CITY GOVERNMENT OF ADDIS ABABA EDUCATION BUREAU
MATHEMATICS MODEL EXAMINATION

GENERAL DIRECTIONS

This Examination Contains Total Number of **60** Multiple Choice Questions. Select the Correct Answer and write the Letter of Your Choice on the Separate Answer Sheet Provided

Follow the Instructions on the Answer Sheet and the Examination Paper Carefully

. Please Erase All Unnecessary Marks Completely from Your Answer Sheet.

You are allowed to Work on the Exam for **3** Hours. When Time is Called, You Must Immediately Stop Working Put Your pen down, and Wait Further Instructions.

Any forms of Cheating or an Attempt to cheat in the Examination Will Result in Automatic Dismissal from the Examination Hall and Cancelation of Your Score(S).

Please Make Sure that You Have Written All the Required Information's on the Answer Sheet before You Start to Work the Examination.

Do Not Turn This Page Over Until You Are Told to Do So!



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

1. Which term of the following arithmetic sequence $-6,1,8,15,\ldots$ is 414?
   A. 31
   B. 62
   C. 61
   D. 32

2. $\sum_{n=4}^{17}(\frac{1}{k^2+5k+6})$ is equal to:
   A. $\frac{11}{102}$
   B. $\frac{7}{60}$
   C. $\frac{12}{85}$
   D. $\frac{10}{119}$

3. Which of the following Geometric sequence is divergent?
   A. $a_n = (-1)^{2n+1}(\frac{3}{7})^n$
   B. $a_n = (-\frac{3}{5})^{2n+1}$
   C. $a_n = \frac{1}{10}(\frac{5}{2})^n$
   D. $a_n = \frac{2}{5^n}$

4. A new auditorium in Addis Ababa has 30 seats in the first row, 34 in the second, and 38 in the third. If this pattern continues: What is the total seating capacity of the theater if it has 20 rows?
   A. 106
   B. 3880
   C. 580
   D. 1360

5. What is slope of a tangent line for a curve of a function $f(x) = x^2(x + \sqrt{x})$ at a point (1,2)?
   A. $11x - 2y - 7 = 0$
   B. $10x + 2y + 7 = 0$
   C. $5x - 2y - 7 = 0$
   D. $5x - y - 3 = 0$

6. If $g(x) = x^2, f(x) - \sqrt{f(x)}$ and $f(1) = f'(1) = 9$,then $g'(1)$ is equal to:
   A. $\frac{51}{2}$
   B. $\frac{31}{2}$
   C. $\frac{39}{2}$
   D. $\frac{57}{2}$

7. A manufacture wants to design an open box that has a square base and a surface area of 75 square unit. What dimensions of height will produce a box with a maximum volume?
   A. 5 units
   B. 2.5 unit
   C. 7.5 units
   D. 15 units

8. What is the area of a region enclosed between $f(x) = x^2 - 4$ over the interval [1,5]?

A. $\frac{5}{3}$ C. $\frac{16}{3}$

B. $\frac{65}{3}$ D. $\frac{86}{3}$

9. For 10 observations, the sum was 120 and sum of square was 1640.If one observation 10 is corrected to 20, then the corrected standard deviation is:

A. 5 C. 6

B. 4 D. 7

10. What is the coefficient of quartile range? for the data sets:

23,15,8,7,13,24,6,20,26,5

A. $\frac{7}{23}$ B. $\frac{7}{30}$ C. $\frac{30}{23}$ D. $\frac{16}{30}$

11. For the data set:4,8,10,12,8,9, the mean deviation from the median is:

A.1.66 B.10 C.8.52 D.1.56

12. The mean and standard deviation of the income of two companies are given below:

Company	$\bar{x}$	σ
A	8000	160
B	5000	120

Which one of the following is true about the two companies?

A. Company A has more variable income than company B.

B. Company B has more consistent income than company A.

C. It is not impossible to compare variability of data.

D. Company B has more variable data than company A.

13. A researcher wants to ensure that students from the different colleges at Addis Ababa University (e.g., Engineering, Business and Economics, Social Sciences) are proportionally represented in a survey about online learning. Which technique is most appropriate?

A. Simple random sampling C. Stratified random sampling

B. Systematic sampling D. Convenience sampling

14. What is the solution set of the inequality $\frac{x}{x-3} \leq 2$?

A. $(3,6]$ C. $(-\infty, 3) \cup [6, \infty)$

B. $(-\infty, 3) \cup (6, \infty)$ D. $[6, \infty)$

15. A dairy farmer in Addis Ababa wants to mix two types of feed, Feed A and Feed B, to minimize cost while meeting nutritional requirements for his cows

Feed A costs Birr 14 per kilogram and feed B costs Birr 21 per kilogram
Each Feed A contains 0.4 kg of protein and 0.2 of fiber. Each kg of Feed B contains 0.3kg of protein and 0.5kg of fiber.
The daily requirement is at least 12 kg of protein and at least 10kg of fiber
What is the minimum cost that satisfies the minimum daily requirement?

A. 450
C. 700
B. 540
D. 840

16. A furniture seller in Adama sells a bed for 45,000 Birr. If this price includes a 25% markup based on cost, what was the original cost of the bed?

A. 33,750 Birr
C. 37,500 Birr
B. 36,000 Birr
D. 40,000 Birr

17. Which one of the following is true about an amortization schedule?

A. Only the total interest paid over the loan
B. A breakdown of each payment into principal, interest, and remaining balance.
C. The banks profit from the loan
D. Only down payment of the principal

18. In leasing a building tax is required from rental income. The following is the tax rate to a total amount of rent per year in Birr.

Taxable income	Tax rate	Deducted amount
< 7200	Exempted	0
7201 – 19,800	10%	720
19,801 – 38,400	15%	1,710
38,401 – 63,000	20%	3,630
63,001 – 93,600	25%	6,780
93,601 – 130,800	30%	11,460
Over 130,800	35%	18,000

If a shop is rented in Birr 2,800 per month for one year, what is the amount of tax is payable?

A. Birr 3,330
C. Birr 0
B. Birr 5,040
D. Birr 2,800

19. What is the range of the signum $f(x) = 3 + sgn(x^2 + 1)$?

A. The set of all integers.
B. $\{2,3,4\}$.
C. $\{4\}$
D. $\{-1,0,1\}$

20. If $f(x) = ax + b$ and $f^{-1}(2x) = x - 3$, then what is the value of a?

A. 3 B. 1 C. -3 D. 2

21. What are the respective values A, B, C, so that $\frac{4x^2-x+2}{x^3+x} = \frac{A}{x} + \frac{Bx+c}{x^2+1}$?

A. $-1,1,1$ B. $-1,1,2$ C. $-1,-2,0$ D. $2,2,-1$

22. Which one of the following is true about asymptote(s) of the rational function $f(x) = \frac{x^2-5x+6}{x(x-3)(x-1)}$?

A. It has an oblique asymptote.
B. The graph of f does not intersect its asymptotes.
C. As $x \to 3^+, f(x) \to +\infty$
D. As $x \to 0^-, f(x) \to -\infty$

23. Suppose $A = \begin{pmatrix} 4 & 0 \\ 1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 2 \\ 6 & -4 \end{pmatrix}$. If x is 2x2 matrix such that $C + \frac{1}{2}B^T = AB$, then C is equal to:

A. $\begin{pmatrix} 7 & 5 \\ 5 & 0 \end{pmatrix}$
B. $\begin{pmatrix} 5 & -3 \\ 5 & 0 \end{pmatrix}$
C. $\begin{pmatrix} 5 & -3 \\ 5 & -2 \end{pmatrix}$
D. $\begin{pmatrix} 7 & 5 \\ 7 & -4 \end{pmatrix}$

24. What should be the values of k so that the system of equation $\begin{cases} x - y + z = 1 \\ -x + 5y - 4z = 1 \\ 2x + 2y - z = k \end{cases}$ has no solution?

A. $k \neq 4$ B. $k = -4$ C. $k \neq -4$ D. $k = 4$

25. Suppose that A and B are 3x3 matrices and I is identity matrix of order 3 such that $AB = 3I$ and det(A)= 9, then what is det(B)?

A. $\frac{1}{3}$
B. 3
C. 27
D. $\frac{1}{9}$

26. Consider the system $\begin{cases} x+2y-z=0 \\ 2x+5y+z=0 \\ 3x+by-2z=1 \end{cases}$ and let determinant of coefficient matrix is equal 8, then what are the values of x and y respectively?

A. $\frac{7}{8} and \frac{3}{8}$
B. $\frac{5}{8}\ and -\frac{5}{8}$
C. $\frac{7}{8}\ and -\frac{3}{8}$
D. $-\frac{3}{8} amd\ 1$

27. If vector $u=(3,-2), v=(-2,1)$ and $w=(3,-3)$,then find a vector $\vec{a}$ such that $\vec{a}+w=2u-v$

A. $(5,2)$
B. $(5,-2)$
C. $(11,2)$
D. $(-2,5)$

28. Let $u=(5,2) and\ v=((2,-2)$,then $|2u-v|$ is equal to:

A. -8
B. 3
C. 24
D. 10

29. What is area of a parallelogram spanned between the vector $i+2j+k$ and $2i-j+2k$?

A. $5\sqrt{2}$ square unit
B. 5 square unit
C. $2\sqrt{5}$ square unit
D. $2\sqrt{19}$ square unit

30. What is image of a circle $x^2+y^2-6x+4y+12=0$under the translation vector $T(2,-3)$?

A. $x^2+y^2-10x+10y+49=0$
B. $x^2+y^2+10x-6y+49=0$
C. $x^2+y^2-6x+8y+9=0$
D. $x^2+y^2-10x-10y-1=0$

31. What is the image of a line $y = 2x + 1$ after reflecting along the line $y = x - 3$?

A. $x + 2y + 10 = 0$
B. $2x - y - 10 = 0$
C. $x + y - 10 = 0$
D. $x - 2y - 10 = 0$

32. What is the inter -quartile range of score of 40 students given below:

Score	10-20	20-30	30-40	30-40	40-50	50-60
Frequency	2	3	12	5	10	8

A. 34.16
B. 48
C. 13.84
D. 38

33. If the modal value of the data below is 67.5, then what is the value of m?

Score	41-50	51-60	61-70	71-80	81-90	91-100
Frequency	4	2	m	6	1	8

A. 7 B. 8 C. 9 D. 10

34. In how many different ways a committee of 4 members can be selected from a group of 6 boys and 4 girls if the committee contains at most 2 boys?
A. 85
B. 115
C. 24
D. 125

35. Which one of the following is true about the events $E_1 = \{2,3,5\}, E_2 = \{1,6\}$, $E_3 = \{2,4,6\}$ for a Rolling a die.
A. They are mutually exclusive events.
B. They exhaustive events.
C. $p(E_1 \cup E_3) = 1$
D. $p(E_1 \cap E_3) = \frac{1}{4}$

36. A committee consisting of 3 students is to be selected from 10 candidates among which 4 are girls. What is the probability that at most one girl is selected?
A. $\frac{2}{3}$
B. $\frac{3}{4}$
C. $\frac{1}{3}$
D. $\frac{5}{6}$

37. Which of the following is onto function?

A. $f:\mathbb{R}\to\mathbb{R}, f(x)=|x|$
B. $f:\mathbb{R}\to\mathbb{R}\, f(x)=x^2$
C. $f:\mathbb{R}\to[0,\infty), f(x)=3^x$
D. $f:(0,\infty)\to\mathbb{R}, f(x)=\log_2 x$

38. Given the function $f=\{(1,0),(-1,2),(3,4),(2,1)\}$ and $g=\{(0,0),(-1,2),(3,4),(2,1)\}$,then which one of the following is correct?

A. $2f(2)=2g(1)$
B. $(f+g)(-1)=1$
C. $(f-g)(3)=0$
D. $(f.g)(2)=-1$

39. Which one of the following is NOT true about the graph of the polynomial function $f(x)=2x^5-7x^3+2x-1$?

A. It has at most 4 turning points and intersects the x-axis almost 5 times.
B. As we move far from the origin it rises upward to the right and falls downward to the left.
C. It is a smooth and continuous curve.
D. It passes through the origin.

40. What is the value of b such that $x-1$ and $x+1$ are factors of $ax^3-bx^2+3x-10$?

A. -10
B. 7
C. -7
D. 14

41. What is the simplified form of $3^{2+\log_9 25}$?

A. 75
B. 45
C. 9
D. 5

42. Which one of the following is false about the function $f(x)=\log_3(x-3)$?

A. $f(x)\geq 0$,for $x\geq 3$
B. $0<f(x)<1$,for $4<x<6$
C. Domain of the function is real number greater than 3.
D. The line $x=3$ is vertical asymptote.

43. What is value of $\sec(240^0)$?

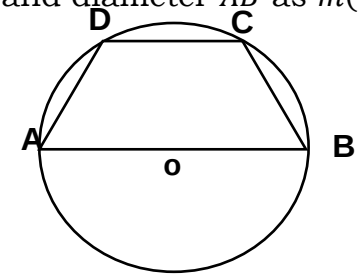
A. $-\frac{2\sqrt{3}}{3}$
B. 2
C. -2
D. $\frac{2\sqrt{3}}{3}$

44. If θ is second quadrantal angle and $\csc\theta=\frac{5}{3}$,then what is the value of $\cot\theta$?

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

45. Consider a circle with center O and diameter $\overline{AB}$ as $m(< DAB) = 72^0$and AD = DC, find m(<ADC)

A. 72^0
B. 128^0
C. 256^0
D. 144^0



46. A regular pyramid has square base whose side is 10cm long. If the length of the lateral edge is 13cm, then which one of the following is its total surface area?

A. 240 cm^2
B. 340 cm^2
C. $260cm^2$
D. $360cm^2$

47. The lower and upper bases of a frustum of a right circular cone of radii are 4 cm and 3 cm respectively. If the altitude of frustum the is 6cm, then its volume is equal to:

A. $54\pi cm^3$
B. $424\pi cm^3$
C. $50\pi cm^3$
D. $300\pi cm^3$

48. What is the point that divides a line segment that has end points $p(2,3)$ and $Q(-2,4)$ internally with into ratio1:2?

A. $\left(\frac{2}{3}, -\frac{10}{3}\right)$
B. $\left(\frac{10}{3}, \frac{5}{3}\right)$
C. $\left(\frac{2}{3}, \frac{10}{3}\right)$
D. $\left(-\frac{2}{3}, \frac{11}{3}\right)$

49. Out of 135 students in a school, 59 take Mathematics, 99 take English. If 10 students take neither of the two subjects, find the number of students that takes both subjects?

A. 43 B. 59 C. 33 D. 23

50. If $x = 2.131131113$ …. and $y = 7.868868886$ … ., then find the value of $\frac{x+y}{5}$?

A. 20
B. 2
C. 1
D. $\frac{1}{5}$

51. Which of the following is not true about real numbers?
   A. The difference of two irrational number is always irrational.
   B. The product of nonzero rational number and irrational number is irrational.
   C. Between any two irrational numbers there is a rational number.
   D. If $a < b$,then $a < \frac{a+b}{2} < b$

52. What is possible value of k such that the system $\begin{cases} 2x - 3y = 15 \\ \frac{2}{3}x + ky = 5 \end{cases}$ has exactly one solution?
   A. -1
   B. 9
   C. $\frac{4}{3}$
   D. $-\frac{6}{5}$

53. The solution of $|2x - 4| + |x + 5| = 8$?
   A. $\{-3,1\}$ B. $\{1,\frac{7}{3}\}$ C. $\{-3,1,\frac{7}{3}\}$ D. $\{-3,\frac{7}{3}\}$

54. Suppose a building casts a shadow of length 45 meters when the angle of elevation of the sun is 30^0. How high is this building?
   A. $45\sqrt{3}$ meters
   B. $\frac{45\sqrt{3}}{2}$ meters
   C. $\frac{45\sqrt{2}}{2}$meter
   D. $\frac{45\sqrt{3}}{3}$ meters

55. If the measure of each exterior angle of a regular polygon is 40^0, then how many sides does this polygon have?
   A. 8 C. 7
   B. 10 D. 9

56. A triangle of area of $128cm^2$ has one of the sides 8cm and the corresponding side of another similar triangle has a side length of 12cm, then what is area of the other triangle?
   A. $129cm^2$ C. $288cm^2$
   B. $192cm^2$ D. $64cm^2$

57. Let $u = (5,3)$ and $v = (-8,1)$,then what is the unit vector in the direction of $u + v$?

A. $\frac{3}{5}i - \frac{2}{5}j$

B. $-\frac{3}{5}i + \frac{4}{5}j$

C. $\frac{1}{2}i - \frac{2}{5}j$

D. $\frac{4}{5}i + \frac{2}{5}i$

58. The mean monthly salary of 10 employes of a form is Birr 6450.If one more person joins the firm who gets Birr 7000per month, what will be the mean monthly salary of 11 employes?

A. Birr 6650

B. Birr 6600

C. Birr 6550

D. Birr 6500

59. If the variance of a, b, c, d is 9, then what is the standard deviation of $2a + 3, 2b + 3, 2c + 3, 2d + 3$?

A. 36

B. 18

C. 9

D. 6

60. If two dice are thrown together, then what is the probability of getting a sum multiple of 5 or greater than 9?

A. $\frac{5}{18}$

B. $\frac{1}{4}$

C. $\frac{11}{36}$

D. $\frac{13}{36}$

