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ETHIO EXAMS CHANNEL FOR NATURAL STUDENTS

MATHEMATICS FIRST MODEL EXAMINATION FOR GRADE 12

MAY, 2021/ GINBOT, 2013

BOOKLET CODE: XX

SUBJECT CODE: XX

NUMBER OF ITEMS: 65

TIME ALLOWED: 3:00hr

GENERAL DIRECTIONS:

THIS BOOKLET CONTAINS MATHEMATICS EXAMINATION. IT CONTAINS 65 ITEMS. THERE IS ONLY ONE BEST ANSWER FOR EACH ITEM. CHOOSE THE BEST ANSWER FROM THE SUGGESTED OPTIONS AND BLACKEN THE LETTER OF YOUR CHOICE ON THE ANSWER SHEET **USING ONLY A PENCIL**. YOUR ANSWER MARK SHOULD BE HEAVY AND DARK, COVERING THE ANSWER SPACE COMPLETELY. PLEASE ERASE ALL UNECESSARY **PENCIL/PEN** MARKS COMPLETELY FROM YOUR ANSWER SHEET

YOU WILL BE ALLOWED TO WORK FOR **3 HOURS**. IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY GO BACK AND REVIEW. WHEN TIME IS CALLED, YOU MUST IMMEDIATELY STOP WORKING, LAY YOUR PENCIL DOWN, AND WAIT FOR FURTHER INSTRUCTIONS.

ANY FORM OF CHEATING OR AN ATTEMPT TO CHEAT IN THE EXAMINATION ROOM WILL RESULT IN AN AUTOMATIC DISMISSAL FROM THE EXAMINATION ROOM AND CANCELLATION OF YOUR SCORE(S).

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO

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1. Let $f(x) = 4x + 1$ and $g(x) = 3x + k$, find the value of k for which $(f \circ g)(x) = (g \circ f)(x)$ A. 2 B. 3 C. $\frac{2}{3}$ D. $\frac{3}{2}$

2. Determine B so that the line with equation $5x + By - 6 = 0$ is perpendicular to the line with equation $Y = \frac{4}{7}x + 1$.

A. $-\frac{7}{4}$ B. $\frac{20}{7}$ C. $\frac{7}{20}$ D. $-\frac{20}{7}$

3. If a circle has centre at the $(5, 12)$ and is tangent to the line with equation $2x - y + 3 = 0$, write the equation of the circle

A. $(x-5)^2 + (y-12)^2 = \frac{1}{5}$ C. $(x+5)^2 + (y+12)^2 = 5$
 B. $(x-5)^2 + (y+12)^2 = \frac{1}{5}$ D. $(x-5)^2 + (y-12)^2 = \frac{2}{5}$

4. Calculate the median of the following set of data about score of students in an exam

Score of students	Number of students (f)
1 - 7	2
8 - 14	5
15 - 21	7
22 - 28	12
29 - 35	7
36 - 42	5
43 - 49	2
Total	40

A. 90.19 B. 90 C. 25 D. 25.15

5. From the above question (6) what is the mean

A. 25 B. 89.5 C. 46 D. 26

6. Which one of the following is valid logical argument?

A. $P \Rightarrow q, q \vdash P$

C. $\neg p \wedge q, q \Rightarrow r \vdash r$

B. $p \Leftrightarrow q, p \Rightarrow q \vdash q$

D. $\neg p, p \vee q, r \vdash q \wedge r$

7. Let $f(x) = \begin{cases} \frac{a}{x^2+3}, & \text{if } x \leq 1 \\ \frac{x-1}{\sqrt{x}-1}, & \text{if } x > 1 \end{cases}$ what is the values of a if f is continuous

at $x = 1$ A. 8 B. 4 C. 2 D. 0

8. The daily profits (in birr) of 100 shops are distributed in the following table. Find the modal value?

profit	1 - 100	101-200	201-300	301-400	401-500	501-600
No of shops	12	18	27	20	20	6

A. 265.75 B. 256.75 C. 45.21 D. 87

9. from the above question (8) find D_4 and P_{70} respectively

A. 200.5 and 343.5 C. 300.5 and 540.5
B. 343.5 and 200 D. 345.5 and 172.72

10. A committee of 5 students has been formed from 9 boys and 9 girls. In how many ways can this be done when the committee consists of 2 girls and 3 boys?

A. 126 ways B. 1512 ways C. 2772 ways D. 1500ways

11. in the expression of $(a+b)^{10}$ find the terms whose coefficient is 45

A. a^8b^2 and a^2b^8 C. a^8b^2 and a^2b^8
B. a^4b^2 and a^2b^8 D. a^7b and a^6b^5

12. A red ball and 4 white balls are in a box .if two balls are drawn without replacement what is the probability of getting a red ball on the first draw and a white ball on the second?

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

13. There are 4 black, 2 red and 4 white balls in a box. If three balls are

selected at random what is the probability that at least one ball is white?

- A. $\frac{1}{30}$ B. $\frac{1}{12}$ C. $\frac{4}{15}$ D. $\frac{5}{6}$

14. Let

$$\text{Matrix } A = \begin{bmatrix} 2 & -1 & 3 \\ 1 & -1 & 0 \\ 0 & 0 & 3 \end{bmatrix} \quad \text{and} \quad \text{matrix } B = \begin{bmatrix} 1 & -4 \\ 2 & 3 \\ 4 & 0 \end{bmatrix}$$

If $C = AB$ then find C_{32} A. 12 B. -1 C. -12 D. 0

15. Solve the systems

$$\begin{cases} 2x+3y=5 \\ x+3z=6 \\ 5y-z=11 \end{cases} \quad (X, y, z) \text{ respectively}$$

- A. $(\frac{14}{9}, \frac{73}{27}, \frac{68}{27})$ B. $(\frac{9}{14}, \frac{27}{73}, \frac{27}{68})$ C. $(\frac{-14}{9}, \frac{-27}{73}, \frac{-68}{27})$ D. $(\frac{-14}{9}, \frac{73}{27}, \frac{68}{27})$

16. the most basic method for solving linear systems directly is ____

- A. Gaussian elimination C. Cholesky factorization
B. LU factorization D. QR factorization

17. Find the Eigen values of the matrix $A = \begin{bmatrix} 0 & -2 & 2 \\ -2 & -3 & 2 \\ -3 & -6 & 5 \end{bmatrix}$

- A. (2, 1, -1) B. (-2, -1, 1) C. (1, 0, 1) D. (2, -1, 0)

18. Based on the above question (17) find the spectral radius of the matrix A A. -1 B. 1 C. 2 D. -2

19. Consider the equation $y'' + y' - 2y = 0$ the characteristic polynomial is $p(r) = r^2 + r - 2$. find the roots?

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

20. Which one of the following statement is correct?

- A. $\sqrt{-1}$ is an imaginary number
B. $5+4i$ is complex number
C. $(3+2i)(5+11i) = -7+42i$
D. all of the above

21. The equation $9x^2+1=0$ has

- A. Two real root

- B. One complex root
- C. One complex and one real root
- D. Two imaginary roots

22. Express $\sqrt{3} + i$ in polar form

- A. $2(\cos \frac{\pi}{6} + i \sin \frac{\pi}{6})$
- B. $\cos \frac{\pi}{3} + i \sin \frac{\pi}{3}$
- C. $\cos \frac{5\pi}{6} + i \sin \frac{5\pi}{6}$
- D. none of these

23. Which one of the following statements is not true about the two solutions?

- A. Two solutions ϕ_1 and ϕ_2 of $L(y) = 0$ are linearly independent on an interval if and only if $\omega(\phi_1, \phi_2)(x) \neq 0$
- B. Two solutions ϕ_1 and ϕ_2 of $L(y) = 0$ are linearly independent on an interval if and only if $\omega(\phi_1, \phi_2)(x) = 0$
- C. Let ϕ_1, ϕ_2 be two solutions of $L(y) = 0$ on an interval and let x_0 be any point on interval
- D. Let ϕ_1, ϕ_2 be any two linearly independent solution of $L(y) = 0$ on an interval I , every solution ϕ of $L(y) = 0$ can be written $\phi = c_1\phi_1 + c_2\phi_2$ where c_1 and c_2 are any constants.

24. Consider the equation $y''' - 3y' + 2y = 0$. The characteristic polynomial is $p(r) = r^3 - 3r + 2$ and its roots are 1, 1, and -2 find the three linearly independent solutions

- A. (e^x, xe^x, e^{-2x})
- B. $(e^{-x}, xe^{-x}, e^{-2x})$
- C. (e^x, e^{-x}, e^{2x})
- D. (x, x^2e^x, e^{2x})

25. Which one of the following statement is false?

- A. modulus and radius are the same for complex number.
- B. all complex numbers are imaginary
- C. $x^2 + 4x + 6 = 0$ has two complex roots
- D. $4\cos(\frac{\pi}{6} + i \sin \frac{\pi}{6}) = 2\sqrt{3} + 2i$

26. The number of solution of the equation $\tan x + \sec x = 2\cos x$ lying in the interval $[0, 2\pi]$ is A.0 B.2 C.3 D.1

27. If $\cos^{-1} \frac{3}{5} - \sin^{-1} \frac{4}{5} = \cos^{-1}(x)$, then x is equal to

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

28. If $y = 5\cos(\frac{\pi}{4}t - \frac{\pi}{2})$, the amplitude and the phase angle is

- A. $5, \frac{\pi}{2}$ B. $5, \frac{\pi}{4}$ C. $8, 0$ D. $5, 180^\circ$
29. $\text{Arctan} \frac{\sqrt{3}}{3}$ is _____ A. $\frac{\pi}{4}$ B. $\frac{\pi}{2}$ C. $\frac{\pi}{6}$ D. π
30. If $\theta = \arccos \frac{1}{2}$ what is the value of $\tan \theta$?
- A. $\frac{1}{\sqrt{3}}$ B. $\sqrt{3}$ C. $\frac{\sqrt{3}}{2}$ D. 1
31. Which one of the following is the solution set of $\sqrt{3} \sin 2x = \cos 2x$ on $[0, \pi]$
- A. $\left\{ \frac{\pi}{6}, \frac{\pi}{12} \right\}$ C. $\left\{ \frac{\pi}{12}, \frac{7\pi}{12} \right\}$
 B. $\left\{ \frac{\pi}{6}, \frac{\pi}{3} \right\}$ D. $\left\{ \frac{\pi}{6}, \frac{2\pi}{3} \right\}$
32. If $\vec{a} = 2\vec{i} - 3\vec{j}$, $\vec{b} = 3\vec{i} - \vec{j}$ and $\vec{c} = \vec{i} - \vec{j}$, then which of the following is equal to $\vec{a} \cdot (2\vec{b} - \vec{c})$ A. -10 B. 7 C. 10 D. 13
33. The magnitude of vector $\vec{V}$ is 15 and its direction is 120° from the positive x-axis what are the vector $\vec{v}$?
- A. $\left(\frac{-15}{2}, \frac{15\sqrt{3}}{2} \right)$ C. $\left(\frac{-15}{2}, 15\sqrt{2} \right)$
 B. $\left(10\sqrt{3}, \frac{15}{2} \right)$ D. $\left(12\sqrt{3}, \frac{-15}{\sqrt{2}} \right)$
34. What is the vector equation of the line passing through $(-1, 4)$ and parallel to the line $y - 3x = 10$
- A. $(X, Y) = (0, -7) + t(1, 3)$ C. $(X, Y) = (0, 7) + t(1, -3)$
 B. $(X, Y) = (1, 10) + t(1, 3)$ D. $(X, Y) = (-1, 4) + t(1, 3)$
35. Which one of the following is correct statement about the proposition $(p \Rightarrow q) \Rightarrow (\neg p \vee q)$? the proposition
- A. is true only when q is true
 B. is false when q is false
 C. is true for all possible combination of the truth values of p and q
 D. has the same truth value as that of q
36. Let $p(x) = x^2 + x$ is positive. Which of the following is equivalent to

$\neg(\exists x)p(x)$ A. $(\exists x) \neg(x^2 + x > 0)$ C. $(\forall x) (x^2 + x < 0)$
 B. $(\exists x) (x^2 + x \leq 0)$ D. $(\forall x) (x^2 + x \leq 0)$

37. Which of the following is a vector that lies on the line through $(0, 0)$ and $(2, 4)$

A. $\vec{U} = (2, 1)$ B. $\vec{U} = (-1, -2)$ C. $\vec{U} = (\frac{1}{2}, 2)$ D. $\vec{U} = (-2, -6)$

38. If p , q and r are proposition such that $(p \Leftrightarrow r) \Rightarrow (\neg q \Leftrightarrow p)$ has the truth value false which of the following have the truth value false

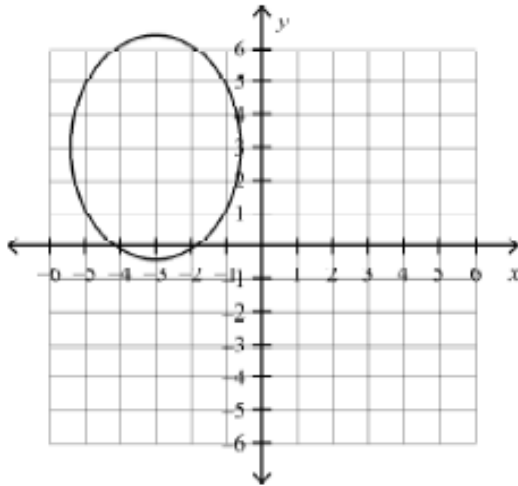
A. $\neg r \Rightarrow p$ B. q C. $\neg r$ D. $p \vee q$

39. If $(p \wedge \neg q) \Rightarrow \neg r$ is false, then the truth value of p , q and r respectively are A. T, F, F B. F, T, T C. T, F, T D. F, T, F
 40. Which one of the following is not true about the function $f(x) = x^{-2}$

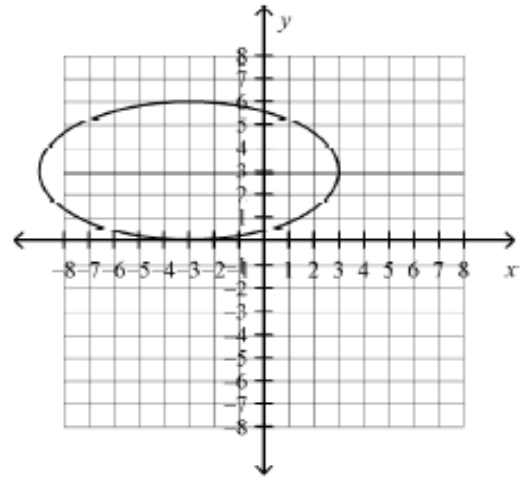
A. its domain is $(-\infty, 0) \cup (0, \infty)$ B. its range is $(0, \infty)$
 C. it is increasing on $(-\infty, 0)$ D. it has a cusp at $(0, 0)$

41. Write an equation of an ellipse with centre $(3, -3)$, vertical major axis of length 12, and Minor-axis of length 6. Graph the ellipse

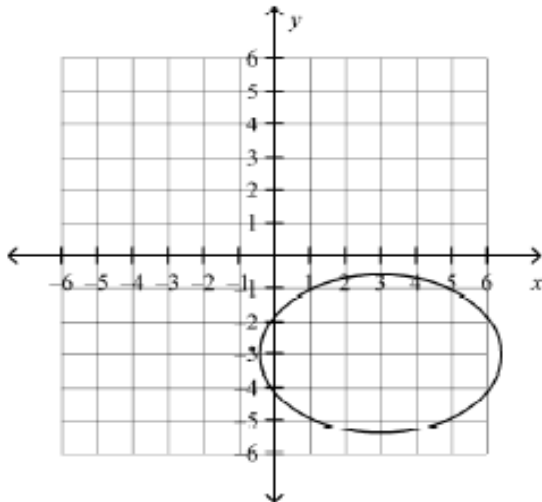
A $\frac{(x+3)^2}{6} - \frac{(y-3)^2}{12} = 1$



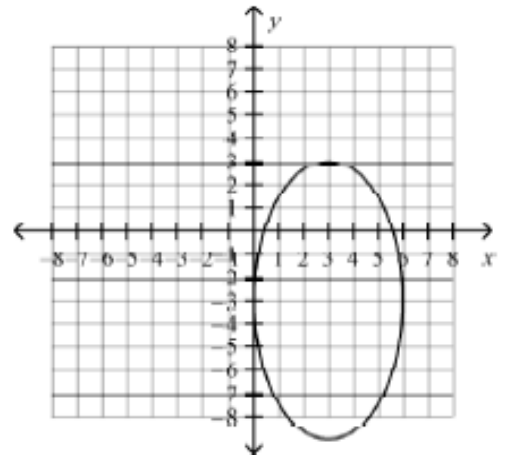
C $\frac{(x+3)^2}{36} - \frac{(y-3)^2}{9} = 1$



B $\frac{(x-3)^2}{12} + \frac{(y+3)^2}{6} = 1$



D $\frac{(x-3)^2}{9} + \frac{(y+3)^2}{36} = 1$



42. If $f(x) = e^x \ln x$, then $f''(1)$ is equal to:

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

43. Which of the following is equal to $\lim_{x \rightarrow -3} \left(\frac{3x+5}{3x+2} \right)^{-x+3}$?

- A. $e^{-\frac{7}{3}}$ B. $e^{\frac{7}{3}}$ C. e^{-1} D. e^3

44. If the sum of the first n - terms of an arithmetic sequence is

$n^2 + 4n$, then which of the following is **true**?

- A. The first term of the sequence is 4
- B. Its common difference is 7
- C. The n^{th} - term of the sequence is $3n+2$
- D. Every term of the sequence is odd

45. The largest possible interval on which the function

$f(x)=\sqrt{9-4x^2}$ is differentiable will be:

- A. $\left(-\frac{3}{2}, \frac{3}{2}\right)$
- B. $\left(-\infty, -\frac{3}{2}\right) \cup \left(\frac{3}{2}, \infty\right)$
- C. $\left(-\infty, -\frac{3}{2}\right] \cup \left[\frac{3}{2}, \infty\right)$
- D. $\left[-\frac{3}{2}, \frac{3}{2}\right]$

46. Find the absolute maximum value for the given function on the given interval.

If $f(x) = x^3 - 3x^2$: $[-1, 3]$ A. 2 B. -4 C. 0 D. 4

47. If the product of two positive integers are 288. Find the numbers which minimize the sum of the second number and twice the first number.

- A. 12 & 24 B. 13 & 12 C. -12 & -24 D. 144 & 12

48. Which one of the following interval is the graph of?

$F(x) = \frac{x}{x^2 + 9}$ increasing

- A. $(-\infty, \infty)$ B. $(-\infty, 3]$ C. $[-3, 3]$ D. $[3, \infty)$

49. Find $\frac{dy}{dx}$ with respect to x. $y = \cos (x^2 + 4)$

A. $2x \cos (x^2 + 4)$

C. $-2x \sin (x^2 + 4)$

B. $-2x \cos (x^2 + 4)$

D. $2x \sin (x^2 + 4)$

50. Which one of the following row operation is not apply to reduce the matrix?

$$\begin{bmatrix} 1 & -1 & 3 & -6 \\ 5 & 3 & -2 & 4 \\ 1 & 3 & 4 & 11 \end{bmatrix} \text{ In to echelon form}$$

A. $R_2 \rightarrow -5R_1 + R_2$

C. $R_2 \rightarrow \frac{1}{8}R_2$ and $R_3 \rightarrow R_3 + -4R_2$

B. $R_3 \rightarrow -R_1 + R_3$

D. $R_2 \rightarrow \frac{1}{2}R_2$ and $R_3 \rightarrow R_3 + 4R_1$

51. $\lim_{x \rightarrow 3} \left(\frac{\sqrt{x-3} + \sqrt{x} - \sqrt{3}}{\sqrt{x^2-9}} \right)$ is equal to; ____

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

52. Find $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots + s_{\infty}$ is A. 2 B. 1 C. -1 D. 4

53. if the midpoint of a line segment is at M(2, 5, -3) and one of its end points is at R(-3, 2, 4), then find the coordinate of the other end points ?

A. (7, 8, 10) B. (-7, -10, 8) C. (-10, 8, 7) D. (7, 8, -10)

54. Which one of the following is not true?

A. $\operatorname{sgn} \sqrt{3} = 1$

C. $\operatorname{sgn} \left(\frac{-2}{3} \right) = -3$

B. $\text{sgn} 0 = 0$ D. $\text{sgn} \left(\frac{-12}{10} \right) + \text{sgn} \left(\frac{-34}{10} \right) = -3$

55. Which one of the following functions has no vertical asymptotes?

A. $f(X) = \ln(x+1)$ C. $f(X) = \frac{x^2-9}{x-3}$

B. $f(X) = \frac{x^2+1}{x^3+8}$ D. $f(x) = \frac{x-1}{x^2-x}$

56. If $x^2 - 6x + y^2 + k = 0$ is equation of a circle with radius 2, then what is the value of k? A. 13 B. -4 C. 4 D. 5

57. If a fair six-sided die is tossed twice, the probability that the first toss will be a number less than 4 and the second toss will be a number greater than 4 is A. $\frac{1}{3}$ B. $\frac{5}{6}$ C. $\frac{1}{6}$ D. $\frac{3}{4}$

58. The volume of a sphere is increasing at the rate of 3 cubic meters per minute. At what rate is the radius increasing when the radius is 8 meters? A. $\frac{3}{64\pi}$ m/min C. $\frac{3}{128\pi}$ m/min

B. $\frac{3}{256\pi}$ m/min D. $\frac{3}{144\pi}$ m/min

59. Which one of the following functions is not continuous at every point?

A. Polynomial functions B. absolute value of continuous functions
C. exponential functions D. rational functions

60. Suppose $s_n = 3n^2 + n$ be the sum of the first n terms of a certain sequence, then what will be the 8th term of the sequence

A. 46 B. 200 C. 155 D. 48

61. Let $\{a_n\}$ be a sequence such that $a_1 = a_2 = 1$ and $a_{n+2} = 2a_n + a_{n+1}$ for $n \geq 1$ what is the value of $3(a_6 - a_4)$?

- A. 54 B. 96 C. 48 D. 66

62. among the following which is qualitative data?

- A. volume of water in barrel C. Score of a team in soccer match
B. neatness of our sounding D. rank of students by examination result

63. Find the second derivatives of $y = x \sin x$?

- A. $2\cos x + x \sin x$ C. $\cos x - x \sin x$
B. $2\cos x - x \sin x$ D. $2x \cos x - \sin x$

64. Given the equation of the sphere to be $x^2 + y^2 + z^2 - 6x - 4y - 10z = -22$. Find the centre of the sphere?

- A. $(-3, 2, -5)$ B. $(3, -2, 5)$ C. $(-6, -4, -10)$ D. $(3, 2, 5)$

65. Which one of the following functions has no vertical asymptotes?

- A. $f(x) = \ln(x+1)$ C. $f(x) = \frac{x^2-9}{x-3}$
B. $f(x) = \frac{x^2+1}{x^3+8}$ D. $f(x) = \frac{x-1}{x^2-x}$

First MODEL MATHEMATICS ANSWERS key

1. C	14. D	27. B	40. D	53. D
2. B	15. D	28. A	41. D	54. D
3. A	16. D	29. C	42. B	55. C
4. C	17. A	30. B	43. C	56. D
5. A	18.C	31. C	44. D	57. C
6. C	19.B	32. D	45.B	58. B
7. A	20.D	33. A	46. C	59. D
8. B	21. D	34. D	47.A	60. A
9. A	22. A	35. C	48. C	61. C
10.B	23. B	36. D	49. C	62. B
11.C	24. A	37. B	50. D	63. B
12.A	25. B	38. A	51. C	64. D
13.D	26. B	39. C	52. B	65. C

