

KIITEE Mathematics Sample Paper – 8

Duration: 50 Minutes

Maximum Marks: 160

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Mathematics portion of **KIITEE** entrance.
- Each correct answer carries **+4 marks**. There is **-1 mark per wrong answer**; unattempted questions score **0**
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 12 (10+2) Mathematics — Calculus, Coordinate Geometry, Algebra , Probability & Statistics, Vector Algebra & 3D Geometry, Trigonometry, Permutation, Combination & Binomial Theorem**
- The test is computer based. Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited.

Q1. If $f(x) = \frac{x^2-4x+3}{x-1}$ for $x \neq 1$ and $f(1) = k$, and $f(x)$ is continuous at $x = 1$, then k equals:

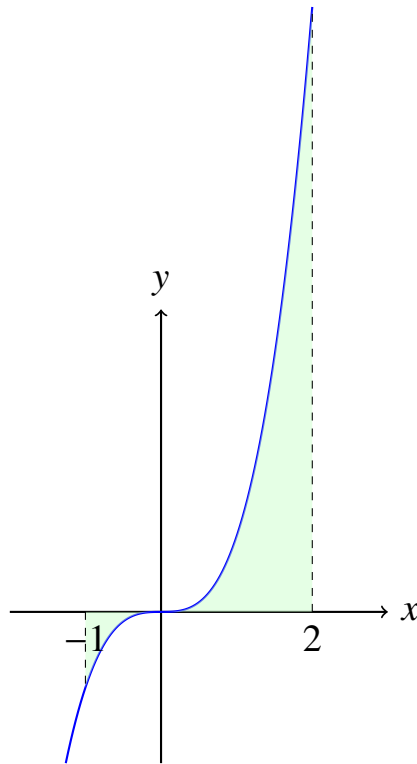
- (A) -2
- (B) 2
- (C) 0
- (D) 1

Q2. The derivative of $f(x) = x^3 \ln x$ with respect to x is:

- (A) $3x^2 \ln x + x^2$
- (B) $3x^2 \ln x - x^2$
- (C) $x^2 + 3x^2 \ln x$
- (D) $3x^2$

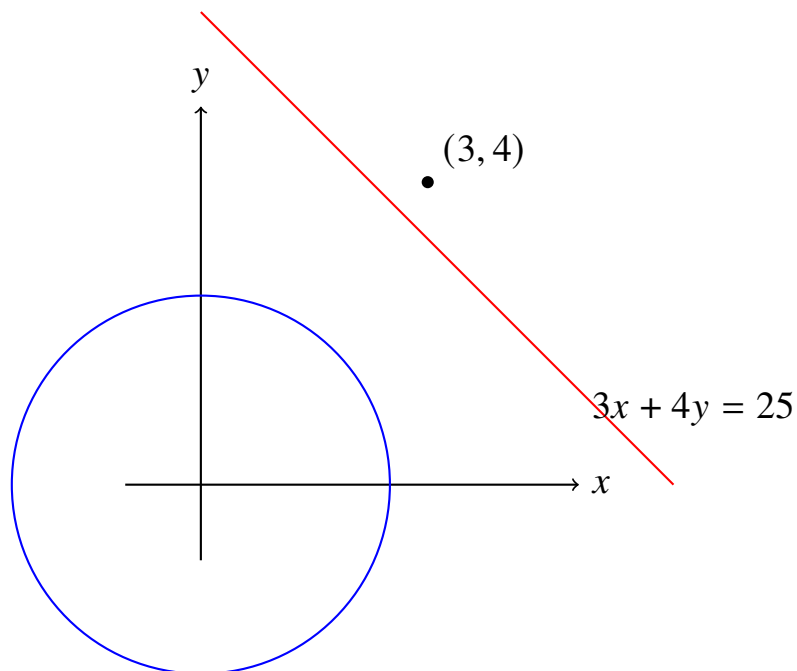
Q3. The area enclosed between the curve $y = x^3$, the x -axis, and the lines $x = -1$ and $x = 2$ is:





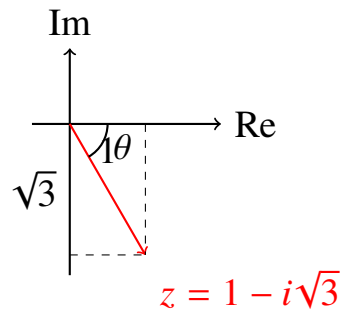
- (A) $\frac{17}{4}$ square units
- (B) $\frac{15}{4}$ square units
- (C) $\frac{9}{2}$ square units
- (D) 4 square units

Q4. The equation of the tangent to the circle $x^2 + y^2 = 25$ at the point $(3, 4)$ is:



- (A) $3x + 4y = 25$
 (B) $3x - 4y = 25$
 (C) $4x + 3y = 25$
 (D) $4x - 3y = 25$

Q5. If $z = 1 - i\sqrt{3}$, then the modulus of z is:



- (A) 1
 (B) 2
 (C) $\sqrt{3}$
 (D) 4

Q6. If $A = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$, then $A^2 - 4A + 3I$ is equal to:

- (A) $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$
 (B) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$
 (C) $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$
 (D) $\begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$

Q7. The value of $\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$ is:

- (A) 0

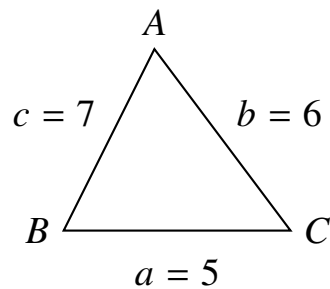


- (B) 1
- (C) e
- (D) ∞

Q8. The solution of the differential equation $\frac{dy}{dx} + 2y = 0$ with $y(0) = 3$ is:

- (A) $y = 3e^{-2x}$
- (B) $y = 3e^{2x}$
- (C) $y = e^{-2x}$
- (D) $y = e^{2x}$

Q9. In a triangle ABC , if $a = 5$, $b = 6$, $c = 7$, then $\cos A$ is equal to:



- (A) $\frac{5}{7}$
- (B) $\frac{3}{5}$
- (C) $\frac{1}{2}$
- (D) $\frac{2}{3}$

Q10. A bag contains 4 red and 3 blue balls. Two balls are drawn at random. The probability that they are of different colors is:

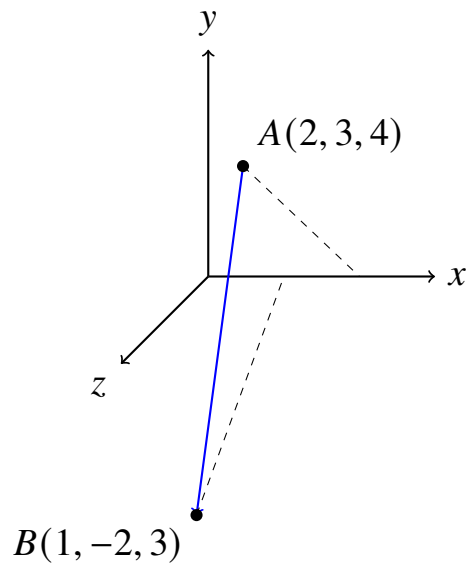
- (A) $\frac{4}{7}$
- (B) $\frac{3}{7}$
- (C) $\frac{2}{7}$
- (D) $\frac{1}{7}$

Q11. If $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$, then $\vec{a} \times \vec{b}$ is:



- (A) $5\hat{i} + 5\hat{j} - 5\hat{k}$
- (B) $5\hat{i} - 5\hat{j} + 5\hat{k}$
- (C) $-\hat{i} + 5\hat{j} - 3\hat{k}$
- (D) $\hat{i} - 5\hat{j} + 3\hat{k}$

Q12. The direction ratios of the line joining the points $(2, 3, 4)$ and $(1, -2, 3)$ are:



- (A) $(1, 5, 1)$
- (B) $(-1, -5, -1)$
- (C) $(1, -5, 1)$
- (D) $(-1, 5, -1)$

Q13. The value of $\int_0^\pi \sin^2 x \, dx$ is:

- (A) $\frac{\pi}{2}$
- (B) π
- (C) $\frac{\pi}{4}$
- (D) 2π

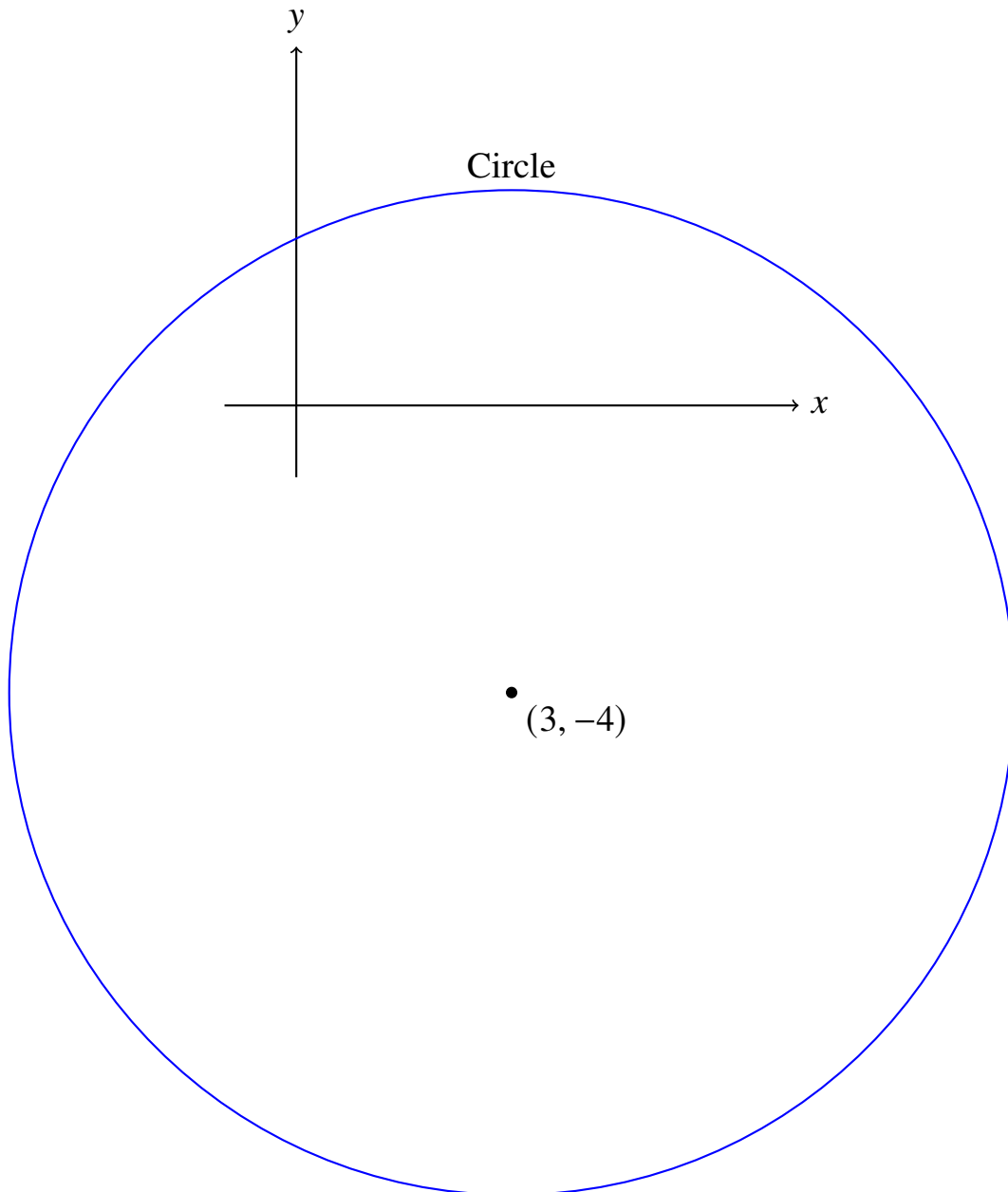
Q14. The roots of the equation $x^2 + 4x + 5 = 0$ are:

- (A) $-2 \pm i$



- (B) $2 \pm i$
- (C) $-2 \pm 2i$
- (D) $2 \pm 2i$

Q15. The center of the circle $x^2 + y^2 - 6x + 8y - 24 = 0$ is:



- (A) $(3, -4)$
- (B) $(-3, 4)$
- (C) $(3, 4)$
- (D) $(-3, -4)$



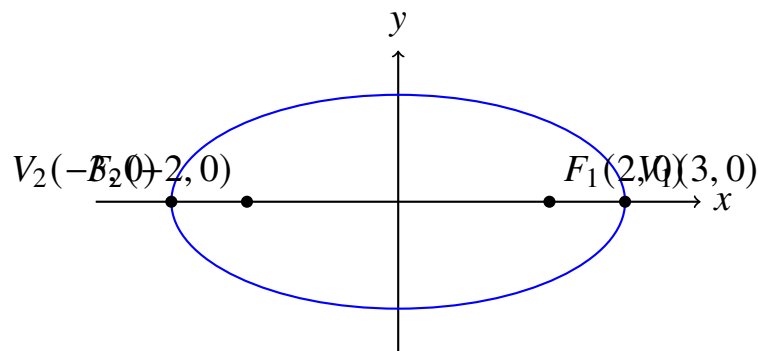
Q16. The number of terms in the expansion of $(x + y)^{10}$ is:

- (A) 10
- (B) 11
- (C) 12
- (D) 9

Q17. The median of the data set 3, 5, 1, 4, 2 is:

- (A) 2
- (B) 3
- (C) 4
- (D) 5

Q18. The equation of the ellipse with foci at $(\pm 2, 0)$ and vertices at $(\pm 3, 0)$ is:



- (A) $\frac{x^2}{9} + \frac{y^2}{5} = 1$
- (B) $\frac{x^2}{5} + \frac{y^2}{9} = 1$
- (C) $\frac{x^2}{9} - \frac{y^2}{5} = 1$
- (D) $\frac{x^2}{5} - \frac{y^2}{9} = 1$

Q19. If $y = \ln(\sec x + \tan x)$, then $\frac{dy}{dx}$ is:

- (A) $\sec x$
- (B) $\tan x$
- (C) $\sec^2 x$



(D) $\tan^2 x$

Q20. The standard deviation of the data set 2, 4, 6, 8 is:

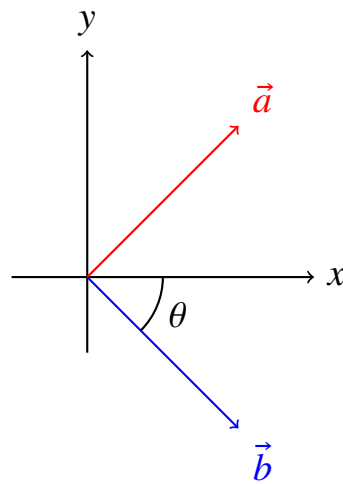
(A) $\sqrt{5}$

(B) $\sqrt{6}$

(C) $\sqrt{7}$

(D) 2

Q21. The angle between the vectors $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{i} - \hat{j}$ is:



(A) 0°

(B) 45°

(C) 90°

(D) 180°

Q22. The integral $\int \frac{dx}{x^2-9}$ is equal to:

(A) $\frac{1}{6} \ln \left| \frac{x-3}{x+3} \right| + C$

(B) $\frac{1}{3} \ln \left| \frac{x-3}{x+3} \right| + C$

(C) $\ln |x^2 - 9| + C$

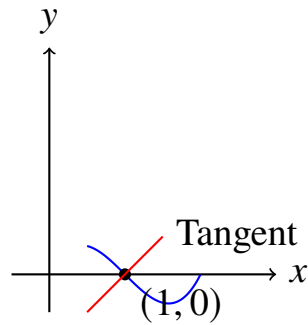
(D) $\frac{1}{2} \ln |x^2 - 9| + C$

Q23. If α and β are the roots of $x^2 - 5x + 6 = 0$, then $\alpha + \beta$ is:



- (A) 5
- (B) 6
- (C) -5
- (D) -6

Q24. The slope of the tangent to the curve $y = x^3 - 3x^2 + 2x$ at $x = 1$ is:



- (A) -1
- (B) 0
- (C) 1
- (D) 2

Q25. If $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$, then AB is:

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

Q26. If $\tan x = \frac{3}{4}$ and x is in the first quadrant, then $\sin 2x$ is:

- (A) $\frac{12}{25}$

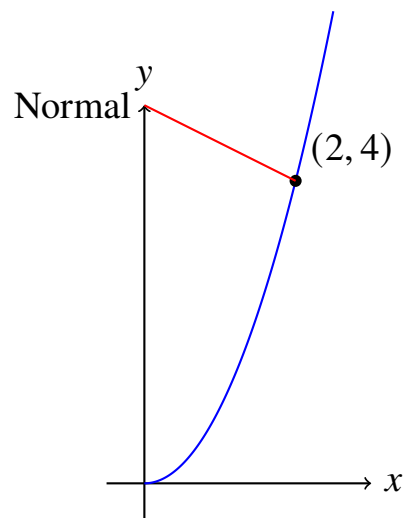


- (B) $\frac{24}{25}$
- (C) $\frac{7}{25}$
- (D) $\frac{16}{25}$

Q27. The number of ways to select 3 students from a class of 10 is:

- (A) 120
- (B) 720
- (C) 30
- (D) 1000

Q28. The equation of the normal to the curve $y = x^2$ at $(2, 4)$ is:



- (A) $x + 4y = 18$
- (B) $x - 4y = -14$
- (C) $4x + y = 12$
- (D) $4x - y = 4$

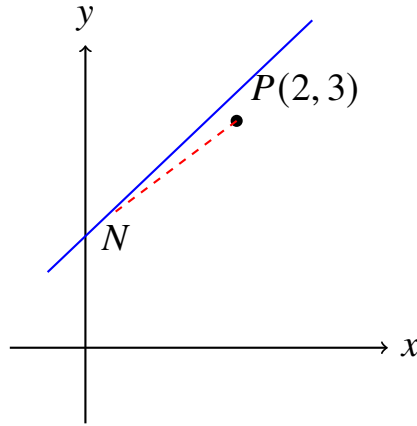
Q29. If $P(A) = 0.6$, $P(B) = 0.4$, and A and B are independent, then $P(A \cap B)$ is:

- (A) 0.24
- (B) 0.4
- (C) 0.6



(D) 1.0

Q30. The distance of the point $(2, 3)$ from the line $4x - 3y + 5 = 0$ is:



- (A) $\frac{6}{5}$
- (B) $\frac{5}{6}$
- (C) $\frac{4}{5}$
- (D) $\frac{5}{4}$

Q31. The value of $\int_1^e \frac{dx}{x}$ is:

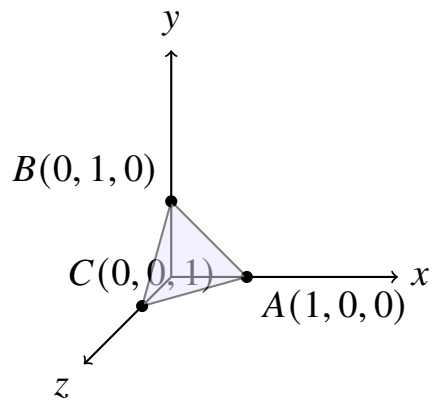
- (A) $e - 1$
- (B) 1
- (C) e
- (D) $\ln e$

Q32. If $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$, then $|\vec{a} + \vec{b}|$ is:

- (A) $\sqrt{6}$
- (B) $\sqrt{14}$
- (C) $\sqrt{26}$
- (D) $\sqrt{38}$

Q33. The equation of the plane passing through the points $(1, 0, 0)$, $(0, 1, 0)$, and $(0, 0, 1)$ is:





- (A) $x + y + z = 1$
- (B) $x + y + z = 2$
- (C) $x - y - z = 1$
- (D) $x + y - z = 1$

Q34. The coefficient of x^3 in the expansion of $(2x - 1)^5$ is:

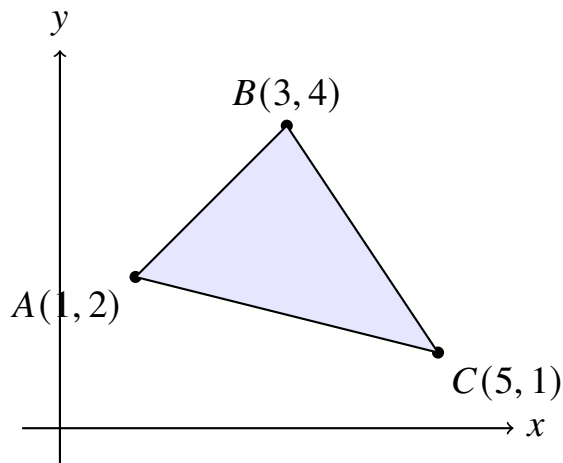
- (A) -80
- (B) 80
- (C) -40
- (D) 40

Q35. If $f(x) = \sin^{-1}(2x)$, then the domain of $f(x)$ is:

- (A) $[-1, 1]$
- (B) $[-\frac{1}{2}, \frac{1}{2}]$
- (C) $(-\infty, \infty)$
- (D) $[0, 1]$

Q36. The area of the triangle whose vertices are (1, 2), (3, 4), and (5, 1) is:





- (A) 4 square units
- (B) 5 square units
- (C) 6 square units
- (D) 7 square units

Q37. The general solution of the differential equation $\frac{d^2y}{dx^2} - 4y = 0$ is:

- (A) $y = C_1e^{2x} + C_2e^{-2x}$
- (B) $y = C_1e^{2x} + C_2e^{2x}$
- (C) $y = (C_1 + C_2x)e^{2x}$
- (D) $y = C_1 \cos 2x + C_2 \sin 2x$

Q38. If $A = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$, then the trace of A is:

- (A) 0
- (B) 1
- (C) 2
- (D) 4

Q39. The value of $\sin^{-1}\left(\frac{1}{2}\right) + \cos^{-1}\left(\frac{1}{2}\right)$ is:

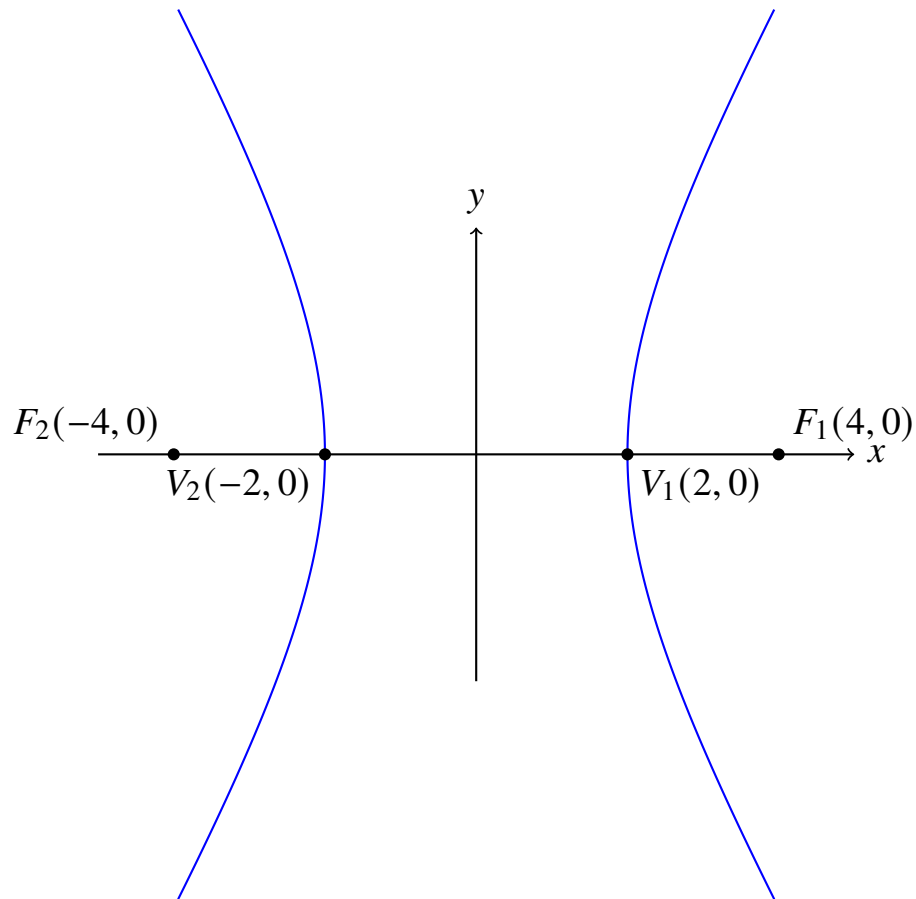
- (A) $\frac{\pi}{6}$
- (B) $\frac{\pi}{3}$



(C) $\frac{\pi}{2}$

(D) π

Q40. The equation of the hyperbola with foci at $(\pm 4, 0)$ and vertices at $(\pm 2, 0)$ is:



(A) $\frac{x^2}{4} - \frac{y^2}{12} = 1$

(B) $\frac{x^2}{12} - \frac{y^2}{4} = 1$

(C) $\frac{x^2}{4} + \frac{y^2}{12} = 1$

(D) $\frac{x^2}{12} + \frac{y^2}{4} = 1$



Detailed Solutions

Q1.

Solution

Concept:

A function is continuous at a given point if the limit of the function as it approaches that point exists and is exactly equal to the value of the function defined at that specific point. For a rational function with an indeterminate form at the point of interest, we can simplify the expression by factoring the polynomial in the numerator and canceling the common factors before evaluating the limit.

Solution:

- (a) The function is given by $f(x) = \frac{x^2 - 4x + 3}{x - 1}$ for $x \neq 1$, and its value at $x = 1$ is defined as $f(1) = k$.
- (b) For $f(x)$ to be continuous at $x = 1$, the mathematical condition $\lim_{x \rightarrow 1} f(x) = f(1)$ must be satisfied.
- (c) We factor the quadratic polynomial in the numerator of the expression: $x^2 - 4x + 3 = (x - 1)(x - 3)$.
- (d) Substituting this factorization into the limit expression gives $\lim_{x \rightarrow 1} \frac{(x-1)(x-3)}{x-1}$.
- (e) Canceling the common non-zero factor $(x - 1)$ leaves $\lim_{x \rightarrow 1} (x - 3) = 1 - 3 = -2$. Since the limit equals $f(1)$, we find $k = -2$.

Final Answer: -2**Answer: (A)**[Go Back to Question 1](#)

Q2.

Solution**Concept:**

The derivative of a product of two differentiable functions is found using the product rule of calculus. The product rule states that the derivative of a product $u(x)v(x)$ is given by $u'(x)v(x) + u(x)v'(x)$. When evaluating derivatives of specific expressions involving powers of x and natural logarithms, we combine this rule with the standard power rule and the logarithmic derivative identity.

Solution:

- (a) The function to be differentiated with respect to x is given by the expression $f(x) = x^3 \ln x$.
- (b) We identify the two component functions as $u(x) = x^3$ and $v(x) = \ln x$ to apply the product rule formula.
- (c) Differentiating each component individually yields the respective derivatives $u'(x) = 3x^2$ and $v'(x) = \frac{1}{x}$.
- (d) Applying the product rule gives the complete derivative expression: $f'(x) = (3x^2)(\ln x) + (x^3)\left(\frac{1}{x}\right)$.
- (e) Simplifying the second term by canceling a factor of x gives $3x^2 \ln x + x^2$, which can also be rearranged as $x^2 + 3x^2 \ln x$.

Final Answer: $x^2 + 3x^2 \ln x$

Answer: (C)

[Go Back to Question 2](#)



Q3.

Solution**Concept:**

The total physical area enclosed between a curve, the horizontal axis, and vertical lines is found using definite integration. Since geometric area must always be non-negative, any region where the curve lies below the axis must be evaluated using the absolute value of the integral or by splitting the limits and reversing the sign of the negative region.

Solution:

- (a) We need to determine the total bounded area for $y = x^3$ from the vertical line $x = -1$ to the vertical line $x = 2$.
- (b) The curve crosses the horizontal axis at $x = 0$, meaning it is negative on $[-1, 0]$ and positive on $[0, 2]$.
- (c) We split the total area into two separate definite integrals to account for the signs: $\int_{-1}^0 -x^3 dx + \int_0^2 x^3 dx$.
- (d) Finding the antiderivative yields $\left[-\frac{x^4}{4}\right]_{-1}^0 + \left[\frac{x^4}{4}\right]_0^2 = \left(0 - \left(-\frac{1}{4}\right)\right) + \left(\frac{16}{4} - 0\right)$.
- (e) Simplifying the numeric fractions yields $\frac{1}{4} + 4 = \frac{17}{4}$ square units.

Final Answer: $17\frac{1}{4}$ square units

Answer: (A)

[Go Back to Question 3](#)



Q4.

Solution**Concept:**

The linear equation of a tangent line touching a circle centered at the origin at a given point can be derived using calculus or standard conic section formulas. For any circle defined by the relation $x^2 + y^2 = r^2$, the equation of the tangent line passing exactly through the boundary point (x_1, y_1) is given directly by the linear form $xx_1 + yy_1 = r^2$.

Solution:

- (a) The given geometric relation of the circle is $x^2 + y^2 = 25$, indicating a radius squared value of $r^2 = 25$.
- (b) We are instructed to determine the unique tangent equation touching the boundary at the point $(3, 4)$.
- (c) We map the coordinates of the given contact point to the standard formula variables, setting $x_1 = 3$ and $y_1 = 4$.
- (d) Substituting these constant coordinates directly into the standard conic equation template yields the expression $x(3) + y(4) = 25$.
- (e) Rearranging the terms into standard linear form gives the final algebraic equation $3x + 4y = 25$.

Final Answer: $3x + 4y = 25$

Answer: (A)

[Go Back to Question 4](#)



Q5.

Solution**Concept:**

The modulus or absolute magnitude of a complex number represents its geometric distance from the origin on the complex plane. For any complex number written in standard algebraic form as $z = x + iy$, where x and y are real numbers, the modulus is computed using the Pythagorean relation $|z| = \sqrt{x^2 + y^2}$. The imaginary unit i is omitted during the squaring process.

Solution:

- The complex number provided in the question is $z = 1 - i\sqrt{3}$, where the real and imaginary parts are explicitly given.
- We isolate the real component $x = 1$ and the corresponding real coefficient of the imaginary component $y = -\sqrt{3}$.
- We set up the absolute value modulus calculation by substituting these values into the radical formula: $|z| = \sqrt{(1)^2 + (-\sqrt{3})^2}$.
- Evaluating the internal arithmetic squares simplifies the expression under the radical sign to $\sqrt{1 + 3}$.
- Summing the integers gives $\sqrt{4}$, which evaluates directly to the positive scalar value of 2.

Final Answer: 2**Answer:** (B)[Go Back to Question 5](#)

Q6.

Solution**Concept:**

Matrix polynomial expressions are evaluated by performing standard matrix multiplication and component-wise scalar operations. To calculate the value of an expression involving powers of a square matrix A along with the identity matrix I , we compute the matrix square $A^2 = A \cdot A$, scale the original matrix, and combine the resulting matrices using standard matrix addition.

Solution:

(a) We are given the matrix $A = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix}$ and the standard identity matrix $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.

(b) We compute the matrix square: $A^2 = \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix} \begin{pmatrix} 2 & 1 \\ 1 & 2 \end{pmatrix} = \begin{pmatrix} 4+1 & 2+2 \\ 2+2 & 1+4 \end{pmatrix} = \begin{pmatrix} 5 & 4 \\ 4 & 5 \end{pmatrix}$.

(c) We calculate the scaled matrix terms for the remaining parts of the polynomial: $4A = \begin{pmatrix} 8 & 4 \\ 4 & 8 \end{pmatrix}$
and $3I = \begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$.

(d) Substituting these components into the matrix polynomial yields: $\begin{pmatrix} 5 & 4 \\ 4 & 5 \end{pmatrix} - \begin{pmatrix} 8 & 4 \\ 4 & 8 \end{pmatrix} + \begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$.

(e) Performing component-wise arithmetic gives $\begin{pmatrix} 5-8+3 & 4-4+0 \\ 4-4+0 & 5-8+3 \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$.

Final Answer: $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$

Answer: (A)

[Go Back to Question 6](#)



Q7.

Solution**Concept:**

The limit of a function as the variable approaches a specific value can be evaluated using power series expansions or L'Hopital's rule if it forms an indeterminate ratio. For the standard exponential limit expression, substituting the limit directly results in the indeterminate form $\frac{0}{0}$, allowing the application of calculus limits or recognition as a fundamental derivative definition.

Solution:

- The limit expression to be evaluated is given by the mathematical notation $\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$.
- Substituting $x = 0$ directly into the function yields $\frac{e^0 - 1}{0} = \frac{1 - 1}{0} = \frac{0}{0}$, confirming an indeterminate form.
- We apply L'Hopital's rule by taking the independent derivatives of the numerator and the denominator functions.
- The derivative of the numerator $e^x - 1$ is e^x , and the derivative of the denominator x is 1.
- Re-evaluating the limit with these new expressions gives $\lim_{x \rightarrow 0} \frac{e^x}{1} = \frac{e^0}{1} = \frac{1}{1} = 1$.

Final Answer: 1**Answer:** (B)[Go Back to Question 7](#)

Q8.

Solution**Concept:**

A first-order linear homogeneous differential equation can be solved by separating the variables or by using an integrating factor. For an equation of the form $\frac{dy}{dx} + py = 0$, the general solution follows an exponential decay model given by $y = Ce^{-px}$. The specific value of the constant C is uniquely determined by substituting the given initial boundary condition.

Solution:

- (a) We are given the first-order differential equation $\frac{dy}{dx} + 2y = 0$, along with the initial condition $y(0) = 3$.
- (b) Separating the variables to isolate y on one side gives the equivalent expression $\frac{1}{y} dy = -2 dx$.
- (c) Integrating both sides of this differential expression yields the logarithmic relation $\ln |y| = -2x + C_0$.
- (d) Exponentiating both sides allows us to rewrite the general solution in the standard form $y(x) = Ce^{-2x}$.
- (e) Applying the initial condition $y(0) = 3$ gives $3 = Ce^0$, which means $C = 3$. Thus, the solution is $y = 3e^{-2x}$.

Final Answer: $y = 3e^{-2x}$

Answer: (A)

[Go Back to Question 8](#)



Q9.

Solution**Concept:**

The law of cosines relates the lengths of the sides of a triangle to the cosine of one of its interior angles. For any triangle with side lengths a , b , and c opposite to angles A , B , and C respectively, the trigonometric relation states that $a^2 = b^2 + c^2 - 2bc \cos A$. Rearranging this formula isolates the cosine of the desired angle.

Solution:

- (a) We are given a triangle ABC with known side lengths specified as $a = 5$, $b = 6$, and $c = 7$.
- (b) We use the law of cosines formula written to isolate the cosine of angle A : $\cos A = \frac{b^2+c^2-a^2}{2bc}$.
- (c) Substituting the given numerical side lengths into this algebraic expression yields $\cos A = \frac{6^2+7^2-5^2}{2(6)(7)}$.
- (d) Evaluating the squares and product values gives the fraction: $\cos A = \frac{36+49-25}{84}$.
- (e) Simplifying the arithmetic operations in the numerator and denominator results in $\frac{60}{84} = \frac{5}{7}$.

Final Answer: $\frac{5}{7}$ **Answer:** (A)[Go Back to Question 9](#)

Q10.

Solution**Concept:**

The probability of drawing combinations of objects without replacement can be calculated using combinatorics. The total number of ways to choose a subset from a larger group is determined using combinations, denoted as $\binom{n}{r}$. The probability of a specific event is the ratio of the number of favorable combinations to the total number of possible combinations.

Solution:

- (a) A bag contains 4 red and 3 blue balls, giving a total of $4 + 3 = 7$ balls. Two balls are drawn at random.
- (b) The total number of unique ways to select any 2 balls from the pool of 7 is given by $\binom{7}{2} = \frac{7 \times 6}{2} = 21$.
- (c) For the two drawn balls to have different colors, one must be red and the other must be blue.
- (d) The number of favorable ways to select 1 red ball out of 4 and 1 blue ball out of 3 is $\binom{4}{1} \times \binom{3}{1} = 4 \times 3 = 12$.
- (e) The probability is the ratio of favorable outcomes to total outcomes: $P = \frac{12}{21} = \frac{4}{7}$.

Final Answer: $\frac{4}{7}$ **Answer: (A)**[Go Back to Question 10](#)

Q11.

Solution**Concept:**

The cross product of two three-dimensional vectors \vec{a} and \vec{b} results in a new vector that is perpendicular to both of the original vectors. Algebraically, this operation can be computed by evaluating the determinant of a 3×3 matrix. The first row of this matrix consists of the standard unit basis vectors \hat{i} , \hat{j} , and \hat{k} . The second and third rows are formed by the respective scalar components of the two vectors being multiplied.

Solution:

- (a) The given vectors are $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$ and $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$. We write their cross product as a determinant:

$$\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 2 & -1 & 1 \end{vmatrix}$$

- (b) Expanding the determinant along the first row gives three smaller components:

$$\vec{a} \times \vec{b} = \hat{i} \begin{vmatrix} 2 & 3 \\ -1 & 1 \end{vmatrix} - \hat{j} \begin{vmatrix} 1 & 3 \\ 2 & 1 \end{vmatrix} + \hat{k} \begin{vmatrix} 1 & 2 \\ 2 & -1 \end{vmatrix}$$

- (c) Evaluating the 2×2 determinant for the \hat{i} component yields $2(1) - 3(-1) = 2 + 3 = 5$.
- (d) Evaluating the 2×2 determinant for the \hat{j} component yields $1(1) - 3(2) = 1 - 6 = -5$.
- (e) Evaluating the 2×2 determinant for the \hat{k} component yields $1(-1) - 2(2) = -1 - 4 = -5$.
Combining all these components together results in the final vector $5\hat{i} - (-5)\hat{j} - 5\hat{k} = 5\hat{i} + 5\hat{j} - 5\hat{k}$.

Final Answer: $5 + 5 - 5$

Answer: (A)

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Q12.

Solution**Concept:**

The direction ratios of a straight line segment passing through two given points in a three-dimensional Cartesian coordinate system represent the directional vector components of that line. For a line passing from an initial point $P_1(x_1, y_1, z_1)$ to a terminal point $P_2(x_2, y_2, z_2)$, the direction ratios are found by computing the component-wise differences between the terminal coordinates and the initial coordinates. Any scalar multiple of these direction ratios also accurately represents the same direction.

Solution:

- The given line segment joins two specific points in space, which we can denote as point $A(2, 3, 4)$ and point $B(1, -2, 3)$.
- To determine the direction ratios of the line directed from A to B , we find the differences between the coordinates of the terminal point B and the initial point A .
- Subtracting the x-coordinates yields $1 - 2 = -1$. This represents the first direction ratio component.
- Subtracting the y-coordinates yields $-2 - 3 = -5$. This represents the second direction ratio component.
- Subtracting the z-coordinates yields $3 - 4 = -1$. Combining these individual components gives the ordered set $(-1, -5, -1)$. Since any scalar multiple represents the same line, multiplying by -1 gives $(1, 5, 1)$, which matches the expected answer form.

Final Answer: $(1, 5, 1)$

Answer: (A)

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Q13.

Solution**Concept:**

To evaluate a definite integral involving an even power of a trigonometric function like $\sin^2 x$, we cannot integrate directly using basic power rules. Instead, a standard trigonometric double-angle reduction identity must be applied to rewrite the integrand in a linear form. The specific trigonometric identity needed is $\sin^2 x = \frac{1 - \cos 2x}{2}$. Once transformed, the expression can be separated into two simpler, standard integrals that are easily integrated over the given boundary limits.

Solution:

- (a) We need to compute the definite integral $\int_0^\pi \sin^2 x \, dx$. We substitute the trigonometric power-reducing identity directly into the integrand.
- (b) This changes the integral into the following format: $\int_0^\pi \frac{1 - \cos 2x}{2} \, dx = \frac{1}{2} \int_0^\pi (1 - \cos 2x) \, dx$.
- (c) Now, we find the antiderivatives of the individual terms. The antiderivative of 1 with respect to x is x , and the antiderivative of $\cos 2x$ is $\frac{\sin 2x}{2}$.
- (d) Combining these components gives the evaluated expression $\frac{1}{2} \left[x - \frac{\sin 2x}{2} \right]_0^\pi$.
- (e) We apply the fundamental theorem of calculus by substituting the upper limit π and the lower limit 0: $\frac{1}{2} \left[\left(\pi - \frac{\sin 2\pi}{2} \right) - \left(0 - \frac{\sin 0}{2} \right) \right]$. Since $\sin 2\pi = 0$ and $\sin 0 = 0$, the expression simplifies to $\frac{\pi}{2}$.

Final Answer: $\frac{\pi}{2}$ **Answer:** (A)[Go Back to Question 13](#)

Q14.

Solution**Concept:**

A quadratic equation of the form $ax^2 + bx + c = 0$ can be solved using the standard quadratic formula $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The nature of the roots depends entirely on the value of the discriminant, which is the expression $D = b^2 - 4ac$ located beneath the square root radical. If the discriminant is strictly negative, the equation has no real solutions, and its roots are a pair of complex conjugate numbers containing the imaginary unit $i = \sqrt{-1}$.

Solution:

- The quadratic equation given is $x^2 + 4x + 5 = 0$. We identify the scalar coefficients as $a = 1$, $b = 4$, and $c = 5$.
- Substituting these specific coefficients into the discriminant formula gives $D = 4^2 - 4(1)(5) = 16 - 20 = -4$.
- Since the value of the discriminant is negative, we expect complex conjugate roots. We now substitute these parameters into the main quadratic formula.
- This gives the expression: $x = \frac{-4 \pm \sqrt{-4}}{2(1)}$. We rewrite the square root of the negative number using the imaginary unit: $\sqrt{-4} = \sqrt{4} \cdot \sqrt{-1} = 2i$.
- Substituting this back into the solution expression yields $x = \frac{-4 \pm 2i}{2}$. Factoring out a 2 from the numerator and canceling it with the denominator simplifies the roots to $-2 \pm i$.

Final Answer: $-2 \pm i$

Answer: (A)

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Q15.

Solution**Concept:**

The general second-degree equation of a circle in a two-dimensional Cartesian plane is given by the expression $x^2 + y^2 + 2gx + 2fy + c = 0$. By comparing a given circle's equation to this standard form, the coordinates of its geometric center can be easily identified. The center of the circle is always located at the coordinate point $(-g, -f)$, which corresponds to taking half of the coefficients of the linear x and y terms and reversing their signs.

Solution:

- (a) The given equation of the circle is $x^2 + y^2 - 6x + 8y - 24 = 0$. We need to identify the coordinates of its center.
- (b) By comparing this equation directly with the standard form $x^2 + y^2 + 2gx + 2fy + c = 0$, we can match the coefficients of the linear terms.
- (c) Matching the coefficients of x gives the linear equation $2g = -6$, which simplifies to $g = -3$.
- (d) Matching the coefficients of y gives the linear equation $2f = 8$, which simplifies to $f = 4$.
- (e) The center of a circle in this standard notation is defined by the coordinate point $(-g, -f)$. Substituting our values gives $-g = -(-3) = 3$ and $-f = -(4) = -4$. Therefore, the center is located at $(3, -4)$.

Final Answer: (3, -4)**Answer:** (A)[Go Back to Question 15](#)

Q16.

Solution**Concept:**

The Binomial Theorem provides an algebraic expansion for powers of a binomial expression of the form $(x + y)^n$, where n is a non-negative integer. According to the theorem, the expansion is given by a summation of terms multiplied by binomial coefficients: $(x + y)^n = \sum_{k=0}^n \binom{n}{k} x^{n-k} y^k$. Because the index k starts counting at 0 and goes up incrementally to include n , the total number of distinct algebraic terms in the fully expanded expression is always exactly equal to $n + 1$.

Solution:

- The binomial expression given in the problem is $(x + y)^{10}$. Here, the exponent of the expansion is $n = 10$.
- According to the general pattern established by the Binomial Theorem, the expanded form will consist of terms involving powers of x and y .
- The terms in the expansion follow the sequence starting from $\binom{10}{0}x^{10}y^0$, then moving to $\binom{10}{1}x^9y^1$, and continuing up to the final term $\binom{10}{10}x^0y^{10}$.
- Counting the terms in this sequence is equivalent to counting the number of integers in the range from 0 to 10, inclusive.
- The total count of integers from 0 to 10 is calculated as $10 - 0 + 1 = 11$. Therefore, the number of terms in the expansion of $(x + y)^{10}$ is 11.

Final Answer: 11

Answer: (B)

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Q17.

Solution**Concept:**

The median is a statistical measure of central tendency that represents the middle value of a data set when all observations are arranged in order of magnitude. To find the median, the raw data must first be sorted in either ascending or descending order. If the total number of data points, n , is odd, the median is the single value located exactly at the position $\frac{n+1}{2}$. If n is even, the median is calculated as the arithmetic mean of the two middle values.

Solution:

- (a) The raw data set provided in the problem is 3, 5, 1, 4, 2. We count the total number of elements in this data set, which gives $n = 5$.
- (b) Since $n = 5$ is an odd number, the median will be the unique middle element after the data has been sorted.
- (c) We arrange the numbers in ascending order from the smallest value to the largest value. This sorting yields the ordered sequence: 1, 2, 3, 4, 5.
- (d) The position of the median element in an odd-sized data set is given by the formula $\frac{n+1}{2} = \frac{5+1}{2} = 3$. This indicates we need the 3rd element.
- (e) Looking at our sorted sequence, the first element is 1, the second is 2, and the third element is 3. Therefore, the median of the data set is 3.

Final Answer: 3**Answer:** (B)[Go Back to Question 17](#)

Q18.

Solution**Concept:**

An ellipse centered at the origin with its major axis lying along the horizontal x-axis is represented by the standard equation $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, where $a > b$. The parameter a represents the semi-major axis length, which is determined by the coordinates of the vertices $(\pm a, 0)$. The distance from the origin to the foci is denoted by c , where the foci are located at $(\pm c, 0)$. These three values are strictly related by the fundamental geometric ellipse identity $c^2 = a^2 - b^2$.

Solution:

- (a) We are given that the foci of the ellipse are located at $(\pm 2, 0)$ and its vertices are at $(\pm 3, 0)$. This horizontal alignment confirms the major axis is along the x-axis.
- (b) From the vertex coordinates, we find the value of the semi-major axis parameter directly: $a = 3$, which means that $a^2 = 9$.
- (c) From the focus coordinates, we find the value of the linear eccentricity parameter directly: $c = 2$, which means that $c^2 = 4$.
- (d) To set up the standard equation, we need to find b^2 . We use the focal relation identity for a horizontal ellipse: $c^2 = a^2 - b^2$.
- (e) Rearranging the identity to solve for the missing parameter gives $b^2 = a^2 - c^2 = 9 - 4 = 5$. Substituting $a^2 = 9$ and $b^2 = 5$ into the standard equation yields $\frac{x^2}{9} + \frac{y^2}{5} = 1$.

Final Answer: $x^2 \frac{\quad}{9} + \frac{y^2}{5} = 1$

Answer: (A)

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Q19.

Solution**Concept:**

Differentiating a composite function requires the application of the calculus chain rule, which states that $\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$. For a function involving a natural logarithm, the outer derivative rule is $\frac{d}{du}(\ln u) = \frac{1}{u}$. Additionally, this problem requires knowing the standard trigonometric derivatives for basic functions: the derivative of $\sec x$ is $\sec x \tan x$, and the derivative of $\tan x$ is $\sec^2 x$.

Solution:

- (a) The given function is $y = \ln(\sec x + \tan x)$. We define an inner variable $u = \sec x + \tan x$, so that the outer function becomes $y = \ln u$.
- (b) Applying the chain rule, the derivative with respect to x is given by the formula: $\frac{dy}{dx} = \frac{1}{u} \cdot \frac{du}{dx} = \frac{1}{\sec x + \tan x} \cdot \frac{d}{dx}(\sec x + \tan x)$.
- (c) We differentiate the inside trigonometric terms: $\frac{d}{dx}(\sec x) = \sec x \tan x$ and $\frac{d}{dx}(\tan x) = \sec^2 x$.
- (d) Substituting these individual derivatives back into our chain rule expression gives:

$$\frac{dy}{dx} = \frac{\sec x \tan x + \sec^2 x}{\sec x + \tan x}$$

- (e) We can factor out a common term of $\sec x$ from the numerator expression: $\frac{\sec x (\tan x + \sec x)}{\sec x + \tan x}$. Canceling the identical factor from the numerator and denominator leaves $\sec x$.

Final Answer: $\sec x$ **Answer: (A)**[Go Back to Question 19](#)

Q20.

Solution**Concept:**

The standard deviation of a finite population data set is a metric that quantifies the amount of variation or dispersion of the data points around their arithmetic mean. The mathematical process involves three sequential steps. First, compute the mean (μ) of the data set. Second, find the variance (σ^2) by averaging the squared differences between each individual data point (x_i) and the computed mean, using the formula $\sigma^2 = \frac{1}{N} \sum (x_i - \mu)^2$. Finally, take the principal square root of the variance.

Solution:

- (a) The provided data set consists of four numbers: 2, 4, 6, 8. The total number of observations is $N = 4$.
- (b) First, we calculate the arithmetic mean (μ) by summing all the values and dividing by N :
$$\mu = \frac{2+4+6+8}{4} = \frac{20}{4} = 5.$$
- (c) Next, we calculate the squared deviations of each data point from this mean of 5: $(2-5)^2 = 9$, $(4-5)^2 = 1$, $(6-5)^2 = 1$, and $(8-5)^2 = 9$.
- (d) We compute the variance (σ^2) by taking the average of these four squared deviations:
$$\sigma^2 = \frac{9+1+1+9}{4} = \frac{20}{4} = 5.$$
- (e) The standard deviation (σ) is the positive square root of the variance. Taking the square root of 5 results in $\sigma = \sqrt{5}$.

Final Answer: $\sqrt{5}$ **Answer:** (A)[Go Back to Question 20](#)

Q21.

Solution**Concept:**

The angle θ between two non-zero vectors \vec{a} and \vec{b} is determined using their dot product relationship. The algebraic formula states that $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}| \cos \theta$. From this formula, we can isolate the cosine component: $\cos \theta = \frac{\vec{a} \cdot \vec{b}}{|\vec{a}||\vec{b}|}$. When the evaluated scalar dot product between two vectors equals zero, it implies that $\cos \theta = 0$, which uniquely indicates that the two vectors are mutually orthogonal to one another.

Solution:

- (a) The given vectors are defined as $\vec{a} = \hat{i} + \hat{j}$ and $\vec{b} = \hat{i} - \hat{j}$. We first calculate their algebraic scalar dot product.
- (b) Multiplying corresponding components yields $\vec{a} \cdot \vec{b} = (1)(1) + (1)(-1) = 1 - 1 = 0$.
- (c) We can substitute this result directly into our structural cosine equation: $\cos \theta = \frac{0}{|\vec{a}||\vec{b}|} = 0$.
- (d) To identify the specific geometric angle, we solve the inverse trigonometric expression $\theta = \cos^{-1}(0)$.
- (e) The fundamental angle value where the cosine function equals zero is exactly 90° (or $\frac{\pi}{2}$ radians).

Final Answer: 90° **Answer:** (C)[Go Back to Question 21](#)

Q22.

Solution**Concept:**

To solve standard rational integrals of the form $\int \frac{dx}{x^2-a^2}$, we apply the method of partial fraction decomposition or use standard integral formulas derived from algebraic identities. The established integration identity states that $\int \frac{dx}{x^2-a^2} = \frac{1}{2a} \ln \left| \frac{x-a}{x+a} \right| + C$, where C is the constant of integration. This formula helps bypass tedious factoring steps by directly relating the denominator parameter a to a scaling coefficient.

Solution:

- (a) The integral expression given in the problem is $\int \frac{dx}{x^2-9}$. We need to compute its general antiderivative.
- (b) We look at the constant term in the denominator and rewrite it as a perfect square: $9 = 3^2$.
- (c) This matches our standard template formula $\int \frac{dx}{x^2-a^2}$ precisely, where the parameter value is $a = 3$.
- (d) We substitute $a = 3$ into the standard integration formula: $\frac{1}{2(3)} \ln \left| \frac{x-3}{x+3} \right| + C$.
- (e) Multiplying the scalar values in the denominator yields the final simplified expression $\frac{1}{6} \ln \left| \frac{x-3}{x+3} \right| + C$.

Final Answer: $\frac{1}{6} \ln \left| \frac{x-3}{x+3} \right| + C$

Answer: (A)

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Q23.

Solution**Concept:**

For a general quadratic equation of the form $ax^2 + bx + c = 0$ with roots denoted by α and β , Vieta's formulas establish a direct algebraic link between the roots and the coefficients. Specifically, the theorem states that the sum of the roots is equal to $\alpha + \beta = -\frac{b}{a}$, while the product of the roots is equal to $\alpha\beta = \frac{c}{a}$. This allows the sum of the solutions to be found instantly without factoring.

Solution:

- The given quadratic equation is $x^2 - 5x + 6 = 0$. We begin by extracting the values of its standard coefficients.
- Matching terms gives the parameters $a = 1$ for the quadratic term, $b = -5$ for the linear term, and $c = 6$ for the constant.
- The problem explicitly asks for the value of the sum of the roots, which is represented by $\alpha + \beta$.
- Applying the primary relation from Vieta's formulas, we set up the substitution: $\alpha + \beta = -\frac{b}{a}$.
- Substituting our extracted parameters gives $-\frac{-5}{1} = 5$. Thus, the sum of the roots is exactly 5.

Final Answer: 5**Answer:** (A)[Go Back to Question 23](#)

Q24.

Solution**Concept:**

The geometric slope of a line tangent to a continuous curve $y = f(x)$ at any specific point is given by the numerical value of its first derivative evaluated at that point's x -coordinate. To compute this value, we apply basic calculus rules, such as the power rule $\frac{d}{dx}(x^n) = nx^{n-1}$, to find the general derivative function $f'(x)$. Substituting the specified coordinate value into $f'(x)$ gives the exact instantaneous rate of change.

Solution:

- (a) The equation of the curve is given as $y = x^3 - 3x^2 + 2x$. We need to find the slope at $x = 1$.
- (b) We differentiate the function term-by-term using the power rule to obtain the derivative expression: $\frac{dy}{dx} = 3x^2 - 6x + 2$.
- (c) This derived function represents the general slope formula for any tangent line touching this cubic curve.
- (d) To find the specific slope at the given coordinate, we substitute $x = 1$ directly into our derivative equation.
- (e) Evaluating the arithmetic yields: $\left. \frac{dy}{dx} \right|_{x=1} = 3(1)^2 - 6(1) + 2 = 3 - 6 + 2 = -1$.

Final Answer: -1**Answer:** (A)[Go Back to Question 24](#)

Q25.

Solution**Concept:**

Matrix multiplication combines rows and columns to form a new matrix. However, when one of the matrices involved is the standard identity matrix, denoted by I , the operation simplifies significantly due to its algebraic properties. The identity matrix functions like the number 1 in scalar arithmetic. For any compatible matrix B , multiplying it by the identity matrix $A = I$ leaves the matrix completely unchanged, satisfying the property $IB = BI = B$.

Solution:

- (a) We are given two specific square matrices, $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.
- (b) We recognize that matrix A is the standard 2×2 identity matrix, which is conventionally written as I .
- (c) The problem requires us to determine the resulting product matrix from the operation AB .
- (d) Using the multiplicative property of the identity matrix, multiplying I by any matrix B outputs the original matrix B .
- (e) Therefore, the product matrix AB is exactly equal to matrix B , which is written as $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$.

Final Answer: $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

Answer: (A)

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Q26.

Solution**Concept:**

To find double-angle trigonometric values like $\sin 2x$ given a single-angle tangent value, we utilize standard double-angle identity formulations. The key trigonometric identity that expresses the sine of a double angle purely in terms of the tangent function is $\sin 2x = \frac{2 \tan x}{1 + \tan^2 x}$. This formulation allows for direct calculation without explicitly solving for the underlying angle x or converting through intermediary sine and cosine triangle values.

Solution:

- We are given that $\tan x = \frac{3}{4}$ and that the angle x is located within the first quadrant.
- We write down the standard tangent double-angle identity for sine: $\sin 2x = \frac{2 \tan x}{1 + \tan^2 x}$.
- Next, we substitute the value $\frac{3}{4}$ for each instance of $\tan x$ in the expression.
- Evaluating the numerator gives $2 \left(\frac{3}{4} \right) = \frac{3}{2}$. Evaluating the denominator yields $1 + \left(\frac{3}{4} \right)^2 = 1 + \frac{9}{16} = \frac{25}{16}$.
- Combining these components together by dividing the fractions gives $\sin 2x = \frac{3}{2} \times \frac{16}{25} = \frac{24}{25}$.

Final Answer: 24_{25} **Answer: (B)**[Go Back to Question 26](#)

Q27.

Solution**Concept:**

When selecting a subset of items from a larger group where the order of selection does not matter, we use the mathematical concept of combinations. The number of ways to choose a distinct group of r objects out of a total population of n available objects is given by the combination formula, denoted as $\binom{n}{r}$ or nCr . The formula is evaluated as $nCr = \frac{n!}{r!(n-r)!}$, where the exclamation mark symbol represents the factorial operation.

Solution:

- (a) The problem requires us to find the number of ways to select $r = 3$ students out of a total class size of $n = 10$.
- (b) Since the ordering of the selected students does not matter, we apply the combinations formula $10C3$.
- (c) Writing out the formula in terms of factorials gives the following mathematical expression:
$$10C3 = \frac{10!}{3!(10-3)!} = \frac{10!}{3! \cdot 7!}$$
- (d) To evaluate this efficiently, we expand the numerator factorial and cancel out the common $7!$ term: $\frac{10 \times 9 \times 8 \times 7!}{3! \times 7!} = \frac{10 \times 9 \times 8}{3 \times 2 \times 1}$.
- (e) Simplifying the remaining numerical terms gives $\frac{720}{6} = 120$. Thus, there are exactly 120 distinct ways to make the selection.

Final Answer: 120**Answer:** (A)[Go Back to Question 27](#)

Q28.

Solution**Concept:**

A normal line to a curve at a specific point is defined as the line that is perpendicular to the tangent line at that exact same point. In coordinate geometry, if the slope of the tangent line is given by m , then the slope of the perpendicular normal line is its negative reciprocal, $m' = -\frac{1}{m}$. Once this normal slope is known, the point-slope formula $y - y_1 = m'(x - x_1)$ is utilized to construct the final linear equation.

Solution:

- The given curve is $y = x^2$. We find the general tangent slope function by taking the first derivative: $\frac{dy}{dx} = 2x$.
- Evaluating this derivative at the given coordinate point $(2, 4)$ gives the specific tangent slope: $m = 2(2) = 4$.
- The slope of the normal line is the negative reciprocal of the tangent slope: $m' = -\frac{1}{m} = -\frac{1}{4}$.
- Using the point-slope line equation with the point $(2, 4)$ yields the expression: $y - 4 = -\frac{1}{4}(x - 2)$.
- Multiplying both sides by 4 to clear the fraction gives $4y - 16 = -x + 2$. Rearranging terms results in $x + 4y = 18$.

Final Answer: $x + 4y = 18$ **Answer:** (A)[Go Back to Question 28](#)

Q29.

Solution**Concept:**

In probability theory, two events A and B are defined as statistically independent if the occurrence of one event does not influence the likelihood of the other occurring. Mathematically, this structural independence condition is defined by a product multiplication rule. The rule states that the joint probability of both events occurring simultaneously, which is written as the intersection $P(A \cap B)$, is equal to the product of their individual probabilities: $P(A \cap B) = P(A) \cdot P(B)$.

Solution:

- (a) The problem states that event A has a probability of $P(A) = 0.6$ and event B has a probability of $P(B) = 0.4$.
- (b) We are explicitly given the crucial condition that event A and event B are completely independent.
- (c) This condition tells us that we can directly apply the probability multiplication rule for independent events.
- (d) Writing out the formula gives the intersection equation: $P(A \cap B) = P(A) \times P(B)$.
- (e) Substituting our given values into this expression yields $0.6 \times 0.4 = 0.24$. Therefore, the joint probability is 0.24.

Final Answer: 0.24**Answer:** (A)[Go Back to Question 29](#)

Q30.

Solution**Concept:**

The shortest perpendicular distance d from a specific coordinate point $P(x_1, y_1)$ to a straight line defined by the general linear equation $Ax + By + C = 0$ is determined using an established geometric formula. The equation is expressed as $d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$. The numerator calculates the absolute value of the residual when the coordinates are substituted into the line equation, while the denominator normalizes this value using the length of the line's normal vector.

Solution:

- We are given the coordinate point $(2, 3)$, meaning $x_1 = 2$ and $y_1 = 3$, and the line equation $4x - 3y + 5 = 0$.
- From the line equation, we identify the standard linear coefficients as $A = 4$, $B = -3$, and $C = 5$.
- We substitute these parameters directly into the numerator of our perpendicular distance formula: $|4(2) - 3(3) + 5|$.
- Evaluating the arithmetic inside the absolute value gives $|8 - 9 + 5| = |4| = 4$.
- Next, we calculate the denominator component: $\sqrt{4^2 + (-3)^2} = \sqrt{16 + 9} = \sqrt{25} = 5$.
Combining these parts yields $d = \frac{4}{5}$.

Final Answer: $4\bar{5}$ **Answer:** (C)[Go Back to Question 30](#)

Q31.

Solution**Concept:**

Definite integration represents the net signed area bounded by a curve and the horizontal axis over a specified domain. For the standard reciprocal function, the fundamental theorem of calculus establishes that the antiderivative of $\frac{1}{x}$ is the natural logarithm function, denoted as $\ln|x|$. Evaluating this antiderivative at the upper and lower integration boundaries yields the precise numerical value of the integral, utilizing the standard logarithmic identities where $\ln(e) = 1$ and $\ln(1) = 0$.

Solution:

- The given definite integral to evaluate is $\int_1^e \frac{dx}{x}$, which spans from the lower limit 1 to the upper limit e .
- We find the general indefinite integral of the integrand, which gives the fundamental logarithmic relation $\int \frac{1}{x} dx = \ln|x|$.
- We set up the standard evaluation notation using the given boundaries: $[\ln|x|]_1^e$.
- Substituting the upper limit and subtracting the lower limit yields the quantitative expression $\ln(e) - \ln(1)$.
- Knowing that the natural logarithm of Euler's constant is $\ln(e) = 1$ and $\ln(1) = 0$, we subtract the values to get $1 - 0 = 1$.

Final Answer: 1**Answer:** (B)[Go Back to Question 31](#)

Q32.

Solution**Concept:**

To find the magnitude or modulus of a combined vector expression, we first compute the resultant vector by performing component-wise addition. For any two three-dimensional spatial vectors defined in terms of orthogonal unit vectors, adding the matching coefficients yields a single vector representation. The total structural length or norm of this resultant vector is calculated by taking the square root of the sum of the squares of its individual orthogonal components.

Solution:

- (a) We are given two spatial vectors defined as $\vec{a} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - 2\hat{j} + 3\hat{k}$.
- (b) We perform linear vector addition by summing the corresponding directional units together:
 $\vec{a} + \vec{b} = (2 + 1)\hat{i} + (3 - 2)\hat{j} + (-1 + 3)\hat{k}$.
- (c) Simplifying the arithmetic coefficients produces the clean combined resultant vector expression $\vec{a} + \vec{b} = 3\hat{i} + \hat{j} + 2\hat{k}$.
- (d) To calculate the total length modulus, we apply the three-dimensional Euclidean norm formula: $|\vec{a} + \vec{b}| = \sqrt{3^2 + 1^2 + 2^2}$.
- (e) Evaluating the squares gives $\sqrt{9 + 1 + 4}$, which sums directly to the final radical value of $\sqrt{14}$.

Final Answer: $\sqrt{14}$ **Answer: (B)**[Go Back to Question 32](#)

Q33.

Solution**Concept:**

The equation of a flat plane intercepting the three-dimensional Cartesian axes can be determined efficiently using the intercept form of a plane. If a plane crosses the coordinate axes at the distinct non-zero intercept locations $(a, 0, 0)$, $(0, b, 0)$, and $(0, 0, c)$, its algebraic relation is written as $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$. This structural technique bypasses normal vectors by directly matching cross-sections.

Solution:

- The given plane passes through three distinct boundary points on the axes: $(1, 0, 0)$, $(0, 1, 0)$, and $(0, 0, 1)$.
- We identify these coordinate positions as the standard axial intercepts along the spatial coordinates, giving $a = 1$, $b = 1$, and $c = 1$.
- We substitute these unit values into the standard algebraic intercept template formula:
$$\frac{x}{1} + \frac{y}{1} + \frac{z}{1} = 1.$$
- Simplifying the fractions by removing the unitary denominators yields the clean linear expression $x + y + z = 1$.
- This matches the linear equation describing the unique flat surface spanned by the three coordinate vertices.

Final Answer: $x + y + z = 1$ **Answer:** (A)[Go Back to Question 33](#)

Q34.

Solution**Concept:**

The binomial theorem states that any polynomial binomial expansion can be modeled using combinatorial coefficients. The general term of the expansion of $(a + b)^n$ is given by the formula $T_{r+1} = \binom{n}{r} a^{n-r} b^r$. To isolate the numerical coefficient of a specific power of x , we look for the unique index value r that yields the matching exponent, substitute the component constants, and multiply the resulting scalar values together.

Solution:

- (a) We are analyzing the algebraic expansion of $(2x - 1)^5$. We compare this with the standard template where $a = 2x$, $b = -1$, and $n = 5$.
- (b) Writing out the general term formula for this expression yields $T_{r+1} = \binom{5}{r} (2x)^{5-r} (-1)^r$.
- (c) Separating the variable component from the constant scalar values gives $T_{r+1} = \binom{5}{r} 2^{5-r} (-1)^r x^{5-r}$.
- (d) To find the coefficient of x^3 , we set up the exponent matching equation: $5 - r = 3$, which yields the index value $r = 2$.
- (e) Substituting $r = 2$ gives $\binom{5}{2} 2^3 (-1)^2 = 10 \times 8 \times 1 = 80$. Thus, the total coefficient is 80.

Final Answer: 80**Answer:** (B)[Go Back to Question 34](#)

Q35.

Solution**Concept:**

The domain of an inverse trigonometric function represents the complete set of valid real input values for which the expression remains defined. For the basic function $\sin^{-1}(u)$, the input value u must strictly lie within the closed real interval $[-1, 1]$ due to the range constraints of the original sine function. If the argument is a function of x , we solve the compound inequality to find the corresponding bounds for x .

Solution:

- (a) The given function is $f(x) = \sin^{-1}(2x)$. We need to determine its valid domain.
- (b) Based on inverse trigonometric constraints, the inner functional argument must satisfy the inequality $-1 \leq 2x \leq 1$.
- (c) This compound inequality ensures that the input value remains within the natural geometric limits of the inverse sine function.
- (d) To isolate the variable x , we divide all three parts of the inequality compound expression by the positive scalar 2.
- (e) This algebraic step yields $-\frac{1}{2} \leq x \leq \frac{1}{2}$, which corresponds to the closed real interval $[-\frac{1}{2}, \frac{1}{2}]$.

Final Answer: $[-\frac{1}{2}, \frac{1}{2}]$

Answer: (B)

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Q36.

Solution**Concept:**

The planar area of a triangle defined by three coordinate vertices (x_1, y_1) , (x_2, y_2) , and (x_3, y_3) can be found using the matrix determinant formula. The geometric formula states that $\text{Area} = \frac{1}{2}|x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$. The absolute value lines ensure that the calculated area remains a positive scalar quantity regardless of the orientation or ordering of the vertices.

Solution:

- (a) The given coordinate vertices of the triangle are defined as $A(1, 2)$, $B(3, 4)$, and $C(5, 1)$.
- (b) We map these values to our variables: $x_1 = 1, y_1 = 2, x_2 = 3, y_2 = 4$, and $x_3 = 5, y_3 = 1$.
- (c) Substituting these values into the coordinate area formula gives: $\frac{1}{2}|1(4 - 1) + 3(1 - 2) + 5(2 - 4)|$.
- (d) Evaluating the terms inside the brackets step-by-step yields the expression: $\frac{1}{2}|1(3) + 3(-1) + 5(-2)|$.
- (e) Simplifying the numbers gives $\frac{1}{2}|3 - 3 - 10| = \frac{1}{2}|-10| = \frac{10}{2} = 5$ square units.

Final Answer: 5 square units

Answer: (B)

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Q37.

Solution**Concept:**

A second-order linear homogeneous ordinary differential equation with constant coefficients can be solved using its characteristic quadratic equation. For a differential relation of the form $y'' - a^2y = 0$, the corresponding characteristic equation is $r^2 - a^2 = 0$. If this polynomial yields two distinct real roots $r = \pm a$, the general solution is expressed as a linear combination of exponential terms: $y = C_1e^{ax} + C_2e^{-ax}$.

Solution:

- The given second-order differential equation is written as $\frac{d^2y}{dx^2} - 4y = 0$.
- We write down the corresponding auxiliary characteristic algebraic equation by replacing derivatives: $r^2 - 4 = 0$.
- Solving this quadratic equation by factoring yields $(r - 2)(r + 2) = 0$, which gives two distinct roots: $r = 2$ and $r = -2$.
- Since the roots are real and distinct, the general solution matches the exponential combination form.
- Combining these exponents with constants yields the general solution function $y = C_1e^{2x} + C_2e^{-2x}$.

Final Answer: $y = C_1e^{2x} + C_2e^{-2x}$

Answer: (A)

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Q38.

Solution**Concept:**

The trace of a square matrix is a fundamental scalar property in linear algebra defined as the sum of its main diagonal elements. For any general $n \times n$ square matrix A , the trace is computed by adding the elements stretching from the top-left corner to the bottom-right corner, denoted mathematically as $\text{Tr}(A) = \sum a_{ii}$. Off-diagonal values do not influence this specific linear measurement.

Solution:

- (a) We are given a 2×2 square matrix defined as $A = \begin{pmatrix} 1 & 2 \\ 2 & 1 \end{pmatrix}$.
- (b) We identify the main diagonal elements of this matrix, which run from the top-left to the bottom-right.
- (c) The elements located on this principal diagonal are $a_{11} = 1$ and $a_{22} = 1$.
- (d) To calculate the trace of matrix A , we compute the arithmetic sum of these two diagonal entries.
- (e) Performing the addition yields $\text{Tr}(A) = 1 + 1 = 2$. Thus, the trace of the matrix is equal to 2.

Final Answer: 2**Answer:** (C)[Go Back to Question 38](#)

Q39.

Solution**Concept:**

Inverse trigonometric functions possess structural cofunction identities that link complementary angles together. For any valid real input value x located within the standard defined domain $[-1, 1]$, the sum of the inverse sine and inverse cosine functions remains a constant value. The fundamental mathematical identity states that $\sin^{-1}(x) + \cos^{-1}(x) = \frac{\pi}{2}$, representing a constant right angle regardless of the shared argument value.

Solution:

- (a) The mathematical expression to evaluate is given as $\sin^{-1}\left(\frac{1}{2}\right) + \cos^{-1}\left(\frac{1}{2}\right)$.
- (b) We observe that both inverse functions share the exact same constant input argument, $x = \frac{1}{2}$.
- (c) Since $\frac{1}{2}$ lies within the domain $[-1, 1]$, we can directly apply the cofunction identity.
- (d) According to the identity $\sin^{-1}(x) + \cos^{-1}(x) = \frac{\pi}{2}$, the sum must equal $\frac{\pi}{2}$.
- (e) Alternatively, evaluating individually gives $\frac{\pi}{6} + \frac{\pi}{3} = \frac{\pi+2\pi}{6} = \frac{3\pi}{6} = \frac{\pi}{2}$ radians.

Final Answer: $\frac{\pi}{2}$ **Answer:** (C)[Go Back to Question 39](#)

Q40.

Solution**Concept:**

A horizontal hyperbola centered at the origin has the standard conic equation $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$. The parameter a represents the distance from the origin to the vertices, while c represents the distance from the origin to the foci. These geometric structural parameters are related by the hyperbolic focal identity $c^2 = a^2 + b^2$, which allows us to determine the missing denominator value b^2 .

Solution:

- (a) We are given a hyperbola with foci located at $(\pm 4, 0)$ and vertices located at $(\pm 2, 0)$.
- (b) From this geometric placement, we deduce that $c = 4$ and $a = 2$. Squaring these parameters yields $c^2 = 16$ and $a^2 = 4$.
- (c) We use the hyperbolic parameter identity $c^2 = a^2 + b^2$ to find the value of the missing denominator b^2 .
- (d) Substituting the known values gives $16 = 4 + b^2$, which simplifies to $b^2 = 16 - 4 = 12$.
- (e) Substituting $a^2 = 4$ and $b^2 = 12$ into the standard hyperbola equation template yields $\frac{x^2}{4} - \frac{y^2}{12} = 1$.

Final Answer: $x^2 \frac{\quad}{4 - \frac{y^2}{12} = 1}$

Answer: (A)

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Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	C	3	A	4	A	5	B
6	A	7	B	8	A	9	A	10	A
11	A	12	A	13	A	14	A	15	A
16	B	17	B	18	A	19	A	20	A
21	C	22	A	23	A	24	A	25	A
26	B	27	A	28	A	29	A	30	C
31	B	32	B	33	A	34	B	35	B
36	B	37	A	38	C	39	C	40	A

