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EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE (EAES)
ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE
EXAMINATION (ESSLCE)
MATHEMATICS FOR NATURAL SCIENCE

BOOKLET CODE: 109

(12)
B.C.D
150-110
SUBJECT CODE: 02

TIME ALLOWED: 3 HOURS

GENERAL DIRECTIONS

12
13
60¹¹
THIS BOOKLET CONTAINS MATHEMATICS EXAMINATION FOR THE NATURAL SCIENCE CANDIDATES ONLY. THE CODE FOR THIS SUBJECT IS 02 AND THE CODE FOR THIS PARTICULAR BOOKLET IS 109. PLEASE COPY THESE CODES ON YOUR ANSWER SHEET WHERE IT READS SUBJECT CODE AND BOOKLET CODE.

IN THIS EXAMINATION, THERE ARE A TOTAL OF 65 MULTIPLE CHOICE ITEMS. CAREFULLY SELECT THE BEST 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 INCLUDING ANSWERS YOU HAVE CHANGED FROM YOUR ANSWER SHEET.

YOU ARE ALLOWED TO WORK ON THE EXAM FOR THREE 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 SCORES.

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 OVER UNTIL YOU ARE TOLD TO DO SO.

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Let p and q be propositions. Which one of the following propositions is equivalent to the proposition $\neg p \vee (p \wedge q)$?

A. $\neg p \vee \neg q$

B. $p \Rightarrow q$

C. $\neg p \wedge q$

D. $\neg p \Rightarrow q$

2. Which one of the following is NOT true about the function $f(x) = \tan^{-1} x$?

A. The line $x = -\frac{\pi}{2}$ is a vertical asymptote to the graph of f .

B. The graph of f is the image of the graph of $y = \tan x$ after it is reflected with respect to the line $y = x$.

C. The graph of f intersects the x -axis at $(0, 0)$.

D. The line $y = \frac{\pi}{2}$ is a horizontal asymptote to the graph of f .

3. Which one of the following statements is true?

A. If x and y are integers and x divides y , then y divides x .

B. If x is an even integer and y is an odd integer, then $x^2 + y^2$ is odd.

C. If x and y are even integers, then $x + y$ is an odd integer.

D. If x and y are positive integers, then $\frac{x}{y}$ is a positive integer.

4. Let p , q and r be propositions. If $\overset{T}{p}$, $\overset{F}{q}$ and $\overset{F}{r}$ are True, False and False respectively, which one of the following propositions has truth value True?

A. $(\overset{T}{p} \wedge \neg \overset{F}{q}) \Leftrightarrow (\overset{T}{p} \vee \overset{F}{r})$

B. $(\overset{T}{q} \wedge \overset{F}{r}) \Leftrightarrow (\overset{T}{p} \wedge \neg \overset{F}{q})$

C. $\overset{T}{p} \Rightarrow (\overset{F}{q} \vee \overset{F}{r})$

D. $(\overset{T}{p} \vee \overset{F}{q}) \Rightarrow \overset{F}{r}$

5. Which one of the following is the equation of the tangent line to the graph of $f(x) = 2x^3 - 4x^2 + 5x + 3$ at the point $(0, 3)$?

A. $3x + 5y - 3 = 0$

B. $3x - 5y - 3 = 0$

C. $5x - y + 3 = 0$

D. $5x + y + 3 = 0$

$$\frac{y-3}{x} = 5$$

$$y-3 = 5x$$

$$5x - y + 3 = 0$$

6. Let $\vec{v} = \vec{AB}$ and $\vec{w} = \vec{CD}$ be vectors in the plane, where $A(1, -1)$, $B(2, -2)$, $C(-1, 3)$ and $D(4, -3)$. Which one of the following is equal to $\vec{v} - \vec{w}$?

A. $5\vec{i} - 6\vec{j}$

B. $\vec{i} - 15\vec{j}$

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

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

$$\vec{v} = \begin{pmatrix} 2-1 \\ -2-(-1) \end{pmatrix} = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$$

$$\vec{w} = \begin{pmatrix} 4-(-1) \\ -3-3 \end{pmatrix} = \begin{pmatrix} 5 \\ -6 \end{pmatrix}$$

$$\vec{v} - \vec{w} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} - \begin{pmatrix} 5 \\ -6 \end{pmatrix} = \begin{pmatrix} -4 \\ 5 \end{pmatrix}$$

7. Which one of the following is true about the graph of the function $f(x) = 4 \sin \frac{2}{3}x$?

A. The amplitude of the graph of f is 8.

B. The maximum value of the function is 4.

C. The range of the function is $[-\frac{2}{3}, \frac{2}{3}]$ D. The period of the graph of f is $\frac{2}{3}$.

$$\frac{2\pi}{\frac{2}{3}} = 3\pi$$

8. Let $z_1 = 1 + 2i$ and $z_2 = 2 - 2i$ be complex numbers. Which one of the following is equal to $\frac{z_1}{z_2}$?

A. $\frac{1}{4} - \frac{3}{4}i$

B. $-\frac{1}{4} + \frac{3}{4}i$

C. $\frac{1}{8} + \frac{1}{4}i$

D. $\frac{1}{8} - \frac{1}{4}i$

$$\frac{(1+2i)(2+2i)}{(2-2i)(2+2i)}$$

$$\frac{2+2i+4i+4}{4-4i^2}$$

$$\frac{6+6i}{4-(-4)}$$

$$\frac{6+6i}{8}$$

$$\frac{1+2i}{2-2i} \times \frac{2+2i}{2+2i}$$

$$\frac{2+2i+4i+4}{4-4i^2}$$

$$\frac{6+6i}{8}$$

9. Let $z_1 = (3 - 4i)$ and $z_2 = -4 + 3i$ be complex numbers. Which one of the following is equal to $|z_1 - z_2|$?

A. $7 - 7i$

C. $1 - i$

B. $-7 + 7i$

D. $-1 + i$

D 10

- Let $f(x) = x^2 + 2x - 5$. What is the meaning of the value $\frac{f(3) - f(1)}{3 - 1}$?

It is the slope of the tangent line to the graph of f at:

A. $(2.5, f(2.5))$.

C. $(1, f(1))$.

B. $(3, f(3))$.

D. $(2, f(2))$.

$2x + 2 = 6$

11. If θ is the principal argument of the complex number $z = 4 + 3i$, which one of the following is equal to $\tan \theta$?

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

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

B. $\frac{4}{5}$

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

12

- Let p, q, r and s be propositions. Which one of the following defines that the argument form $[p, q, r \vdash s]$ is a valid argument?

A. If $p \wedge (q \wedge r)$ is true, then s is true. ✓

B. If $p \wedge (q \vee r)$ is true, then s is true. ✓

C. If $p \vee (q \wedge r)$ is true, then s is true. ✓

D. If $p \vee (q \vee r)$ is true, then s is true. ✓

T.V.T

13. Let A and B be two nonempty sets. Which one of the following is true about an ~~onto~~ function $f: A \rightarrow B$?

A. For any $x \in A$, there exists $y \in B$ such that $f(y) = x$. ~~x~~

B. For $x, y \in A$, if $f(x) = f(y)$, then $x = y$. ~~x~~

C. The range of f is a proper subset of B . ✓

D. For any $y \in B$, there exists $x \in A$ such that $f(x) = y$. ✓

14. Which one of the following is the standard form of equation of a parabola with vertex $V(1, -4)$ and focus $F(1, 4)$?

A. $(x-1)^2 = 16(y+4)$

C. $(x-1)^2 = 32(y+4)$

B. $(x-1)^2 = 16(y-4)$

D. $(x-1)^2 = 32(y-4)$

15. Which of the following is the value of the tangent of the angle between the lines $\ell_1: 3x+2y=3$ and $\ell_2: 2x+3y=1$ measured counterclockwise from ℓ_1 to ℓ_2 ?

A. $\frac{5}{12}$

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

B. $-\frac{5}{12}$

D. $-\frac{5}{6}$

16. Let " $p(n)$: For any natural number n , $n^2+3n+33$ is divisible by 3." We can show that $p(1)$ is false. What kind of proof have we used?

A. Proof by contrapositive

C. Proof by contradiction

B. Proof by counter example

D. Proof by direct proof

17. Which one of the following is true about a right angled triangle $\triangle ABC$ with right angle at B?

A. $\cot(\angle ACB) = \frac{BC}{AB}$

C. $\sec(\angle BAC) = \frac{AB}{AC}$ ~~x~~

B. $\sin(\angle BAC) = \frac{AC}{BC}$ ~~x~~

D. $\csc(\angle BCA) = \frac{BC}{AC}$



$\frac{1}{\cos A} = \frac{AC}{AB}$

$\frac{1}{\tan C} = \frac{AB}{BC}$

$\frac{1}{\tan C} = \frac{AB}{BC}$

$\frac{1}{\sec A} = \frac{AB}{AC}$

18. Which one of the following is true about a rigid motion?
- A. Reflection is an example of a rigid motion.
 - B. A rotation by 180 degree is the identity rotation.
 - C. A rigid motion carries an isosceles triangle to a scalene triangle.
 - D. Every rigid motion preserves orientation of plane figures.

19. Consider the sequence defined by $a_1 = a_2 = 1$ and $a_n = a_{n-1} + a_{n-2}$ for $n \geq 3$. Which one of the following is equal to a_{15} ?
- $a_2 + a_1$
- A. 377
 - B. 233
 - C. 987
 - D. 610

20. A radioactive substance of 1024 grams loses half of its weight per year. What is the weight of the substance that will be left at the end of the ninth year?

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

512
 $G_1 = 512 \left(\frac{1}{2}\right)^{n-1}$

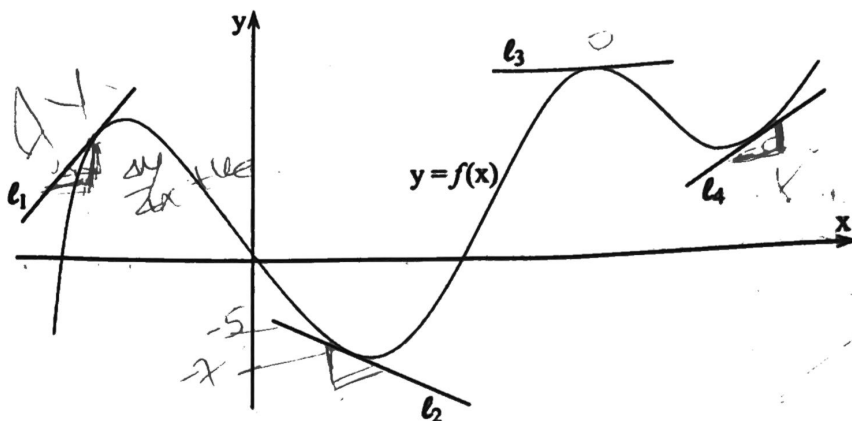
$= \frac{512}{2} = 256$

256

$r = \frac{1}{2}$

$2 \times 2 \times 2 \times 2$
 16
 256

21. The following figure is the graph of a function f and lines l_1 , l_2 , l_3 and l_4 are tangent to the graph of f at the indicated points.



Which one of the following is true about the slopes l_1 , l_2 , l_3 and l_4 ?

- A. The slope of l_3 negative. $\times$
 B. The slope of l_4 positive. $\checkmark$
 C. The slope of l_1 is negative $\times$
 D. The slope of l_2 is positive $\times$

$$\frac{1}{2\sqrt{4-x}} = \frac{f'(x)}{1} = \frac{1}{1+1}$$

22. What is the value of $\lim_{x \rightarrow 0} \frac{\sqrt{4-x}-2}{x^2-x}$?

- A. $\frac{1}{4}$
 B. $-\frac{1}{4}$
 C. $\frac{1}{8}$
 D. $-\frac{1}{8}$

23. Which one of the following is the distance between the points $P(1, -1, 2)$ and $Q(3, 1, -1)$ in space?

- A. 7 units
 B. 17 units
 C. $\sqrt{7}$ units
 D. $\sqrt{17}$ units

$$\sqrt{4 + 4 + 9}$$

24. Which one of the following numbers satisfies the Rolle's Theorem for the function $f(x) = \frac{1}{4}x^4 - 2x^2$ on the closed interval $[-3, 3]$?

A. 3

C. 1

B. 4

D. 2

$$f(x) = \frac{1}{4}x^4 - 2x^2$$

$$f'(x) = x^3 - 4x = 0$$

$$x(x^2 - 4) = 0$$

25. An object was fired upward from the top of a building and its height (in meters) at time t (in seconds) is given by $h(t) = -2t^2 + 26t + 50$. Which one of the following is the instantaneous velocity of the object at $t = 5$ seconds?

A. -6m/sec C. 6m/sec B. -26m/sec D. 26m/sec

$$h(t) = -2t^2 + 26t + 50$$

$$h'(t) = -4t + 26$$

$$h'(5) = -4(5) + 26$$

$$= -20 + 26$$

$$= 6$$

26. Let $f(x) = x^3 + 2x^2 - 3$. Which one of the following is true about f ?

A. f is increasing on $(0, \infty)$ ✓C. f is increasing on $(-\frac{4}{3}, 0)$ ✗B. f is decreasing on $(\frac{4}{3}, \infty)$ ✗D. f is decreasing on $(-\infty, -\frac{4}{3})$ ✓

27. Which one of the following is equal to $\int \cos(3x+5)dx$?

A. $\frac{\sin(3x+5)}{3} + c$ C. $5\sin(3x+5) + c$ B. $\frac{\sin(3x+5)}{5} + c$ D. $3\sin(3x+5) + c$

$$f'(x) = 3x^2 + 4x = 0$$

$$x(3x+4) = 0$$

$$x = 0 \text{ or } x = -\frac{4}{3}$$

$$3 \left(\frac{16}{9} \right) - \frac{16}{3}$$

$$3(36) - 24$$

$$\frac{\sin(3x+5)}{3}$$

28. Which one of the following is equal to $\int 3x^2(x^3+2)^4 dx$?

A. $\frac{x^3(x^3+2)^5}{15} + c$

C. $\frac{(x^3+2)^5}{5} + c$

B. $15x^3(x^3+2)^5 + c$

D. $5(x^3+2)^5 + c$

$G_n = 10^{-3}(10)^{n-1}$

29. Let f and g be continuous functions on an interval I . If $\int f(x) dx = F(x)$ and $\int g(x) dx = G(x)$ on I , which one of the following expressions is true?

A. $\int (f+g)(x) dx = (F+G)(x)$ ✓

C. $\int (fg)(x) dx = (FG)(x)$ ✗

B. $\int \left(\frac{f}{g}\right)(x) dx = \frac{F(x)}{G(x)}$ ✗

D. $\int (2f)(x) dx = \frac{F(x)}{2}$ ✓

30. What is the sum of the first 7 terms of a sequence defined by $G_n = 10^{n-4}$ for $n = 1, 2, 3, \dots$?

A. 1111.001

C. 1111.111

B. 1111.101

D. 1110.111

$10^{-3}, 10^{-2}, 10^{-1}, 1, 10, 10^2, 10^3$

$r = 10$

31. Which one of the following is the greatest lower bound of the sequence $\left\{ \frac{2n-3}{3n+2} \right\}$?

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

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

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

D. $-\frac{1}{5}$

$u = x^3 + 2$

$\frac{du}{dx} = 3x^2$

$S_n = \frac{G_1(1-r^n)}{1-r} = \frac{10^{-3}(1-10^7)}{1-10}$

$10000000000 = 10^{-3} \frac{1-10^7}{-9(10^3)} = \frac{1-10^7}{-9000}$

$\frac{9999999}{9000} =$

32. Let $\mathbf{v} = \overrightarrow{AB}$ and $\mathbf{w} = \overrightarrow{CD}$ be vectors in the plane where $A(-1, 2)$, $B(2, 1)$, $C(3, 1)$ and $D(4, -3)$. Which one of the following is equal to the scalar (or dot) product of $\mathbf{v}$ and $\mathbf{w}$?

A. 7

C. 5

B. 8

D. 3

33. Let $M = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 3 & 4 \\ -1 & -1 & 2 \end{pmatrix}$. Which one of the following is the $\det(M)$?

A. -10

C. 30

B. 0

D. 10

34. Let $M = \begin{pmatrix} 2 & -8 & -4 \\ 0 & 2 & 0 \\ 6 & -4 & 10 \end{pmatrix}$. Which one of the following is equal to $\frac{1}{2}M$?

A. $\begin{pmatrix} 1 & -8 & -4 \\ 0 & 2 & 0 \\ 3 & -4 & 10 \end{pmatrix}$

C. $\begin{pmatrix} 1 & -4 & -2 \\ 0 & 2 & 0 \\ 6 & -4 & 10 \end{pmatrix}$

B. $\begin{pmatrix} 1 & -4 & -2 \\ 0 & 1 & 0 \\ 3 & -2 & 5 \end{pmatrix}$

D. $\begin{pmatrix} 1 & -8 & -4 \\ 0 & 1 & 0 \\ 6 & -4 & 5 \end{pmatrix}$

Use the Following Frequency Table to Answer Question 35 and 36.

The following table depicts ranges of the marks that Grade 12 students of a certain school scored in Mathematics Final Examination.

Table

Scores of Students	Number of Students
0-10	13
11-20	28
21-30	40
31-40	55
41-50	80

35. Which one of the following is the fourth decile of the data given in Table?

- A. 24.17
B. 26.33
C. 23.83
D. 25.37

36. Which of the following is true about the given data in Table?

- A. The class midpoint of the third class of the given data is 25.5.
B. The lower class boundary of the fifth class is 41.
C. The lower class limit of the second class is 10.5.
D. The class interval of the given data is 50.

37. Let A, B and C be three exhaustive and mutually exclusive events of a random experiment and S be the sample space of the given experiment. Which one of the following is true?

- A. $A \cap B \cap C = S$
B. $A \cap B = S \cup C$
C. $A \cup B \cup C = S$
D. $A \cup B = S \cup C$

P-D 7

17-07P

38. Which one of the following is the contrapositive of the statement "If x is an even natural number, then x is divisible by 2"?

- A. If x is a natural number that is not divisible by 2, then x is not even
 B. If x is an even natural number, x is NOT divisible by 2.
 C. If x is a natural number divisible by 2, then x is even
 D. If x is not an even natural number, then x is not divisible by 2

39. Let $P(n, r)$ be the number of permutation of n objects taking r at a time and $C(n, r)$ be the number of ways of selecting r objects from a set of n objects without considering the order of selection. Which of the following is true?

- A. $C(10, 4) = P(10, 4) 4!$ ~~X~~ C. $C(10, 5) = P(10, 5) 5!$
 B. $P(10, 4) = P(10, 4) 4!$ ~~X~~ D. $P(10, 5) = C(10, 5) 5!$

40. Let $f(x) = 2 \sin\left(\frac{1}{2}x\right)$. Which one of the following is equal to $f^{(5)}(x)$?

- A. $-\frac{1}{16} \sin\left(\frac{1}{2}x\right)$ C. $\frac{1}{16} \sin\left(\frac{1}{2}x\right)$
 B. $-\frac{1}{16} \cos\left(\frac{1}{2}x\right)$ D. $\frac{1}{16} \cos\left(\frac{1}{2}x\right)$

41. Which one of the following is the derivative of the function $f(x) = \frac{x^2 e^x}{x+1}$?

- A. $\frac{(2x + 2x^2 + x^3)e^x}{(x+1)^2}$ C. $\frac{(2x + x^2)e^x}{(x+1)^2}$
 B. $\frac{(2x + 2x^2 + x^3)e^x}{x^2 + 1}$ D. $\frac{(2x + x^2)e^x}{x^2 + 1}$

$$f'(x) = 2 \cos\left(\frac{1}{2}x\right) \cdot \frac{1}{2} = \cos\left(\frac{1}{2}x\right)$$

$$f''(x) = -\sin\left(\frac{1}{2}x\right) \cdot \frac{1}{2} = -\frac{1}{2} \sin\left(\frac{1}{2}x\right)$$

$$f'''(x) = -\frac{1}{2} \cos\left(\frac{1}{2}x\right) \cdot \frac{1}{2} = -\frac{1}{4} \cos\left(\frac{1}{2}x\right)$$

42. Which one of the following is the maximum value of the function $f(x) = \frac{1}{3}x^3 - x$ on the closed interval $[0, 3]$? $f'(x) = x^2 - 1$

A. $-\frac{2}{3}$

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

B. 6

D. 9

$2x^3 - 8x$

$\frac{x^4}{4} - 8x^2$

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

$\frac{1}{2} - \frac{8}{2}$

$f(0) = 0$

$f(1) = -\frac{2}{3}$

$f(3) = -\frac{2}{3}$

43.

What is the derivative of the function $f(x) = \ln(\sqrt{x^2+1})$?

$\frac{2x}{2\sqrt{x^2+1}}$

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

$0 - (-\frac{1}{2}) = \frac{1}{2}$

C. $\frac{x}{x^2+1}$

B. $\frac{2x+1}{2x^2+1}$

$\frac{16}{2} - \frac{16}{2} = -\frac{16}{2}$

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

$x^3 = x^4$

$x^2 = 4$
 $x = \pm 2$

44. What is the area of the region enclosed by the graph of the function $f(x) = 2x^3$ and the line $y = 8x$ between the vertical lines $x = -1$ and $x = 2$?

A. 11.5 square units

C. 12.5 square units

B. 16 square units

D. 32 square units

$\int_{-1}^0 2x^3 dx + \int_0^2 8x dx$

$\frac{2}{2} + \frac{16}{2} = 23/2$

$-\frac{1}{2} + \frac{1}{2} = 0$

45. Let a and b be real numbers and $a < b$. Let f be a continuous function on $[a, b]$ and F be an antiderivative of f . Which one of the following is true?

A. $\int_a^b f(x) dx = F(a) - F(b)$ ✗

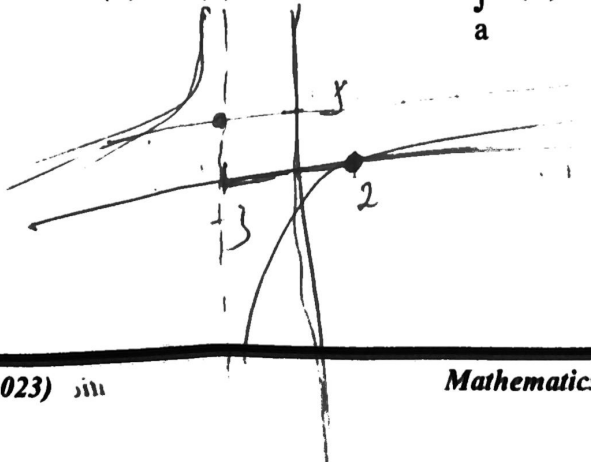
C. $\int_a^b F(x) dx = f(b) - f(a)$ ✗

B. $\int_a^b f(x) dx = F(b) - F(a)$ ✓

D. $\int_a^b F(x) dx = f(a) - f(b)$

$\frac{x-2}{x+3} = 0$

$\frac{-5}{1} = -5$



46. Which one of the following is true in a standard coordinated space?
- A. The intersection of the z-axis and the x-axis is the yz-plane.
 - B. The intersection of the xz plane and the xy-plane is the xz-plane.
 - C. The x-axis and the y-axis determine the xy-plane
 - D. The y-axis and the z-axis determine the xz-plane.

Suppose S and T can complete a job in two hours if they can work together. T needs 3 more hours than S to complete the job. If T works alone, in how many hours can he complete the job?

- A. 3 hours
- B. 6 hours
- C. 9 hours
- D. 12 hours

$$\frac{1}{T} + \frac{1}{S} = \frac{1}{2}$$

48. Which one of the following points is the intersection point of the line $l: 3x - 2y + 4 = 0$ and the circle $C: x^2 + y^2 - 2x - 4y - 5 = 0$?

- A. $(-4, -4)$
- B. $(2, 5)$
- C. $(4, 8)$
- D. $(-2, -1)$

$$\frac{1}{T} + \frac{1}{T+3} = \frac{1}{2}$$

$$\frac{T+3+T}{T^2+3T} = \frac{1}{2}$$

$$2(2T+3) = T^2+3T$$

$$4T+6 = T^2+3T$$

$$T^2-T+6=0$$

49. What is the range of the function $f(x) = 1 - |x|$?

- A. $(-\infty, 1]$
- B. $(-\infty, -1]$
- C. $[-1, \infty)$
- D. $[1, \infty)$

50. Which one of the following is NOT true about the graph of the function

$$f(x) = \frac{x^2 - 4}{x^4 + 5x^2 + 6}$$

$$\frac{(x+2)(x-2)}{(x+3)(x+2)}$$

- A. The graph of f is symmetric with respect to the y-axis.
- B. The graph of f is symmetric with respect to the origin.
- C. The x-intercepts of the graph of f are $(-2, 0)$ and $(2, 0)$
- D. The y-intercept of the graph of f is $(0, -\frac{2}{3})$

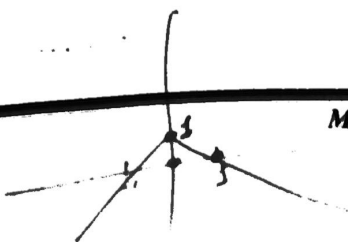
$$T = \frac{-3}{2}$$

$$(T-3)(T+2) = 0$$

$$T = 3 \text{ or } T = -2$$

$$1-x \times 2 = 0$$

$$1+x \times 2 = 0$$



51. Consider the ellipse defined by the equation $\frac{x^2}{25} + \frac{y^2}{16} = 1$. Which one of the following is true about the ellipse?
- A. The eccentricity of the ellipse is $\frac{3}{5}$. ✓
- B. The length of a latusrectum the ellipse is 9 units. ✗
- C. The length of its major axis is 50 units ✗
- D. The length its minor axis is 32 units ✗
- Handwritten notes: $a=5$, $b=4$, $b^2 + e^2 = a^2$, $c^2 = 25 - 16$, $c^2 = 9$, $c = 3$, $\frac{16}{10} = 8/5$

52. Which one of the following is the limit of the sequence $\left\{ \frac{2n^2 - 3n + 4}{2 - 5n - 6n^2} \right\}$?
- A. $\frac{1}{3}$
- B. $\frac{2}{3}$
- C. $-\frac{1}{3}$
- D. $-\frac{2}{3}$
- Handwritten note: $\frac{2}{-6} = -\frac{1}{3}$

53. Which one of the following is the augmented matrix of the system of linear equations given by
- $$\begin{cases} x - y + z - 1 = 0 \\ 3x - 2y + 2z + 3 = 0 \\ 2x + 3y - 4z - 2 = 0 \end{cases}$$

A. $\begin{pmatrix} 1 & -1 & 1 & 0 \\ 3 & -2 & 2 & 0 \\ 2 & 3 & -4 & 0 \end{pmatrix}$

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

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

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

54.

Let $M = \begin{pmatrix} -1 & 2 & 1 \\ 0 & 1 & 0 \\ 1 & 3 & -2 \end{pmatrix}$

Which one of the following is equal to M^{-1} ?

A. $\begin{pmatrix} -2 & 5 & -1 \\ 0 & 1 & 0 \\ -1 & 3 & -1 \end{pmatrix}$

B. $\begin{pmatrix} -2 & 5 & 1 \\ 0 & 1 & 0 \\ -1 & 3 & 1 \end{pmatrix}$

C. $\begin{pmatrix} -2 & 5 & -1 \\ 0 & 1 & 0 \\ -1 & 3 & 1 \end{pmatrix}$

D. $\begin{pmatrix} -2 & 5 & 1 \\ 0 & 1 & 0 \\ -1 & 3 & -1 \end{pmatrix}$

$(3, -2)$

$(6, 2)$

$-1 \cdot -1 = 1$
 $\oplus -1$

$r^2 = 9 + 16 = 25$

55.

Let $\vec{C} = 3\mathbf{i} - 2\mathbf{j}$ and $\vec{P} = 6\mathbf{i} + 2\mathbf{j}$ be the position vectors of the center C of a circle and a point P on the circle respectively. Which one of the following is an equation of the circle?

A. $x^2 + y^2 + 6x - 4y - 12 = 0$

B. $x^2 + y^2 + 6x - 4y + 12 = 0$

C. $x^2 + y^2 - 6x + 4y - 12 = 0$

D. $x^2 + y^2 - 6x + 4y + 12 = 0$

$(x-3)^2 + (y+2)^2 = 25$
 $x^2 + y^2 - 6x + 4y + 13 = 0$
 $x^2 + y^2 - 6x + 4y - 12 = 0$

56.

Let P be a point in the coordinated space. If P is located 3 units in the direction of negative x-axis from the origin, 1 unit in the direction of positive y-axis from the origin and 2 units in the direction of positive z-axis from the origin, which one of the following ordered triple of numbers represent point P?

A. $(3, -1, 2)$

B. $(3, 1, -2)$

C. $(3, -1, -2)$

D. $(-3, 1, 2)$

$-3, 1, 2$

57. Let A and B be two nonempty sets and $f : A \rightarrow B$ be a function. Which one of the following is a sufficient condition so that f has an inverse function?
- f has to be a 1-1 correspondence.
 - The range of f is B.
 - f is a one to one function
 - f is an on to function.

58. Let f and g be two real valued function of the real variable and c be a real number. If $\lim_{x \rightarrow c} f(x) = 2$ and $\lim_{x \rightarrow c} g(x) = -3$, which one of the following is true?

- $\lim_{x \rightarrow c} (f \cdot g)(x) = 6$
- $\lim_{x \rightarrow c} \left(\frac{f}{g} \right)(x) = -\frac{2}{3}$
- $\lim_{x \rightarrow c} (f + g)(x) = 5$
- $\lim_{x \rightarrow c} (f - g)(x) = -1$

59. Let f be a function defined by $f(x) = \begin{cases} 3 - bx^2, & \text{for } x \geq 1 \\ ax, & \text{for } -1 < x < 1 \\ ax^2 + b, & \text{for } x \leq -1 \end{cases}$

$$\begin{aligned} 3 - b &= a \\ -a &= a + b \\ 3 &= a + b \\ -2a &= b \end{aligned}$$

What are the values of a and b so that f is continuous on the whole real line?

- $a = -3$ and $b = 6$
- $a = 3$ and $b = -6$
- $a = 3$ and $b = 6$
- $a = -3$ and $b = -6$

$$\begin{aligned} -2a &= 3 - a \\ -2a + a &= 3 \\ -a &= 3 \\ a &= -3 \end{aligned}$$

Which one of the following is true about a given data?

- The heights of students in a school is a continuous data.
- The family size of households in a village is a continuous data.
- The number of participants in a meeting is a discrete data.
- The number of people who are members of a club is a continuous data.

61. Let $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$. Which one of the following is true about minors and cofactors of entries of A?

- A. The minor of the entry 5 is 12. $\times$
 B. The cofactor of the entry 7 is 3. $\times$
 C. The minor of the element 9 is 3. $\times$
 D. The cofactor of the element 6 is 6. $\checkmark$

62. Consider the following system of linear equations:

$$\begin{cases} x + y = 0 \\ y + z = 1 \\ x + z = 0 \end{cases} \quad \begin{array}{l} x = -y \\ y + z = 1 \\ -y + z = 0 \end{array} \quad \begin{array}{l} 2z = 1 \\ z = \frac{1}{2} \end{array}$$

Which one of the following is the solution set of the given system of linear equations?

A. $\left\{ \begin{pmatrix} \frac{1}{2} \\ -\frac{1}{2} \\ \frac{1}{2} \end{pmatrix} \right\}$

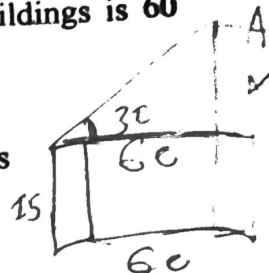
C. $\left\{ \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix} \right\}$

B. $\left\{ \begin{pmatrix} -\frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{2} \end{pmatrix} \right\}$

D. $\left\{ \begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix} \right\}$

63. The angle of elevation from the top of a building of height 15 meters to the top of building A is 30° . If the distance between the two buildings is 60 meters, what is the height of building A?

- A. $20\sqrt{3}$ meters
 B. $(20\sqrt{3} + 15)$ meters
 C. $60\sqrt{3}$ meters
 D. $(60\sqrt{3} + 15)$ meters



64. Which one of the following is the coefficient of x^5y^6 in the expansion of $(x+y)^{11}$?

- A. $\frac{11!}{6!5!}$
 B. $\frac{11!}{5!6!}$
 C. $\frac{11!}{5!}$
 D. $\frac{11!}{6!}$

$$C_r^n x^r y^{n-r}$$

$$C_6^{11} \frac{11!}{6!5!}$$

$$\tan \theta = \frac{x}{60}$$

$$\frac{1}{2} \cdot \frac{1}{\sqrt{3}}$$

$$\frac{1}{\sqrt{3}} = \frac{x}{60}$$

$$x = \frac{60}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}}$$

65. Let f and g be two continuous functions on closed interval $[a, b]$, k be a constant and c be a real number between a and b . Which one of the following is **NOT** true about the functions f and g ?

- A. $\int_a^b f(x) dx = - \int_b^a f(x) dx$ ✓
 B. $\int_a^b f(x) dx = \int_c^b f(x) dx - \int_a^c f(x) dx$ ✗
 C. $\int_a^b (kf)(x) dx = k \int_a^b (f)(x) dx$ ✓
 D. $\int_a^b (f+g)(x) dx = \int_a^b f(x) dx + \int_a^b g(x) dx$ ✓

C

$$\frac{60\sqrt{3}}{3}$$

$$20\sqrt{3}$$

THE END