



## Mathematics: Arithmetic

# Lecture 04

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- ◆ Percentage
- ◆ Ratio Equivalence

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- ◆ Set

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## Math Lecture Sheet: 04

### Percentage

#### Basic definition:

Percent implies for every hundred and the sign % is read as percentage and x% is read as x percent. In other word, a fraction with denominator 100 is called a percent. For example, 20% mean  $\frac{20}{100}$  (i.e. 20 parts from 100). This can also be written as 0.2.

Basic formula: In order to calculate p% of q, use the formula:

$$\frac{p}{100} \times q = \frac{pq}{100}$$

\* p% of q = q% of p.

#### Basic Tip - 01:

If the new value of something is n times the previous given value, then the percentage increase is  $(n - 1) \times 100\%$

Example: If  $X = 5.35Y$ , then find the percentage increase when the value of something is from Y to X.

Solution: Percentage increase from Y to X =  $(5.35 - 1) \times 100 = 435\%$

#### Basic Tip - 02:

When a quality N is increased by k% then the new quantity =  $N \left(1 + \frac{k}{100}\right)$

Example: What is the new value when 265 is increased by 15%.

Solution: New quantity =  $N \left(1 + \frac{k}{100}\right)$

$$= 265 \left(1 + \frac{15}{100}\right)$$

$$= 304.75$$

If a quantity N is decreased by k%, then the new quantity =  $N \left(1 - \frac{k}{100}\right)$

#### Formula:

01. If A is p% more than B, then B is  $\frac{100p}{100+p}$  % less than A and, if A is p% less than B, then B is  $\frac{100p}{100-p}$  % more than A.

Example: If A's income is 60% less than that of B's, Then B's income is what percent more than that of A?

Solution: here,  $x = 60$

$$\therefore \text{Required percentage} = \frac{100 \times 60}{100 - 60} = \frac{100 \times 60}{40} = 150\%$$

02. If the price of an item goes up by  $p\%$ , then the quantity consumed should be reduced by  $\left(\frac{100p}{100+p}\right)\%$  so that the total expenditure remain the same, and if price of an item goes down by  $p\%$ , the quantity consumed should be increased by  $\frac{100p}{100-p}\%$ , so that the total expenditure remain the same.

Example: If the price of LPG is raised 20%, find by how much percent a householders must reduce his consumption of LPG so as not increase his expenditure?

Solution: here,  $p = 20\%$

$$\therefore \text{Consumption should be reduced by} = \frac{100 \times 20}{100 + 20}\%$$

$$= \frac{100 \times 20}{120}\%$$

$$= \frac{50}{3}\%$$

$$= 16\frac{2}{3}\%$$

03. Suppose a number N undergoes –

i. a percentage increase of  $x\%$  and then  $y\%$ , the net change is  $= \left(x + y + \frac{xy}{100}\right)\%$

ii. a percentage decrease of  $x\%$  and then  $y\%$ , the net change is  $= \left(-x - y + \frac{xy}{100}\right)\%$

iii. a percentage increase of  $x\%$  and a decreases of  $y\%$ , the net change is  $= \left(x - y - \frac{xy}{100}\right)\%$

Example: Abir's salary is increased by 10% and then decreased by 10%, the change in salary is –

Solution: here,  $x = 10\%$

$y = 10\%$

$$\text{Formula is} = \left(x - y - \frac{xy}{100}\right)\%$$

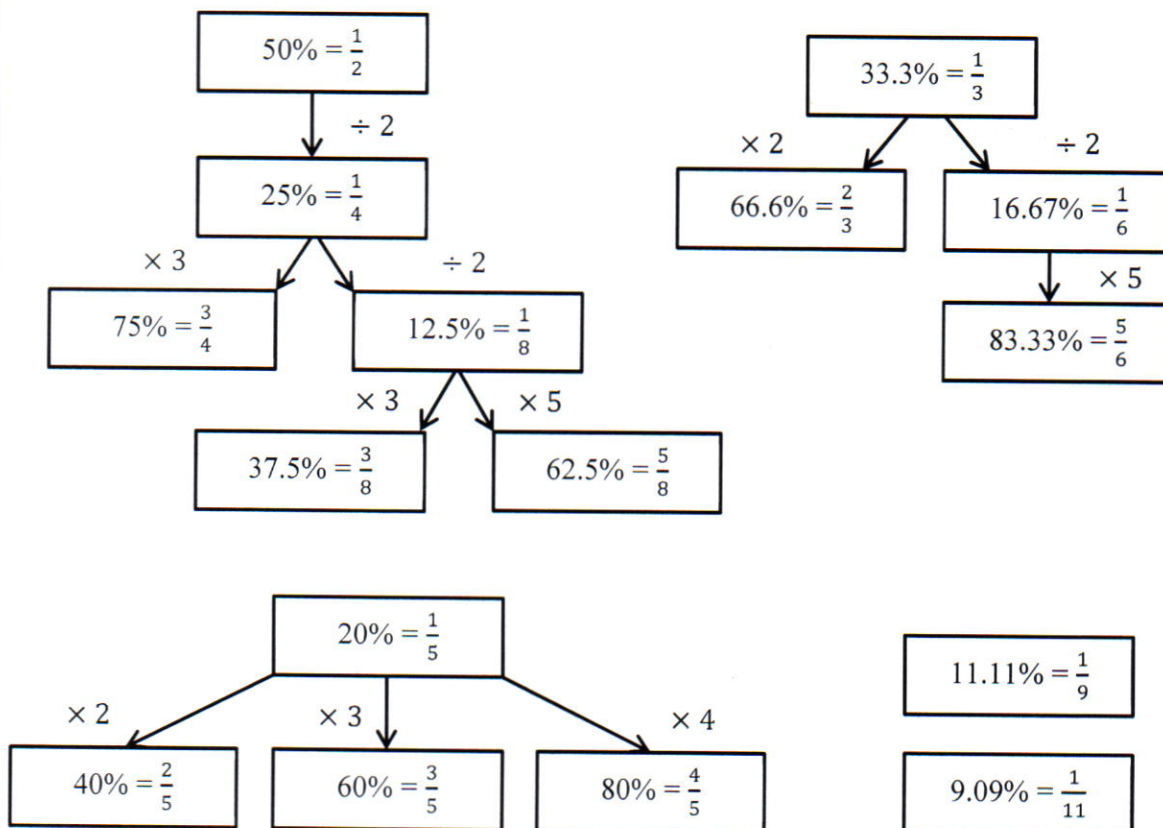
$$= \left(10 - 10 - \frac{10 \times 10}{100}\right)\%$$

$$= -1\%$$



Negative sign shows a decrease; hence the final salary is decreased by 1%.

### Ratio Equivalence



### Practice Test

1. If 45 is 120% of a number, what is 80% of the same number?  
A. 30                      B. 36                      C. 38                      D. 41                      E. None of these
2. A number when 35 is subtracted from it, reduces to its 80 percent. What is four-fifth of that number?  
A. 70                      B. 90                      C. 120                      D. 140                      E. 180
3. 50% of a% of b is 75% of b% of c. Which of the following is c?  
A. 1.5a                      B. .0667a                      C. 0.5a                      D. 1.25a                      E. 0.667a
4. Three workers X, Y and Z are paid a total of tk. 5,500 for a particular job. X is paid 133.33% of the amount paid to Y and Y is paid 75% of amount paid to Z. How much paid to Z?  
A. tk. 1780                      B. tk. 1890                      C. tk. 1975                      D. tk. 2000                      E. tk. 2500
5. In a batch of 500 students, forty percent are girls, twenty-five percent of the boy and half of the girls agreed to go for a study tour. What percent of the entire batch did not agree to go for the four?  
A. 35%                      B. 85%                      C. 17.5%                      D. 25%                      E. None of these
6. After the increase of price of oil by 40%, a family decided to reduce its oil consumption so that the expenditure for oil goes up by 26% only. If the total consumption of oil before the price rise was 10 kg per month, then what is the current consumption of oil per month (in kg)?  
A. 8                      B. 8.50                      C. 9                      D. 9.50                      E. 9.75
7. A candidate scoring 25% marks in an examination fails by 30 marks while another candidate who score 50% marks gets 20 marks more than the minimum pass marks. What is the minimum pass mark?  
A. 50                      B. 60                      C. 70                      D. 80                      E. 100
8. A school has raised 75% of the amount it needed for a new building by receiving an average donation of tk. 60 from the people already solicited. The people already solicited represent 60% of the people the college will ask for donation. If the college is to raise exactly the amount needed for the new building, how much the remaining people donate per person?  
A. 25                      B. 30                      C. 40                      D. 50                      E. 20
9. P is 6 times a large as q. The % that q is less than p is:  
A.  $83\frac{1}{3}$                       B.  $16\frac{2}{3}$                       C. 90                      D. 60                      E. 0.02

10. Hamid can have his mobile phone repaired for tk. 4000 or he can trade it in and receive tk. 2000 credit toward the purchase of new mobile that sells for tk. 8400. If Hamid trades in his current mobile phone, the cost to him of purchasing the new mobile is what percent greater than the cost of having his current mobile phone repaired?

[June 2015]

- A. 44                      B. 60                      C. 70                      D. 75                      E. None of these

11. In a box there are 60 more black marbles than red marbles. If the number of red marbles is 40% of the total number of marbles, how many marbles are there in the box?

[December 2015]

- A. 270                      B. 280                      C. 300                      D. 360                      E. None of these

12. If 55 percent of a group of people have brown hair and 80 percent of the same group do not have red hair. What fraction of those who do not have brown hair have red hair?

- A.  $\frac{1}{4}$                       B.  $\frac{4}{11}$                       C.  $\frac{4}{9}$                       D.  $\frac{5}{9}$                       E.  $\frac{4}{5}$

13. The work force of company X is 60% female. The company hired 20 additional male workers and as a result the percent of female workers dropped to 55%. How many employees did the company have after hiring the additional male workers?

- A. 160                      B. 220                      C. 240                      D. 360                      E. 420

14. A store charges tk. 52 for a video game. This price is 30% greater than the store's cost to buy the game from its supplier. As an incentive to the store's clerks, the manager allows a clerk to purchase the video game for 10% less than the store's cost. How much would a store clerk have to pay for this video game?

[BBA 13-14]

- A. tk. 15.60                      B. tk. 20.80                      C. tk. 31.20                      D. tk. 32.76                      E. tk. 36.00

15. In a club, one half of the members are male and of the other half of the members are female. Forty percent of the members are engineers and the rest are architects. If 15% of the members are male engineers, what percent of the members are female architects? [June 2016]

- A. 15                      B. 25                      C. 30                      D. 35                      E. None of these

16. Among the members of a club there are three times as many doctors as engineers. Half of the club members are female and  $\frac{4}{5}$  of the male members are doctors. What percent of the club members are female engineers?

[December 2016]

- A. 10                      B. 15                      C. 20                      D. 25                      E. None of these



17. Box 1 contains 500 marbles, 24% of which are black. Box 2 contain some marble of which 10% are black. You put the marbles together in another box and found that the percentage of black marbles is 20%. How many marbles were there in box 2? [June 2017]

- A. 100                      B. 150                      C. 200                      D. 250                      E. None of these

18. In a club, 20% of the members are below 25 years of age. The number of members above 25 years of age is 16. Which is two-third of the number of members of 25 years of age. What is the total number of members in the club? [December 2017]

- A. 50                      B. 52                      C. 60                      D. 72                      E. None of these

19. A restaurant meal had cost tk. 35.00 and there was no tax. If the service charge was more than 10 percent but less than 15 percent of the cost of the meal, then the total amount paid must have been between tk. [BBA 13-14]

- A. 40 and 42                      B. 39 and 41                      C. 36 and 42                      D. 37 and 39                      E. 36 and 37

20. After a 20% decrease, the price of a shirt was tk. 120. What was the original price of the shirt?

- A. tk. 100                      B. tk. 144                      C. tk. 150                      D. tk. 160                      E. tk. 180

21. In a class, 200 chocolates were distributed equally among the students in such a way that the number of chocolate received by each student is 12.5% of the total number of students. How many chocolate did each student receive? [December 2017]

- A. 4                      B. 5                      C. 8                      D. 10                      E. None of these

22. In a class, 120 students are finance major and 100 students are marketing major, 25% of finance students and 20% of the marketing students are male. 20% of the male finance students and 25% of the male marketing students passed the final exam. What percentage of male students passed the exam?

- A. 5%                      B. 10%                      C. 15%                      D. 20%                      E. None of these

23. The price of raw materials has gone up by 15%, labor cost has also increased from 25% of the cost of raw material to 30% of the cost of raw material. By how much percentage should there be a reduction in the usage of material so as to keep the cost same?

- A. 30%                      B. 24%                      C. 28%                      D. 25%                      E. 17%

24. In town X, 64 percent of the populations are employed and 48 percent of the populations are employed males. What percent of the employed people in town X are females?

- A. 16%                      B. 25%                      C. 32%                      D. 48%                      E. 52%

25. Sadib and Tazul each saved tk. 5000 in 2012. In 2013 Tazul saved 10% more than what he saved the previous year and together they both saved a total of tk. 9000 that year. Approximately what percent less did Sadib save in 2013 compared to 2012?

- A. 59%                      B. 41%                      C. 30%                      D. 25%                      E. 44%

### Homework

1. A manufacturer sells three products i.e A, B and C. Product A costs 200 and sells for 250. Product B costs 150 and sells for 180, product C costs 100 and sells for 110. On which product, he has maximum percentage of profit?
- A. C only      B. B only      C. A only      D. A & B both      E. B & C both
2. If 15% of 40 is greater than 25% of a number by 2, then the number is -
- A. 16      B. 12      C. 20      D. 24      E. 30
3. An employer pays 3 workers X, Y and Z a total of tk. 36600 a week. X is paid 125% of the amount Y is paid and 80% of the amount Z is paid. How much does X make a week?
- A. 9000      B. 12000      C. 10800      D. 11700      E. 12800
4. There are n students in school. If r% among the students are 12 years or younger, which of the following expressions represents the number of the students who are older than 12?
- A.  $n(1 - r)$       B.  $100(1 - r)n$       C.  $\frac{n(1-r)}{100}$       D.  $\frac{n(100-r)}{100}$       E. None of these
5. At a symposium, 20% of the professors are psychologists, 60% are biologists and the remaining 12 professors are economists. If 20 of the professors wear glasses, what percent of the professors do not wear glass?
- A. 20%      B. 33%      C. 50%      D. 60%      E. None of these
6. Of that total amount that Sadia spent on a shopping trip, excluding taxes, she spent 50% on clothing, 20% on food and 30% on another item. If Sadia paid 4% tax on clothing, no tax on the food and an 8% tax on all other items, then the total tax that she paid was what percent of the total amount she spent, excluding taxes?
- A. 3.6%      B. 4.4%      C. 5.2%      D. 6%      E. 7.2%
7. The household expenses of a family went up by 20%. By how many percent must the family reduce household expenditure so that expenses remain same as before?
- A. 16%      B.  $16\frac{2}{3}\%$       C. 18%      D. 20%      E. 25%
8. The organizers of a fair projected 25% increase of visitors this year over that of the last year but the actual turnover was 20% less than that of the last year. What percent of projected visitor attended the fair?
- A. 60%      B. 50%      C. 84%      D. 64%      E. 54%
9. In a club, 40% of the members were female. Forty new male become members of the club and as a result the percent of female members dropped to 30%. How many female members are there in the club now?
- [June 2015]
- A. 40      B. 42      C. 46      D. 48      E. None of these



10. If the price of pen is discounted by 40%, for tk. 120 you can buy 4 more pens than you could buy at the original price. How many pens could be bought for tk. 120 at the original price? [June 2015]

- A. 6                      B. 8                      C. 10                      D. 12                      E. None of these

11. There were twice as many girls as boys in a class. If 30% of the girls and 45% of the boys have already handed over their reports, what percent of the students have not yet done so?

- A. 25                      B. 35                      C. 45                      D. 55                      E. 65

12. Abir has 40% more stamp than Shahadat, if he gives 45 of his stamps to Shahadat, then Shahadat will have 10% more stamps than Abir. How many stamps did Abir begin with?

- A. 175                      B. 200                      C. 220                      D. 245                      E. None of these

13. The wage earned by Arif is 30% more than that earned by Babu. If the wage earned by Salek is 60% more than that earned by Babu. How much is the wage earned by Salek more than that earned by Arif? [December 2015]

- A. 23%                      B. 18.75%                      C. 30%                      D. 50%                      E. None of these

14. The price of a TV was first discounted by a certain percent and then by another 20 percent of the discounted price. If these two discounts are equivalent to single discount of 32 percent of the original price, what was the first discount? [June 2016]

- A. 10%                      B. 12.5%                      C. 15%                      D. 26%                      E. None of these

15. In an exam 62% of the students were declared as passed. However due to compilation error, 20% of the students who have actually passed were shown as failed and 20% of the students who have actually failed were declare as passed. What percent of the students actually passed? [December 2016]

- A. 68                      B. 70                      C. 72                      D. 75                      E. None of these

16. In a group, 30% of the men are more than 25 years old and 80% of the men are less than or equal to 50 years old. Twenty percent of all men play football. If 20% of the men above the age of 50 play football, what percentage of the football players are less than or equal to 50 years? [December 2017]

- A. 50%                      B. 60%                      C. 75%                      D. 80%                      E. None of these

17. There are 900 students in a school. In January 4% of the boys leave the school and 5% new girls admitted in the school, total number of students is unchanged. What is the number of boys before January?

- A. 250                      B. 350                      C. 450                      D. 550                      E. None of these

18. A box contains 200 marbles, 25% of which are of black color. Maria took some marbles from the box and found that 30% of them are black. Of the remaining marbles, 10% were black marbles. How many marbles did Maria take?

- A. 120                      B. 125                      C. 140                      D. 145                      E. 150

19. Rahim's convertible gets gas mileage that is 40% higher than that of Karim's SUV. If Jalil's hatchback gets gas mileage that is 15% higher than that of Rahim's convertible, then Jalil's hatchback gets gas mileage that is what percent greater than that of Karim's SUV?

- A. 46%                      B. 55%                      C. 61%                      D. 65%                      E. 25%

20. In an exam, A scoring 40% marks fails by 10 marks, B scoring 50% marks gets 10 more than the passing marks. What was the total marks in the exam? [December 2017]

- A. 88                      B. 100                      C. 160                      D. 200                      E. None of these

21. A reduction of 25% of the price of an article enables a buyer to buy 50 kilograms more for tk. 500. What is the reduced price per kilogram in taka?

- A. 2                      B. 2.25                      C. 2.5                      D. 2.75                      E. 3

22. In a sample of 900 university students, all students are either freshmen or sophomores or junior or seniors, 24 percent are juniors and 72 percent are not sophomore. If there are 144 seniors, how many more freshmen than sophomores are there among the sample of students? [BBA 10-11]

- A. 252                      B. 36                      C. 48                      D. 288                      E. None of these

23. In an election, 30% of the voters voted for candidate A whereas 60% of the remaining voted for candidate B. The remaining voters did not vote. If the difference between those who voted for candidate A and these who did not vote was 1200, how many individuals were eligible for casting vote in the election?

- A. 10,000                      B. 6,000                      C. 45,000                      D. 60,000                      E. 72,000

24. The population of a certain town increase by 50 percent every 50 years. If the population in 1950 was 810, in what year was the population 160?

- A. 1650                      B. 1700                      C. 1750                      D. 1800                      E. None of these

25. A person who has a certain amount with him goes to market. He can buy 50 apples or 40 bananas. He retains 10% of the amount for taxi fares and buys 20 bananas, and of the balance, he purchases apples. Number of apples he can purchase is:

- A. 36                      B. 40                      C. 20                      D. 18                      E. 24