Natural

EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE

(EAES)

ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)

MATHEMATICS FOR NATURAL SCIENCE, TIKIMT 2014/15 (NOVEMBER 2022)

BOOKLET CODE: 059

SUBJECT CODE: 02

TIME ALLOWED: 3:00 HOURS

GENERAL DIRECTIONS

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 **059**. PLEASE COPY THESE CODES ON YOUR ANSWER SHEET WHERE IT READS ***BOOKLET CODE*** AND ***SUBJECT CODE***. THEN, BLACKEN THE CORRESPONDING BOXES IN THE COLUMNS BELOW EACH NUMBER.

IN THIS EXAMINATION THERE ARE A TOTAL OF **65 MULTIPLE CHOICE ITEMS**. CAREFULLY SELECT THE BEST ANSWER FROM THE SUGGESTED OPTIONS AND BLACKEN ONLY THE LETTER OF YOUR CHOICE ON THE SEPARATE ANSWER SHEET PROVIDED. FOLLOW THE INSTRUCTIONS ON THE EXAMINATION PAPER AND THE ANSWER SHEET 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 **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

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ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION (ESSLCE)
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BOOKLET CODE: 059 **SUBJECT CODE: 02**
Number of Items: 65 **Time Allowed: 3 hours**

1. Consider the points A(−2, 1), B(3, 0), C(3, −1) and D(1, 1) in xy-plane. If $u = \overrightarrow{AB}$ and $v = \overrightarrow{CD}$, then which one of the following is equal to $u - v$?

A. (3, 1) C. (−3, 1)

B. (−7, 3) D. (7, −3)

2. Which one of the following is the derivative of $f(x) = \tan x + 3^x$?

A. $-\tan x + 3^x \ln x$ C. $\sec^2 x + 3^x \ln x$

B $\sec^2 x + 3^x$ D. $-\csc^2 x + 3^x \ln x$

3. Given matrices $A = \begin{pmatrix} 2 & 0 & 5 \\ 3 & 1 & 4 \\ 0 & 6 & -2 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 3 & 0 \\ 6 & 5 & 2 \\ 9 & 7 & 0 \end{pmatrix}$. Which one of the following is A − B?

A. $\begin{pmatrix} 1 & 3 & 5 \\ -3 & -4 & -2 \\ -9 & 1 & 2 \end{pmatrix}$ C. $\begin{pmatrix} 1 & 3 & 5 \\ -3 & -4 & 2 \\ 9 & 1 & 2 \end{pmatrix}$

B. $\begin{pmatrix} 1 & -3 & 5 \\ -3 & -4 & 2 \\ -9 & -1 & -2 \end{pmatrix}$ D. $\begin{pmatrix} 1 & -3 & -5 \\ -3 & -4 & 2 \\ 9 & 1 & 2 \end{pmatrix}$

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4. What is the dot (scalar) product of the vectors $u = i + 2j$ and $v = -2i + 4j$?

A. -8 C. 6

B. 5 D. 7

5. Which one of the following quantities represents a vector?

A. Volume of a box C. Weight of an object

B. The width of your bedroom D. Speed of a motorbike

6. What is the image of the circle with equation $(x + 2)^2 + (y - 2)^2 = 1$, when it is rotated through $\frac{\pi}{6}$ about the origin?

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

B. $(x - (\sqrt{3} + 1))^2 + (y + (\sqrt{3} - 1))^2 = 1$

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

D. $(x - (\sqrt{3} - 1))^2 + (y + (\sqrt{3} + 1))^2 = 1$

7. The radian measure of an angle of 120° is equal to:

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

B. $\frac{\pi}{8}$ D. $\frac{\pi}{4}$

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8. Which one of the following is **true**?

A. The range of arctangent function is $[-\pi, \pi]$.
B. The range of arcsine function is $(-\infty, \infty)$.
C. The domain of arccosine function is $[-1, 1]$.
D. The domain of arcsine function is $[0, \pi]$.

9. What are the quotient and remainder respectively, when 75 is divided by 20?

A. 15 and 3
B. 2 and 19
C. 3 and 15
D. 4 and 5

10. In rolling a fair die, what is the probability of obtaining 3 or 5?

A. $\frac{1}{4}$
B. $\frac{1}{3}$
C. $\frac{1}{2}$
D. $\frac{1}{6}$

11. Which of the following is the measure of an exterior angle of a 10 sided regular polygons?

A. 180°
B. 36°
C. 72°
D. 144°

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12. If $f(x) = x^2 + px + 1$ where $f(0)$ and $f(1)$ have opposite signs so that f has a root in (0, 1), then which one of the following number is a possible value p?

A. 2
B. 3
C. −3
D. −2

13. If the volume of a right circular cone is $64\pi\ cm^3$ and the diameter of its base is 8cm, what is the height of the cone?

A. 12cm
B. 4cm
C. 3cm
D. 8cm

14. Let $R = \{(x, y) | y \geq x^2 + 1 \text{ and } y \leq 5\}$ be a relation. Then which one of the following defines the inverse of R?

A. $\{(x, y) | x \leq y^2 + 1, x \geq 5\}$
B. $\{(x, y) | x \geq y^2 - 1, x \leq 5\}$
C. $\{(x, y) | x \geq y^2 + 1, x \leq 5\}$
D. $\{(x, y) | x \geq y^2 + 1, x \geq 5\}$

15. What is the surface area of a sphere with radius 6 cm?

A. $36\pi\ cm^2$
B. $24\pi\ cm^2$
C. $144\pi\ cm^2$
D. $48\pi\ cm^2$

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16. What is the locus all points in the plane in which the sum of the distances from two fixed points is constant?

A. Ellipse
B. Circle
C. Hyperbola
D. Parabola

17. A line segment chord in an ellipse which passes through the center and perpendicular to the major axis is called:

A. Minor axis
B. Semi-major axis
C. Latus rectum.
D. Eccentricity

18. The distance from the point P(3, 4) to the line L with equation: $3x + 4y - 5 = 0$ is _____.

A. 6 units
B. 5 units
C. 7 units
D. 4 units

19. The angle of depression of the top of a flag pole from the top of a building that is $40\sqrt{3}$ m away from the flag pole is 30°. If the height of the flag pole is 10m, what is the height of the building?

A. $20\sqrt{3}$ m
B. $10(4\sqrt{3}+1)$ m
C. 50 m
D. 40 m

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20. Suppose f is a continuous function on an interval [a, b] and differentiable on (a, b) with the property f(a) = f(b). Which one of the following must be true?

A. The function has maximum value in (a, b).

B. The graph of f has horizontal tangent line at $(c, f(c))$ for some $c \in (a, b)$.

C. The function has a zero in (a, b).

D. The function has minimum value in (a, b).

21. Let f be a continuous function on $\mathbb{R}$ and c be a number in the domain of f. Which one of the following must be true about the function?

A. If $f(c)$ is a local minimum value of f, then $f'(c) = 0$.

B. An absolute maximum value of f which is attained at a critical number is also a local maximum value of f.

C. If c is a critical number of f, then $f(c)$ is a local extreme value of f.

D. If $f''(c) = 0$, then $(c, f(c))$ is an inflection point of f.

22. If the perimeter of a rectangle is 120 m, what are the length l and width w of the rectangle that maximizes its area?

A. $l = 35$ m and $w = 25$ m

B. $l = 40$ m and $w = 20$ m

C. $l = 50$ m and $w = 10$ m

D. $l = 30$ m and $w = 30$ m

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23. Which one of the following trigonometric values is correct?

A. $\tan(-120^\circ) = -1$

B. $\cos(-60^\circ) = \frac{\sqrt{3}}{2}$

C. $\sin(-120^\circ) = 0.5$

D. $\cos(-120^\circ) = -0.5$

24. What are the coordinates of a point that divides the line segment with end points P(0, 1) and Q(5, 6) in the ratio 2:3 from P?

A. (3, 2)

B. (0, 3)

C. (2, 3)

D. (0, 2)

25. Which one of the following intervals is the solution set of the inequality $x^2 - 5x + 6 \leq 0$?:

A. $[3, \infty)$

B. $(-\infty, 2]$

C. [0, 2]

D. [2, 3]

26. The solution set of the equation given by $\log(x^2 - 3) = 2\log(x - 1)$ is:

A. {2}

B. $\left\{\frac{1}{2}\right\}$

C. ϕ

D. {4}



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27. Which of the following is true about the trigonometric values of the given pairs of angles?

A. $\sin(75^\circ) = \cos(105^\circ)$
B. $\tan(75^\circ) = \tan(105^\circ)$
C. $\sin(120^\circ) = \sin(60^\circ)$
D. $\cos(120^\circ) = \cos(60^\circ)$

28. Which one of the following is the simplified form of $\frac{4x^4 - 64}{2 - x}$ for $x \neq 2$?

A. $4(x - 2)(x^2 - 4)$
B. $4(x + 2)(x^2 + 4)$
C. $-4(x - 2)(x^2 + 4)$
D. $-4(x + 2)(x^2 + 4)$

29. Which one of the following is an onto function from $\mathbb{R}$ on to $[0, \infty)$?

A. $f(x) = |x| + 2$
B. $f(x) = \sqrt{x^2}$
C. $f(x) = 2^x$
D. $f(x) = x^2 + 1$

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30. Which one of the following is the augmented matrix associated to the system of equations $\begin{cases} 2x+y+3z=4 \\ x-z=1 \\ -4x+y-3=0 \end{cases}$?

A. $\left(\begin{array}{ccc|c} 1 & 2 & 3 & 4 \\ -1 & 1 & -1 & 1 \\ 1 & -4 & -1 & 3 \end{array}\right)$

B. $\left(\begin{array}{ccc|c} 2 & 1 & 3 & 4 \\ 1 & 0 & -1 & 1 \\ -4 & 1 & 0 & 3 \end{array}\right)$

C. $\left(\begin{array}{ccc|c} 3 & 2 & 1 & 1 \\ -1 & 1 & -1 & 3 \\ -1 & -4 & 1 & 4 \end{array}\right)$

D. $\left(\begin{array}{ccc|c} 3 & 1 & 2 & 4 \\ -1 & 0 & 1 & 1 \\ -4 & 1 & -3 & 0 \end{array}\right)$

31. If A is a 3×3 matrix with $\det(A) = 5$, then what is the determinant of $2A^T$?

A. 40

B. 30

C. 10

D. $\frac{2}{5}$

32. In order to find point P in space one can start from the origin O(0, 0, 0); move 5 units in the direction of negative x-axis, then move 5 units in the direction of positive y-axis and finally move 5 units in the direction of negative z-axis. Which one of the following is the ordered triple of numbers represented by point P?

A. (5, 5, 5)

B. (–5, 5, –5)

C. (5, –5, 5)

D. (–5, –5, 5)

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33. What is the seventh term of an arithmetic sequence whose third term is -4 and common difference is 5?

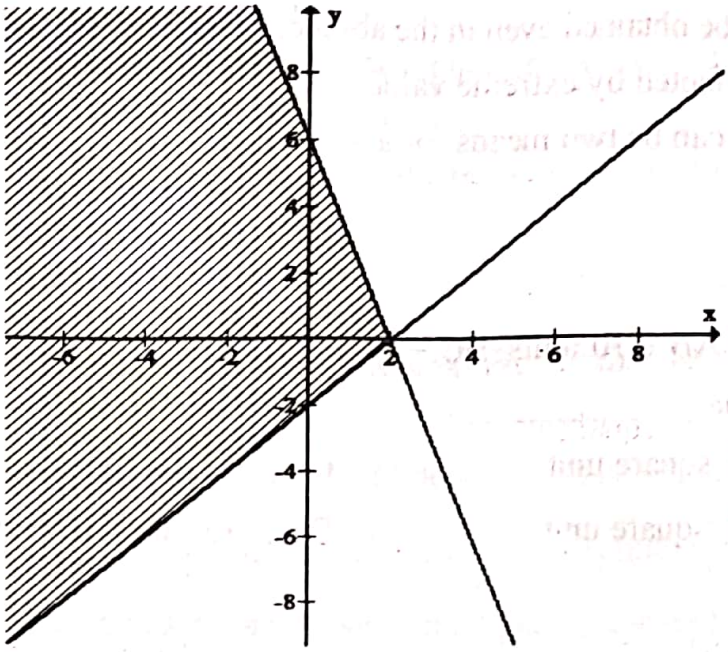
A. 16
B. -16
C. 15
D. -15

34. The sum of the first 8 terms of a geometric sequence with first term 0.3 and common ratio $\frac{1}{10}$ is equal to:

A. $\frac{1}{3}\left(\frac{10^8-1}{10^8}\right)$
B. $\frac{3}{10}\left(\frac{10^8-1}{10^8}\right)$
C. $\frac{3}{10}\left(\frac{10^8-1}{10^9}\right)$
D. $\frac{1}{3}\left(\frac{10^8-1}{10^7}\right)$

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35. The graph of a certain relation **R** is represented by the shaded region shown on the figure below.



Which one of the following pairs of sets respectively gives the domain and range of this relation?

A. $\{x/x \leq 2\}$ and $\mathbb{R}$

B. $\{x/x \leq 2\}$ and $\{y/y \leq 6\}$

C. $\mathbb{R}$ and $\mathbb{R}$

D. $\mathbb{R}$ and $\{y/y \leq 2\}$

36. Which one of the following sets is the symmetric difference, $A \Delta B$, of the sets $A = \{1, 3, 5, 6, 8, 10\}$ and $B = \{2, 5, 8, 11\}$?

A. $\{1, 2, 3, 6, 10, 11\}$

B. $\{1, 3, 6, 10\}$

C. $\{1, 2, 3, 5, 6, 8, 10, 11\}$

D. $\{2, 11\}$

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37. Which of the following is true about the Arithmetic Mean of a given data?

A. It can also be used for qualitative data.

B. It can be obtained even in the absence of some of the values in the data.

C. It is affected by extreme values

D. There can be two means for a given data.

38. In ΔABC, if AB = 10 units, BC = 14 units and AC = 8 units, then the area of the triangle is _____.

A. $16\sqrt{3}$ square unit

B. $16\sqrt{2}$ square unit

C. $10\sqrt{6}$ square unit

D. $16\sqrt{6}$ square unit

39. The simplified form of the expression $\frac{6\sqrt{20}-3\sqrt{45}}{3\sqrt{75}}$ is:

A. $\frac{1}{5}$

B. 5

C. $\sqrt{5}$

D. $\frac{\sqrt{15}}{15}$

40. Suppose f is a twice continuously differentiable function and $f''(3) = 5$. If $g(x) = f(2x + 3)$, then the second derivative of g at 0 is equal to:

A. 5

B. 10

C. 40

D. 20

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41. Which of the following is true about bounded sequence?

A. Every decreasing bounded sequence converges to the least upper bound of the sequence.

B. Every monotone bounded sequence converges.

C. Every bounded sequence is convergent.

D. Every increasing bounded sequence converges to the greatest lower bound of the sequence.

42. Let f and g be two functions. Which one of the following statements is true about f or g?

A. If $f'(a) = 0$, then the tangent line to the graph of f at $(a, f(a))$ is $y = a$.

B. If f and g differentiable at a, then $\frac{f}{g}$ is differentiable at a.

C The line $y = 0$ is the a tangent line to the graph of $f(x) = |x|$ at $(0, 0)$.

D. If f differentiable at a, then it is continuous at a.

43. If $\lim_{x\to 2} f(x) = 6$ and $\lim_{x\to 2} g(x) = -9$, then $\lim_{x\to 2}\left(\frac{f-g}{2f-7}\right)(x) =$ _____.

A. 15

B. −15

C. 3

D. −3

44. If f and g are continuous functions at a, then which of the following functions may **NOT** be continuous at a?

A. $f \cdot g$

B. $2f + 3g$

C. $f - 2g$

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

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45. What is the derivative of the function $f(x) = \frac{xe^x}{\cos x}$ at $x = 0$?

A. -1 C. 0

B. 2 D. 1

46. What is the value of a for which the function defined by,

$f(x) = \begin{cases} ax+3, & \text{for } x \geq 1 \\ x^2-2x+3, & \text{for } x < 1 \end{cases}$ is continuous at 1?

A. -1 C. 4

B. 1 D. 3

47. $\int\left(\frac{1}{\sqrt{x}} - e^{-3x} + \frac{5}{x^2}\right) dx$ is equal to:

A. $2\sqrt{x} - \frac{e^{-3x}}{3} - \frac{5}{x} + c$ C. $2\sqrt{x} + \frac{e^{-3x}}{3} + \frac{5}{x} + c$

B. $2\sqrt{x} - \frac{e^{-3x}}{3} + \frac{5}{x} + c$ D. $2\sqrt{x} + \frac{e^{-3x}}{3} - \frac{5}{x} + c$

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48. Let f be a continuous function on $[a, b]$. Then which of the following is NOT true?

A. $\int_a^b kf(x)dx = k\int_a^b f(x)dx$ for any constant k.

B. $\int_a^b f(x)dx = -\int_b^a f(x)dx$

C. $\int_c^c f(x)dx = 0$ for any c in (a, b).

D. $\int_a^b f(x)dx = \int_a^c f(x)dx - \int_c^b f(x)dx$ for any c in (a, b).

49. What is the value of $\int_0^1 xe^x dx$

A. e

B. $-e$

C. -1

D. 1

50. What is the product of the two complex number $z = 2 - 3i$ and $w = 5 + 2i$?

A. $16 - 11i$

B. 29

C. $16 + 11i$

D. $4 - 11i$

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51. Which one of the following gives the polar form of the complex number $z = 2 - 2\sqrt{3}i$?

A. $4\left(\cos\frac{1}{4}\pi + i\sin\frac{1}{4}\pi\right)$

B. $4\left(\cos\frac{5}{3}\pi + i\sin\frac{5}{3}\pi\right)$

C. $4\left(\cos\frac{1}{3}\pi + i\sin\frac{1}{3}\pi\right)$

D. $4\left(\cos\frac{3}{4}\pi + i\sin\frac{3}{4}\pi\right)$

52. Which of the following pairs of events are dependent?

A. Drawing two balls successively from a box containing balls having the same size and shape with replacement.

B. Any events obtaining from tossing a coin and rolling a die at the same time.

C. Tossing two coins simultaneously and obtaining head from one and tail from the other.

D. Drawing two cards one after the other from a well shuffled pack of cards without replacement.

53. Which one of the following compound statements has a converse with truth value False?

A. If man is immortal, then the earth does not rotate around the sun.

B. If 6 is a prime integer, then 4 is an even number.

C. If man is mortal, then the earth does not rotate around the sun.

D. If athlete Derartu Tulu was born on October 21, 1971, then 6 is prime.

54. Which of the following is the variance of the data given as: 2, 3, 4, 5, 7.

A. 2.96

B. 2.46

C. 3.70

D. 3.06

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55. What is the point of intersection of the medians of ΔABC whose vertices are given by A(0, 0), B(6, 0) and C(0, 4)?

A. $\left(\frac{9}{5}, \frac{6}{5}\right)$

B. $\left(\frac{6}{5}, \frac{4}{5}\right)$

C. $\left(2, \frac{4}{3}\right)$

D. $\left(1, \frac{2}{3}\right)$

56. Which one of the following is **NOT** true about the graph of $f(x) = 5 + \frac{|x|}{x+1}$?

A. $y = 4$ is its horizontal asymptote.

B. $x = -1$ is its vertical asymptote of f.

C. $y = 5 + x$ is its oblique asymptote.

D. $y = 6$ is its horizontal asymptote of f.

57. Which one of the following points is, inside the sphere with equation $x^2 + y^2 + z^2 = 5$

A. (1, –2, 2)

B. (1, 1, 1)

C. (1, 2, 3)

D. (0, –2, 3)

58. If Birr 20,000 is deposited in a Bank at a rate of 12% interest compounded monthly, how long will it take to double the amount?

A. 5.81 years

B. 5 years

C. 7.59 years

D. 6 years

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59. Which one of the following is true about the matrix $\begin{pmatrix} 1 & 3 & 5 \\ 6 & 4 & 2 \\ 9 & 7 & 0 \end{pmatrix}$?

A. The minor of the entry 0 is 14
B. The cofactor of the entry 1 is -14.
C. The minor of the entry 3 is 18
D. The cofactor of the entry 5 is -6.

60. If r_1 and r_2 are the roots of the equation $3x^2 + 9x + 16 = 0$, which one of the following is true?

A. $r_1 \cdot r_2 = -\frac{16}{3}$
B. $r_1 + r_2 = 3$
C. $\frac{1}{r_1} + \frac{1}{r_2} = \frac{9}{16}$
D. $r_1^2 + r_2^2 = -\frac{5}{3}$

61. Let p and q be propositions. Which of the following compound statement is a tautology?

A. $(p \wedge q) \Leftrightarrow p$
B. $(p \Rightarrow q) \Leftrightarrow (\neg p \vee q)$
C. $(p \vee q) \Leftrightarrow p$
D. $(p \Rightarrow q) \Leftrightarrow p$

62. If $\vec{a} = (4,3,2)$ and $\vec{b} = (1,2,-3)$ are two vectors in space, then which one of the following is **NOT** correct?

A. $\vec{a} + \vec{b} = (5,5,-1)$
B. $\vec{a} + 2\vec{b} = (6,7,-4)$
C. $\vec{b} - \vec{a} = (-3,-1,-5)$
D. $\vec{a} - 2\vec{b} = (2,1,8)$

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63. $\int \frac{x^3+x^2-x}{x^2+x-2}\,dx$ is equal to:

A. $\frac{x^2}{2} - \frac{1}{3}\ln|x-1| - \frac{2}{3}\ln|x+2| + c$

B. $\frac{x^2}{2} + \frac{1}{3}\ln|x-1| + \frac{2}{3}\ln|x+2| + c$

C. $\frac{x^2}{2} + \frac{1}{3}\ln|x-1| - \frac{2}{3}\ln|x+2| + c$

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

64. The following is the distribution of the marks of students obtained in Mathematics test out of 50.

Range of marks	20 – 25	26 – 31	32 – 37	38 – 43	44 – 49
Frequency	15	30	25	20	10

What is the first quartile of the distribution?

A. 26.5

B. 27.5

C. 28

D. 26

65. Which of the following is **NOT** true about argument and validity?

A. An argument which is not valid is fallacy

B. The validity of an argument can be checked by using a truth table.

C. In a valid argument, the conclusion may be true or false whenever all the premises are true.

D. In a valid argument if all the premises are true then the conclusion must also be true.

THE END

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