EDUCATIONAL ASSESSMENT AND EXAMINATIONS SERVICE
(EAES)
ETHIOPIAN SECONDARY SCHOOL LEAVING CERTIFICATE EXAMINATION
(ESSLCE)
MATHEMATICS FOR NATURAL SCIENCE, TIKIMT 2014/15 (NOVEMBER 2022)

BOOKLET CODE: 058

SUBJECT CODE: 02
TIME ALLOWED: 3:00 HOURS

GENERAL DIRECTIONS

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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).

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BOOKLET CODE: 058 **SUBJECT CODE: 02**
Number of Items: 65 **Time Allowed: 3 hours**

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

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

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

A. $\frac{2\pi}{3}$ C. $\frac{\pi}{2}$
B. $\frac{\pi}{4}$ D. $\frac{\pi}{8}$

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

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

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

A. 72° C. 180°
B. 144° D. 36°

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5. If the volume of a right circular cone is 64π cm^3 and the diameter of its base is 8cm, what is the height of the cone?

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

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

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

7. 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. -3
B. -2
C. 2
D. 3

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

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

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9. 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 $[0, \pi]$.

10. 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

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

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

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

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

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

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13. 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)

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

A. Weight of an object
B. Speed of a motorbike
C. Volume of a box
D. The width of your bedroom

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

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

16. 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. $(0, -2, 3)$

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

A. $4\left(\cos\frac{5}{3}\pi + i\sin\frac{5}{3}\pi\right)$
B. $4\left(\cos\frac{1}{4}\pi + i\sin\frac{1}{4}\pi\right)$
C. $4\left(\cos\frac{3}{4}\pi + i\sin\frac{3}{4}\pi\right)$
D. $4\left(\cos\frac{1}{3}\pi + i\sin\frac{1}{3}\pi\right)$

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

A. $16 + 11i$
B. $4 - 11i$
C. $16 - 11i$
D. 29

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

A. It is affected by extreme values
B. There can be two means for a given data.
C. It can also be used for qualitative data.
D. It can be obtained even in the absence of some of the values in the data.

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

A. $10\sqrt{6}$ square unit
B. $16\sqrt{6}$ square unit
C. $16\sqrt{3}$ square unit
D. $16\sqrt{2}$ square unit

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

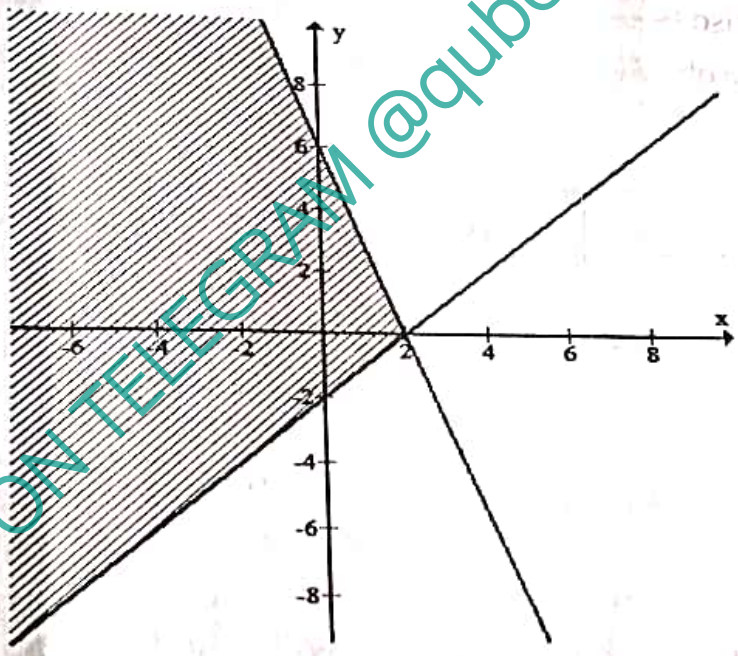
A. $2\sqrt{x} + \frac{e^{-3x}}{3} + \frac{5}{x} + c$

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

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

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

23. 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 $\{y/y \leq 6\}$

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

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

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

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

A. $2f+3g$
B. $f \cdot g$
C. $\frac{f}{g}$
D. $f-2g$

37. 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. An absolute maximum value of f which is attained at a critical number is also a local maximum value of f.
B. If $f''(c) = 0$, then $(c, f(c))$ is an inflection point of f.
C. If $f(c)$ is a local minimum value of f, then $f'(c) = 0$.
D. If c is a critical number of f, then $f(c)$ is a local extreme value of f.

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

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

39. 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. $l = 50$ m and $w = 10$ m
B. $l = 30$ m and $w = 30$ m
C. $l = 35$ m and $w = 25$ m
D. $l = 40$ m and $w = 20$ m

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40. 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. $\frac{3}{10}\left(\frac{10^8-1}{10^8}\right)$

B. $\frac{1}{3}\left(\frac{10^8-1}{10^8}\right)$

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

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

41. 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 a zero in (a, b).

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

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

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

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

A. 5 units

B. 6 units

C. 4 units

D. 7 units

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

A. Semi-major axis

B. Minor axis

C. Eccentricity

D. Latus rectum.

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

A. 10
B. $\frac{2}{5}$
C. 40
D. 30

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

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

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

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

46. 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.

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

A. If 6 is a prime integer, then 4 is an even number.
B. If man is immortal, then the earth does not rotate around the sun.
C. If athlete Derartu Tulu was born on October 21, 1971, then 6 is prime.
D. If man is mortal, then the earth does not rotate around the sun.

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

A. $\left\{\frac{1}{2}\right\}$
B. $\{2\}$
C. $\{4\}$
D. ϕ

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

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

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

A. $[0, 2]$
B. $[2, 3]$
C. $[3, \infty)$
D. $(-\infty, 2]$

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61. $\int \frac{x^3+x^2-x}{x^2+x-2}\,dx$ 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. $\frac{x^2}{2}+\frac{1}{3}\ln|x-1|-\frac{2}{3}\ln|x+2|+c$

62. 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. $r_1 + r_2 = 3$

B. $r_1 r_2 = -\frac{16}{3}$

C. $r_1^2 + r_2^2 = -\frac{5}{3}$

D. $\frac{1}{r_1}+\frac{1}{r_2}=\frac{9}{16}$

63. 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. 28

B. 26

C. 26.5

D. 27.5

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

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

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

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

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

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

A. -8

B. 5

C. 6

D. 7

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55. 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. 7.59 years
B. 6 years
C. 5.81 years
D. 5 years

56. 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 3 is 18
B. The cofactor of the entry 5 is –6
C. The minor of the entry 0 is 14
D. The cofactor of the entry 1 is –14.

57. 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)
B. (–7, 3)
C. (–3, 1)
D. (7, –3)

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51. 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. (2, 3)
B. (0, 2)
C. (3, 2)
D. (0, 3)

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

A. $\sin(-120^\circ) = 0.5$
B. $\cos(-120^\circ) = -0.5$
C. $\tan(-120^\circ) = -1$
D. $\cos(-60^\circ) = \frac{\sqrt{3}}{2}$

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

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

54. 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. $-4(x - 2)(x^2 + 4)$

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

A. 2
B. −1
C. 1
D. 0

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

A. Every bounded sequence is convergent.
B. Every increasing bounded sequence converges to the greatest lower bound of the sequence.
C. Every decreasing bounded sequence converges to the least upper bound of the sequence.
D. Every monotone bounded sequence converges.

35. 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. 40
B. 20
C. 5
D. 10

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30. 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. 3
B. −3
C. 15
D. −15

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

A. The line $y = 0$ is the a tangent line to the graph of $f(x) = |x|$ at (0, 0).
B. If f differentiable at a, then it is continuous at a.
C If $f'(a) = 0$, then the tangent line to the graph of f at $(a, f(a))$ is $y = a$.
D. If f and g differentiable at a, then $\frac{f}{g}$ is differentiable at a.

32. 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
B. −1
C. 3
D. 4

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27. 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. $\{1, 2, 3, 5, 6, 8, 10, 11\}$
B. $\{2, 11\}$
C. $\{1, 2, 3, 6, 10, 11\}$
D. $\{1, 3, 6, 10\}$

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

A. 2.46
B. 2.96
C. 3.06
D. 3.70

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

A. Tossing two coins simultaneously and obtaining head from one and tail from the other.
B. Drawing two cards one after the other from a well shuffled pack of cards without replacement.
C. Drawing two balls successively from a box containing balls having the same size and shape with replacement.
D. Any events obtaining from tossing a coin and rolling a die at the same time.

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

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

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

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

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

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

A. $-e$

B. e

C. 1

D. -1

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

A. $\sqrt{5}$

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

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

D. 5

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

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

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

A. $y = 5 + x$ is its oblique asymptote.
B. $y = 6$ is its horizontal asymptote of f.
C. $y = 4$ is its horizontal asymptote.
D. $x = -1$ is its vertical asymptote of f.

THE END

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