NATIONAL EDUCATIONAL ASSESMENT AND EXAMINATIONS AGENCY (NEAEA)
ETHIOPIAN UNIVERSITY ENTRANCE EXAMINATION (EUEE)
MATHEMATICS EXAMINTION 2006

BOOKLET CODE: 00
NUMBER OF ITEMS:

SUBJECT CODE: 00
TIME ALLOWED: 00

1. A water tank is a circular cylinder with base radius 2m and height 3m. If the tank is empty and water is pumped into it at rate of $2m^3$/min, how long does it take for the tank to be full?

- A) 1.5 min
- B) 3/2 πmin
- C) 6π
- D) 12 min

2. If $A=\begin{pmatrix}2 & 0 & -1\\ 1 & 2 & 0\\ 0 & 0 & -1\end{pmatrix}$ **and** $(2A+B)^T = A^TA$**, then which one of the following is equal to B?**

- A) $\begin{pmatrix}1 & 0 & -2\\ 2 & 0 & 0\\ 0 & 0 & 4\end{pmatrix}$
- B) $\begin{pmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}$
- C) $\begin{pmatrix}8 & 0 & -4\\ 4 & 8 & 0\\ 0 & 0 & -4\end{pmatrix}$
- D) $\begin{pmatrix}1 & 2 & 0\\ 0 & 0 & 0\\ -2 & 0 & 4\end{pmatrix}$

3. Which one of the following represents a geometric sequence?

- A) 3, 1, 1/3, 1/9, 1/27,?
- B) 1/2, -1/3, 1/4, -1/5, 1/6,?
- C) 1,3, 6, 10, 15,?
- D) -3, 6, -9, 12, -15,?

4. The sequence $\left\{\frac{(n-1)(2n+1)}{1-n^2}\right\}_{n=1}^{\infty}$ converges to:

- A) -∞
- B) -2
- C) 0
- D) 1

5. If F(x) is an ant derivative of f(x)= 1- 2/x^2 and F(1) = 0, then F(2) is equal to:

- A) 0
- B) 1/2
- C) -1/2
- D) 3

6. Which one of the following expression is a polynomial expression?

- A) x^2 - 3x + sinx
- B) $\frac{4x^3+12x^2-x}{\pi x^2}$
- C) $\frac{2+\pi}{1+\pi^2}$
- D) $2-3x^{\frac{2}{3}}+7x^{\frac{5}{2}}+3x^{-1}$

7. What is the distance from the origin to the line that passes through (1, 0) and (0, 1)?

- A) 1/2 √2
- B) 1
- C) 1/2
- D) √2

8. If the list of a measurement is 10, α, 5, α,5, 10, 20, 15,20,5 with mean a then α in terms of a is equal to:

- A) 10a-90
- B) 9a-90
- C) 5a-90
- D) 5a-45

9. The total cost (in Birr) of producing x iron sheets per day is C(x) = 1,000 + 100x - 0.5x^2, 0 ≤ x ≤ 100. What is the marginal (rate of change of) cost at a production level of 80 iron sheets?

- A) 8.5
- B) 20
- C) 1,800
- D) 5,800

10. If z = x + yi is a complex number, then $|z|^2 + \frac{1}{2}(z - \bar{z})^2 = 1$ is equivalent to which one of the following equations?

- A) $x^2 - y^2 = 1$
- B) $x^2 - 3iy^2 = 1$
- C) $x^2 - y^2 = 2$
- D) $2x^2 - y^2 = 1$

11. 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 and standard deviation of the distribution, respectively?

- A) 15,2√5
- B) 15, √7.5
- C) 12.5, 5√2
- D) 12.5, √15

12. If $(p \vee q) \Rightarrow (\neg r \wedge r)$ is true, then which one of the following is necessarily true?

- A) $((p \vee r) \Rightarrow q$
- B) $\neg p \wedge r$
- C) $\neg p \Rightarrow r$
- D) $\neg p \vee r$

13. What is the actual value of the sum $\sum_{n=1}^{\infty} \left(\frac{2^n+5^n}{10^n}\right)$

- A) 0.325
- B) 1
- C) 5/4
- D) 37/9

14. If $f(x) = \frac{x+1}{x-1}$ and $f(a) = 5$ then $f(2a)$ is equal to:

- A) 2
- B) 4
- C) 6
- D) 8

15. If $f(x) = \sqrt[3]{1 + e^{-x}}$, which of the following is equal to $f^{-1}(x)$?

- A) $\ln\left(\frac{1}{x^3-1}\right)$
- B) $\frac{1}{\ln(x^3-1)}$
- C) $\ln(1 - x^3)$
- D) $(1 + e^{-x})^3$

16. What is the equation of the directrix for the parabola whose equation is $y^2 + 8x + 6y + 25 = 0$?

- A) y = 3
- B) x = 2
- C) x = 0
- D) x = 4

17. Given that $\lim_{x\to 3} f(x) = 5$ and $\lim_{x\to 3} g(x) = 11$, what is the value of $\lim_{x\to 3}\left(\frac{(f(x)-g(x))(g(x))}{g(x)^2-f(x)^2}\right)^n$?

- A) -66/96
- B) -1/16
- C) 0
- D) does not exist

18. If $f(x) = \frac{x^2}{1+xg(x)}$, g(2) = 1 and g(2) = 10, then which one of the following is equal to f'(2)(the derivative of f at 2)?

- A) -8
- B) -8/9
- C) 4/3
- D) 8/9

19. If $w = \frac{16i}{1+i} + (1-3i)^2$ and $z = |w| + \bar{w}$, which one of the following is the simplest form of z?

- A) √2 + 2i
- B) 2 + 2i
- C) 4 - 2i
- D) 2 - 2i

20. If $M = \begin{pmatrix} 0 & 1 & 2 \\ 3 & -1 & 0 \\ 5 & 2 & 4 \end{pmatrix}$ and $A^T M = 21$, where A is a 3 x 3 matrix and I is the identity matrix of order 3, then what is det(A)?

- A) 0.2
- B) 4/17
- C) 0.8
- D) 1/17

21. If distinct codes (words of eight letters are formed by rearranging the letters in the word'ABBEBAYE', how many of the codes begin with B or Y?

- A) 840
- B) 630
- C) 1680
- D) 420

22. What should be the value 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 a solution?**

- A)0
- B) 1
- C) -4
- D) 4

23. Let $f(x)=\begin{cases} a\frac{sinx}{x-|x|} & if\ x<0 \\ e^{-x}+cosx, & if\ x\geq 0 \end{cases}$ **if f is continuous at x = 0, then what is the value of a?**

- A) 4
- B) 2
- C) 1/2
- D) -4

24. What is the area of the region between the graphs of $y = -x^2 + 2$ and $y=|x|$, where $-1 \leq x \leq 2$?

- A) 11/6
- B) 25/6
- C) 7/3
- D) 11/3

25. What is the derivative of $f(x)=\int_0^{x^2+\pi}\frac{dt}{sint+1}$ **?**

- A) $\frac{cosx}{sin(x^2+\pi)+1}$
- B) $\frac{2x}{sin(x^2+\pi)+1}$
- C) $\frac{2xcox}{sin(x^2+\pi)+1}$
- D) $\int_0^{2x}\frac{dt}{sint+1}$

26. If two lines y=x and y= x - 4 are tangent to a circle at (2, 2) and (4, 0), respectively, then what is the equation of the circle?

- A) $(x - 2)^2 + y^2 = 4$
- B) $(x - 4)^2 + (y - 2)^2 = 4$
- C) $(x - 3)^2 + (y - 1)^2 = 2$
- D) $(x - 1)^2 + (y + 1)^2 = 10$

27. Which one of the following is the set of all critical numbers of $f(x) = \frac{1}{3}x^3 - |4x - 1|$?

- A) {1/4, 2}
- B) {-2, 1/4, 2}
- C) {-2, 2}
- D) {1/4}

28. Which one of the following is equal to $\int_0^{\frac{\pi}{2}} \frac{x - sinx}{secx} dx$?

- A) $\frac{\pi - 3}{2}$
- B) $\frac{\pi - 1}{2}$
- C) $\frac{3 - \pi}{2}$
- D) $\frac{\pi + 3}{2}$

29. Which one of the following is true?

- A) a polynomial can have infinitely many vertical asymptotes
- B) the graph of a rational function can never cross its horizontal asymptote.
- C) the graph of $f(x) = \frac{3x - 1}{x - 1}$ has no horizontal asymptote.
- D) the graph of $f(x) = \frac{x^3 - x}{x^2 - x}$ has no vertical asymptote.

30. The simplified form of the derivative of $f(x) = \frac{1 + sinx}{cosx}$ is

- A) secx + tanx
- B) $\frac{1 + sinx}{cos^2 x}$
- C) $\frac{1}{1 + tanx}$
- D) $\frac{cosx}{sin^2 x}$

31. If Qi, Di and Pi are respectively the i^{th} ?quartile, decile and percentile of a data arranged in an increasing order, then which one of the following is necessarily true?

- A) $Q_2 = \frac{Q_1 + Q_3}{2}$
- B) $D_3 > P_{25}$

C) $P_{25} > Q_1$

D) Q_2 = mean of the data

32. If  **, what is the slope of the tangent line to the graph of f at x=2?**

A) -4

B) 2

C) 18

D) 17

33. If $f(x) = e^{2x} \sin x$, then $f''(x)$ is equal to

A) $3e^{2x} \sin x - 4e^{2x} \cos x$

B) $4e^{2x} \sin x + 2e^{2x} \cos x$

C) $e^{2x} (3\sin x + 4\cos x)$

D) $e^{2x} (4\sin x - 3\sin x)$

34. If the equation $(x - 2)^2 - (y - 2)^2 = 1$ represents a hyperbola, which one of the following represents equation of an asymptote to the hyperbola?

A) $y = 4 - x$

B) $x + y = 1$

C) $x = 2 - y$

D) $x + 2y = 3$

35. What is the sum of the series $\sum_{n=1}^{\infty} (-1)^n 3^{-2n}$?

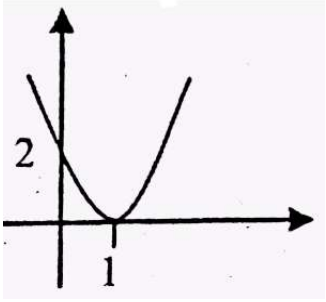
A) -1/8

B) -0.13

C) -0.1

D) 1/8

36. Which of the equations below is represented by the following parabola?



A) $y=x^2+2$

B) $y=(2x-1)^2$

C) $y=2(x-1)^2$

D) $y=(2x+1)^2$

37. A company produced 25,000 bulbs and randomly tested 2% of the product. Among the tested bulbs, if 40 have defect of type D_1, 60 have defect of type D_2 and 25 have both types of defects, what is the probability that a bulb produced by the company had none of the defects?

- A) 0.95
- B) 0.80
- C) 0.85
- D) 0.20

38. A semi-elliptical arc over a tunnel for a road through a mountain has a major axis of length 80 meters and a height of 30 meters at the center. What is the equation of the semi-elliptical arc over the tunnel, if the center is considered as the origin?

- A) $\frac{x^2}{6400}+\frac{y^2}{900}=1$
- B) $\frac{x^2}{1600}+\frac{y^2}{900}=1$
- C) $\frac{x^2}{900}+\frac{y^2}{6400}=1$
- D) $\frac{x^2}{8100}+\frac{y^2}{6400}=1$

39. Suppose AX=b, where A is a 3 x 3 matrix, $b=(b_1, b_2, b_3)^T$ and $X= (x, y, z)^T$. Which one of the following is necessarily true about this system of linear equations?

- A) The system has a solution only when det(A)≠0.
- B) the Cramer?s rule is suitable to solve the system if two rows of A are identical
- C) if det(A)≠0 and the second column of A is a multiple of b, then x = 0
- D) if b = 0, then $x=(0, 0, 0)^T$ is the only solution of the system.

40. If $y =\sin(3x^2)$, then the simplified form of $\frac{d^2y}{dx^2}$ is :

- A) $-6\sin(3x^2)$
- B) $\cos(6x) -6\sin(3x^2)$
- C) $6\cos(3x^2) + 36x2\sin(3x^2)$
- D) $x^2\cos(3x^2) + 6\sin(3x^2)$

41. If S is a set with 10 elements and A ⊆ S, what is the probability that A has 3 or more elements?

- A) 7/10
- B) 8/11
- C) 121/128
- D) 7/128

42. If $a_{n=}\left(\frac{n+3}{n+1}\right)^n$, then the limit of the sequence $\{a_n\}_{n=1}^{\infty}$ is equal to :

- A) 1

- B) 1/2 e
- C) e^2
- D) $+\infty$

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

- A) e^6
- B) e^{-3}
- C) $e^{-3/2}$
- D) e^{-6}

44. If a box with square base open top is made from 1,200cm^2 material, what is the largest volume of the box in cm^3 ?

- A) 4000
- B) 8000
- C) 15,000
- D) 3000

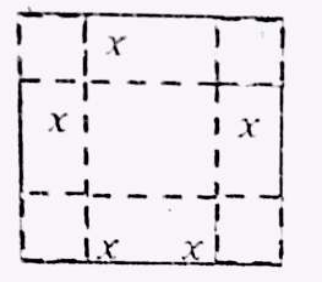
45. Which one of the following is true about the graph of $f(x)=\frac{x^2-1}{x-x^2}$?

- A) x = 0 and x = 1 are its vertical asymptotes.
- B) y = 1 is tis horizontal asymptote
- C) y = x - 1 is its oblique asymptote
- D) it is almost the same as the horizontal line y = -1 as $x \to \pm\infty$

46. Which one of the following is a valid logical argument?

- A) $p \Rightarrow q, q \vdash p$
- B) $p \Leftrightarrow q, p \Rightarrow q \vdash q$
- C) $\neg p \wedge q, \square q \Rightarrow r \vdash r$
- D) $\neg p, p \vee q, r \Rightarrow q \vdash r$

47. Suppose that equal squares are cut from each of the four corners of a square cardboard whose sides are 72 centimetres long. [see the figure below.] The resulting flaps are then folded up to form a box without a top. How long should be each of the four squares that has to be cut off to maximize the volume of the box?



- A) 6cm
- B) 12cm

C) 15cm

D) 24cm

48. What is the area of the region between the graph of $f(x) = -x^2 + 4x - 3$ and the x axis from x = 0 to x = 3?

A) -2/3

B) 2/3

C) 4/3

D) 8/3

49. Which one of the following is equal to $\int \frac{x+\ln(x+1)}{(x+1)^2} dx$?

A) $\ln(x+1) + \frac{x}{x+1} + c$

B) $(x+1)^2 \frac{1}{x+1} + c$

C) $(x+1)^2 - \frac{x}{x+1} + c$

D) $\frac{x\ln(x+1)}{x+1} + c$

50. If $F(x)=f(2x + 2)\, g(1 - x^2)$, with f(2)= -3, f'(2) = 4, g(1)= -5, and g(1) = -5, then what is the actual value of F'(0)?

A) -40

B) -20

C) 0

D) 19

51. Suppose that an airplane is descending at a speed of 50 miles per hour at an angle of 30^0 below the horizontal line. What is the x and y components, respectively of the velocity of the plane in terms of mile?

A) $25\sqrt{3}$, 25

B) -25, $50\sqrt{3}$

C) 25, $-25\sqrt{3}$

D) $-25\sqrt{3}$, -25

52. If a point (2, 5) is reflected under a line to the point(-3, 1), what is the line of reflection?

A) 2x + 3y= 7

B) x + 3y= 7

C) 8y + 10x= 19

D) 2x + 3y + 5= 0

53. Let the equation $x^2 + 2x + y^2 = 8$ represents a circle. Then which one of the following lines cut the circle at exactly two points?

A) 4x + 3y + 19 = 0

B) 3x + 4y + 14 = 0

- C) 2y= 5x + 43
- D) 2x =y - 50

54. Suppose $\vec{A} = 2\vec{\imath} - \vec{\jmath} + 2\vec{k}$ *and* $\vec{B}$ is a vector in space such that $|\vec{B}| = \vec{A}.\vec{B}$ if $\vec{u}$ is the unit vector in the direction of $\vec{B}$, then $|\vec{A} + \vec{u}|^2$ is equal to

- A) 16
- B) 12
- C) 10
- D) 14

55. If A= (-2, 3), B= (3, 1) and C is any other point on the plane, then which one of the following is the coordinate form of $\overrightarrow{AC} - \overrightarrow{BC}$?

- A) (-5, 2)
- B) (5, -2)
- C) (1, 4)
- D) (-1, -4)

56. What is the equation of a line that passes through the point (-1, -2) and parallel to the vector (1, -1)?

- A) 2x - y= 1
- B) x + y - 1 = 0
- C) x - 2y = 3
- D) y - 2x + 1 = 0

57. Suppose P and Q are point in space such that the midpoint of PQ is on the negative z-axis and the distance between P and Q is 6. If P=(2, -1, 0), then what is the coordinate of Q?

- A) (-2, 1, 4)
- B) (2, -1, 6)
- C) (2, -1, -6)
- D) (-2, 1, -4)

58. Which one of the following is equivalent to $\neg\,[(\forall x)(p(x) \Rightarrow Q(x))]$?

- A) $(\forall x)(\neg p(x) \Rightarrow \neg q(x))$
- B) $(\exists x)(\neg p(x) \Rightarrow \neg q(x))$
- C) $(\exists x)(\neg p(x) \wedge q(x))$
- D) $(\exists x)(p(x) \wedge \neg q(x))$

59. An observer on level ground is at a distance $10\sqrt{3}$ m form a building. The angles of elevation to the bottom of the windows on the second and third floors are 30^0 and 60^0, respectively. What is the distance h between the bottoms of the windows?
[you may use the values: $\sin 30^0 = \cos 60^0 = 1/2$ and $\sin 60^0 = \cos 30^0 = \sqrt{3}/2$]

- A) 15m
- B) 20m
- C) $15\sqrt{3}$ m
- D) 32m

60. The following is an assertion of a person and his proof. ?For any natural numbers n, $n! < 10^n$.
Proof:
Step 1 let n=1 Since $1! = 1$ and $10^1 = 10$, it is true that $1! < 10^1$
step 2 let n=2, Since $2! = 2$ and $10^2 = 100$, it is true that $2! < 10^2$
step 3 let n=3, Since $3! = 6$ and $10^3 = 1000$, it is true that $2! \ 10^2$
step 4 continuing in this manner , we can see that whenever $k! < 10^k$ is true, then $(k + 1)! < 10^{k+1}$ is also true.
Therefore, by induction, $n! < 10^n$ for all natural numbers.?
Which one of the following is true about the proof?

- A) The proof is correct by the principle of mathematical induction, though Step 2 and Step 3 can be omitted.
- B) The proof is correct by the principle of mathematical induction; through Step 2 and Step 3 are necessary since they provide additional information.
- C) The proof is invalid because Step 4 did not justify the desired induction step.
- D) The proof follows the technique of a proof by exhaustion.

61. What is the image of the line given by $(x, y) = (-1, 0) + t(3, 6)$, $t \in R$, under the transition that takes (1, 0) to (0, 1) following by the reflection about the line $y = 2x$?

- A) $y = 2x + 3$
- B) $y= 2x - 3$
- C) $y = 2x + 6$
- D) $y = 2x - 5$

62. If $\theta = 2 \arctan (1/2)$, then which one of the following is equal to $\sec(\theta)$?

- A) 35/3
- B) 4/5
- C) 5/3
- D) 5/4

63. If a translation T takes the circle $x^2 + y^2 - 2x + 6y + 3 = 0$ into the circle whose equation is $(x + 2)^2 + (y - 4)^2 = 7$, then what is the image of the origin under T?

- A) (-3, 7)
- B) (1, 2)
- C) (1, -3)
- D) (-2, 4)

64. If L is the line passing through (0, 2) & parallel to $v = \vec{i} + 3\vec{j}$. Which one of the following is true about L and the circle $(x - 2)^2 + (y - 1)^2 = 5$?

- A) L is tangent to the circle at (0, 2)

- B) L is tangent to the circle at some point P, where P ≠ (0, 2).
- C) L intersects the circle at two distinct points.
- D) the distance between L and the centre of the circle is greater than ≠5

65. Suppose $\vec{A} = \overrightarrow{3\imath} - \overrightarrow{4j}\ and \vec{B}$ is a vector in the xy- plane such that the angle between $\vec{A}\ and\ \vec{B}\ is \frac{\pi}{3}$, if $\vec{u}$ is the unit vector in the direction of $\vec{B}$, then $\vec{A}.(\vec{A} - 2\vec{u})$ is equal to:

- A) 20
- B) 5
- C) 15
- D) 30

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