CAPSTONE

Mathematics: Algebra

Lecture 02

Overview	Next Lecture
◆ Fraction ◆ Approximation ◆ Exponent ◆ Equation	◆ Inequality ◆ Average

Name: **Batch:**

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Reach Us

Panthapath : 01972-277 866
Mouchak : 01999-017 011
Mirpur : 01970-985 421
Chattogram : 01970-985 420

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Math Lecture Sheet: 02

Fraction

A fraction is part of a unit. It indicates a division or a part of number. For example, the fraction $\frac{7}{5}$ indicates $(7 \div 5)$. The number of the top, 7 in the above example is called the NUMERATOR and the number at the bottom, 5 in the example is called the DENOMINATOR.

Types of Fraction:

Proper Fraction:

If the numerator of a fraction is less than the denominator, the fraction is called proper fraction. Example: $\frac{1}{5}$

Improper Fraction:

If the numerator is equal to or greater than the denominator, the fraction is called an improper fraction. Example: $\frac{5}{5}, \frac{7}{3}, \frac{25}{4}$

Mixed Fraction/ Number:

A whole number plus a proper fraction makes a mixed number. Example: $2\frac{3}{5}$

To compare fraction:

We can discuss it with an example.

Which fraction is greater: $\frac{1}{4} or \frac{7}{27}$?

Solution:

Step 1: Multiply the numerator of the first with the denominator of the second,

$1 \times 27 = 27$

Step 2: Now multiply the denominator of the first with numerator of the second,

$4 \times 7 = 28$

Since $28 > 27$, the second fraction $\frac{7}{27}$ is greater than the first $\frac{1}{4}$

Note:

➔ Since a fraction is a division and division by zero is undefined, the denominator of fraction cannot be zero.

➔ If the numerator is zero (and the denominator is not zero), than the fraction equal zero.

➔ The value of fraction is unchanged when the numerator and denominator are multiplied by the same quantity.

Some common used fraction, percentage:

Fraction	*Decimal*	*Percent*	*Fraction*	*Decimal*	*Percent*	*Fraction*	*Decimal*	*Percent*
$\frac{1}{2}$	0.5	50%	$\frac{1}{6}$	0.1666.....	16.66%	$\frac{5}{9}$	0.555.....	55.55%
$\frac{1}{3}$	0.33.....	33.33%	$\frac{5}{6}$	0.8333.....	83.33%	$\frac{7}{9}$	0.777.....	77.77%
$\frac{2}{3}$	0.66.....	66.66%	$\frac{1}{8}$	0.125	12.5%	$\frac{8}{9}$	0.888.....	88.88%
$\frac{1}{4}$	0.25	25%	$\frac{3}{8}$	0.375	37.5%	$\frac{1}{10}$	0.1	10%
$\frac{3}{4}$	0.75	75%	$\frac{5}{8}$	.625	62.5%	$\frac{1}{11}$	0.0909	9.09%
$\frac{1}{5}$	0.2	20%	$\frac{7}{8}$	.875	87.5%	$\frac{1}{12}$	0.0833	8.33%
$\frac{2}{5}$	0.4	40%	$\frac{1}{9}$	0.111.....	11.11%	$\frac{1}{16}$	0.0625	6.25%
$\frac{3}{5}$	0.6	60%	$\frac{2}{9}$	0.222.....	22.22%	$\frac{1}{32}$	0.03125	3.13%
$\frac{4}{5}$	0.8	80%	$\frac{4}{9}$	0.444.....	44.44%			

Decimals:

A decimal is a fraction whose denominator is a power of 10; that is, the denominator is 10, 100 and so on. For example in 0.313 the first digit after decimal point stand for tenths, the second digit for hundredths, and the last digit for thousandths.

Thus, $0.313 = \frac{3}{10} + \frac{1}{100} + \frac{3}{1000} = \frac{313}{1000}$

Example math:

01. $138.009 + 341.981 - 146.305 = 123.6 + ?$

A. 120.85 B. 120.085 C. 210.085 D. 210.85 E. 180.085

Solution: Let, the number be z.

$\therefore 138.009 + 341.981 - 146.305 = 123.6 + z$

$\Rightarrow z = 138.009 + 341.981 - 146.305 - 123.6$

$\Rightarrow z = (138.009 + 341.981) - (146.305 + 1236)$

$\Rightarrow z = 479.99 - 269.905$

$\Rightarrow z = 210.085$

Answer: C. 210.085

Approximation

3	5	7	2		1	2	4	5	1	4	.	6	8	2	6
↑	↑	↑	↑	↑	↑	↑	↑	↑	↑	↑		↑	↑	↑	↑
Billions	Hundred million	Ten million	Millions		Hundred thousands	Ten thousands	Thousands	Hundred	Ten	Ones		Tenths	Hundredths	Thousandths	Ten thousandths

Concept of Rounding up:

Steps:

1. Determine the place value to which the number is to be rounded
2. Identify the rounding place value in the number to be rounded
3. Locate the number in the place value to the right of your rounding number
4. Round up for numbers 5, 6, 7, 8 and 9
5. If the number to the right of your rounding place value digit is 0, 1, 2, 3 or 4, the rounding place value digit will remain the same

An example:

765.3682 become:

1000 when asked to round to the nearest thousand (1000)

800 when asked to round to the nearest hundred (100)

770 when asked to round to the nearest ten (10)

765 when asked to round to the nearest one (1)

765.4 when asked to round to the nearest tenth (10th)

765.37 when asked to round to the nearest hundredth (100th.)

765.368 when asked to round to the nearest thousandth (1000th)

Exponents

In the expression a^n, a is called the base and n is called the exponent. So, in the expression 2^5 we have 2 as base and 5 as exponent. The exponent tells how many factors are there.

Laws of exponents:

$x^1 = x$

$x^0 = 1$

$x^{-1} = \frac{1}{x}$

$x^m . x^n = x^{m+n}$

$\frac{x^m}{x^n} = x^{m-n}$

$(x^m)^n = x^{mn}$

$x^{\frac{m}{n}} = \sqrt[n]{x^m} = (\sqrt[n]{x})^m$

$(xy)^n = x^n . y^n$

$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$

$x^{-n} = \frac{1}{x^n}$

Laws of roots:

$\sqrt{x} = x^{\frac{1}{2}}$ $\quad \sqrt[3]{x} = x^{\frac{1}{3}}$ $\quad \sqrt[3]{x^2} = x^{\frac{2}{3}}$ $\quad x^{\frac{1}{n}} = \sqrt[n]{x}$

$\sqrt[n]{xy} = \sqrt[n]{x}.\sqrt[n]{y}$ $\quad \sqrt[n]{\frac{x}{y}} = \frac{(\sqrt[n]{x})}{(\sqrt[n]{x})}$ $\quad \sqrt{x}.\sqrt{y} = \sqrt{xy}$ $\quad \frac{\sqrt{x}}{\sqrt{y}} = \sqrt{\frac{x}{y}}$

Square of 1 to 30:

$1^2 = 1$	$6^2 = 36$	$11^2 = 121$	$16^2 = 256$	$21^2 = 441$	$26^2 = 676$
$2^2 = 4$	$7^2 = 49$	$12^2 = 144$	$17^2 = 289$	$22^2 = 484$	$27^2 = 729$
$3^2 = 9$	$8^2 = 64$	$13^2 = 169$	$18^2 = 324$	$23^2 = 529$	$28^2 = 784$
$4^2 = 16$	$9^2 = 81$	$14^2 = 196$	$19^2 = 361$	$24^2 = 576$	$29^2 = 841$
$5^2 = 25$	$10^2 = 100$	$15^2 = 225$	$20^2 = 400$	$25^2 = 625$	$30^2 = 900$

Cube of 1 to 10:

$1^3 = 1$	$3^3 = 27$	$5^3 = 125$	$7^3 = 343$	$9^3 = 729$
$2^3 = 8$	$4^3 = 64$	$6^3 = 216$	$8^3 = 512$	$10^3 = 1000$

Square root of 1 to 10:

$\sqrt{1} = 1$	$\sqrt{3} = 1.732$	$\sqrt{5} = 2.236$	$\sqrt{7} = 2.646$	$\sqrt{9} = 3$
$\sqrt{2} = 1.414$	$\sqrt{4} = 2$	$\sqrt{6} = 2.449$	$\sqrt{8} = 2.828$	$\sqrt{10} = 3.162$

Equation

An equation is a statement of equality between two exercises, as in $4x = 100$

Some basic formula:

$i.\ (a+b)^2 = a^2 + 2ab + b^2$

$ii.\ (a-b)^2 = a^2 - 2ab + b^2$

$iii.\ a^2 - b^2 = (a+b)(a-b)$

$iv.\ (a+b)^3 = a^3 + b^3 + 3ab(a+b)$

$v.\ (a-b)^3 = a^3 - b^3 - 3ab(a-b)$

$vi.\ a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

$vii.\ a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

Example math's:

02. If $a + 2b = 6$ and $ab = 4$, what is $\frac{2}{a} + \frac{1}{b}$?

A. $\frac{1}{2}$ B. 1 C. $\frac{3}{2}$ D. 2 E. $\frac{5}{2}$

Solution:

Here, $\frac{2}{a} + \frac{1}{b} = \frac{2b+a}{ab} = \frac{a+2b}{ab} = \frac{6}{4} = \frac{3}{2}$

Answer: C. $\frac{3}{2}$

03. $50^7 \times 20^7$ is 10^x times larger than 1×10^8, where x is:

A. 13 B. 6 C. 21 D. 29 E. 31

Solution: $50^7 \times 20^7 = (50 \times 20)^7 = (1000)^7 = (10^3)^7 = 10^{21}$

Now, according to the question,

$10^x \times 1 \times 10^8 = 10^{21}$

$\Rightarrow 10^{x+8} = 10^{21}$

$\Rightarrow x + 8 = 21$

$\Rightarrow x = 13$

Answer: A. 13

04. $5^{-3} + 5^{-3} + 5^{-3} + 5^{-3} + 5^{-3} = ?$

A. 25^{-15} B. 25^{-2} C. 5^{-2} D. 5^{-1} E. 5^{-4}

Solution: $5^{-3} + 5^{-3} + 5^{-3} + 5^{-3} + 5^{-3}$

$= 5.5^{-3}$ [as there are 5.5^{-3} here]

$= 5^1.5^{-3}$

$= 5^{(1-3)}$

$= 5^{-2}$

Hence answer is C

Answer: C. 5^{-2}

Practice Test

1. Find the largest fraction from the following:

A. $-\frac{5}{11}$ B. $-\frac{8}{13}$ C. $-\frac{7}{19}$ D. $-\frac{15}{97}$ E. Cannot be determined

2. Four liters of milk are to be poured into a 2 liter and a 4 liter bottle. If each bottle is to be lied to the same fraction of its capacity, how many liters of milk should be poured into the 4 liters bottle?

A. $\frac{7}{3}$ B. $\frac{2}{3}$ C. $\frac{8}{3}$ D. $\frac{4}{3}$ E. $\frac{16}{3}$

3. Eight people are planning to share the cost of rental car. If one person withdrawn from the arrangement and the others share equally the entire cost of the car, then the share of each of the remaining persons will be increased by -

A. $\frac{1}{7}$ B. $\frac{1}{8}$ C. $\frac{7}{8}$ D. $\frac{1}{2}$ E. $\frac{1}{14}$

4. At a college football game $\frac{4}{5}$ of the seats in the lower deck of the stadium were sold. If one fourth of all the seating in the stadium is located in lower deck, and if $\frac{2}{3}$ of all the seats in the stadium were sold, what fraction of the unsold seats in the stadium were in the lower deck?

A. $\frac{3}{20}$ B. $\frac{1}{6}$ C. $\frac{1}{3}$ D. $\frac{7}{15}$ E. $\frac{6}{20}$

5. The numerator of a fraction is multiple of two integers. One of the numbers is greater than the other by 2. If the greater number is smaller than denominator by 4, what will be the minimum value of the fraction?

A. -1 B. $-\frac{1}{5}$ C. 0 D. $\frac{1}{5}$ E. 1

6. XYZ Ltd has profiled tk. 1,08,000 from its ventures in FY 2017. Its investment strategy for FY 2018 is as follows. Out of the total profit it will invest $\frac{1}{6}^{th}$ in customer care, of the remaining amount it will invest $\frac{1}{3}^{rd}$ in advertising and product development, and out of the balance it will invest $\frac{2}{3}^{rd}$ in increasing production facilities. If the company plans to create an employee entertainment fund of the remaining amount, how much would that fund amount to?

A. tk. 17,000 B. tk 19,000 C. tk. 21,000 D. tk, 20,000 E. tk. 2000

7. A batch of cookies was divided among 3 times: $\frac{2}{3}$ of all the cookies were placed in either the blue or the green tin, and the rest were placed in the red tin. If $\frac{1}{4}$ of all the cookies were placed in the blue tin, what fraction of the cookies that were placed in the other tins were placed in the green tin?

A. $\frac{15}{2}$ B. $\frac{9}{4}$ C. $\frac{5}{9}$ D. $\frac{7}{5}$ E. $\frac{9}{7}$

8. One-fourth of a number is equal to two fifth of another number. If 50 is added to the larger number, it becomes two times the second number. What is the smaller number? [BBA 14-15]

A. 75 B. 80 C. 100 D. 125 E. None of these

9. A man spent $\frac{1}{2}$ of his money and then lost $\frac{1}{4}$ of the remainder. He was left with tk. 3600. How much did he start with? [MBA 2015-16]

A. tk. 8000 B. tk. 8600 C. tk. 9600 D. tk. 9200 E. None of these

10. In a national poll, people were asked 2 questions. If $\frac{2}{5}$ of them answered 'yes' to question 1 and of those $\frac{1}{3}$ also answered 'yes' to question 2, which of the following represents the number of people polled who did not answer 'yes' to both questions? [BBA 10-11]

A. $\frac{11}{13}$ B. $\frac{3}{13}$ C. $\frac{13}{15}$ D. $\frac{2}{15}$ E. None of these

11. A club has equal number of male and female member. On a certain day, two thirds of the members were absent. Of the member present, One third was male, what is the ratio of male and female who were not present on that day? [BBA 14-15]

A. $\frac{1}{3}$ B. $\frac{2}{3}$ C. $\frac{3}{5}$ D. $\frac{7}{5}$ E. $\frac{9}{5}$

12. Asif, Rakib and Saad have x, y and z number of marbles respectively. If $x = 6y = 3z$, what fraction of his marbles should Asif give to Rakib and Saad so that all of them have equal number of marbles? [MBA 16-17]

A. $\frac{1}{5}$ B. $\frac{1}{4}$ C. $\frac{1}{3}$ D. $\frac{1}{2}$ E. None of these

13. At a certain club, the number of male members is twice than that of female members. It $\frac{1}{4}$ male members are engineers and $\frac{1}{5}$ of female members are engineer, what fraction of the members are non-engineers? [MBA 17]

A. $\frac{13}{25}$ B. $\frac{23}{30}$ C. $\frac{2}{5}$ D. $\frac{8}{19}$ E. None of these

14. If $x = y^a, y = z^b, z = x^c$, then the value of abc is:

A. 1 B. 2 C. 0 D. 0.5 E. -1

15. If x and y are positive integers and $x^4y^5 = 512$, which of the following is the value of xy? [MBA 15-16]

A. 2 B. 4 C. 8 D. 10 E. None of these

16. A son got $\frac{3^{th}}{5}$ of his father's property. He sells $\frac{2^{rd}}{3}$ of his share for tk. 1,00,000. What is the value of the original property owned by his father?

A. 33,333 B. 4,50,000 C. 3,00,000 D. 2,50,000 E. 3,50,000

17. In a department, $\frac{3}{5}$ of the worker are men and the rest women. If $\frac{1}{2}$ of the men and $\frac{3}{7}$ of the women in the department are over 35, what fraction of all the worker in the department are over 35?

A. $\frac{33}{70}$ B. $\frac{66}{70}$ C. $\frac{33}{140}$ D. $\frac{35}{140}$ E. $\frac{65}{140}$

18. A student loses 1 mark for wrong answer and scores 2 marks for every correct answer. If he answer all the 60 questions in an exam scores 39 marks, how many of them were correct?

A. 31 B. 37 C. 33 D. 27 E. 23

19. Abir gave half of his stamps to Ayon. Ayon gave half of his stamps to Mithila. Mithila gave $\frac{1}{4}$ of the stamps given to her to Sadib and kept the remaining 12. How many stamps did Abir start with?

A. 48 B. 52 C. 56 D. 60 E. 64

20. 6 students did not participate and 10 students failed in exam. Among the students who passed in the exam, Abir stood 15^{th} from the top and 30^{th} from the bottom in the merit list. How many students were there in the class? [MBA '18]

A. 44 B. 50 C. 60 D. 57 E. None of these

21. A boy was asked to multiply a number by $\frac{7}{8}$, instead he divided the number by $\frac{7}{8}$ and got the result $\frac{15}{14}$ more than what he should have got if he had multiplied the number by $\frac{7}{8}$. The number is-

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

22. Given $2x + 2y = 6z, 2x - 2y = 2z$ and $y - z = 0$, how many unique solution are there for y? [MBA 15-16]

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

23. On a particular day, a shop sold 3 fewer laptops of brand X than two times the numbers of laptops of brand Y. If a customer who bought a laptop of X brand had purchased a laptop of Y brand instead of X brand, number of brand X and brand Y sold would have been the same. What is the total number of laptops sold? [MBA 15-16]

A. 8 B. 9 C. 10 D. 12 E. None of these

24. When 117 chocolate are equally distributed among x number of students, you are left with $(x - 9)$ chocolate. Which of the following could be a value of x? [MBA 15-16]

A. 15 B. 18 C. 21 D. 24 E. None of these

25. If $4y - 3x = 5$, what is the smallest value of x for which $y > 100$? [MBA 16-17]

A. 130 B. 131 C. 132 D. 135 E. None of these

Homework

1. If the number $\frac{17}{24}, \frac{1}{2}, \frac{3}{8}, \frac{3}{4}$ and $\frac{9}{16}$ were ordered greatest to least, the middle number of the resulting sequence would be ?

A. $\frac{3}{8}$ B. $\frac{3}{4}$ C. $\frac{9}{16}$ D. $\frac{17}{24}$ E. $\frac{1}{2}$

2. Ayon and Mithila together have tk. 1210. If $\frac{4}{15}$ of Ayon's amount is equal to $\frac{2}{5}$ of Mithila's amount, how much amount Mithila has?

A. 460 B. 484 C. 550 D. 726 E. 626

3. The value of a fraction is $\frac{2}{5}$. If the numerator is decreased by 2 and the denominator increased by 1, the resulting fraction is equivalent to $\frac{1}{4}$. Find the numerator of the original fraction:

A. 3 B. 4 C. 6 D. 10 E. 15

4. What pair of rational numbers lies between $\frac{1}{4}$ and $\frac{3}{4}$?

A. $\frac{9}{40}, \frac{31}{40}$ B. $\frac{24}{100}, \frac{74}{100}$ C. $\frac{252}{1000}, \frac{748}{1000}$ D. $\frac{262}{1000}, \frac{752}{1000}$ E. None of these

5. If $\frac{1}{3}$ of the liquid contents of a can evaporates on the first day and $\frac{3}{4}$ of the remainder evaporates on the second day. The fractional part of the original contents remaining at the closing of the second day is:

A. $\frac{4}{7}$ B. $\frac{1}{2}$ C. $\frac{1}{6}$ D. $\frac{7}{12}$ E. None of these

6. A box contains only marbles. If $\frac{1}{4}$ of the marbles were removed, the box would be filled $\frac{1}{3}$ of its capacity. If instead 100 marbles were added, the box would be full. How many marbles are there in the box? [MBA 15-16]

A. 80 B. 110 C. 140 D. 170 E. None of these

7. Abir took $\frac{3}{5}$ of the marbles kept in a box. His younger took another $\frac{3}{5}$ of the remaining marbles. Then his sister took another $\frac{3}{5}$ of the remaining marbles. What fraction of the marbles left in the box? [MBA 2016]

A. $\frac{8}{125}$ B. $\frac{11}{125}$ C. $\frac{13}{125}$ D. $\frac{17}{125}$ E. None of these

8. Abir contributed $\frac{2}{3}$ of his salary to a charity, which is half the salary of Sadib. Sadib contributed $\frac{3}{4}$ of his salary to the same charity which is twice the salary of Tazul. Tazul contributed $\frac{1}{4}$ of his salary to the charity. If Sadib's salary is tk. 20,000, what was the total contribution to the charity? [BBA 14-15]

A. tk. 26,875 B. tk. 27,325 C. tk. 28,525 D. tk. 29,675 E. tk. 30,000

9. If $(a + a + a) = (b + b + b + b)$ and $a + b = 7$, then what is the value of $(a^2 - b^2)$? [MBA 16-17]

A. 0 B. 3 C. 4 D. 7 E. None of these

10. If x is an integer and $(0.5)(0.005)(0.05)(0.005)10^x$ is an integer, what is the least possible value of x? [MBA 15-16]

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

11. If $4^a + 4^{a+1} = 4^{a+2} - 176$, what is the value of a?

A. 2 B. 4 C. 6 D. 8 E. 10

12. Omar could buy a certain number of notebooks for tk. 300. If each notebook cost is tk. 5 more, he could have bought 10 notebooks less for the same amount. Find the price of each notebook.

A. 15 B. 12 C. 10 D. 20 E. 8

13. Half of the people on a bus get off at each stop after the first, and no one gets on after the first stop. If only 4 person gets off at stop number 4, how many people got on at the first stop?

A. 16 B. 24 C. 32 D. 36 E. 44

14. Mr. Shahadat and Mr. Sadib have a combined weekly salary of tk. 1000. If salary of Shahadat is increased by 2.5 times and salary of Sadib is increased by 1.5 times, the combined salary would be tk. 1600. What was the original salary of Sadib?

A. tk. 100 B. tk. 150 C. tk. 900 D. tk. 1000 E. tk. 750

15. 54 is divided into two parts such that the sum of 10 times the first and 22 times the second is 780. The bigger part is:

A. 24 B. 29 C. 30 D. 34 E. 35

16. The product of two numbers is 900 and their sum exceed their difference by 30. The greater of these two numbers is:

A. 90 B. 75 C. 65 D. 60 E. 15

17. Asif earns tk. 8.50s per hour on days other than Sundays and twice that rate on Sundays. Last week he worked a total of 40 hours, including 8 hours on Sunday. What were his earning for the week?

A. tk. 272 B. tk. 340 C. tk. 398 D. tk. 408 E. tk. 400

18. Two tanks A and B are filled with petrol. Tank A holds 600 liters more than tank B. If 100 liters of petrol were taken out from each tank, tank A would then contain 3 times as much as petrol as tank B. What is the total number of liters of fuel in the two full tanks?

A. 1000 B. 1200 C. 1300 D. 1400 E. 1500

19. A man sells seven different sized balls. Each ball costs n taka more than the next one below it in size, and the price of the biggest ball is tk. 46. If the sum of the prices of seven different balls is tk. 196, what is the value of n? [MBA '16]

A. 6 B. 7 C. 8 D. 9 E. None of these

20. If x and y are integers, and $7x - 4y = 20$, which of the following could be the value of x? [MBA 15-16]

A. 6 B. 8 C. 9 D. 15 E. None of these

21. Tazul has X number of books, which is 3 times as many as Sadib and $\frac{1}{2}$ as many as Mimi. How many books do the three of them have altogether , in terms of x? [MBA '17]

A. $\frac{5x}{6}$ B. $\frac{7x}{3}$ C. $\frac{10x}{3}$ D. $\frac{7x}{2}$ E. None of these

22. The cost of 12 pencils and 10 pens is tk. 320. The cost of 20 pencils and 15 pens is tk. 500. What is the difference between the cost of a pen and a pencil? [MBA '17]

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

23. 3 people are splitting a tk. 150 bill. If Ayon pays tk. 5 less than Abir, while Tazul pays more than tk. 60, what is the most Ayon can pay, given all of them pay integer amounts? [MBA '18]

A. 29 B. 42 C. 47 D. 61 E. None of these

24. Tasty cookies sells two kinds of cakes: lemon for tk. 40 and cheese for tk. 25. On a certain day, the shop sold 100 cakes and got tk. 2980 in revenue from the sales. How many lemon cakes did they sell? [MBA 15-16]

A. 30 B. 32 C. 40 D. 48 E. None of these

25. If 'm' and 'n' are whole numbers such that $m^n = 121$, the value of $(m - 10)^{(n+1)}$ is:

A. 21 B. 10 C. 100 D. 1000 E. None of these