

OROMIA EDUCATION BUREAU

MATHEMSTICS MODEL EXAM FOR GRADE 12, 2018/2026.

TIME ALLOWED: 3:00 HOURS.

GENERAL DIRECTIONS

FOLLOW THE FOLLOWING RULES AND REGULATIONS IN DOING THE EXAMINATION:

- WRITE THE NECESSARY INFORMATION (NAME, SECTION AND ROLL NUMBER) ON THE ANSWER SHEET PROVIDED.
- ENSURE YOU UNDERSTAND THE FORMAT OF THE EXAM AND THE TYPES OF QUESTIONS INCLUDED.
- THE EXAM CONSISTS OF **60** OBJECTIVE QUESTIONS. CHOOSE ONLY THE **CORRECT** ANSWER FOR EACH QUESTION AND **BLACKEN** THE LETTER OF YOUR CHOICE ON THE ANSWER SHEET PROVIDED.
- NO OTHER MATERIALS OR ELECTRONIC DEVICES ARE PERMITTED EXCEPT PEN/PENCIL.
- ANY FORM OF **CHEATING** IS **PROHIBITED** AND RESULTS IN THE CANCELLATION OF YOUR SCORES.
- **STOP** WORKING IMMEDIATELY WHEN THE ALLOTED TIME IS UP.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

DIRECTION: CHOOSE THE **CORRECT** ANSWER FROM THE SUGGESTED OPTIONS AND BLACKEN THE LETTER OF YOUR CHOICE ON THE ANSWER SHEET PROVIDED.

- Which of the following is the mean of the data 4, 5, 7, 8, 2, 11, 6, 5?

A. 6 B. 8 C. 4 D. 3
- Which of the following is the measure of the angle between the vectors $\vec{u} = 5i + 3j$ and $\vec{v} = 4i - j$?

A. 45° B. 225° C. 315° D. 135°
- If $\sin \theta = -\frac{3}{5}$ and θ is a 4^{th} quadrant angle, then which of the following is the value of $\sec \theta$?

A. $-\frac{5}{3}$ B. $\frac{5}{4}$ C. $\frac{5}{3}$ D. $-\frac{5}{4}$
- If α and β are roots of the polynomial function $f(x) = 5x^2 - 3x + 9$, then find $\frac{1}{\alpha} + \frac{1}{\beta}$.

A. $\frac{1}{3}$ B. $-\frac{1}{3}$ C. 9 D. $\emptyset$
- In a class of 60 students, if 25 students play cricket and 20 students play tennis, and 10 students play both the games, then which of the following is the number of students who play neither?

A. 0 B. 25 C. 35 D. 45
- Some identical balls are arranged in rows to form an equilateral triangle. The first row consists of one ball, the second row consists of two balls, the third row consists of three balls and so on. If 99 more identical balls are added to the total number of balls used in forming the equilateral triangle, then all these balls can be arranged in a square whose each side contains exactly 2 balls less than the number of all each side of the triangle contains. Then which of the following is the number of balls used to form an equilateral triangle?

A. 10 B. 9 C. 190 D. 19
- The mean age of 25 teachers in a school is 40 years. A teacher retires at the age of 60 years and a new teacher is appointed in his place. If now the mean age of the teachers in this school is 39 years, then the age of the newly appointed teacher is equal to:

A. 50 B. 40 C. 25 D. 35
- Let $A = \begin{pmatrix} 2 & 3 \\ 2 & -1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 5 & -4 \\ 3 & 2 & 6 \end{pmatrix}$. Then $(AB)^T$ is equal to:

A. $\begin{pmatrix} 13 & 1 \\ 16 & 8 \\ 10 & -14 \end{pmatrix}$ B. $\begin{pmatrix} 13 & 6 & 10 \\ 1 & 8 & -14 \end{pmatrix}$ C. $\begin{pmatrix} 13 & 10 & 16 \\ 1 & -14 & 8 \end{pmatrix}$ D. $\begin{pmatrix} 13 & 1 \\ 10 & -14 \\ 16 & 8 \end{pmatrix}$
- The solution set of the equation given by $\log_2(x-2) + \log_2 x = 3$ is:

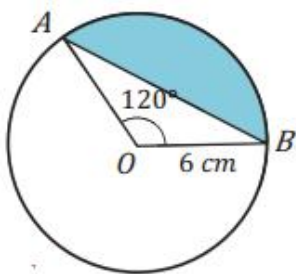
A. $\{-2, 4\}$ B. $\{4\}$ C. $\{-2\}$ D. $\{-4, 2\}$
- If $R = \{(x, y) : x, y \in \mathbb{R}, y \geq x+1 \text{ and } y < 2-x\}$ be a relation, then which one of the following is equal to R^{-1} ?

A. $\{(x, y) : x, y \in \mathbb{R}, y \leq x-1 \text{ and } y < x-2\}$ C. $\{(x, y) : x, y \in \mathbb{R}, y \leq x-1 \text{ and } y < 2-x\}$
 B. $\{(x, y) : x, y \in \mathbb{R}, y \geq x-1 \text{ and } y > 2-x\}$ D. $\{(x, y) : x, y \in \mathbb{R}, y \geq x-1 \text{ and } y > x-2\}$



11. If two balanced dice are tossed once, then which of the following is the probability of the event, that the sum of the integers coming on the upper sides of the two dice is 9?
- A. $\frac{1}{6}$ B. $\frac{1}{9}$ C. $\frac{5}{36}$ D. $\frac{1}{4}$
12. In an examination, if the probability of a student getting mark A is $\frac{1}{10}$, B is $\frac{3}{5}$ or C is $\frac{1}{4}$, then which of the following is the probability that the student fail in the examination?
- A. 0.95 B. 0.135 C. 0.05 D. 0.83
13. If $A = \{x : x^2 - 5x + 6 = 0\}$, $B = \{2, 4\}$ and $C = \{4, 5\}$, then $A \times (B \cap C)$ is equal to:
- A. $\{(2, 4), (3, 4)\}$ C. $\{(2, 4), (3, 4), (4, 4)\}$
 B. $\{(2, 2), (3, 3), (4, 4), (5, 5)\}$ D. $\{(4, 2), (4, 3)\}$
14. If Mr. Soresa deposits a sum of money in a bank at 10% interest rate per year compounded monthly, then how long will it take to double the principal, to nearest value? (Use : $\log 2 = 0.3010$, $\log 1.008 = 0.00346$).
- A. 7 B. 8 C. 10 D. 11
15. What is the domain of the function $f(x) = \frac{x^2 + 2x + 1}{x^2 - 5x - 6}$?
- A. $\mathbb{R} \setminus \{-1, 6\}$ B. $\mathbb{R} \setminus \{6\}$ C. $\mathbb{R} \setminus \{-6, 1\}$ D. $\mathbb{R} \setminus \{1, 6\}$
16. Which of the following is the sum of the first 50 terms of the sequence $\frac{1}{2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \dots$?
- A. $\frac{52}{51}$ B. $\frac{50}{51}$ C. $\frac{51}{50}$ D. $\frac{1}{51}$
17. If 7^{th} and 13^{th} terms of an arithmetic sequence are 34 and 64 respectively, then which of the following is the 18^{th} term of the sequence?
- A. 89 B. -21 C. 88 D. -87
18. Find the sum of all odd numbers of two digits.
- A. 2745 B. 5049 C. 4905 D. 2475
19. If $\tan \theta - \cot \theta = a$ and $\sin \theta + \cos \theta = b$, then which of the following is equal to $(b^2 - 1)^2 (a^2 + 4)$?
- A. 2 B. -4 C. 4 D. -2
20. If $\lfloor x \rfloor^2 - 5\lfloor x \rfloor + 6 = 0$ where $\lfloor \cdot \rfloor$ denote the greatest integer function, then which of the following is true?
- A. $x \in [3, 4]$ B. $x \in [2, 3]$ C. $x \in [2, 3)$ D. $x \in [2, 4)$
21. The system of equations $\begin{cases} x + y + z = 6 \\ x + 2y + 5z = 9 \\ x + 5y + \lambda z = \alpha \end{cases}$ has no solution if:
- A. $\lambda = 17, \alpha = 18$ B. $\lambda = 17, \alpha \neq 18$ C. $\lambda \neq 17, \alpha = 18$ D. $\lambda \neq 17, \alpha \neq 18$
22. The average mark of boys in a class is 52 and that of girls is 42. If the average marks of boys and girls combined is 50, then which of the following is the percentage of boys in the class?
- A. 20% B. 60% C. 80% D. 52%

23. A spherical chocolate ball has a layer of ice-cream of uniform thickness around it. When the thickness of the ice cream layer is 1 cm , the ice-cream melts at the rate of $81\text{ cm}^3 / \text{min}$ and the thickness of the ice-cream layer decreases at the rate of $\frac{1}{4\pi} \text{ cm} / \text{min}$. The surface area (in cm^2) of the chocolate ball (without the ice-cream layer) is equal to:
- A. 324π B. 196π C. 225π D. 256π
24. Let $a_1, a_2, a_3, \dots$ are in geometric sequence where $a_1 < 0$, $a_1 + a_2 = 4$, $a_3 + a_4 = 16$ and if $\sum_{i=1}^9 a_i = 4\lambda$, then which of the following is the value of λ ?
- A. -171 B. 171 C. -513 D. $-\frac{511}{3}$
25. In arithmetic progression if $S_{40} = 1030$ and $S_{12} = 57$, then $S_{30} - S_{10}$ is equal to:
- A. 525 B. 515 C. 505 D. 510
26. In a certain store, the profit is 320% of the cost. If the cost increases by 25% but the selling price remains constant, approximately what percentage of the selling price is the profit?
- A. 75% B. 90% C. 70% D. 65%
27. Sumeya started a software business by investing Birr 50,000. After six months, Nanati joined her with a capital of Birr 80,000. After 3 years, they earned a profit of Birr 24,500. What was Sumeya's share in the profit?
- A. Birr 14,000 B. Birr 12,500 C. Birr 18,375 D. Birr 10,500
28. Which of the following is the area (in square units) of the triangle with vertices $A(1, 0)$, $B(3, 5)$ and $C(5, -2)$?
- A. 24 B. 12 C. 11 D. 22
29. If $\vec{u} = (4, 3, 2)$ and $\vec{v} = (1, 2, -3)$ are two vectors, then which of the following is a unit vector in the direction of $\vec{u} - 2\vec{v}$?
- A. $\frac{1}{\sqrt{35}}(3, 1, 5)$ B. $\frac{1}{\sqrt{51}}(5, 5, -1)$ C. $\frac{1}{\sqrt{69}}(2, -1, 8)$ D. $\frac{1}{\sqrt{101}}(6, 7, -4)$
30. If a segment of a circle has a central angle of 120° with radius 6 cm , then what is the area of this segment shown below?



- A. $(12\pi - 9\sqrt{3})\text{ cm}^2$ B. $4\pi\text{ cm}^2$ C. $(12 + 4\pi)\text{ cm}^2$ D. $12\pi\text{ cm}^2$
31. If the diameter of a right circular cone is 16 cm and its slant height is 10 cm , then which of the following is the volume of this cone?
- A. $384\pi\text{ cm}^3$ B. $144\pi\text{ cm}^3$ C. $80\pi\text{ cm}^3$ D. $128\pi\text{ cm}^3$



32. Which of the following relation is always a function?

A. $R = \{(x, y) : y \text{ is a multiple of } x\}$

C. $R = \{(x, y) : y \text{ is the area of triangle } x\}$

B. $R = \{(x, y) : y = x^2\}$

D. $R = \{(x, y) : x \text{ is the father of } y\}$

33. What is the value of a and k , respectively so that $x+1$ is a factor of $f(x) = ax^4 - 2kx^3 + ax^2 - kx + 4$ and $f(1) = 4$?

A. $-\frac{2}{3}, -1$

B. $\frac{2}{3}, 1$

C. $1, \frac{2}{3}$

D. $-1, -\frac{2}{3}$

34. A toy company manufactures two types of dolls; type A and type B. Market research and available resources have indicated that the combined production level should not exceed 1200 dolls per week and the demand for dolls of type B is at most half of the dolls type A. Further, the production level of dolls of type A can exceed three times the production of dolls of type B by at most 600 units. If the company makes profit of Birr 12 and Birr 16 per doll respectively on dolls A and B, and x = the number of type A dolls and y = the number of type B dolls, then which one of the following standard forms of linear programming models should be used to maximize the profit?

A. Maximize $P = 16x + 12y$,

C. Maximize $P = 12x + 16y$,

subject to:
$$\begin{cases} x + y \leq 1200 \\ x - 2y \geq 0 \\ x - 3y \leq 600 \\ x \geq 0, y \geq 0 \end{cases}$$

subject to:
$$\begin{cases} x + y \leq 1200 \\ 2x + y \geq 0 \\ x - 3y \geq 600 \\ x \geq 0, y \geq 0 \end{cases}$$

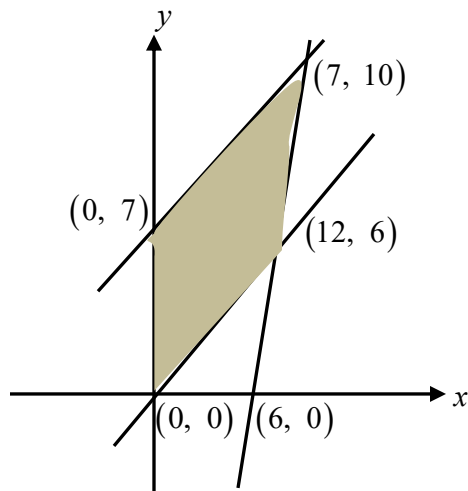
B. Maximize $P = 12x + 16y$,

D. Maximize $P = 12x + 16y$,

subject to:
$$\begin{cases} x + y \leq 1200 \\ x - 2y \geq 0 \\ x - 3y \leq 600 \\ x \geq 0, y \geq 0 \end{cases}$$

subject to:
$$\begin{cases} x + y \leq 1200 \\ x - 2y \geq 0 \\ 3x + y \leq 600 \\ x \geq 0, y \geq 0 \end{cases}$$

35. The feasible region for the linear programming problem is shown in the figure below.



If $Z = 3x - 4y$ is an objective function, then which of the following is the maximum of Z ?

A. 18

B. 12

C. 28

D. 19



36. What is the area (in square units) of the region bounded by the curve $y = x + 1$ between the lines $x = -2$ and $x = 3$?
- A. $\frac{15}{2}$ B. 8 C. $\frac{17}{2}$ D. $\frac{7}{2}$
37. What is the image of the line $y = 2x - 10$ after it has been reflected about the line $y = 2x - 5$?
- A. $y = -2x$ B. $y = 2x$ C. $y = -2x + 2$ D. $y = 2x - 2$
38. What is the total surface area of a regular hexagonal pyramid, given that an edge of the base is 8cm and its altitude is 12cm ?
- A. $192\sqrt{3}\text{cm}^2$ B. $96\sqrt{3}\text{cm}^2$ C. $288\sqrt{3}\text{cm}^2$ D. $48\sqrt{3}\text{cm}^2$
39. What are the coordinates of a point that divides the line segment with end points $A(4, -1)$ and $B(4, 3)$ in the ratio of $1:3$?
- A. $(4, 2)$ B. $(2, 0)$ C. $(2, 4)$ D. $(4, 0)$
40. What is the inverse of the matrix $\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$?
- A. $\begin{pmatrix} 3 & -2 \\ -2 & 1 \end{pmatrix}$ B. $\begin{pmatrix} -3 & -2 \\ -2 & -1 \end{pmatrix}$ C. $\begin{pmatrix} -3 & 2 \\ 2 & -1 \end{pmatrix}$ D. $\begin{pmatrix} 3 & -2 \\ 2 & -1 \end{pmatrix}$
41. Which of the following is the definition of a polynomial function?
- A. A function p defined by $p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$, where n is integer, $a_n \neq 0$ and $a_n, a_{n-1}, a_{n-2}, \dots, a_1, a_0 \in \mathbb{R}$.
- B. A function p defined by $p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$, where n is natural number, $a_n \neq 0$ and $a_n, a_{n-1}, a_{n-2}, \dots, a_1, a_0 \in \mathbb{R}$.
- C. A function p defined by $p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$, where n is rational number, $a_n \neq 0$ and $a_n, a_{n-1}, a_{n-2}, \dots, a_1, a_0 \in \mathbb{R}$.
- D. A function p defined by $p(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$, where n is whole number, $a_n \neq 0$ and $a_n, a_{n-1}, a_{n-2}, \dots, a_1, a_0 \in \mathbb{R}$.
42. Which one of the following statements is necessarily true?
- A. If a feasible region of a linear programming problem is bounded, then the objective function $Z = ax + by$ has both a maximum and a minimum value on the feasible region.
- B. Maximum value of the objective function $Z = ax + by$ in a linear programming problem always occurs at only one corner point of the feasible region.
- C. In a linear programming problem, the minimum value of the objective function $Z = ax + by$ is always 0 if origin is one of the points of feasible region.
- D. In any linear programming problem, the maximum value of the objective function $Z = ax + by$ is always positive integer number.
43. Which of the following is the maximum value of the function $f(x) = [x(x-1)+1]^{\frac{1}{3}}$ on $[0, 1]$?
- A. $\frac{\sqrt{3}}{3}$ B. 1 C. $\frac{1}{2}$ D. 4

44. Which of the following is the value of x for which the function $f(x) = 2x^3 + 9x^2 + 12x - 1$ is decreasing?
 A. $[-2, -1]$ B. $(-\infty, -2] \cup [-1, \infty)$ C. $(-\infty, -2]$ D. $[-1, 1]$
45. Which of the following are the points at which the tangents to the curve $y = x^3 - 12x + 18$ are parallel to x -axis?
 A. $(2, -2)$ and $(2, 34)$ C. $(2, -2)$ and $(-2, -34)$
 B. $(2, 2)$ and $(-2, 34)$ D. $(-2, 0)$ and $(0, 34)$
46. If the side of an equilateral triangle is $20\sqrt{3}cm$, then which of the following is the value of the radius of the circle circumscribing the triangle?
 A. $20\sqrt{3}cm$ B. $20\pi cm$ C. $20cm$ D. $\frac{20\sqrt{3}}{3}cm$
47. If position vectors of the points A and B are $4i - 3j$ and $-i + 2j$ respectively, then which of the following is the position vector of the point C such that $\overrightarrow{AC} = 3\overrightarrow{AB}$?
 A. $-15i + 15j$ B. $-11i + 12j$ C. $-19i + 12j$ D. $11i + 12j$
48. After rationalizing the denominator of the expression $\frac{4\sqrt{3} + 5\sqrt{2}}{\sqrt{48} + \sqrt{18}}$, it is equal to:
 A. $\frac{9 + 4\sqrt{2}}{15}$ B. $\frac{39 + 16\sqrt{6}}{33}$ C. $\frac{9 + 4\sqrt{6}}{15}$ D. $\frac{15 + 4\sqrt{6}}{33}$
49. Which of the following is the maximum number of students among whom 3003 pens and 2730 pencils can be distributed in such a way that each student gets the same number of pens and same number of pencils?
 A. 293 B. 300 C. 910 D. 273
50. In a frequency curve of scores, it is found that the mode is greater than mean. Then, which of the following is correct about frequency curve?
 A. Positively Skewed C. Symmetric
 B. Negatively Skewed D. Cannot be determined
51. Which of the following is the quartile deviation of daily wages (*in Dollars*) of 11 persons given below?
 140, 145, 130, 165, 160, 125, 150, 170, 175, 120, 180
 A. 20 B. 130 C. 150 D. 40
52. Which of the following is the Bowley's coefficient of skewness?
 A. $\frac{Q_3 + Q_1 - 2Q_2}{Q_3 + Q_1}$ B. $\frac{Q_3 - Q_1 - 2Q_2}{Q_3 - Q_1}$ C. $\frac{Q_3 - Q_1 - 2Q_2}{Q_3 + Q_1}$ D. $\frac{Q_3 + Q_1 - 2Q_2}{Q_3 - Q_1}$
53. Given the systems of linear equations $\begin{cases} ax + by = 2 \\ x + 3y + 2z = 0 \\ 2x + y + z = 0 \end{cases}$. If the determinant of the coefficient matrix is 2, then what is the solution set of the system?
 A. $\{(1, -5, 3)\}$ B. $\{(-2, -6, 10)\}$ C. $\{(1, 3, -5)\}$ D. $\{(-2, 10, -6)\}$
54. What is the solution set of the equation given by $\frac{5}{x^2 + 4} - 1 = \frac{1}{x} - \frac{x-1}{x^2 - x}$?
 A. $\{-1, 1\}$ B. $\{2\}$ C. $\{0, 1\}$ D. $\{-1\}$

55. What is the image of a circle $(x+4)^2 + (y-6)^2 = 9$, under a rotation through an angle π , about $(-7, -3)$?
- A. $(x+10)^2 + (y+12)^2 = 9$ C. $(x-10)^2 + (y-12)^2 = 9$
 B. $(x+10)^2 + (y+6)^2 = 9$ D. $(x-10)^2 + (y-6)^2 = 9$
56. The coefficient of x^4y in the expansion of $(2x-5y)^5$ is equal to:
- A. 400 B. -80 C. 16 D. -400
57. Mr. Jaleta divided Birr 20,000 for his three children A, B and C in the ratio of $\frac{1}{2} : \frac{3}{10} : \frac{1}{5}$, then what is the ratio of B's share to C's share?
- A. $\frac{3}{2}$ B. $\frac{2}{3}$ C. $\frac{1}{5}$ D. $\frac{3}{5}$
58. Which of the following is equation of tangent line to a circle $x^2 + y^2 - 8x - 10y - 128 = 0$ at the point $(-8, 10)$?
- A. $12x + 5y + 146 = 0$ C. $-12x - 5y - 146 = 0$
 B. $-12x - 5y + 146 = 0$ D. $-12x + 5y - 146 = 0$
59. The mark that students scored in an examination is grouped in class intervals as shown in the following table.

<i>Class interval (mark)</i>	<i>Number of students (f)</i>
55 – 64	8
65 – 74	12
75 – 84	20
85 – 94	6
95 – 104	4

What is the median of the mark?

- A. 25.0 B. 75.5 C. 77.0 D. 79.5
60. A box contains 5 white, 6 red and 4 black balls of identical size. If 3 balls are randomly taken out of the box one after the other, what is the probability that the 1st ball is white, and both the 2nd and 3rd balls are red?
- A. $\frac{2}{15}$ B. $\frac{15}{91}$ C. $\frac{4}{75}$ D. $\frac{5}{91}$

THE END