

NATIONAL EDUCATIONAL ASSESSMENT AND EXAMINATIONS AGENCY (NEAEA)
ETHIOPIAN UNIVERSITY ENTRANCE EXAMINATION (EUEE)
MATHEMATICS FOR NATURAL SCIENCE STREAM
YEKATIT 2012/13 MARCH 2020/21

BOOKLET CODE: 49

SUBJECT CODE: 02

Time Allowed: 3 hours

1. Which one of the following is true about $f(x) = -2 + 3\sin(\frac{1}{2}x + 3)$?
 A. The phase shift is 6 C. The amplitude is 1
 B. The range is $[-5, 1]$ D. The period is 2π
2. If the 1st and 4th terms of a geometric progression are 3 and 81 respectively, what is the common ratio for this progression?
 A. $1/3$ C. $1/9$
 B. 9 D. 3
3. If $f(x) = \begin{cases} k(2^x), & \text{if } x > 2 \\ x^3 - x + 1, & \text{if } x \leq 2 \end{cases}$, then for what value of k is f continuous at $x = 2$?
 A. $\frac{7}{2}$ C. 4
 B. 2 D. $\frac{7}{4}$
4. $\lim_{x \rightarrow \infty} \left(\frac{x-2}{x} \right)^{-2x+1} =$
 A. e^{-2} C. e^{-4}
 B. e^2 D. e^4

5. Given $0 < a_n < \frac{1}{n}$ for each $n = 1, 2, 3, \dots$. Which of the following is true?

A. $\lim_{n \rightarrow \infty} a_n$ does not exist

C. $\lim_{n \rightarrow \infty} a_n < 0$

B. $\lim_{n \rightarrow \infty} a_n > 0$

D. $\lim_{n \rightarrow \infty} a_n = 0$

6. Which of the following is the lower bound for the sequence $\left\{\frac{n}{n-1}\right\}_{n=2}^{\infty}$?

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

C. 1

B. $\frac{7}{4}$

D. $\frac{9}{5}$

7. The general term of a sequence is $a_n = \left(\frac{1}{2}\right)^{1-n}$. Then which of the following is true about this sequence?

- A. Its terms are natural numbers. C. Its terms are non-positive.
 B. Its terms are odd numbers. D. 0 is one of its terms.

8. Which of the following is an upper bound for the sequence $\left\{\frac{n+1}{n}\right\}_{n=1}^{\infty}$?

A. $\frac{4}{3}$

C. 0

B. 2

D. 1

9. Let $\{a_n\}$ be a sequence of real numbers. Then which of the following is true about the sequence?
- M is an upper bound of $\{a_n\}$ if $M \leq a_n$ for all a_n .
 - m a lower bound of $\{a_n\}$ if $a_n \leq m$ for all a_n .
 - The sequence $\{a_n\}$ is bounded if it has both an upper bound and a lower bound.
 - The sequence $\{a_n\}$ is bounded if there exists $k > 0$ such that $k \leq |a_n|$ for all a_n .
10. A Geometric Series with first term a and common ratio r is convergent if
- $r < 1$
 - $r \leq 1$
 - $r > 1$
 - $r \geq 1$
11. Let $z_1 = 2 + i$, $z_2 = 3 + i$ and $z_3 = 1 - i$, then what are the real and imaginary parts of $z_1 z_2 z_3$ respectively?
- 10 and 0
 - 1 and 1
 - 6 and -3
 - 6 and 3
12. If p and q are propositions, then which one of the following pairs of compound propositions are equivalent?
- $\neg p \Rightarrow q$ and $q \Rightarrow \neg p$
 - $p \Leftrightarrow q$ and $\neg p \Leftrightarrow \neg q$
 - $\neg(p \wedge q)$ and $\neg p \vee \neg q$
 - $p \Rightarrow \neg q$ and $\neg p \wedge q$

P	Q	$\neg P \Rightarrow Q$	$Q \Rightarrow \neg P$	$\neg(P \wedge Q)$
T	T	T	F	F
T	F	T	T	F
F	T	T	F	T
F	F	F	F	T

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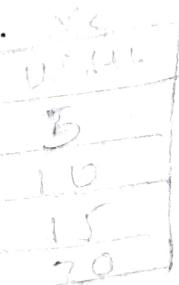
13. Which of the following is correct about $f(x) = \cot x$?

- A. Its period is 2π
- B. Its range is $(-\infty, 1] \cup [1, \infty)$
- C. Its domain is $\{x \in \mathbb{R}; x \neq n\pi, n \in \mathbb{Z}\}$
- D. Its domain is $\{x \in \mathbb{R}; x \neq \frac{n}{2}\pi, n \in \mathbb{Z}\}$

(1A)
12)

14. The following is the frequency distribution of a grouped data.

Class Intervals	Frequency (f)
3 - 7	2
8 - 12	2
13 - 17	10
18 - 22	6



What is the mean of the data?

- A. 13
- B. 12.5
- C. 14
- D. 15

$$\begin{aligned} & 3(8) + 10(12) + 10(16) \\ & 24 + 120 + 160 \\ & 304 \quad 304 \\ & \cancel{304} = 15.180 \\ & 304 \quad 304 \\ & \cancel{304} = 15.180 \end{aligned}$$

15. Which of the following statements is NOT true?

- A. A large value of variance shows that the data values are closer to the mean.
- B. If two data have equal mean, the data with less variance shows less variability.
- C. Variance indicates the variability of a set of numerical data items.
- D. When the variance of a data is close to zero, the data shows less variability.

16. If the functions f and g are continuous at $x = c$, then which one of the following combinations is continuous at $x = c$?

A. f^2

C. $\frac{f}{g}$

B. f^{-1}

D. \sqrt{g}

17. Which of the following is equal to $\lim_{n \rightarrow \infty} \frac{\sin n}{n^2}$?

A. 0

C. 1

B. π

D. -1

$$\frac{\sin n}{n} = L$$

$$\frac{\sin n}{n^2} = \frac{1}{n^2} = 0$$

18. $\lim_{x \rightarrow \infty} \left(1 + \frac{5}{x}\right)^x$ is equal to?

A. e^{-5}

e^5

C. e^5

B. $5e$

D. $\frac{1}{e}$

19. Which of the following is true about limit of a function?

- A. Whenever the limit exists for a function it is the same as functional value.
- B. Intuitively, the limit of a function f is a y -value L to which $f(x)$ approaches as x approaches to some specified number. \times
- C. Right hand and left hand limits are the same for every function. \times
- D. Limit of a constant function is always zero. \times

$f(x) \rightarrow L$
 $x \rightarrow x_0$

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20. What is the value of a and b if $\frac{a+2i}{3i} = \frac{b+i}{4}$?
- A. $a = -3/4, b = -8/3$ C. $a = 3/4, b = 8/3$
 B. $a = -3/4, b = 8/3$ D. $a = 3/4, b = -8/3$
21. If p : "the rainy season is very good this year" and q : "rivers are rising", then the statement "It is not true that neither the rainy season is very good this year nor rivers are rising" denoted by
- A. $(\neg p \Rightarrow \neg q) \vee \neg q$ C. $\neg p \wedge \neg q$
 B. $(p \Rightarrow q) \vee (\neg p \Rightarrow \neg q)$ D. $\neg(\neg p \vee \neg q)$
22. Let $f(x) = \frac{x^2 - x}{2x^2 - x - 1}$, which of the following is NOT true about f and its graph?
- A. $y = \frac{1}{2}$ is a horizontal asymptote. ✓
 B. f is an even function.
 C. The graph of f has a hole at $(1, \frac{1}{3})$. ✓
 D. $x = -\frac{1}{2}$ is a vertical asymptote. ✓
23. The distance between point $(4, -3)$ and the line $l: x + y - 7 = 0$ is _____
- A. $3\sqrt{2}$ C. $2\sqrt{2}$
 B. $\frac{3\sqrt{2}}{2}$ D. $4\sqrt{2}$

24. The function $f(x) = (x - 1)^{\frac{2}{3}}$ is differentiable on
- A. $(-\infty, 1) \cup (1, \infty)$ C. $(-\infty, 1]$
 B. $(-\infty, -1) \cup (-1, \infty)$ D. $[1, \infty)$
25. Which of the following is an interval at which the function $f(x) = \frac{1}{x-1} - \sqrt{4-x^2}$ is differentiable?
- A. $[-2, 1) \cup (1, 2]$ C. $(-2, 2)$
 B. $(-\infty, -2) \cup (2, \infty)$ D. $(-2, 1) \cup (1, 2)$
26. The second derivative of the function $f(x) = xe^{-x}$ is _____.
- A. $(x + 2)^2 e^{-x}$ C. $(2 - x)e^{-x}$
 B. $(x - 2)e^{-x}$ D. $-xe^{-x}$
27. What is the slope of the line tangent to the graph of $f(x) = x^2 + \tan x$ at $(\pi, f(\pi))$?
- A. $2\pi - 1$ C. 2
 B. $2\pi + 1$ D. 2π
28. The equation of a parabola is given by $y^2 + 6y + 8y + 25 = 0$. Which one of the following is NOT true about this parabola?
- A. Its focus lies at $(-4, -3)$ C. Its directrix is the y-axis
 B. It opens to the right D. Its vertex is $(-2, -3)$

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29. Let $x^2 + y^2 + kx = 1$ be equation of a circle for some $k \in \mathbb{R}$. What is the radius of the circle if its center is $(2, 0)$?
- A. 2 C. $\sqrt{5}$
 B. $\sqrt{2}$ D. 5
30. What is the value of $\lim_{x \rightarrow 0} \frac{\sin 4x}{\sin 6x}$?
- A. 6 C. $\frac{2}{3}$
 B. 24 D. $\frac{3}{2}$
31. Which one of the following is NOT true about transformation?
- A. Rotations move triangles into congruent triangles.
 B. Translations move angles to congruent angles.
 C. Rotation is a rigid motion.
 D. Reflection is not a rigid motion.

- 32.** Consider the following frequency distribution of grouped data.

values	Frequency
95—99	4
90—94	6
85—89	10
80—84	16
75—79	9
70—74	5

Which of the following statements is true about this frequency distribution?

- A. The class interval is 4.
 - B. 95.5 is the upper limit of the second class.
 - C. 85.5—90.5 is one of the class boundaries.
 - D. 82 is the class midpoint of the fourth class.
- 33.** Consider the experiment of rolling a die whose sample space is {1,2,3,4,5,6}. If two dice are rolled simultaneously, what is the probability that a prime number turns up on one of the dice and a composite number on the other?

A. $\frac{1}{3}$

C. $\frac{5}{6}$

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

D. $\frac{1}{6}$

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34. Consider the sequence whose terms are $a_1 = 6$, and $a_{n+1} = -\frac{1}{3}(a_n)$ for $n \in \mathbb{N}$.

Then what is the sum of the first ten terms is

A. $9 \left(1 - \left(-\frac{1}{3} \right)^{10} \right)$

B. $\frac{9}{2} \left(1 - \left(-\frac{1}{3} \right)^{10} \right)$

C. $9 \left(1 - \left(-\frac{1}{3} \right)^{11} \right)$

D. $\frac{9}{2} \left(1 - \left(-\frac{1}{3} \right)^{11} \right)$

35. Let $f(x) = \frac{1}{(1-\sqrt{x})^2}$. Then $f'(4)$ is equal

A. $\frac{1}{2}$

B. $-\frac{1}{2}$

C. 1

D. 2

36. For what value of c the conclusion of Rolle's theorem is satisfied for the function $f(x) = 2x - x^2 - x^3$ on $[-2, 1]$?

A. $\frac{-1 \pm \sqrt{7}}{3}$

B. $\frac{1 \pm \sqrt{5}}{3}$

C. $\frac{1 \pm \sqrt{7}}{3}$

D. $\frac{-1 \pm \sqrt{5}}{3}$

37. The product of two positive real numbers is 100, such that the sum of two times the first number and eight times the second number is minimum. Which of the following pairs of numbers are the first and the second numbers respectively?
- A. 50 and 2 C. 20 and 5
 B. 1 and 99 D. 25 and 4
38. The volume of a cube is increasing at a rate of $9\text{cm}^3/\text{sec}$. How fast is the surface area increasing when the length of an edge is 10cm?
- A. $6\text{cm}^2/\text{sec}$ C. $36\text{cm}^2/\text{sec}$
 B. $90\text{cm}^2/\text{sec}$ D. $3.6\text{cm}^2/\text{sec}$
39. Let $A = \begin{pmatrix} 2 & 3 \\ 2 & -1 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & 5 & -4 \\ 3 & 2 & 6 \end{pmatrix}$. The AB is?
- A. $\begin{pmatrix} 13 & 16 & 10 \\ 1 & 8 & -14 \end{pmatrix}$ C. $\begin{pmatrix} 13 & 1 \\ 16 & 8 \\ 10 & -14 \end{pmatrix}$
 B. $\begin{pmatrix} 8 & -1 \\ 13 & 8 \\ 18 & -2 \end{pmatrix}$ D. $\begin{pmatrix} 8 & 13 & -18 \\ -1 & 8 & -2 \end{pmatrix}$
40. For what value of k does the system

$$\begin{cases} 2x - y + 4k = 6 \\ kx - y - z = 2 \\ x + y + 2z = 8 \end{cases}$$
 has a unique solution?
- A. $k \neq \frac{1}{2}$ C. $k \neq -\frac{1}{3}, \frac{1}{2}$
 B. $k \neq -\frac{1}{6}$ D. $k \neq -\frac{1}{2}$

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41. Which one of the following is a row reduced echelon form of the matrix

$$\begin{pmatrix} 1 & 1 & 1 \\ 2 & 1 & 3 \\ 4 & -1 & 4 \end{pmatrix}?$$

A. $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

B. $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$

C. $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$

D. $\begin{pmatrix} 1 & 1 & 1 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{pmatrix}$

42. Let p and q be propositions with truth value True and False respectively.
 Then which of the following is correct?
 A. $(p \Rightarrow q) \wedge p$ is True. \times
 B. $p \vee (q \wedge \neg p)$ is True. \times
 C. $\neg p \Rightarrow q$ is False.
 D. $(p \vee \neg q) \Rightarrow q$ is True.

$T \vee (F \wedge F)$

$T \vee F = T$

43. A real number a is the limit of a sequence $\{a_n\}$ if
 A. a is very close to all terms a_n from some arbitrarily big n onwards.
 B. $|a_n| \leq a_n \leq |a|$ for all n .
 C. a is closer to every term of the sequence.
 D. $a \leq |a_n|$ for all n .

44. Let $f(x) = 3 - 2x$. What is the inverse of f ?

A. $f^{-1}(x) = \frac{x}{2} - \frac{3}{2}$

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

C. $f^{-1}(x) = 3 + 2x$

D. $f^{-1}(x) = 2x - 3$

$y = 3 - 2x$

$x = 3 - 2y$

$x - 3 = -2y$

45. Given the function $f(x) = 2x^2 - 3x + 1$, what is the slope of the line passing through the points $(-1, f(-1))$ and $(2, f(2))$?

A. -1

C. 1

B. $-\frac{1}{3}$

D. $\frac{1}{3}$

46. If $f(x) = \frac{\ln 2}{x^2}$, then $f'(x)$ is equal to

A. $\frac{1}{2x^2}$

C. $\frac{-2}{x^4}$

B. $\frac{-2\ln 2}{x^3}$

D. $\frac{1+2\ln x}{x^3}$

47. If $f(x) = 4 - x^2 \sin x$, then which of the following expressions describes $f'(x)$?

A. $-x(x \cos x + 2\sin x)$

C. $x(x \cos x - 2\sin x)$

B. $1 + \cos x + 2\sin x$

D. $1 - \cos x - 2\sin x$

48. Which one of the following is the standard form of the equation of the ellipse with vertices: $(3, 1), (3, 9)$; and minor axis of length 6

A. $\frac{(x-3)^2}{4} + \frac{(y-3)^2}{36} = 1$

C. $\frac{(x+2)^2}{4} + \frac{(y-3)^2}{9} = 1$

B. $\frac{(x-3)^2}{9} + \frac{(y-5)^2}{16} = 1$

D. $\frac{(x-1)^2}{16} + \frac{(y-9)^2}{64} = 1$

49. What is the image of the ellipse $\frac{(x-3)^2}{6} + \frac{(y-2)^2}{4} = 1$ when it is rotated through 90° about the origin?
- A. $6(x+2)^2 + 4(y-3)^2 = 24$ C. $4(x+3)^2 + 6(y-2)^2 = 24$
 B. $\frac{(x+2)^2}{6} + \frac{(y-3)^2}{4} = 1$ D. $\frac{(x-2)^2}{4} + \frac{(y+3)^2}{6} = 1$
50. If $z = -1+i$ and $w = 1-3i$, what is the simplified form of $\frac{5z}{w} + |z|^2\bar{w}$?
- A. $5i$ C. $5+4i$
 B. $4i$ D. $4+5i$
51. Which of the following is a zero for the function $f(x) = x^3 - 3x^2 + 3x - 1$?
- A. -1 C. 1
 B. -2 D. 0
52. Suppose the measurement of height (in meter) of twelve students is:
 $1.72, 1.65, 1.70, 1.56, 1.72, 1.70, 1.65, 1.70, 1.65, 1.65, 1.70, 1.72$
 Which one is true about the mode of the data?
- A. The data is multimodal.
 B. The data is bimodal with mode 1.65 and 1.70.
 C. The data is unimodal with mode 1.70.
 D. The data is unimodal with mode 1.65.

53. The table shown below is a simple frequency distribution of data with variable x .

x	1	3	4	5	7
Frequency	2	5	6	5	2

What is the variance of the data?

- A. 3
- C. 3.2
- B. $\sqrt{3}$
- D. 2.3

54. The maximum profit that a company can make if the profit function is given by $P(x) = 36 + 72x - 18x^2$ is

- A. 124
- C. 2232
- B. 31
- D. 108

55. Let $f(x) = x^2 + 2x + 3$ find a number $c \in (1, 3)$ such that $f'(c) = \frac{f(3) - f(1)}{2}$?

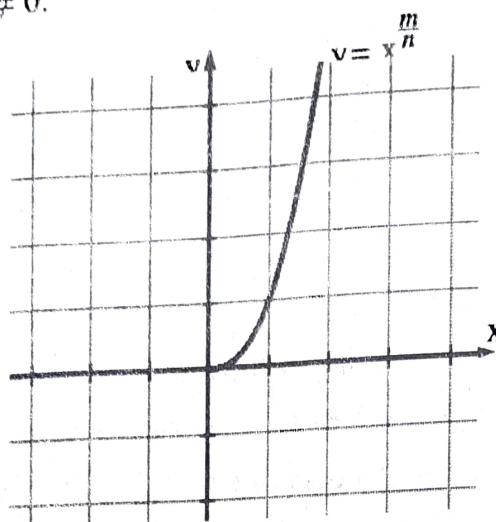
- A. 2
- C. 6
- B. -2
- D. -6

56. Given a rational function $f(x) = \frac{2x+4}{x-1}$ which of the following is NOT true about its graph? The graph has;

- A. a horizontal asymptote, $y = 2$.
- B. a vertical asymptote, $x = 1$.
- C. y -intercept $(0, -4)$.
- D. x -intercept at $(-4, 0)$

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57. The following graph is the graph of the function $y = x^{\frac{m}{n}}$, where m and n are positive integers and $n \neq 0$.



Which of the following is true about m and n ?

- A. m is odd, n is even and $m > n$.
 B. m is even, n is odd and $m < n$.
 C. m is odd, n is even and $m < n$.
 D. m is even, n is odd and $m > n$.
58. Let $f(x) = \sqrt{x+2}$ and $g(x) = x^2 - 1$. What are the domain and range of the composition of f with g , $f \circ g$ respectively?
 A. \mathbb{R} and $[1, \infty)$ C. $[0, \infty)$ and $[1, \infty)$
 B. \mathbb{R} and $[0, \infty)$ D. $[0, \infty)$ and $[0, \infty)$

59. Let $\vec{u} = (2, 0)$ and $\vec{v} = (-1, 3)$ be two vectors in the plane and $\vec{w} = -3\vec{u} + 2\vec{v}$.

Which one of the following is the unit vector in the direction of \vec{w} , in terms of the standard unit vectors \vec{i} and \vec{j} ?

A. $\frac{4}{5}\vec{i} - \frac{3}{5}\vec{j}$

C. $\frac{3}{5}\vec{i} - \frac{4}{5}\vec{j}$

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

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

60. Which of the following is NOT true about the scalar product of vectors?

A. The scalar product is commutative.

B. The scalar product of non-zero parallel vectors is zero.

C. The scalar product is distributive over addition of vectors.

D. The scalar product of perpendicular vectors is zero.

61. What is the slope of the line tangent to the graph of $f(x) = x^2 + \tan x$ at $(\pi, f(\pi))$?

A. $2\pi - 1$

C. 2

B. $2\pi + 1$

D. 2π

$$x - y + z = 3$$

62. What is the set of values of k so that the system $2x + y - z = 4$ has a solution?

A. $\mathbb{R} \setminus \{-1, 1\}$

C. $\mathbb{R} \setminus \{1\}$

B. $\mathbb{R} \setminus \{-1\}$

D. \mathbb{R}

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63. If the inverse of the matrix $\begin{pmatrix} x & 2x \\ -x & x \end{pmatrix}$ is $\begin{pmatrix} -1 & -2 \\ 1 & 1 \end{pmatrix}$, then which one of the following is the value of x ?
- A. $\frac{1}{3}$ C. 1
 B. $-1/3$ D. -1
64. Let $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 2 & -1 \\ -1 & 3 \end{pmatrix}$. Then which of the following is equal to $3A + 2B$?
- A. $\begin{pmatrix} 3 & 4 \\ 2 & 18 \end{pmatrix}$ C. $\begin{pmatrix} 7 & 1 \\ 7 & 7 \end{pmatrix}$
 B. $\begin{pmatrix} 3 & 1 \\ 2 & 7 \end{pmatrix}$ D. $\begin{pmatrix} 7 & 4 \\ 7 & 18 \end{pmatrix}$
65. Which of the following is equal to $\sin^{-1}(\sin \frac{5\pi}{4})$?
- A. $\frac{\sqrt{2}}{2}$ C. $\frac{5\pi}{4}$
 B. $-\frac{\sqrt{2}}{2}$ D. $-\frac{\pi}{4}$

THE END