 4800\right) = \text{Tk } 32000.$$

05. An employer reduces the number of employees in the ratio of 9:8 and increases their wages in the ratio 14:15. In what ratio the wages bill is increased or decreased?

Sol. Initially let the number of employees be  $9x$  and wages per head be Tk 14y.

$$\text{Total wages bill} = \text{Tk } (9x \times 14y) = \text{Tk } 126xy.$$

Further reduced number of employees =  $8x$  and wages per head is Tk 15y.

$$\text{Total wages bill} = \text{Tk } (8x \times 15y) = \text{Tk } 120xy.$$

$$\text{Ratio of wages bills} = 126xy : 120xy = 21 : 20.$$

Hence, the wages bill is decreased in the ratio 21:20.

06. How much of tea costing Tk 36.60 per kg be mixed with 63 kg of tea costing Tk 17.10 per kg so that the mixture may cost Tk 24 per kg?

Sol. Let  $x$  kg of tea costing Tk 36.60 per kg be mixed with 63 kg of 2<sup>nd</sup> kind.

$$\text{Then } (36.60 \times x) + (63 \times 17.10) = (x+63) \times 24$$

$$\Rightarrow 12.60x = 63 \times (24 - 17.10)$$

$$\Rightarrow 12.60x = 63 \times 6.90$$

$$\Rightarrow x = \left(\frac{63 \times 690}{1260}\right)$$

$$\Rightarrow x = 34.5.$$

$\therefore$  Required quantity = 34.5 kg.

07. 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 alloys are melted to form a third alloy C, find the ratio of gold and copper in C.

Sol. Gold in 1 gm of A =  $\frac{7}{9}$  gm, Gold in 1 gm of B =  $\frac{7}{18}$  gm.

$$\text{Gold in 2 gm of C} = \left(\frac{7}{9} + \frac{7}{18}\right) \text{ gm} = \left(\frac{21}{18}\right) \text{ gm} = \frac{7}{6} \text{ gm}.$$

$$\text{Copper in 1 gm of A} = \frac{2}{9} \text{ gm, Copper in 1 gm of B} = \frac{11}{18} \text{ gm}.$$

$$\text{Copper in 2 gm of C} = \left(\frac{2}{9} + \frac{11}{18}\right) \text{ gm} = \frac{15}{18} \text{ gm} = \frac{5}{6} \text{ gm}.$$

$$\text{Ratio of gold and copper in C} = \frac{7}{6} : \frac{5}{6} = 7:5.$$

08. Three equal jugs are filled with a mixture of milk and water. The proportion of milk and water in each glass is in the ratio 1:2, 2:3 and 3:4. The contents of the three jugs are emptied into a single vessel. What is the proportion of milk and water in it?

Sol. Let the volume of each jug be  $x$  litres. Then,

$$\text{Milk in 1<sup>st</sup> glass} = \frac{x}{3} \text{ litres;}$$

$$\text{water in 1<sup>st</sup> glass} = \frac{2x}{3} \text{ litres.}$$

$$\text{Milk in 2<sup>nd</sup> glass} = \frac{2x}{5} \text{ litres;}$$

$$\text{water in 2<sup>nd</sup> glass} = \frac{3x}{5} \text{ litres;}$$

Milk in 3<sup>rd</sup> glass =  $\frac{3x}{7}$  litres;

water in 3<sup>rd</sup> glass =  $\frac{4x}{7}$  litres

$$\begin{aligned}\text{Total milk in final mixture} &= \left(\frac{x}{3} + \frac{2x}{5} + \frac{3x}{7}\right) \text{ litres} \\ &= \frac{122}{105} \text{ L}\end{aligned}$$

$$\begin{aligned}\text{Total water in final mixture} &= \left(\frac{2x}{3} + \frac{3x}{5} + \frac{4x}{7}\right) \text{ litres} \\ &= \frac{193}{105} \text{ L}\end{aligned}$$

$$\begin{aligned}\therefore \text{Required ratio of milk and water} &= \frac{122}{105} : \frac{193}{105} \\ &= 122 : 193.\end{aligned}$$

09. In a mixture of three varieties of tea, the ratio of their weights is 4:5:8. If 5 kg tea of the first variety, 10 kg tea of the second variety and some quantity of tea of the third variety are added to the mixture, the ratio of the weights of three varieties of tea of the third variety are added to the mixture, the ratio of the weights of three varieties of tea becomes 5: 7: 9. Find the quantity of the third variety of tea in the final mixture.

Sol. Let the weights of 1st, 2nd and 3rd varieties of tea in the original mixture be 4x, 5x and 8x kg respectively.

$$\text{Then, } \frac{4x + 5}{5x + 10} = \frac{5}{7}$$

$$\Leftrightarrow 7(4x + 5) = 5(5x + 10)$$

$$\Leftrightarrow 28x + 35 = 25x + 50$$

$$\Leftrightarrow 3x = 15$$

$$\Leftrightarrow x = 5.$$

So, the weights of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> varieties in the original mixture are 20 kg, 25 and 40 kg respectively. Let y kg of third variety be added.

$$\text{Then, } \frac{25 + 10}{40 + y} = \frac{7}{9}$$

$$\Leftrightarrow 7(40 + y) = 9 \times 35$$

$$\Leftrightarrow 40 + y = \frac{9 \times 35}{7} = 45$$

$$\Leftrightarrow y = 5.$$

Hence, quantity of third variety in the final mixture = (40 + 5) kg = 45 kg.

10. Two identical vessels A and B contain mixtures of milk and water in the ratio of 4:5 and 5:1 respectively. In what ratio should quantities of mixtures be taken from A and B to form a mixture in which milk to water is in the ratio 5:4?

Sol. Milk in A =  $\frac{4}{9}$  units; Milk in B =  $\frac{5}{6}$  units;

Water in A =  $\frac{5}{9}$  units; Water in B =  $\frac{1}{6}$  units.

Let A and B be taken in the ratio 1:y.

$$\text{Then, } \frac{\frac{4}{9} + \frac{5y}{6}}{\frac{5}{9} + \frac{y}{6}} = \frac{5}{4}$$

$$\Rightarrow \frac{8 + 15y}{10 + 3y} = \frac{5}{4}$$

$$\Rightarrow 4(8 + 15y) = 5(10 + 3y)$$

$$\Rightarrow 32 + 60y = 50 + 15y$$

$$\Rightarrow 45y = 18$$

$$\Rightarrow y = \frac{2}{5}$$

$$\therefore \text{Required ratio} = 1 : \frac{2}{5} = 5 : 2$$

11. A pot contains 81 litres of pure milk.  $\frac{1}{3}$  of the milk is replaced by that amount of water. Again,  $\frac{1}{3}$  of the mixture is replaced by the amount of water. Find the ratio of milk and water in the new mixture.

Sol. If from x units of liquid in a container, y units are taken out and replaced by water n times, then quantity

Of pure liquid in the mixture =  $x \left(1 - \frac{y}{x}\right)^n$  units.

Quantity of milk replaced each time =  $\frac{1}{3}$  of 81 litres = 27 L.

So, x = 81 litres, y = 27 litres, n = 2.

Quantity of milk in the new mixture =  $\left[81 \left(1 - \frac{27}{81}\right)^2\right] \text{ L}$

=  $\left[81 \times \left(\frac{2}{3}\right)^2\right] \text{ liters} = 81 \times \frac{4}{9} \text{ liters} = 36 \text{ liters}$

Quantity of water in the new mixture = (81 - 36) litres = 45 litres.

$\therefore$  Required ratio = 36:45 = 4:5.

### Home Practice

01. A certain college has students to teacher ratio of 11 to 1. The average annual salary for teacher is Tk. 26,000. If the college pays a total of Tk. 33,80,000 in annual salaries to its teachers. How many students does the college have? [RAKUB Office 14] 1430
02. The salaries of Lamia and Farzin are in the ratio 7:5 and the total of their salaries is Tk. 12,000. If their annual increments are Tk. 200 and Tk. 150 respectively, what will be the ratio of their salaries after one year? [Sonal (off-IT)-16] 144:103
03. In a mixture 60 liters, the ratio of milk and water 2:1. If this ratio is to be 1:2, then estimate the quantity of water in liter to be further added in the mixture. [Standard Bank TAO 18] 60 Liters

04. A mixture contains two liquid in the ratio of 2:3. And another mixture contains the same two liquid in the ratio of 5:4. Find the ratio in which the contents of both the vessels must be mixed to get a new mixture containing two liquid in the ratio equally? [Rupali SO 19] **5:9**
05. A milk vendor has two cans of milk. The first contains 25% water and the rest milk. The second contains 50% water. How much milk should he mix from each of the containers so as to get 12 liters of milk such that the ratio of water to milk is 3:5? [Combined 2 Banks Officer IT 18] **6Liters, 6 Liters**
06. In a mixture the ratio of apples, peaches and grapes is 6:5:2. If the total mixture is 39 pounds then what is the difference between apples and grapes? [BKB SO 17] **12**
07. The ratio of gold and silver in an ornament weighing 42 gm is 4:3. How much gold will need to be added for the ratio of gold and silver to be 5:3? [Combined SO 08] **6gm**
08. How many liters of 15% salt solution must be added to 5 liters of 8% salt solution to get a 10% salt solution? [Sonali SO IT 16] **2Liters**
09. A Jar contains 'x' liters of Milk, a seller withdraws 25% of it and sells it at Tk. 20 per liter. He then replaces it by water. He repeated the process total three times. Every time while selling, he reduces selling price by Tk. 2. After this process, only 108 liters Milk left in the mixture and he decided to sell the entire Mixture at Tk. 15 per liter. Then how much profit did he earn if bought Milk at Tk. 28 per liter? [Combined 7 Banks SO 18] **128**
10. A container contains 40 liters of milk. From this container 4 liters of milk was taken out and replaced by water. This process was repeated further two times. How much milk is now contained by the container? [PKB EO Cash 19] **29.16**
11. In a class of 60 students, the number of boys and girls participating in the annual sports is in the ratio 3:2 respectively. The number of girls not participating in the sports is 5 more than the number of boys not participating in the sports. If the number of boys participating in the sports is 15, than how many girls are there in the school? **(30)**
12. The ratio of the girls and boys in a class was 2:5. If two new girls join the class, the ratio becomes 1:2. What was the total number of students in the class? [Sonali SO IT 16] **28**
13. The price of sugar and rice are in the ratio 4:5. If the price of sugar is increased by 10% and rice by 20%, find the ratio between increased prices of sugar and rice. [Premier Bank TJO 13] **11:15**
14. A bag contains Tomatoes that are either green or red. The ratio of green Tomatoes to red Tomatoes in the bag is 4 to 3. When five green Tomatoes and five red Tomatoes are removed, the ratio becomes 3 to 2. How many red Tomatoes were there originally in the bag? [Jamuna PO 14] **15**
15. Two equal glasses are respectively  $\frac{1}{3}$  and  $\frac{1}{4}$  full of milk. They are then filled up with water and the contents mixed in a tumbler. What is the ratio of milk and water in the tumbler? [SIBL PO 13] **7:17**
16. Daily earning of two persons are in the ratio 4:5 and their daily expense 7:9. If each saves Tk. 50 per day. What is their income? [Modhumoti Bank MTO Feb' 16] **400,500**
17. For every novel in a library there are two science books; for each science book there are seven business and economics books. Express the ratio of business and economics books to science books to novels in the library as a triple ratio. [Bank Asia MTO 08, MTO 05] **14:2:1**
18. A football team has a ratio of win to loss of 3:1. After winning 6 games in a row, the team's ratio of win to loss became 5:1. How many games had the team won before it played the last six games? [NCC Bank Off-02] **09**
19. A solution made up of 40% alcohol by volume is mixed with 4 liters of solution that is 10% alcohol by volume. How much, in liters of the 40% alcohol solution is needed to make a mixture that is 25% alcohol by volume. [Janata Cash 20] **4 Liter**
20. Two metals A and B are 900% and 200% respectively heavier than water. If there two metals make an alloy which is 6 times heavier than water, what is the ratio of the two metals in the alloy? [Bank Asia MTO 05] **4:3**
21. A mixture of 20kg spirit and water contains 10% water. How much water is to be added to increase the water up to 25%? **4Kg**
22. Monthly incomes of two persons are in the ratio 5: 4 and their monthly expenditures are in the ratio of 9:7. If each person saves Tk. 500 per month, then what are their monthly incomes? **(5000, 4000)**
23. One year ago the ratio between A's and B's salary was 3:4. Ratios of their individual salaries between last year's and this year's salaries are 4:5 & 2:3 respectively. At present the total of their salary is Tk.4160. The salary of A now, is? **(1600)**