

Time allotted: 3hr

DIRECTIONS: For each of the following questions, choose the correct answer from the given alternatives and carefully **blacken** the letter of your correct choice on the separate answer sheet provided.

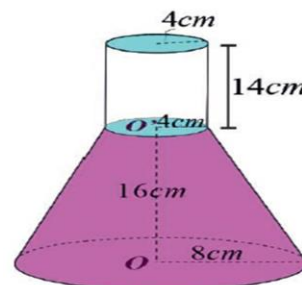
1. Given $a=2 \times 3^3 \times 5^2$ and $b=2^3 \times 3 \times 5^2$. The GCF and LCM of a and b respectively are:
 A. 150 and 5400 B. 15 and 540 C. 120 and 530 D. 150 and 440
2. For $a \geq 0$, p and q are two positive integers. $a^{\frac{p}{q}}$ equals to:
 A. $(a^{\frac{1}{p}})^q$ B. $(\sqrt[p]{a})^q$ C. $(\sqrt[q]{a})^p$ D. $(\sqrt[q]{p})^q$
3. Find the simplified form of $\frac{1}{3}\sqrt{27x^3y^2}$.
 A. $\frac{1}{3}\sqrt{3x}|xy|$ B. $\frac{1}{3}\sqrt{3x}xy$ C. $(\sqrt{3x})(xy)$ D. $\sqrt{3x}|xy|$
4. What are the values of x in $2|x - 5| + |x - 5| = 12$?
 A. 1 and 9 B. -9 and -1 C. -5 and -2 D. $\frac{1}{2}$ and $\frac{1}{9}$
5. If the sum of the roots of the equation $3x^2 + kx + 1 = 0$ is 7, then what will be the value of k?
 A. 21 B. -21 C. $\frac{1}{3}$ D. $-\frac{1}{3}$
6. In a class of 31 students, 22 students study Mathematics, 20 students study Physics and 5 students study neither. Calculate the number of students who study only Mathematics subject.
 A. 16 B. 4 C. 6 D. 18
7. Let $f(x)=3 - x$ and $g(x)=2x + 4$. Then $(\frac{f}{g} - f)(4)$ for $g(x) \neq -2$, equals to:
 A. $-\frac{5}{11}$ B. $\frac{11}{12}$ C. $\frac{5}{8}$ D. $\frac{8}{5}$
8. For $f(x)= ax^2 + c$, $a \neq 0$, $c \in \mathbb{R}$ and $a > 0$. Which of the following can be properties of $f(x)$?
 A. its vertex is (c,0) B. its range is $\{y: y \geq 0\}$ C. the graph opens downward D. the range is $\{y: y \geq c\}$
9. Which of the following can be the measures of each interior angle of regular hexagon?
 A. 120° B. 60° C. 720° D. 129°
10. A ladder 8m long leans against a wall and makes an angle of 60° with the ground. How far is the foot of the ladder from the wall?
 A. $4\sqrt{3}$ m B. 4m C. $\frac{\sqrt{3}}{2}$ m D. $\frac{\sqrt{3}}{3}$ m

11. A segment of a circle of radius 10m is cut off by a chord subtending an angle of 60° at the center of the circle. What is the area of the segment?
 A. $(\frac{50\pi}{3} - 25)m^2$ B. $(\frac{50\pi}{3} + 25)m^2$ C. $(\frac{50\pi}{3} - 25\sqrt{3})m^2$ D. $(\frac{50\pi}{3} + 25\sqrt{3})m^2$
12. If two fair dice are thrown once, then what is the probability of getting the sum of the numbers of the faces up is 9? A. $\frac{1}{36}$ B. $\frac{1}{9}$ C. $\frac{1}{6}$ D. $\frac{1}{18}$
13. Which one of the following represents a position vector opposite to the vector with initial point (2,5) and terminal point (-4,3)? A. $-6i - 2j$ B. $6i + 2j$ C. $-2i - 6j$ D. $2i + 6j$
14. Which one of the following can be polynomial expression?
 A. $\sqrt{(x^2 - 1)^2}$ B. $\frac{x^2+1}{x^2+1}$ C. $\frac{x^2-1}{x^2-1}$ D. $4\sqrt{\pi x} + 2$
15. If $f(x) = x^3 - 1$, the real zero(s) of f is/are: A. 1 B. -1 and 2 C. -2 and 1 D. has no real zeros
16. Which one of the following is incorrect about $g(x) = a^x$, $a > 1$?
 A. (0,1) is y intercept B. its domain is $[0, \infty)$ C. it is increasing on its domain
 D. the graph gets closer to the negative x- axis when x is negative.
17. The solution set of the exponential equation $2^x + 2^x + 2^x + 2^x = 16$ is: A. {4} B. {2,4} C. {2} D. {}
18. The solution set of the inequality $x^2 + 3x - 4 \leq 0$ is:
 A. [-4,1] B. [-4,1) C. (-4,-1) D. [-4,-1]
19. From the following pairs of equations of lines which pair represents perpendicular lines?
 A. $2x - 5y + 1 = 0$ and $5x + 2y + 1 = 0$ B. $2x - 5y + 1 = 0$ and $5x - 2y + 1 = 0$
 C. $2x + 5y + 1 = 0$ and $5x + 2y + 1 = 0$ D. $2x + 5y + 1 = 0$ and $4x + 10y + 2 = 0$
20. If $\sin \theta = k$, then what is the value of $\cos \delta$ for θ and δ are complementary angles?
 A. -k B. $\frac{1}{k}$ C. $-\frac{1}{k}$ D. k
21. A tree which casts a shadow of 12m when the angle of elevation of the sun is 30° . What is the height of a tree? A. $2\sqrt{3}$ m B. 3m C. $6\sqrt{3}$ m D. $4\sqrt{3}$ m
22. The solution set of $|2x + 4| \leq 8$ is: A. [-6,-2] B. [-6,2] C. (-6,-2] D. (-6,-2)
23. The area of a trapezium with bases 5cm and 7cm, and altitude 10cm is:
 A. $60cm^2$ B. $120cm^2$ C. $72cm^2$ D. $40cm^2$
24. The base of a right prism is an equilateral triangle with edge length 3cm and its altitude 8cm. What is its volume? A. $18\sqrt{3}cm^2$ B. $9\sqrt{3}cm^3$ C. $9\sqrt{3}cm^3$ D. $\frac{9\sqrt{3}cm^3}{4}$

25. The perimeter of a regular hexagon with radius 5cm is: A. 60cm B. 45cm C. 30cm D. 20cm

26. The total surface area of the figure given below is :

- A. $16\pi(3\sqrt{17} + 11) \text{ cm}^2$ B. $48\sqrt{17} \pi \text{ cm}^2$
 C. $16\pi(3\sqrt{17} + 3) \text{ cm}^2$ D. $64 \pi \text{ cm}^2$



27. Let f and g be functions such that $g = f^{-1}$. Which of the following is false about f and g ?

- A. Domain of f = Range of g B. Range of f = Domain of g . C. $f \circ g = x$ D. $g \circ f = x^2$

28. One of the following is false about the graph of $f(x) = \frac{x^2+x}{x^2+4x+3}$.

- A. Its vertical asymptote $x=-1$ B. Its Horizontal asymptote is $y=1$
 C. Its x -intercept at the origin D. There is hole at $(-1, \frac{-1}{2})$

29. Which of the following is true about the ellipse $\frac{x^2}{100} + \frac{y^2}{36} = 1$?

- A. its eccentricity 0.6 B. its center is (10,6) C. its major axis 20 units long
 D. its minor axis 16 units long.

30. One of the following is equation of a hyperbola with center at the origin and whose transverse axis horizontal. A. $\frac{y^2}{9} - \frac{x^2}{16} = 1$ B. $\frac{x^2}{9} - \frac{y^2}{16} = 1$ C. $\frac{x^2}{4} + \frac{y^2}{16} = 4$ D. None.

31. Assuming that $U = \mathbb{R}$, which of the following is true? Type equation here.

- A. $(\exists x)(4x - 3 = 2(2x + 1) + 5)$ B. $(\forall x)(x + 2 = 3)$
 C. $(\exists x)(x^2 + 1 = 0)$ D. $(\forall x)(x^2 + 1 > 0)$

32. For the frequency distribution shown below which one is true?

weight	frequency
40 - 49	6
50 - 59	10
60 - 69	17
70 - 79	3

- A. $P_{20} = 40.7$ B. $P_{30} = 54.3$
 C. $P_{75} = 50$ D. $P_{80} = 79$

33. In an examination paper, there are 10 questions .In how many different ways can a student choose 6 questions in all, if three questions are compulsory? A. 100 B. 40 C. 35 D.20

34. If a die is rolled once, which will be the probability that it is even or divisible by 4?

- A. $\frac{1}{2}$ B. $\frac{1}{3}$ C. $\frac{1}{4}$ D. $\frac{2}{5}$

35. If $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & a & 1 \end{bmatrix}$ and $A^{-1} = \frac{1}{2} \begin{bmatrix} 1 & -1 & 1 \\ -2 & 6 & 2b \\ 5 & -3 & 1 \end{bmatrix}$ then the values of a and b are respectively

- A. 1, -1 B. -1, 1 C. 2, $-\frac{1}{2}$ D. $\frac{1}{2}, \frac{1}{2}$

36. The solution set of $\begin{cases} x - 2y - 4z = 0 \\ -x + y + 2z = 0 \\ 3x - 3y + 6z = 0 \end{cases}$ is-----

- A. $\emptyset$ B. $\{(1, 2, 3)\}$ C. $\{(0, 0, 0)\}$ D. $\{(0, -2z, z) : z \in \mathbb{R}\}$

37. The polar representation of $z = 3 - 3i$ is ----

- A. $9(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4})$ B. $3\sqrt{2}(\cos \frac{\pi}{4} + i \sin \frac{\pi}{4})$ C. $9(\cos \frac{3\pi}{4} + i \sin \frac{3\pi}{4})$
D. $3\sqrt{2}(\cos \frac{3\pi}{4} + i \sin \frac{3\pi}{4})$

38. A diet for a sick person must contain at least 4,000 units of vitamins, 50 unit of minerals and 1,400 units of calories, Two foods A&B are available at a cost of birr 4 & birr 3 per unit respectively. If one unit of A contains 200 units of vitamins, 1 unit of mineral & 40 units of calories. One unit of food B contains 100 unit of vitamins, 2 units of minerals & 40 units of calories, which one of the following is the form of linear programming model?

- A. cost = $4x + 3y$ C. cost = $4x + 3y$

$$\text{Subject to } \begin{cases} 2x + y \geq 40 \\ x + 2y \geq 50 \\ x + y \geq 35 \\ x, y \geq 0 \end{cases}$$

$$\text{Subject to } \begin{cases} 2x + 2y \geq 40 \\ 2x + y \leq 50 \\ x + y \geq 35 \\ x, y \geq 0 \end{cases}$$

- B. cost = $3x + 4y$

- D. cost = $3x + 4y$

$$\text{Subject to } \begin{cases} x + 2y \geq 40 \\ 2x + y \geq 50 \\ x + y \leq 35 \\ x, y \geq 0 \end{cases}$$

$$\text{Subject to } \begin{cases} x + 2y \leq 40 \\ 2x + y \leq 50 \\ x + y \geq 35 \\ x, y \geq 0 \end{cases}$$

39. 5% of 5% of Birr 100 is equal to:---

- A. Birr 0.25 B. Birr 0.50 C. Birr 10 D. Birr 25

40. The terms of the sequence defined recursively $a_1 = 1, a_2 = 3$ and $a_n = \frac{1}{2}(a_{n-1} + a_{n-2}), n \geq 3$, and then which statement is **not true**?

- A. $a_3 = 2$ B. $a_4 = \frac{5}{2}$ C. $a_5 = \frac{9}{2}$ D. $a_6 = \frac{19}{8}$

41. The terms of geometric sequence, $G_4 = 3$ and $G_7 = 24$, then find G_1 and r respectively are:

- A. $\frac{3}{8}$ and 2 B. 2 and 8 C. 4 and 3 D. $\frac{1}{2}$ and $\frac{5}{8}$

42. The sum of the first 30 terms of $2 + 5 + 8 + \dots$ is :

- A. 1350 B. 1275 C. 1175 D. 1365

43. The fraction form of the repeating decimal $3.\dot{2}\dot{5}$ is:

- A. $\frac{325}{99}$ B. $\frac{293}{99}$ C. $\frac{290}{9}$ D. $\frac{293}{90}$

44. The population of a certain town is increasing at the rate of 5% per year. If the present number of population is 48000, what will the population be 8 years from now?

- A. $48000(0.5)^8$ B. $48000(1.05)^8$ C. $48000(1.5)^8$ D. 384000

45. Let $f(x) = \frac{x^3+3x}{x^2}$, then the derivative of $f(x)$ is

- A. $1 - \frac{3}{x^2}$ B. $1 + \frac{3}{x^4}$ C. $\frac{1-2x}{x^4}$ D. $3 + \frac{1}{x^3}$

46. The equation of the tangent line to the graph of $f(x) = x^3 + x + 2$ at (0,2) is:

- A. $y = 2x + 1$ B. $y = -2x - 1$ C. $y = x + 2$ D. $y = 3x - 1$

47. A circular plate of metal is being expanded by heating. The radius of the plate increases at the rate of 0.3 cm per second. Then the rate of increase of area when its radius becomes 15cm:

- A. $6\pi cm^2/s$ B. $9\pi cm^2/s$ C. $12\pi cm^2/s$ D. $18\pi cm^2/s$

48. Let $f(x) = x^4 - 6x^2 + 1$ on $[-2,3]$ be given, then which of the following a local maximum value of f?

- A. $f(0)$ B. $f(\sqrt{3})$ C. $f(3)$ D. $f(-\sqrt{3})$

49. The area A of the region bounded between the graph of $f(x) = x^3 - 9x$ and the x - axis from

$x = -2$ and $x = 2$:

- A. 28 square units B. 14 square units C. 12 square units D. 20 square units

50. Which of the following statement is not true about definite integrals?

If there is more area above the x-axis than below, the definite integral will be positive

- A. If there is more area below the x-axis than above, the definite integral will be negative.
- B. If the area above and below the x-axis are the same, the definite integral will be 0
- C. None

51. The inter-quartile range of the data 105,101,102,109,60,100,120 is:

- A. 8
- B. 9
- C. 7
- D. 12

52. The mean deviation about the median of the data 15,11,12,20,19,6,11 is:

- A. 4.2
- B. 5.1
- C. 3.7
- D. 6.3

53. Which of the following statement is true about standard deviation of a data?

- A. It is based on all observation
- B. It is rigidly defined
- C. The standard deviation a data set is the positive square root of variance
- D. All

54. The standard deviation of the population 1,2,6,3 is:

- A. 3
- B. $\sqrt{3}$
- C. 3.5
- D. $\sqrt{3.5}$

55. If mean and standard deviation of the gross incomes of a company are $\bar{x} = 20,000$, $\delta = 4400$, then the coefficient of variation is:

- A. 200
- B. 20
- C. 24
- D. 22

56. If $\text{mean} < \text{median} < \text{mode}$, then what will be the distribution?

- A. Skewed to the right
- B. Skewed to left and right
- C. Perfectly symmetrical
- D. None

57. Which of the following is the limitation of simple random sampling?

- A. Difficult to access lists of the population
- B. Time consuming
- C. Simplicity
- D. All expect C

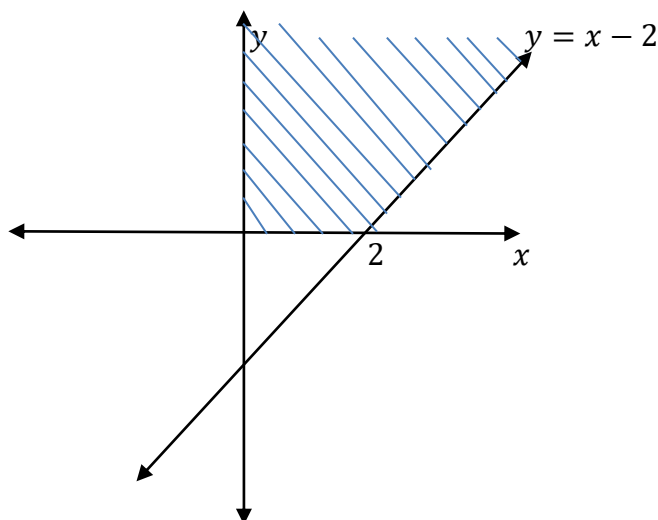
58. Which one of the following system of linear inequality represents the shaded region shown in the figure below?

A. $\begin{cases} y \leq x - 2 \\ x \geq 0 \\ y \geq 0 \end{cases}$

B. $\begin{cases} y \leq x \\ x \geq 0 \\ y \geq 0 \end{cases}$

C. $\begin{cases} y \geq x - 2 \\ x \geq 0 \\ y \geq 0 \end{cases}$

D. $\begin{cases} y \geq -2 \\ x \geq 0 \\ y \geq 0 \end{cases}$



59. From the following given alternatives, what can be the value of x and y which maximize the objective function $Z = 3x + 4y$

Subject to $\begin{cases} x + y \leq 4 \\ x \geq 0 \\ y \geq 0 \end{cases}$?

A. Z has a maximum value at (0,0)

B. Z has a maximum value at (0,4)

C. Z has a maximum value at (4,0)

D. Z has a maximum value at (1,3)

60. There are two products, Cereal and milk for breakfast and assume that a person must consume at least 60 units of iron and 70 units of protein to stay alive, one unit of Cereal cost Birr 120 and contains 30 units of iron and 5 units of protein and one unit of milk cost Birr 30 and contains 15 units of iron and 10 units of protein. The cheapest diet which will satisfy the minimum daily requirement is:

A. 7 units of milk and 14 units of Cereal needed

B. Only 14 units of Cereal needed

- C. Only 7 units of milk needed
- D. Only 7 units Cereal needed

61. The mass of an Aluminum rod varies directly with its length. If a 16cm long rod has a mass of 192 gram, then what is the length of the rod whose mass is 105 gram?

- A. 1.75cm
- B. 12.5cm
- C. 10.5 cm
- D. 7.5 cm

62. A sum of money was divided between Debora, Kalid and Mesfin in the ratio of 5:3:1 respectively. If Debora has received Birr 240, then how much money was there to start with?

- A. 342
- B. 408
- C. 432
- D. 394

63. For how long must a sum be deposited in an account paying 14% compound interest in order to triple in value?

- A. $\log_3 2$
- B. $\log_{1.14} 3$
- C. $\log 1.14$
- D. $\log_{14} 3$

64. Which of the following is the annuity factor of quarterly payments of Birr 500 for 3 years assuming the 10% interest rate?

- A. 18.6
- B. 33.5
- C. 54.2
- D. 13.6

65. Bontu enterprise, unincorporated business has reported earnings before tax of Birr 90,000 at the tax year ended June 30, 2014. What is the amount of business income tax?

(Use: Tax rate in percentage 25% and Deduction in Birr 6,780
Source: Federal Income tax proclamation (No. 979/2016))

- A. Birr 29,280
- B. Birr 21,822
- C. Birr 15,720
- D. Birr 24,195