

ADDIS ABABA CITY ADMINISTRATION EDUCATION BUREAU, ADDIS ABABA

GRADE 12 MATHEMATICS MODEL EXAMINATION

GINBOT 2013/MAY 2021

NUMBER OF QUESTIONS: 65

TIME ALLOWED: 3 HOURS

GENERAL DIRECTIONS

THIS BOOKLET CONTAINS **MATHEMATICS EXAMINATION** FOR **SOCIAL SCIENCE STUDENTS ONLY**. IN THIS EXAMINATION, THERE ARE A TOTAL OF 65 MULTIPLE CHOICE QUESTIONS. CAREFULLY SELECT THE MOST APPROPRIATE ANSWER AND BLACKEN ONLY THE LETTER OF YOUR CHOICE ON THE SEPARATE ANSWER SHEET PROVIDED. FOLLOW THE INSTRUCTIONS ON THE ANSWER SHEET AND THE EXAMINATION PAPER CAREFULLY. USE ONLY PENCIL TO MARK YOUR ANSWERS. YOUR ANSWER MARK SHOULD BE HEAVY AND DARK, COVERING THE ANSWER SPACE COMPLETELY. 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 PENCIL DOWN, AND WAIT FOR FURTHER INSTRUCTIONS

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

PLEASE MAKE SURE THAT YOU HAVE WRITTEN ALL THE REQUIRED INFORMATION ON THE ANSWER SHEET BEFORE YOU START TO WORK ON THE EXAMINATION.

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

DIRECTION: Each of the following questions is followed by four possible alternatives. Read each question carefully and BLACKEN the letter of your choice on the separate answer sheet provided.

1. Which of the following functions is neither even nor odd?

- A) $f(x) = x^5$ B) $g(x) = 2x^2 - |x|$ C) $h(x) = x+1$ D) $k(x) = x^6$

2. The equation of the conic section $4x^2 = 64 + 8y^2$ represents:

- A) Circle B) Hyperbola C) Parabola D) Ellipse

3. Which of the following is the solution set of $\frac{x+1}{2-2x^2} + \frac{6}{x+1} = \frac{2x-1}{x^2-1} - \frac{1}{2-2x}$

- A) $\left\{\frac{8}{7}\right\}$ B) \emptyset C) $\left\{\frac{5}{3}\right\}$ D) $\{2\}$

4. What is the focus of the parabola $y^2 + 6y + 8x = 7$?

- A) (0, -3) B) (0, 3) C) (4, -3) D) (4, 3)

5. Which one of the following statements has truth value T \forall for $x, y \in \mathbb{R}$?

- A) $(\forall x) (\forall y) (x^2 + y < 0)$ C) $(\forall x) (\forall y) (x + y^2 < 0)$
 B) $(\forall x) (\forall y) (x^2 + y < 0)$ D) $(\forall x) \exists (\forall y) (x^2 + y < 0)$

6. Three women W_1, W_2 and W_3 are firing at a target independently and have a probability 0.60, 0.70 and 0.50, respectively of hitting the target. What is the probability that at least one of them hits the target?

- A) 0.94 B) 0.21 C) 0.79 D) 0.75

7. For the given set of data below, what is the value mean (\bar{x}) and the variance (σ^2) respectively?

Marks	20-40	40-60	60-80	80-100
No. of students	4	10	4	2

- A. 58 and 316 B. 54 and 304 C. 64 and 350 D. 48 and 250

8. Suppose $A = \begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$. If X is a 2×2 matrix such that $AX - A^T = 2A$, then what is the value of X?

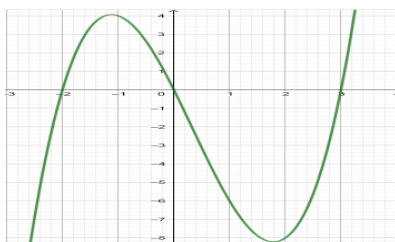
- A) $\begin{pmatrix} 3 & 1 \\ 1 & 3 \end{pmatrix}$ B) $\begin{pmatrix} 3 & 3 \\ 3 & 3 \end{pmatrix}$ C) $\begin{pmatrix} 3 & 6 \\ 6 & 9 \end{pmatrix}$ D) $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$

9. For what value of x is the matrix $A = \begin{pmatrix} -1 & 1 & x \\ 0 & 6 & 1 \\ -x & 1 & 0 \end{pmatrix}$ singular?
- A) $\frac{1}{12}$ B) $\frac{1}{2}, -\frac{1}{3}$ C) $x \in \mathbb{R}$ D) No value for x
10. If $Z = \frac{3+i}{1-i}$ is a given complex number, then what is the conjugate \bar{Z} of Z ?
- A) $1 - 2i$ B) $-1 + 2i$ C) $-1-i$ D) $1 + 2i$
11. Let f be the function given by $f(x) = \frac{(x-1)(x^2-4)}{x^2-a}$. For what **positive** values of a is f continuous for all real numbers x ?
- A. 1 B. 2 C. 4 D. None of the above
12. The sum of first two terms of a G.P is -4 and 5^{th} term is 4 times that of third term. Which one of the following is the Geometric sequence, if $r > 0$?
- A) $4, -8, 16, -32, \dots$ B. $\frac{-4}{3}, \frac{-8}{3}, \frac{-16}{3}, \dots$ C. $-4, 8, -16, 32, \dots$ D. $\frac{4}{3}, \frac{8}{3}, \frac{16}{3}, \dots$
13. What is the sum of the series $\sum_{n=1}^{\infty} \frac{5}{n(n+3)}$?
- A) $\frac{33}{18}$ B. $-\frac{33}{18}$ C. $\frac{55}{18}$ D. $-\frac{55}{18}$
14. What is $\lim_{x \rightarrow 0} \frac{\sqrt{1-x} - 1}{\sqrt[3]{1-x} - 1}$ equals:
- A) $\frac{2}{3}$ B) $\frac{4}{3}$ C) $\frac{3}{2}$ D) $\frac{3}{4}$
15. $\lim_{n \rightarrow \infty} \frac{\sum_{i=1}^n i^3}{n^4}$ is equal to
- A. $\frac{1}{3}$ B. $\frac{1}{4}$ C. $\frac{1}{2}$ D. None
16. Let $\{A_n\}$ be an arithmetic sequence with $A_{12} = 16$ and $A_{23} = 49$, then the value of A_{15} is:
- A. 30 B. 45 C. 25 D. 40
17. $\lim_{x \rightarrow \infty} \left(1 - \frac{1}{x+3}\right)^x$ is equal to:
- A) e^3 B. e^{-3} C. e D. $\frac{1}{e}$
18. Which one of the following is convergent sequence?
- A. $\left\{\left(\frac{5}{3}\right)^n\right\}$ B. $\left\{\frac{2n}{n+1}\right\}$ C. $\left\{\frac{n^2}{n+1}\right\}$ D. $\left\{\frac{(-1)^n}{3}\right\}$
19. Let $f(x) = \begin{cases} k \cos x, & \text{if } x \neq \frac{\pi}{2} \\ 5, & \text{if } x = \frac{\pi}{2} \end{cases}$ if f is continuous at $x = \frac{\pi}{2}$, then what is the value of k ?
- A. 10 B. 5 C. -5 D. -10
20. $\min_{x \rightarrow 4} \frac{-x^3 + 3x^2 + 10x - 24}{x^2 - 16}$ is equal to:
- A. $-\frac{5}{2}$ B. $\frac{7}{2}$ C. $-\frac{7}{4}$ D. $\frac{5}{4}$

21. The least upper bound of $\left\{1 - \frac{(-1)^n}{n}\right\}$ is
 A. 2 B. 1 C. 0 D. $\frac{1}{2}$
22. Which one of the following is Not true about $f(x) = \begin{cases} \frac{x^2}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$?
 A) f continuous at $x = 0$ C. f has an infinite discontinuity at $x = 0$
 B) f is continuous everywhere D. f has no hole on its graph
23. If $f(x) = x|x|$ and $g(x) = \frac{\sqrt{x}-1}{x-1}$ then $\lim_{x \rightarrow 1} (f(x) - g(x))$ is:
 A.1 B. $-\frac{1}{2}$ C. $-\frac{1}{4}$ D. $\frac{1}{2}$
24. What is the largest possible interval on which $f(x) = \sqrt{\frac{16-x^2}{1+x^2}}$?
 A. \mathbb{R} B. $(-\infty, -4] \cup [4, \infty)$ C. $[-4, 4]$ D. $[-4, -1] \cup [1, 4]$
25. If $[x]$ is the greatest integer not greater than x , then $\lim_{x \rightarrow \frac{7}{2}} [x]$ is:
 A. 3 B. 1.5 C. 2 D. 1
26. What is the difference quotient of $f(x) = 2x^3 - x^2 + 1$ at $x_0 = 1$?
 A. $\frac{2x^3 - x^3 + 1}{x - 1}$ B. $6x^2 - 2x$ C. $2x^2 - x + 1$ D. $2x^2 + x + 1$
27. In the xy-plane, the line $x + y = k$, where k is a constant, is tangent to the graph of $y = x^2 + 3x + 1$. What is the value of k ?
 A. -3 B. -2 C. -1 D. 0
28. The gradient of the function $f(x) = 2\cos(3x) - 3\sin(2x)$ at the point where $x = \pi$ is:
 A. 6 B. 12 C. -6 D. 0
29. The range of the function $f(x) = -x^4 + 2x^2 + 1$ is:
 A. $[2, \infty)$ B. $(-\infty, 2]$ C. $(-\infty, \infty)$ D. $[0, 2]$
30. A tangent drawn to the parabola $y = 4 - x^2$ at the point (1,3) forms a right triangle with the coordinate axes. The area of the triangle is:
 A. $\frac{25}{4}$ B. $\frac{9}{4}$ C. 10 D. $\frac{5}{4}$
31. Given the functions $f(x) = \left(\frac{1}{4}\right)^x$ and $g(x) = \log_2(2 + x^2)$, then what is the derivative of the composition function $(f \circ g)(x)$?
 A. $\frac{-4x}{(2+x^2)^2}$ B. $\frac{4x}{(2+x^2)^2}$ C. $\frac{-4x}{(2+x^2)^3}$ D. $\frac{4x}{(2+x)^2}$

32. Let $p(x) = \sin^2(2x) + \cos^2(2x)$, then $p'(0)$ equals to:
 A. 0 B. 2 C. 4 D. 1
33. Let f be a function defined by $f(x) = \begin{cases} cx + d & \text{for } x \leq 2 \\ x^2 - cx & \text{for } x > 2 \end{cases}$ where c and d are constants. If f is differentiable at $x=2$, what is the value of $c + d$?
 A. -4 B. -2 C. 0 D. -6
34. Suppose $f(x) = e^{-x}$, then the n^{th} derivative of f is:
 A. e^{-x} B. $(-1)^n e^{-x}$ C. $(-1)^{n+1} e^{-x}$ D. $-e^{-x}$
35. The set of all critical numbers of the function $f(x) = (x - 2)^2(1 - x)^3$ is:
 A. $\{2, 1\}$ B. $\{-2, -1, 1, \frac{7}{3}\}$ C. $\{1, 2, \frac{3}{4}\}$ D. $\{1, 2, \frac{8}{5}\}$
36. Which one of the following **does not** fulfill the conditions of Rolle's Theorem?
 A. $f(x) = \sin(2\pi x)$ on $[-1, 1]$ B. $p(x) = x^2 - 4x + 1$ on $[0, 4]$
 C. $q(x) = 6 - |x|$ on $[-1, 1]$ D. $h(x) = 5x^4 - 3x^2$ on $[-4, 4]$
37. The interval in which the graph of the function $f(x) = \frac{x}{x^2+1}$ decreasing is:
 A. $(-\infty, -1]$ and $[1, \infty)$ B. $[-1, \infty)$ C. $[-1, 1]$ D. $(-\infty, 1]$
38. Which one of the following is **false** about the graph of the function $(x) = \frac{x}{x+1}$?
 A. it has no local extreme B. it is increasing in $(-\infty, \infty)$
 C. it has no inflection point D. it is concave downward on $(-1, \infty)$
39. Which one is the inflection point of the graph the function $f(x) = x^3 + 3x^2 + x - 3$?
 A. $(-2, -1)$ B. $(1, 2)$ C. $(0, -3)$ D. $(-1, -2)$

40. Suppose the graph of the derivative of a continuous function f with x-intercepts $-2, 0$, and 3 is given below



$$y=f'(x)$$

which one is false about the graph of f ?

- A. f has local maximum at $x=0$ C. f is concave downward on $(-1,2)$
 B. f has inflection points at $x=-2$, $x=0$ & $x=3$ D. f is decreasing on $[0,3]$
41. A dairy farmer plans to fence in a rectangular pasture adjacent to a river. He has 360m of fencing material. What is the maximum area if no fencing is needed along the river?
- A. 8,100m² B. 16,200m² C. 32,400m² D. 3,600m²
42. A 25m long ladder is leaning against the side of a house. The foot of the ladder is pulled away from the house at a rate of 2 m/sec. How fast the top of the ladder is descending when the foot of the ladder is 15m far from the house?
- A. 1.5m/sec B. 15m/sec C. -15m/sec D. -1.5m/sec
43. If you are inflating a spherical balloon at the rate of 32 cm³/sec, how fast is its radius increasing when the diameter is 8 cm?
- A) $\frac{1}{32\pi}$ cm/sec B. $\frac{32}{\pi}$ cm/sec C. $\frac{1}{2\pi}$ cm/sec D. $\frac{2}{\pi}$ cm/s
44. If $x^3 + xy = 5$, then what is the value of $\frac{dy}{dx}$ when $x = 5$?
- A. $-\frac{51}{5}$ B. $\frac{51}{5}$ C. $\frac{119}{5}$ D. $-\frac{119}{5}$
45. If $f''(x) = e^x$, $f'(0) = 2$ and $f(0) = -5$, then $f(1)$ is equal to:
- A. $e - 8$ B. $e - 5$ C. $e + 8$ D. $e + 5$

46. $\int \frac{x}{x+2} dx$ is equal to:

- A. $x + \ln|(x+2)^2| + c$ B. $x - \ln|(x+2)^2| + c$ C. $\ln|x+2| + c$ D. $x \ln|x+2| + c$

47. When $\int \frac{2x+1}{x^2+x} dx$ is evaluated, it is equal to:

- A. $\ln|2x+1| + c$ B. $\frac{1}{2} \ln|2x+1| + c$ C. $\ln|x^2+x| + c$ D. $\frac{1}{2} \ln|x^2+x| + c$

48. $\int_0^3 (x+1)^{\frac{1}{2}} dx$ is equal to _____

- A. $\frac{21}{2}$ B. $\frac{14}{3}$ C. 7 D. $\frac{16}{3}$

49. The area of the region enclosed between the curve of $f(x) = -x^2 + 3x + 3$ and $g(x) = 2x^2 - 3x - 6$ is:

- A. 45 sq. units B. 12 sq. units C. 32 sq. units D. 25 sq. units

50. $\int_1^3 \sqrt{20-4x} dx$ is equivalent to:

- A. $\frac{-1}{4} \int_{-\frac{1}{5}}^{\frac{1}{5}} \sqrt{u} du$ B. $\frac{-1}{4} \int_1^3 \sqrt{u} du$ C. $\frac{1}{4} \int_8^{16} \sqrt{u} du$ D. $4 \int_8^{16} \sqrt{u} du$

51. Which one of the following is **False**?

- A. $\frac{d}{dx} \int f(x) dx = f(x)$ B. $\int f'(x) dx = f(x) + c$
 C. $\int \frac{f'(x)}{f(x)} dx = \ln|f(x)| + c$ D. $\int f(x) f'(x) dx = 2[f(x)]^2 + c$

52. The volume of the solid revolution generated by revolving the region between $f(x) = 2x$ and $g(x) = x^2$ along the x-axis is given by:

- A. $\frac{64}{15} \pi$ B. $\frac{32}{3} \pi$ C. $\frac{32}{5} \pi$ D. $\frac{4}{15} \pi$

53. Which one of the following is **Not** integrable function on the respective interval ?

- A. $f(x) = \frac{2x}{x^2-9}; [-2, 2]$ C. $g(x) = \frac{x^2-16}{x-4}; [-3, 5]$
 B. $h(x) = \frac{x^3+x}{x^2+1}, (-\infty, \infty)$ D. $r(x) = |x|; [-3, 5]$

54. Addis Ababa city administration education bureau divided Birr 88,000,000 for four secondary schools for their best performance and number of students in the ratio 4:3:2:2. Which of the following is the share of each secondary school ?
- A. Birr 22,000,000, Birr 22,000,000, Birr 22,000,000, Birr 22,000,000
 B. Birr 28,000,000, Birr 21,000,000, Birr 20,000,000, Birr 19,000,000
 C. Birr 32,000,000, Birr 24,000,000, Birr 16,000,000, Birr 16,000,000
 D. Birr 24,000,000, Birr 22,000,000, Birr 21,000,000, Birr 21,000,000
55. If the mean test score of the first group of 20 students is 8.5 and the mean score of the second group of 25 students is 6.88, then the combined mean is:
- A. 7 B. 7.4 C. 7.6 D. 7.3
56. What is the maximum value of the $Z=3x+2y$ subject to the constraints $\begin{cases} x \geq 0, y \geq 0 \\ x + 3y \leq 15 \\ 4x + y \leq 16 \end{cases}$?
- A) 13 B) 15 C) 17 D) 19
57. Someone invested Birr 500 at a rate of 6% compounded semi-annually. What is the amount at the end of the 3rd year?
- A) Birr $500(1.03)^6$ B) Birr $500(1.06)^6$ C) Birr $500(1.03)^3$ D) Birr $1000(1.06)$
58. If Birr 18000 is to be divided between Fenet and Ahmed in the ratio 5:4, then Ahmed's share is;
- A. Birr 8,000 B. Birr 900 C. Birr 10,000 D. Birr 200
59. From a population of size 100 listed 1-100, if you need to select a sample of size 20 and the first randomly selected number is 3, then which one of the following is not the member of the sample?
- A) 78 B) 69 C) 33 D) 23

64. Ato Debella bought a house from Flint Stones Homes by paying 20% of the purchase price which is Birr 400,000. What is the mortgage amount?

- A. Birr 320,000 B. Birr 120,000 C. Birr 160,000 D. Birr 80,000

65. The surface area of the earth is approximately $162,778,000 \text{ km}^2$. If 70% of its surface is covered by water, Then the area of the land which is **not** occupied by water is:

- A. $78,653,000 \text{ km}^2$ C. $48,833,400 \text{ km}^2$
B. $93,840,000 \text{ km}^2$ D. $113,944,600 \text{ km}^2$