CAPSTONE

Mathematics: Arithmetic

Lecture 06

Overview	Next Lecture
◆ Ratio ◆ Proportion ◆ Mixture	◆ Probability ◆ Permutation ◆ Combination

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Math Lecture Sheet: 06

Ratio

The ratio between two quantities is the quotient obtained by dividing the first quantity by the second. For example, the ratio between 3 and 12 is $\frac{1}{4}$ and the ratio between 12 and 3 is 4. Ratio is generally indicated by the sign ':', Thus, 12: 3 indicates the ratio of 12 to 3.

A reciprocal or inverse ratio is the reciprocal of the original ratio. Thus the inverses ratio of 5: 7 is 7: 5.
The first term of a ratio is called antecedent and the second term is called consequent.

Proportion:

Proportion is the equality of ratios, thus,

6: 3 = 10: 5 or 6: 3 :: 10: 5

The first and last term is a proportion are called the extremes; the second and third, are called the means. The product of the extremes is equal to the product of the means.

Thus, 6: 3 = 10: 5 and $6 \times 5 = 3 \times 10$

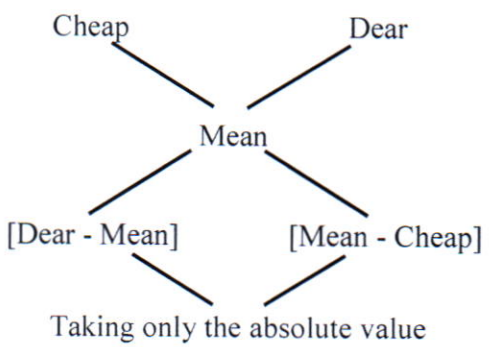
Mixture and allegation:

Allegation is the rule that enables us to

i. find the mean or average value of a mixture.

ii. find the proportion of the mixture.

Tips:



* Mean = $\frac{Cost\ price\ of\ the\ mixture}{Final\ concentration\ of\ the\ mixture}$

* The first entity should always be on the left side.

Example:

In what proportion must a grocer mix two teas, one priced tk. 1.25/ kg and the other tk. 1.50/ kg, so that the mixture may be worth tk. 1.30/ kg?

Solution: here, Cheap = 1.25

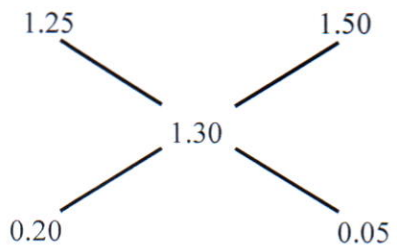
Dear = 1.50

Mean = 1.30

Ratio = 0.20: 0.05

= 20: 5

= 4: 1



Formula:

$Q_1C_1 + Q_2C_2 + \ldots\ldots\ldots\ldots\ldots\ldots = (Q_1 + Q_2 + \ldots\ldots\ldots\ldots)C$

Here, Q_1 = Quantity of first mixture

C_1 = Price/ concentration of first mixture

Q_2 = Quantity of second mixture

C_2 = Price/ concentration of second mixture

C = Final price/ concentration

Example:

A mixture of milk and water weighting 5 kg contains 5% water. How much more water must be poured into it to make it 10%?

Here, water's concentration in first mixture, C_1 = 5%

Water's concentration in second mixture, C_2 = 100%

[Only water will be poured, so water's concentration 100%]

Quantity of first mixture, Q_1= 5 kg

Let, quantity of second mixture $Q_2 = x$

Final concentration, C = 10%

Now,

$Q_1C_1 + Q_2C_2 = C(Q_1 + Q_2)$

$\Rightarrow 5 \times 5 + x \times 100 = 10(5 + x)$

$\Rightarrow 25 + 100x = 50 + 10x$

$\Rightarrow x = \frac{25}{90} = \frac{5}{18}$ kg

$\therefore Q_2 = \frac{5}{18}$ kg

Formula:

Suppose a container contain x units of liquid from which y units are taken out and replaced by water. After n operation, the quantity of pure liquid = $\left[x\left(1-\frac{y}{x}\right)^n\right]$ units.

Example:

8 liters are drawn from a cask full of wine and then filled with water. This operation is performed three more times. The ratio of the quantity of wine now left in cask to that of the water is 16: 81. How much wine did the cask hold originally?

A. 18 liters B. 24 liters C. 32 liters D. 42 liters E. None of these

Solution:

Let, the quantity of the wine in the cask originally be x liters. Then, the quantity of the wine left in cask after 4 operations = $\left[x\left(1-\frac{8}{x}\right)^4\right]$ liters

$$\therefore \frac{x\left(1-\frac{8}{x}\right)^4}{x} = \frac{16}{81}$$

$$\Rightarrow \left(1-\frac{8}{x}\right) = \left(\frac{2}{3}\right)$$

$$\Rightarrow 3x - 24 = 2x$$

$$\Rightarrow x = 24$$

Practice Test

1. Two number are in the ratio 5: 4 and their difference is 10. What is the largest number?

A. 40 B. 30 C. 50 D. 45 E. 55

2. If 20% A = 30% of B = $\frac{1}{6}$ of C, Then $A: B: C$ is?

A. 2: 3: 16 B. 3: 2: 16 C. 10: 15: 18 D. 15: 10: 18 E. None of these

3. 35% of Nadias income is equal to 25% of Nurus income. The ratio of their income is –

A. 2: 5 B. 7: 5 C. 5: 7 D. 7: 3 E. 3: 7

4. If a and b are integer greater than 100 such that $a + b = 300$, which of the following could be the exact ratio of a to b? [BBA 15-16]

A. 9 to 1 B. 5 to 2 C. 5 to 3 D. 4 to 1 E. 3 to 2

5. Two container x and y of the same capacity, are each $\frac{4}{5}$ full of water. If 4 liters of water from container x is added to container y, the ratio of water is the two containers becomes 2: 3. What is the capacity of container x? [BBA 14-15]

A. 16 B. 20 C. 25 D. 32 E. None of these

6. The current ratio of boys to girls at a certain school is 2 to 5. If 12 additional boys were added to the school, the new ratio of boys to girls would be 4 to 5. How many boys do currently attend the school?

A. 27 B. 54 C. 72 D. Cannot be determined E. None of these

7. In a mixture of 50 liters milk and water are in the ratio of 3: 2. How much water would be added to the mixture to make the ratio of the two equal?

A. 14 liters B. 12 liters C. 10 liters D. 8 liters E. None of these

8. A drink contains 20% cranberry juice, 20% raspberry juice and the rest is apple juice. You added 250 ml of water to 750 ml of the drink. Now what is the ratio of water to apple juice in the drink? [BBA 15-16]

A. 6:5 B. 9:5 C. 5:12 D. 5:9 E. None of these

9. Two equal glasses are respectively one third and one fourth full of milk. They are then filled up with water and the contents are mixed in a tumbler. Ratio of milk and water in tumbler is:

A. 7: 5 B. 7: 17 C. 3: 7 D. 11: 23 E. None of these

10. Solution X contains 7% (by weight) of liquid M and solution Y contain 14.5% (by weight) of liquid M. If 3 grams of solution X is mixed with 2 gram of solution Y, then liquid M accounts for what percent of the weight of the resulting solution?

A. 6.09% B. 10% C. 10.75% D. 21.5% E. None of these

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, then how many girls are there in the class?

A. 20 B. 30 C. 25 D. 35 E. None of these

12. The ratio of the number of plants that Kishore has to the number of plants Saad has is 1:5. After Saad gives Kishore 5 plants, the ratio of plants Kishore has to the plants Saad has will be 2:7. How many more plants will Saad have than Kishore after 5 plants are given?

A. 30 B. 45 C. 50 D. 60 E. 75

13. The ratio of flour to water to sugar in a receipe is 7: 4: 1. The ratio in a new receipe calls for a doubling of the ratio of flour to water from the original receipe and a halving of the ratio of flour to sugar. If the new receipe calls for 8 cups of water, how much sugar is required?

A. 4 cups B. 6 cups C. 8 cups D. 12 cups E. 16 cups

14. A milk vender contains 2 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?

A. 4 liters, 8 liters B. 6 liters, 6 liters C. 5 liters, 7 liters D. 7 liters, 5 liters E. 8 liters, 4 liters

15. Sixty percent of the rats included in an experiment were female rats. If some of the rats died during an experiment and 70 percent of the rats that died were male rats, what was the ratio of the death rate among the male rats to the death rates among the female rats?

A. 7:2 B. 7:3 C. 2:7 D. 3:7 E. Cannot be determined

16. The vessels contain water and milk in the ratio 1:2 and 2:5 are mixed in the ratio 1:4. The resulting mixture will have water and milk in the ratio?

A. 31:74 B. 31:75 C. 30:77 D. 30:74 E. 31:77

17. A sample of x liters from container having a 60 liter mixture of milk and water in the ratio of 2:3 is replaced with pure milk so that the container will have milk and water in equal proportions, what is the value of x?

A. 6 liters B. 10 liters C. 15 liters D. 20 liters E. 30 liters

18. Solution A is 20% salt and solution B is 80% salt. If you have 30 ounces of solution A and 60 ounces of solution B, in what ratio could you mix solution A with solution B to produce 50 ounces of a 50% salt solution?

A. 6:4 B. 6:14 C. 4:4 D. 4:6 E. 3:7

19. In a two pound box of nuts and bolts that costs $2.34, the nuts cost 96 cents per pound when purchased separately and the weight in the box due to both is equal to the weight due to nuts. How much will two pound of bolts cost separately?

A. $2.76 B. $1.92 C. $1.59 D. $1.41 E. $1.38

20. The ratio of red and black marbles in a jar is 3: 5. If the number of red marbles is increased by 20% and the number of black marbles is increased by 5 units then the new ratio of red and black marbles remains the same. How many red marbles were in the jar? [MBA June 2015]

A. 12 B. 15 C. 24 D. 30 E. None of these

21. There are 87 balls in a jar. Each ball is painted with at least one of two colors, red and green. It is observed that $\frac{2}{7}$ of the balls that have red color also have green color, while $\frac{3}{7}$ of the balls that have green also have red color. What fraction of the balls in the jar has both red and green colors? [MBA June 2016]

A. $\frac{6}{14}$ B. $\frac{2}{7}$ C. $\frac{6}{35}$ D. $\frac{6}{29}$ E. None of these

22. A trader made 2 different grades of mixture-one containing m kg of melphin and m kg of water and the other mixture containing m kg of melphin and 2m kg of water. Both the mixture were completely sold out. Revenues from selling the mixture were the same. if the selling price of the first mixture was tk. 600 per kg. What was the per kg selling price of the second mixture in taka? [MBA December 2016]

A. 300 B. 400 C. 450 D. 480 E. None of these

23. One year ago, the ratio of salary of Abir and Rakib was 5: 8. Ratio between this year's and last year's salary of Abir is 28: 25 and the same for Rakib is 23: 20. If the sum of their present salay is tk. 1184, the difference between their present salary is: [MBA June 2017]

A. tk. 448 B. tk. 340 C. tk. 288 D. tk. 240 E. None of these

24. The cost price of two article, P and Q are in the ratio 5: 7 and their selling prices in the ratio 2: 5 respectively. If the losses made on both products are the same, what is the ratio between the cost price and the selling price of Q? [MBA December 2017]

A. 5: 4 B. 7: 3 C. 8: 3 D. 15: 4 E. None of these

25. Ayon's monthly income is tk. 5250. The ratio of his monthly expenditure to savings is 8: 7. From the next month, he wants to increase his savings by tk. 550 while his monthly income will remain unchanged. What will be the new ratio of his monthly savings to expenditure? [MBA June 2018]

A. 3: 2 B. 2: 1 C. 8: 7 D. 4: 3 E. None of these

Home Task

1. If the ratio of boys and girls in a school is 5: 3. Which of the following could not be the number of students in the school?

A. 512 B. 416 C. 224 D. 178 E. None of these

2. The ratio of the number of boys and girls in a school is 3: 2. If 20% of the boy's and 25% of the girls are scholarship holders, what percent of the students are not scholarship holders?

A. 56 B. 70 C. 78 D. 72 E. 80

3. If Maliha has twice as much money as Curie has, who has three times as much money as Sadib has, what is the ratio of the amount of money Sadib has to the amount of money Maliha has?

A. 1:8 B. 1: 6 C. 1: 4 D. 1: 2 E. 2: 6

4. A salesman usually makes 45% profit on every TV he sells. During a sale, reduced his margin of profit to 40% and his sales increased by 10%. What is the ratio of his new profit to his usual profit?

A. 9: 8 B. 9: 10 C. 11: 10 D. 44: 45 E. None of these

5. An Iron rod that weight 24 kg is cut into two pieces so that one of these pieces weighs 16 kg and 34 m long. If the weight of each piece is proportional to its length, how long is the other piece?

A. 11 m B. 17 m C. 34 m D. 64 m E. 18 m

6. A jar contains only marbles of three colors red, green and yellow. The red and green marbles are in the ratio of 2: 5 and the yellow and red marbles are in ratio of 5: 6. Which of the following could be the total number of marbles?

A. 52 B. 64 C. 100 D. 42 E. 62

7. Reza's collection contains US, Indian and British stamps. If the ratio of US to Indian stamps is 5 to 2 and the ratio of Indian to British stamps is 5 to 1, what is the ratio of US to British stamps?

A. 5: 1 B. 10: 5 C. 15: 2 D. 25: 2 E. None of these

8. The least whole number which when subtracted from both the terms of the ratio 6: 7 gives a ratio less than 16: 21 is-

A. 2 B. 3 C. 4 D. 6 E. 5

9. A merchant has 1000 kg sugar, part of which he sells at 8% profit and the rest at 18% profit. He gains 14% on the whole. The quantity sold at 18% profit is:

A. 600 kg B. 560 kg C. 400 kg D. 640 kg E. None of these

10. Solution Y is 40 percent sugar by volume and solution X is 20 percent sugar by volume. How many gallon of solution X must be added to 150 gallon of solution Y do create a solution that is 25 percent sugar by volume?

A. 75 B. 150 C. 240 D. 450 E. None of these

11. In what ratio must a grocer mix two varieties of tea worth tk. 60 a kg and tk. 65 a kg so that by selling the mixture at tk. 68.20 a kg, he may gain 10%?

A. 3: 2 B. 3: 4 C. 3: 5 D. 4: 5 E. None of these

12. A 19 liter mixture consists by volume of 1 part juice to 18 parts water. If x liter of juice and y liters of water are added to this mixture to make a 54 liter mixture consisting by volume of 1 part juice to 2 parts water, then what is the value of x?

A. 36 B. 35 C. 27 D. 17 E. 16

13. A mixture contains $\frac{2}{5}$ of element A and $\frac{3}{5}$ of element B. When 5 ml of A is added to the mixture, the proportion of B in the mixture changes to $\frac{1}{5}$. What amount of A was originally present in the mixture before the addition was made?

A. 1 ml B. 1.5 ml C. 2.5 ml D. 6 ml E. None of these

14. The average of two numbers is 62. If 2 is added to the smaller number, the ratio between the numbers becomes 1:2. The smaller number is –

A. 60 B. 90 C. 84 D. 40 E. None of these

15. Robi takes 3 minutes to inspect a car and Sashi takes 4 minutes to inspect a car. If they both start inspecting different cars at 8:30 am, what would be the ratio of the number of cars inspected by Robi and Sashi by 8:54 am of the same day?

A. 3: 2 B. 4: 3 C. 2: 6 D. 8: 12 E. None of these

16. If 200 lb of a mixture contain 80% husk and 20% sand, then how much husk needs to be extracted in order to have 75% concentration of husk?

A. $\frac{1}{4}$ B. $\frac{20}{3}$ C. $\frac{1}{2}$ D. 40 E. 60

17. Two mixture of X and Y have X and Y in the ratio 3:2 and 3:4. In what proportion should these two mixture be mixed to get a new mixture in which the ratio of X to Y is 5:4?

A. 6:1 B. 5:4 C. 20:7 D. 10:9 E. 14:11

18. Five kilograms of orange contained 98% water. If the next day the concentration of water decreased by 2%, what was the new weight of the orange, in kilograms?

A. 4.9 B. 4.8 C. 2.5 D. 2 E. 0.2

19. 8 liters are drawn from a container full of mango juice and is then filled with water. This operation is performed three more times. The ratio of the quantity of mango juice now left in container to that of water is 16: 65. How much mango juice did the container hold originally? [BBA 13-14]

A. 24 liters B. 30 liters C. 36 liters D. 42 liters E. None of these

20. The cost of two articles is in the ratio 3:2. On sale of the first, there is a loss of 40% and on sale of the second there is a gain of 30%. What is the overall percentage of loss? [MBA December 2015]

A. 12% B. 30% C. 40% D. 10% E. None of these

21. A mixture of sugar and water contain sugar and water in the ratio of 3: 2. Another mixture of sugar and water contains sugar and water in the ratio of 2: 5. In what ratio should the two mixture be mixed so that the resultant mixture contains equal proportion of sugar and water? [MBA June 2016]

A. 2: 1 B. 3: 1 C. 3: 2 D. 4: 1 E. None of these

22. A certain company that sells only i-pads and i-phones reported that revenues from i-pad sales in 2015 were down 11% from the sale of 2014. And revenues from i-phones sales in 2015 were up 7% from the sale of 2014. If total revenue from i-pad sale and i-phone sales in 2015 were up 1% from sale of 2014, what is the ratio of revenue from i-pad sales in 2014 to revenue from i-phone sale in 2014? [MBA December 2016]

A. 1: 2 B. 4: 5 C. 1: 1 D. 3: 2 E. None of these

23. A drink contains 20% mango juice, 20% guava juice and the rest is apple juice. You added 250 ml of water to 750 ml of the drink. Now will be the ratio of water to apple juice in the dilute drink? [MBA Dec'16]

A. 6: 5 B. 9: 5 C. 5: 12 D. 5: 9 E. None of these

24. A box contains 200 marbles of which 15% are black and the rest are red. If 100 marbles, comprising of black and red marbles are added to the box, how many of them should be black so that the ratio of black and red marbles in that box becomes 1: 5? [MBA December 2016]

A. 20 B. 25 C. 30 D. 40 E. None of these

25. Silver is 26 times as heavy as Gold and Iron is 17 times as heavy as Gold. You have to prepare a mixture (of Silver & Iron) which is 23 times as heavy as Gold. What will be the ratio of Iron to Silver in the mixture? [MBA June 2017]

A. 2: 1 B. 2: 3 C. 3: 5 D. 1: 2 E. None of these