ADDIS ABABA CITY GOVERNMENT OF EDUCATION BUREAU YEKA SUB– CITY EDUCATION OFFICE SECONDARY SCHOOLS 1st SEMESTER MATHEMATICS MODE EXAMINATION FOR GRADE 12TH NATURAL SCIENCE STREAMS, GINBOT 2013 E.C / MAY 2021 G.C

TIME ALLOWED: 3 HOURS

GENERAL INSTRUCTIONS:

THIS BOOKLET CONTAINS **MATHEMATICS** EXAMINATION. THE EXAMINATION CONTAINS 65 QUESTIONS. ATTEMPT ALL THE QUESTIONS. FOLLOW THE INSTRUCTIONS ON THE ANSWER SHEET AND THE EXAMINATION PAPER EXACTLY. USE ONLY **PENCIL** TO MARK YOUR ANSWERS.

THERE IS ONLY **ONE BEST** ANSWER FOR EACH QUESTION. CHOOSE THE BEST ANSWER FROM THE SUGGESTED OPTIONS AND BLACKEN THE LETTER OF YOUR CHOICE ON THE ANSWER SHEET. YOUR ANSWER MARK SHOULD BE HEAVY AND DARK, COVERING THE ANSWER SPACE COMPLETELY. PLEASE ERASE ALL UNNECESSARY PENCIL/PEN MARKS COMPLETELY FROM YOUR ANSWER SHEET.

YOU WILL BE LOWED TO WORK FOR **3:00** (OR THREE HOURS). IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY GO BACK AND REVISED. 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 HALL WILL RESULT IN AN AUTOMATIC DISMISSAL FROM THE EXAMINATION HALL AND CANCELLATION OF YOUR SCORE(S).

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

Yeka Sub– City Education Office Secondary Schools 1st Semester Mathematics Model Examination for Grade 12th for Natural Science Stream Ginbot 2013 E.C /May 2021 G.C

Time Allowed: 3 hours

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

1. Let R is a relation such that $R = \{(x, y): y = 2\sqrt{18 - 2x^2}$. Then. What is the range and domain of relation R respectively?
   A $(-\infty, -3\,] \cup [3, \infty), [0,\ 6\sqrt{2}]$ C $[0,\ 6\sqrt{2}],\ [-3\,, 3]$
   B $[0,\ 6\sqrt{2}], (-\infty, -3\,] \cup [3, \infty)$ D $[-3\,, 3],\ [0,\ 6\sqrt{2}]$
2. Which one of the following function is neither even nor odd?
   A $f(x) = x^4 + 6x^2 + 10$ C $f(x) = x^5 + 8x^3 - 6x$
   B $f(x) = 2x^2 + 6$D $(x) = 6x^2 - 2|x| + 3x$
3. Which one of the following relation is a function?
   A $\{(x, y): x$ is a son and$y$ is his sister$\}$
   B$\{(\ x, y\ ): x$ is a daughter and y is her father$\}$
   C $\{(\ x, y\ ): y$ is her/his brother and $x$is a child$\}$
   D $\{(\ x, y\ ): x$ is a boy and y is his cousins$\}$
4. Let $(x) = \frac{5x+6}{7x-4}$, then which one of the following is the inverse of $f(x)$?
   A $f(x)^{-1} = \frac{4x+6}{7x-5}$ B $f(x)^{-1} = \frac{4x-6}{7x+5}$ C $f(x)^{-1} = \frac{7x+6}{4x-5}$ D $f(x)^{-1} = \frac{7x-5}{4x+6}$
5. Which one of the following is **not** one-to one correspondence?
   A $f: (0, \infty) \to (0, \infty)$ given by $f(x) = x^4 \forall x \in \mathbb{R}$
   B $f: \mathbb{R} \to \mathbb{R}$ given by $f(x) = \frac{10x+10}{3}$, $\forall x \in \mathbb{R}$
   C $f: [5\,, \infty) \to (-\infty\,, 7]$ given by $f(x) = 7 - \sqrt{x-5}$, $\forall x \in \mathbb{R}$
   D $f: \mathbb{R} \to \mathbb{Q}$ given by $f(x) = 5^x$, $\forall x \in \mathbb{R}$
6. Let $f(x) = 3x + 7$, and$g\big(f(x)\big) = 9x + 11$, then what is $f(x)$?
   A $-3x + 11$ B $-2x + 10$ C $3x - 10$ D $3x + 11$
7. Which one of the following is **not true** about the graph of$f(x) = \frac{x^3+2x^2-x-2}{x^3+x^2-8x-12}$?
   A The graph has vertical asymptotes at $x = -2\ \&\ x = 3$
   B The graph has a hole at $x = -2$
   C The graph of f crosses the $x - axis$ at $x = -2, -1\,,\ 1,$
   D F has a horizontal asymptote at $y = 1$ & $croses\ y - axis\ at\ y = -\frac{1}{6}$
8. Which one of the following is **not** rational expression?
   A $\frac{|x^4+1|}{\sqrt{(x+1)^4}}$ B $\sqrt{(x+1)^2}$C $\sqrt{x^4} - x - 4\pi$D $\frac{x+5}{x-10}$

9. What is the solution set of the expression $\frac{\frac{1}{x-1}+\frac{x-1}{x-1}}{\frac{x}{x^2-2x+1}}=\frac{36(x-2)}{x^2-4x+4}$?

A $\{8,-4\}$ B$\{-8,-4\}$ C$\{8,4\}$ D $\{-8,4\}$

10. What is the equivalent expression when we partially decompose $R(x)=\frac{11x-11}{x^3-2x^2-5x+6}$?

A $R(x)=-\frac{11}{x-1}+\frac{11}{x+2}-\frac{22}{x-3}$ C $R(x)=-\frac{11}{x-1}-\frac{11}{x+2}+\frac{22}{x-3}$

B$R(x)=\frac{11}{x-1}+\frac{11}{x+2}+\frac{22}{x-3}$ D $R(x)=-\frac{11}{x-1}-\frac{11}{x+2}-\frac{22}{x-3}$

11. Let l_1&l_2 represents two perpendicular lines in a plane. If l_2 passes through $(2,3)$ and the equation ofl_1: $6x-2y-12=0$, then what is the equation of l_2?

A $x+2y-8=0$ B $x+3y-11=0$ C $x+2y+6=0$ D $x-2y+6=0$

12. Let the points $r(-3,4)$, $s(1,-5)$, $p(-1,6)$ and $t(1,2)$ are given. Then what is the tangent of the angle between the line that passes through r & s, and p & t if l_1 to l_2 counter clockwise?

A $\frac{9}{11}$ B $\frac{11}{13}$ C $\frac{11}{12}$ D $\frac{4}{9}$

13. Let the point $P(2,4)$ the line l: $8x+6y+10=0$, Then what is the distance between the point P and the line l?

A 5 B 3 C 4 D 6

14. Suppose $\theta=120°$ make an angle with the line l_1, then what is the equation of the line at a point $(-\sqrt{3},-6)$?

A $\sqrt{3}x-y-9=0$ C $\sqrt{3}x+y-9=0$

B$\sqrt{3}x-y+9=0$ D $\sqrt{3}x+y+9=0$

15. What is the equation of the circle if the end points of the diameter are $(-8,3)$and $(2,5)$?

A $x^2+y^2+6x-8y+1=0$ C $x^2+y^2+6x-8y-1=0$

B $x^2+y^2+6x-8y+6=0$ D $x^2+y^2+6x-8y-6=0$

16. Let P $(-8,-8)$ and the center of the circle is $(-8,4)$. Then which of the following is **not true** about the equation of the circle and the point P?

A $x^2+y^2+16x-8y-320=0$ is the equation of the circle passes the point P

B The point (8, 17) is lying outside the circle

C The point (6, 16) is lying on the circle

D. The equation of the circle is $x^2+y^2-16x+8y-400=0$ that passes through P

17. Which one of the following is **not** true about the equation of parabolas $x^2+8x+16y-16=0$?

A the equation of the directricx is $y=6$ C the focus is $(-4,-2)$

B the axis of symmetry is $y=4$ D the vertex is $(-4,\ 2)$

18. Which one of the following is **not** true about the equation of ellipse $9x^2+25y^2-36x+50y-164=0$?

A The length of latus rectum is $\frac{6\sqrt{21}}{5}$C the center is $(2,-1)$

B The equation of the ellipse is $\frac{(x-2)^2}{25}+\frac{(y+1)^2}{9}=1$ Dthe foci are$(-2,\ 1)$& $(6\ ,-1)$

19. Which one of the following is **not** a statement / proposition?
    A $x^2 - 4x + 4 = (x-2)(x-2), \forall x \in \mathbb{R}$ C There is integer which is divisible by 0
    B He found that Biology is important D The sum of any odd integer is even.
20. Which one of the following compound proposition is always **true**?
    A$(\neg p \cup q) \Rightarrow (p \cap \neg p)$ C $(p \Rightarrow q) \Rightarrow (\neg p \cup p)$
    B $(p \cap \neg p) \Leftrightarrow (p \Rightarrow q)$ D $(\neg q \cap q) \Leftrightarrow (\neg p \cup p)$
21. Which one of the following quantified statement has a truth value **false** in the set of real numbers?
    A $\forall x \forall y(-x^2 - y^2 \leq 0)$ C $\forall x \forall y(x^2 - y^2 \leq 0)$
    B $\forall x(x^2 + 2x + 3 \geq 2)$ D $\forall y(y^2 + 6y + 9 \geq 0)$
22. If$(\neg p \Leftrightarrow q) \Rightarrow (p \cup \neg q)$ has a truth value **false**, Then which one of the following is **not** true?
    A $(p \Rightarrow q) \cap (p \Leftrightarrow q)$ C $(\neg p \Rightarrow \neg q) \Leftrightarrow (p \cap q)$
    B $(p \Rightarrow q) \cup (p \cup q)$ D $(p \Rightarrow q) \Rightarrow (p \cup q)$
23. Let A and B be two events. Suppose that the probability that neither event occurs is $\frac{1}{12}$. Then what is the probability that at least one of the events occurs?
    A. $\frac{13}{12}$ B. $\frac{5}{12}$ C. $\frac{7}{12}$ D. $\frac{11}{12}$
24. The following is a table of simple frequency distribution of a data within the data,
    2, 4, 4, 5, 8, 8, 8, 10, 12, 13, 13, 15, 15, 15, 15, 21, 22, 22, 23, 25

What is the deciles four or D_4 and **mean** of the data respectively?

$A.\ 13,12$ B. $11, 13$ C. $11, 13$ D. $12, 13$

25. What is the constant term for the binomial expansion$\left(2x - \frac{2}{x}\right)^8$?
    A $-17{,}920$ B 256 C $17{,}920$ D-256
26. Let the data for 50 candidates with frequency are given below,

Class interval	1−5	6 −10	11−15	16−20	21−25	26−30	31−35
Frequency	4	5	M	15	N	6	5

If the **mode** is16.5, then what is M and N respectively?

A. $\{11, 4\}$ B. $\{12, 3\}$ C. $\{10, 5\}$ D. $\{13, 2\}$

27. A bag contains 2 black, 5 green and 3 red balls. Three balls are drawn one after the other. What is the probability of getting a red ball on the first draw, a green ball on the second draw and a black ball on the third draw if the balls are drawn without replacement?
    A. $\frac{1}{24}$ B. $\frac{1}{20}$ C. $\frac{1}{26}$ D. $\frac{1}{25}$
28. Let the variance of $x_1 + x_2 + x_3 + \cdots + x_n$ is 10. Then what is the variance of $3x_1$+2+ $3\,x_2$ +2 + $3x_3 + 2 + \cdots + 3x_n + 2$?
    A/ 80 B/ 52 C/ 90 D/ 32
29. Suppose there are 5 seats arranged in a row. In how many different ways can 5 people be seated on the seats?
    A/ 240 B/ 120 C/ 720 D/ 540

30. Let a committee of 6 students has to be formed from 9 boys and 9 girls. Then in how many ways can this be done when the committee consists of at most 3 girls?

A/ 525 B/ 662 C/ 562 D/ 625

31. If $C(n,2) = C(n,4)$. Then what is the value of n?

A/ $\{6\}$ B/ $\{6,-1\}$ C/ $\{10,-1\}$ D/ $\{10\}$

32. How many five – digit numbers can be formed from the digits $2,4,6,7,\ 8$ & 9 where a digit is used at most once if the number must be odd & repletion is allowed?

A 1892 B. 1296 C.2592 D. 2500

33. Which one of the following sequence is convergent?

A $\left\{\left(\frac{18}{5}\right)^{n+1}\right\}_{n=1}^{\infty}$ B $\left\{\frac{n^6(n+1)}{n^3+4}\right\}_{n=1}^{\infty}$ C$\left\{\frac{n(n+1)(n-2)}{n^2}\right\}_{n=1}^{\infty}$ D $\left\{\frac{n(n+2)^2(n-2)}{n^2(n-5)(n+9)}\right\}_{n=1}^{\infty}$

34. Suppose the 7th and the 12th terms of an arithmetic sequence are 6 and 24 respectively. Then which of the following is **not** true?

A. The common difference is 9 C. The 1st term of the sequence is-30

B. The 10th term of the sequence is 31 D. The sum of the first ten terms is 150

35. If S_n is the sum of the 1st interms of a geometric sequence with $G_6 = \frac{1}{64}$ and $G_4 = \frac{1}{16}$. Then which of the following is **true**?

A The common ratio is $\frac{1}{4}$ C. The 1st term of the sequence is$\frac{1}{8}$

B The nth term of the sequence $G_n = \frac{1}{2^{n+1}}$ D The sum of the first n terms is 2

36. What is the sum of the infinite series$\sum_{n=1}^{\infty}\left(\frac{3}{5^{n-1}} - \frac{5}{3^n}\right)$?

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

37. A person bought a car for Birr 170,000. If the value of the car depreciates at the rate of Birr 10,000 per year, what is its value at the beginning of the 12th year?

A. 60,000 B. 50,000 C. 70,000 D. 80,000

38. A ball is dropped from a height of 80m above a flat surface. In each bounce, it rebounds to 0.8 of the distance it fell. Then what is the maximum possible vertical distance the ball could travel?

A.820m B.720m C.700m D.800m

39. What are the greatest lower bound and least upper bound of the sequence $\left\{(-1)^n\left(1+\frac{1}{n}\right)\right\}$Respectively?

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

40. Which one of the following is **true** about the sequence $\{a_n\}$ where $a_n = \left\{\frac{15n^2+1}{n^2-3}\right\}$?

A. The lower bound is $(-\infty,\ 8\ ]$ and the upper bound is $(-61,\ \infty\ ]$

B. The sequence $\{a_n\}$ is monotonic and bounded

C. The lub of $\{a_n\}$ is $61$and glb of the sequence $\{a_n\}$ is -8

D. The limit of the sequence$\{a_n\}$ is 14

41. If a function f(x) =$\sqrt{x^2+3}-3$, then which of the following is the$\lim_{x\to 0}\frac{f(x)}{x^2}$?

A. 2 B.$\frac{\sqrt{3}}{6}$ C.$\frac{\sqrt{3}}{2}$ D. 1

42. What is the value of $\lim_{x\to 0}\frac{\sin(8x)}{\sin(9x)} \times \lim_{x\to\infty} x^2 sin\left(\frac{9}{x^2}\right)$?

A. 8 B. 9 C. $\frac{8}{9}$ D. $\frac{9}{8}$

43. What is the value of $\lim_{x\to\infty}\left(\frac{-4x+6}{-4x+10}\right)^{-6x-200}$?

A. e^{-19} B. e^{-20} C. e^{-6} D. e^{-18}

44. If $f(x) = \begin{cases} m-2 \; if \; x \leq 2 \\ x^2+3mx+6 \; if \; x > 2 \end{cases}$, then which of the following is the value m of so that f is continuous at 2?

A -5 B 3 C 5 D -3

45. What is the maximum possible interval for which the function f is continuous for $f(x) = \sqrt{\frac{4x-12}{9-x}}$?

A $[3,9) \cup (9,\infty)$ B $[0,\infty)$ C $(0,\infty)$ D $(-\infty,3] \cup (3,9) \cup [9,\infty)$

46. What is the value of $\lim_{n\to\infty}\left(\left(\frac{10n^4-5n-8}{15n^4+4n+9}\right)\left(\frac{-120n^5-8n+8}{2n^5-8n+6}\right)\right)$?

$A\ 60$ $B-60$ $C\ 40$ $D-40$

47. Which one of the following is **not** continuous function throughout the entire domain?

A polynomial function C logarithmic function

B Signum function D exponential function

48. Which of the following is the equation of the line tangent to the graph of $f(x) = 3x - \sin(3-x)$at $x = 3$?

A $4x+y-3=0$ B $3x-y+1=0$ C $3x-y-1=0$ D $4x-y-3=0$

49. If $f(x) = ln\left(\sqrt{x^2+x-1}\right)$, then which of the following is the value of $f''(2)$?

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

50. Let $x^4 - 2xy = 8$. Then what is the value of $\frac{dx}{dy}$ at the point$(2,5)$?

A. $\frac{2}{11}$ B. $\frac{7}{11}$ C. $\frac{-7}{11}$ D. $\frac{-2}{11}$

51. If $g(x) = \frac{1}{x^3}$ and $f(x) = \sqrt[3]{2-x^2}$. Then which of the following the value of $\frac{d}{dx}(gof)(x)$?

A. $\frac{2x}{(2-x^2)^2}$ B. $\frac{2x}{(2-x^2)^{\frac{3}{2}}}$ C. $\frac{2x}{x^2\sqrt{2-x^2}}$ $D.$ $\frac{2x}{x\sqrt{2-x^2}}$

52. Which of the following is the derivative of $\mathrm{Cot}(8x-5) + 3^{27x-5}$?

A $3^{27x-8}\ln 3 + 8csc^2(8x-5)$ C $3^{27x-8}\ln 3 - 8csc^2(8x-5)$

B $3^{27x-2}\ln 3 - 8csc^2(8x-5)$ D $3^{27x-3}\ln 3 - 8csc^2(8x-5)$

53. Let $f(x) = \sqrt{98-2x^2}$, Then what is the largest interval for which f is differentiable?

A $(-\infty - 7]$ B $(-7,\ 7)$ C $[-7,\ 7]$ D $[7,\infty)$

54. Let$f\ (x) = 2x^3 - 5x^2 + 3x + 1$. Then what is the gradient of the line tangent to the graph of f at $(2,\ 3)$?

$A\ 6$ $B-7$ $C\ 7$ $D-6$

55. Let$f(x) = x^3 + x^2 - 5x - 5$. Then what is the equation of the tangent line at the point where the graph crosses$y = 1 - x^2$?

A $4x+y+4=0$ B $11x-y-25=0$ C $5x+y+1=0$ D $16x-y+56=0$

56. Let $f(x) = \frac{25}{e^{-5x-8}}$, Then what is the formula for the n^{th} derivative of $f(x)$?

A $5^{n+3} \times e^{5x+8}$ B $5^{n-2} \times e^{5x+8}$ C $5^{-n} \times e^{-5x-8}$ D $5^{n+2} \times e^{5x+8}$

57. Let $f(x) = 6x^{12} + x^9 - x^8 + x^7 - x^6 + x^5 - x^4 + x^3 - x^2 + x + 889$. Then what is the value of $f^{(12)}(x)$?

A 12! B 6! (12)! C 72! D 6(12)!

58. Which one of the following is **not** true about the function $f(x) = x^4 - 26x^2 + 25$?

A $\{-\sqrt{13}, 0, \sqrt{13}\}$, are set of critical numbers of function f

B f is increasing on $[-\sqrt{13}, 0] \cup [\sqrt{13}, \infty)$ & decreasing on $(-\infty - \sqrt{13}) \cup [0, \sqrt{13}]$

C f is concave upward on $\left[-\sqrt{\frac{13}{3}}, \sqrt{\frac{13}{3}}\right]$ & downward $\left(-\infty, -\sqrt{\frac{13}{3}}\right]$ and $\left[\sqrt{\frac{13}{3}}, \infty\right)$

D $\left[-\sqrt{\frac{13}{3}}, -\frac{620}{9}\right]$ & $\left[\sqrt{\frac{13}{3}}, -\frac{620}{9}\right]$ are points of inflection of f

59. What is the extreme values of the function $f(x) = x^3 - 12x + 5$ on $\left[-\frac{5}{2}, \frac{5}{2}\right]$?

A. $\left\{-\frac{75}{8}, \frac{155}{8}\right\}$ B. $\{21, -11\}$ C. $\{-21, 11\}$ D. $\left\{-\frac{155}{8}, \frac{75}{8}\right\}$

60. What is the largest possible product of two non-negative numbers whose sum is 200?

A. 10,000 B. 40,000 C. 25000 D. 30,000

61. Let $f(x) = x^3 - 12x + 5$ on $[0, 3]$. Then what value of c in the interval that conclusion of mean value theorem is satisfied?

A $\{-\sqrt{5}\}$ B $\{\sqrt{5}\}$ C $\{-\sqrt{3}\}$ D $\{\sqrt{3}\}$

62. What is the points on the graph of $f(x) = x^2 - 5$ that are closest to $p(0, 4)$?

A $\left(-\frac{\sqrt{17}}{2}, -\frac{3}{4}\right)$ & $\left(\frac{\sqrt{17}}{2}, -\frac{3}{4}\right)$ C $\left(-\frac{\sqrt{17}}{2}, \frac{3}{4}\right)$ & $\left(\frac{\sqrt{17}}{2}, \frac{3}{4}\right)$

B $\left(-\frac{\sqrt{17}}{2}, \frac{3}{4}\right)$ & $\left(\frac{\sqrt{17}}{2}, -\frac{3}{4}\right)$ D $\left(-\frac{\sqrt{17}}{2}, \frac{3}{4}\right)$ & $\left(-\frac{\sqrt{17}}{2}, \frac{3}{4}\right)$

63. Air is being pumped into a spherical balloon at the rate of $48\pi m^3$/min. Then what is the rate of change of the radius when the radius is 2m?

A $6m/\min$ B $3m/\min$ C $4m/min$ D5m/min

64. Let $h(x) = f(x^2 - 6x + 10)$, $f'(2) = 10$, $f''^{(2)} = 12$, then what is the value of $h''(2)$?

A48 B -48 C -68 D 68

65. Let $f(x) = \begin{cases} Px - 2T, x < 2 \\ 4 - x^4, x \geq 2 \end{cases}$, Then if f is differentiable at $x = 2$, what is the value of P and T respectively?

A. $\{32, 26\}$ B. $\{-32, 26\}$ C. $\{-32, -26\}$ D. $\{32, -26\}$

ENDS