

SAAT Mathematics

Sample Paper – 2

Duration: 40 Minutes

Maximum Marks: 40

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Mathematics section of the **SAAT** (Siksha 'O' Anusandhan Admission Test).
- Each correct answer carries **+1 mark**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Attempt every question, since wrong answers are not penalised.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. If $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5\}$, then the number of elements in $A \cup B$ is

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

Q2. The domain of the real-valued function $f(x) = \frac{1}{x-2}$ is

- (A) $\mathbb{R} \setminus \{2\}$
- (B) \mathbb{R}
- (C) $\mathbb{R} \setminus \{0\}$
- (D) $(2, \infty)$

Q3. If $z_1 = 3 + 4i$ and $z_2 = 5$, then $|z_1 z_2|$ is



- (A) 5
- (B) 15
- (C) 25
- (D) 20

Q4. If ω is a non-real cube root of unity, then $\omega^4 + \omega^2$ equals

- (A) 0
- (B) 2
- (C) ω
- (D) -1

Q5. The product of the roots of the quadratic equation $3x^2 - 7x + 6 = 0$ is

- (A) $\frac{7}{3}$
- (B) 2
- (C) $\frac{7}{6}$
- (D) 6

Q6. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then the transpose A^T is

- (A) $\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$
- (B) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$
- (C) $\begin{bmatrix} 4 & 3 \\ 2 & 1 \end{bmatrix}$
- (D) $\begin{bmatrix} 4 & 2 \\ 3 & 1 \end{bmatrix}$



- Q7. The value of the determinant $\begin{vmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{vmatrix}$ is
- (A) 0
(B) 1
(C) 6
(D) 5
- Q8. If A is an invertible matrix with $|A| = 4$, then $|A^{-1}|$ is
- (A) 4
(B) 16
(C) -4
(D) $\frac{1}{4}$
- Q9. The value of 6P_2 is
- (A) 30
(B) 15
(C) 36
(D) 12
- Q10. The value of 7C_3 is
- (A) 21
(B) 35
(C) 42
(D) 210
- Q11. In the expansion of $(x + a)^n$, the general term T_{r+1} is
- (A) ${}^nC_r x^r a^{n-r}$
(B) ${}^nC_r x^n a^r$



- (C) ${}^n C_r x^{n-r} a^r$
(D) ${}^n C_{r+1} x^{n-r} a^r$

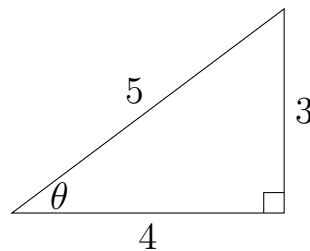
Q12. The sum of the first 10 terms of the arithmetic progression 3, 7, 11, ... is

- (A) 200
(B) 190
(C) 220
(D) 210

Q13. The 5th term of the geometric progression 2, 6, 18, ... is

- (A) 162
(B) 54
(C) 486
(D) 108

Q14. In the right-angled triangle shown, $\sin \theta = \frac{3}{5}$ and $\cos \theta = \frac{4}{5}$. The value of $\sin 2\theta$ is



- (A) $\frac{12}{5}$
(B) $\frac{24}{25}$
(C) $\frac{7}{25}$
(D) $\frac{12}{25}$

Q15. The general solution of $\sin \theta = \frac{1}{2}$ is ($n \in \mathbb{Z}$)

- (A) $2n\pi + \frac{\pi}{6}$

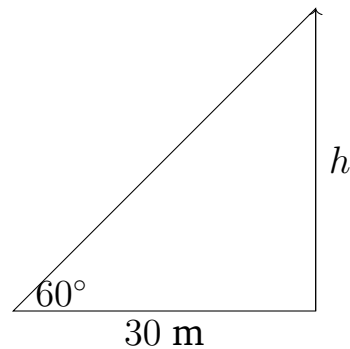


- (B) $n\pi + \frac{\pi}{6}$
- (C) $2n\pi \pm \frac{\pi}{6}$
- (D) $n\pi + (-1)^n \frac{\pi}{6}$

Q16. The principal value of $\tan^{-1}(1)$ is

- (A) $\frac{\pi}{6}$
- (B) $\frac{\pi}{3}$
- (C) $\frac{\pi}{4}$
- (D) $\frac{\pi}{2}$

Q17. The angle of elevation of the top of a tower from a point 30 m from its base is 60° , as shown. The height of the tower is



- (A) $30\sqrt{3}$ m
- (B) 30 m
- (C) $15\sqrt{3}$ m
- (D) 60 m

Q18. The value of $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$ is

- (A) 1
- (B) $\frac{1}{2}$
- (C) 0
- (D) 2



Q19. If the function $f(x) = \begin{cases} x + k, & x \leq 1 \\ 3x, & x > 1 \end{cases}$ is continuous at $x = 1$, then k equals

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

Q20. If $f(x) = 7$ for all x , then $f'(x)$ is

- (A) 7
- (B) $7x$
- (C) 1
- (D) 0

Q21. The derivative of $y = x \sin x$ with respect to x is

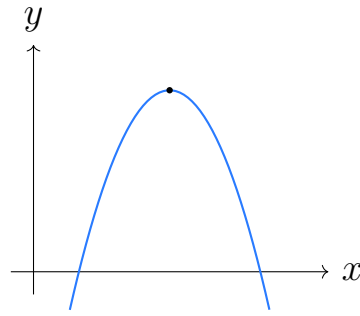
- (A) $\cos x$
- (B) $\sin x + x \cos x$
- (C) $x \cos x$
- (D) $\sin x - x \cos x$

Q22. The slope of the normal to the curve $y = x^2$ at the point where $x = 1$ is

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

Q23. The function $f(x) = -x^2 + 6x - 5$, whose graph is shown, attains its maximum value at $x =$





- (A) 1
- (B) 5
- (C) 6
- (D) 3

Q24. The value of $\int e^x dx$ is

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

Q25. The value of $\int \frac{1}{x} dx$ (for $x > 0$) is

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

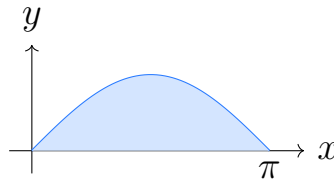
Q26. The value of $\int_0^\pi \sin x dx$ is

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



(D) -2

Q27. The area of the shaded region bounded by $y = \sin x$ and the x -axis from $x = 0$ to $x = \pi$, shown below, is



(A) 0

(B) 1

(C) 2

(D) π

Q28. The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \frac{dy}{dx} + y = 0$ is

(A) 1

(B) 2

(C) 0

(D) 3

Q29. The general solution of the differential equation $\frac{dy}{dx} = x$ is

(A) $y = \frac{x^2}{2} + C$

(B) $y = x^2 + C$

(C) $y = Ce^x$

(D) $y = x + C$

Q30. The slope of the line joining the points $(2, 3)$ and $(5, 9)$ is

(A) $\frac{1}{2}$

(B) 2

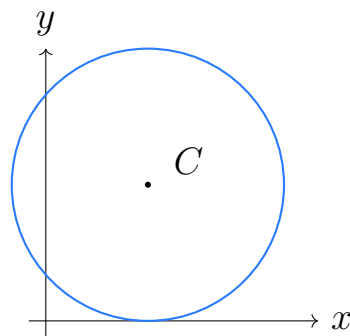


- (C) 3
(D) -2

Q31. The distance between the parallel lines $3x + 4y - 5 = 0$ and $3x + 4y + 5 = 0$ is

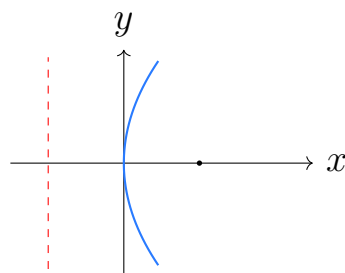
- (A) 5
(B) 1
(C) 2
(D) 10

Q32. The coordinates of the centre of the circle $x^2 + y^2 - 6x - 8y + 9 = 0$, shown below, are



- (A) $(-3, -4)$
(B) $(6, 8)$
(C) $(4, 3)$
(D) $(3, 4)$

Q33. The equation of the directrix of the parabola $y^2 = 8x$, shown below, is

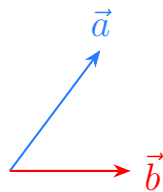


- (A) $x = -2$
- (B) $x = 2$
- (C) $y = -2$
- (D) $x = -4$

Q34. The equations of the asymptotes of the hyperbola $\frac{x^2}{9} - \frac{y^2}{4} = 1$ are

- (A) $y = \pm \frac{3}{2}x$
- (B) $y = \pm \frac{2}{3}x$
- (C) $y = \pm \frac{4}{9}x$
- (D) $y = \pm \frac{9}{4}x$

Q35. For the vectors $\vec{a} = 3\hat{i} + 4\hat{j}$ and $\vec{b} = \hat{i}$, the scalar projection of \vec{a} on \vec{b} is



- (A) 4
- (B) 5
- (C) 3
- (D) 7

Q36. If $|\vec{a}| = 4$, $|\vec{b}| = 5$ and the angle between them is 30° , then the area of the parallelogram with sides \vec{a} and \vec{b} is

- (A) 20
- (B) 5
- (C) $20\sqrt{3}$
- (D) 10



Q37. The midpoint of the line segment joining the points $(2, 4, 6)$ and $(4, 8, 2)$ is

- (A) $(6, 12, 8)$
- (B) $(3, 6, 4)$
- (C) $(1, 2, 2)$
- (D) $(2, 4, 4)$

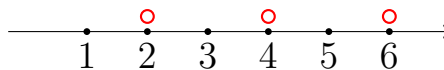
Q38. The mode of the data $2, 3, 3, 4, 5, 5, 5, 6$ is

- (A) 3
- (B) 4
- (C) 5
- (D) 6

Q39. A fair coin is tossed once. The probability of getting a head is

- (A) $\frac{1}{2}$
- (B) 1
- (C) $\frac{1}{4}$
- (D) 0

Q40. A fair die is rolled once. Given that the outcome is an even number, the probability that it is greater than 3 is



- (A) $\frac{1}{2}$
- (B) $\frac{1}{6}$
- (C) $\frac{1}{3}$
- (D) $\frac{2}{3}$



Detailed Solutions

Q1.

Solution

Concept — Union of sets: $A \cup B$ contains every element that lies in A or in B , and each element is written only once even if it appears in both sets.

Step 1 — Write out the two sets: $A = \{1, 2, 3, 4\}$.

Step 2 — Write the second set: $B = \{3, 4, 5\}$.

Step 3 — Collect all elements from A : Start the union with 1, 2, 3, 4.

Step 4 — Add elements of B not already listed: 3 is already in, 4 is already in, 5 is new, so add 5.

Step 5 — Form the union: $A \cup B = \{1, 2, 3, 4, 5\}$.

Step 6 — Count the elements: The set $\{1, 2, 3, 4, 5\}$ has 5 elements, so $n(A \cup B) = 5$.

Why other options are wrong: 4 counts only A ; 6 and 7 double-count the common elements 3, 4.

Final Answer: $n(A \cup B) = 5 \Rightarrow$

[Go Back to Q1](#)

Q2.

Solution

Concept — Domain of a rational function: The function is defined for every real x except the values that make the denominator equal to zero (division by zero is not allowed).

Step 1 — Identify the denominator: The denominator of $f(x) = \frac{1}{x-2}$ is $x-2$.

Step 2 — Set the denominator equal to zero: $x-2 = 0$.

Step 3 — Solve for x : Add 2 to both sides, giving $x = 2$.

Step 4 — Exclude that value: $x = 2$ must be removed, so x can be any real number except 2.

Step 5 — Write the domain: Domain = $\mathbb{R} \setminus \{2\}$.

Why other options are wrong: \mathbb{R} keeps $x = 2$; $\mathbb{R} \setminus \{0\}$ excludes the wrong point;



$(2, \infty)$ drops valid values.

Final Answer: Domain = $\mathbb{R} \setminus \{2\} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q2](#)

Q3.

Solution

Concept — Modulus of a product: The modulus of a product of complex numbers equals the product of their moduli: $|z_1 z_2| = |z_1| |z_2|$.

Step 1 — Modulus formula: For $z = a + bi$, $|z| = \sqrt{a^2 + b^2}$.

Step 2 — Apply to $z_1 = 3 + 4i$: $|z_1| = \sqrt{3^2 + 4^2}$.

Step 3 — Square the parts: $3^2 = 9$ and $4^2 = 16$.

Step 4 — Add and take the root: $|z_1| = \sqrt{9 + 16} = \sqrt{25} = 5$.

Step 5 — Modulus of z_2 : $z_2 = 5$ is a real number, so $|z_2| = 5$.

Step 6 — Multiply the moduli: $|z_1 z_2| = 5 \times 5 = 25$.

Why other options are wrong: 5 is just one factor; 15 and 20 mis-multiply.

Final Answer: $|z_1 z_2| = 25 \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q3](#)

Q4.

Solution

Concept — Powers of ω : A non-real cube root of unity satisfies two facts: $\omega^3 = 1$ and $1 + \omega + \omega^2 = 0$.

Step 1 — Split the exponent of ω^4 : Write $\omega^4 = \omega^{3+1} = \omega^3 \cdot \omega$.

Step 2 — Use $\omega^3 = 1$: $\omega^3 \cdot \omega = 1 \cdot \omega = \omega$.

Step 3 — Rewrite the expression: $\omega^4 + \omega^2 = \omega + \omega^2$.

Step 4 — Use the identity $1 + \omega + \omega^2 = 0$: Subtract 1 from both sides to get $\omega + \omega^2 = -1$.

Step 5 — Conclude: $\omega^4 + \omega^2 = -1$.

Why other options are wrong: 0 would need a +1; 2 and ω ignore the identity.



Final Answer: $\omega^4 + \omega^2 = -1 \Rightarrow$ D

Answer: (D) [Go Back to Q4](#)

Q5.

Solution

Concept — Product of roots: For a quadratic $ax^2 + bx + c = 0$, the product of the two roots equals $\frac{c}{a}$.

Step 1 — Match the equation to the standard form: Compare $3x^2 - 7x + 6 = 0$ with $ax^2 + bx + c = 0$.

Step 2 — Read off the coefficients: $a = 3, b = -7, c = 6$.

Step 3 — Write the product formula: Product of roots = $\frac{c}{a}$.

Step 4 — Substitute the values: Product = $\frac{6}{3}$.

Step 5 — Simplify: $\frac{6}{3} = 2$.

Why other options are wrong: $\frac{7}{3}$ is the sum of roots; $\frac{7}{6}$ and 6 misuse the coefficients.

Final Answer: Product of roots = 2 \Rightarrow B

Answer: (B) [Go Back to Q5](#)

Q6.

Solution

Concept — Transpose of a matrix: The transpose A^T is obtained by turning each row of A into a column; the entry in position (i, j) moves to position (j, i) .

Step 1 — Read the first row of A : The first row is $(1, 2)$.

Step 2 — Make it the first column of A^T : The first column becomes $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$.

Step 3 — Read the second row of A : The second row is $(3, 4)$.

Step 4 — Make it the second column of A^T : The second column becomes $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$.

Step 5 — Assemble the transpose: $A^T = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$.



Why other options are wrong: The second option is A itself; the others reverse or rotate entries.

Final Answer: $A^T = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix} \Rightarrow \boxed{A}$

Answer: (A) [Go Back to Q6](#)

Q7.

Solution

Concept — Determinant of a diagonal matrix: When all off-diagonal entries are zero, the determinant is simply the product of the entries on the main diagonal.

Step 1 — Identify the diagonal entries: They are 1, 2 and 3.

Step 2 — Write the product: Determinant = $1 \times 2 \times 3$.

Step 3 — Multiply the first two: $1 \times 2 = 2$.

Step 4 — Multiply by the last: $2 \times 3 = 6$.

Why other options are wrong: 0 would need a zero on the diagonal; 1 ignores entries; 5 adds instead of multiplying 2 and 3.

Final Answer: Determinant = 6 $\Rightarrow \boxed{C}$

Answer: (C) [Go Back to Q7](#)

Q8.

Solution

Concept — Determinant of an inverse: Because $A \cdot A^{-1} = I$ and $|I| = 1$, taking determinants gives $|A| |A^{-1}| = 1$, so $|A^{-1}| = \frac{1}{|A|}$.

Step 1 — Write the formula: $|A^{-1}| = \frac{1}{|A|}$.

Step 2 — Substitute the given value: The problem states $|A| = 4$, so $|A^{-1}| = \frac{1}{4}$.

Step 3 — State the result: $|A^{-1}| = \frac{1}{4}$.

Why other options are wrong: 4 is $|A|$; 16 is $|A|^2$; -4 has a wrong sign.

Final Answer: $|A^{-1}| = \frac{1}{4} \Rightarrow \boxed{D}$

Answer: (D) [Go Back to Q8](#)



Q9.

Solution

Concept — Permutations: The number of ordered arrangements is ${}^n P_r = \frac{n!}{(n-r)!}$.

Step 1 — Identify n and r : Here $n = 6$ and $r = 2$.

Step 2 — Substitute into the formula: ${}^6 P_2 = \frac{6!}{(6-2)!} = \frac{6!}{4!}$.

Step 3 — Cancel the common factorial: $\frac{6!}{4!} = \frac{6 \times 5 \times 4!}{4!} = 6 \times 5$.

Step 4 — Multiply: $6 \times 5 = 30$.

Why other options are wrong: 15 is ${}^6 C_2$; 36 is 6^2 ; 12 is unrelated.

Final Answer: ${}^6 P_2 = 30 \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q9](#)

Q10.

Solution

Concept — Combinations: The number of unordered selections is ${}^n C_r = \frac{n!}{r!(n-r)!}$.

Step 1 — Identify n and r : Here $n = 7$ and $r = 3$.

Step 2 — Substitute into the formula: ${}^7 C_3 = \frac{7!}{3!(7-3)!} = \frac{7!}{3!4!}$.

Step 3 — Expand the top down to 4!: ${}^7 C_3 = \frac{7 \times 6 \times 5 \times 4!}{3! \times 4!}$.

Step 4 — Cancel 4!: $= \frac{7 \times 6 \times 5}{3!}$.

Step 5 — Write out 3!: $3! = 3 \times 2 \times 1 = 6$, so $= \frac{7 \times 6 \times 5}{6}$.

Step 6 — Multiply the numerator: $7 \times 6 \times 5 = 210$, giving $\frac{210}{6}$.

Step 7 — Divide: $\frac{210}{6} = 35$.

Why other options are wrong: 21 is ${}^7 C_2$; 42 is ${}^7 P_2$; 210 forgets to divide by 3!.

Final Answer: ${}^7 C_3 = 35 \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q10](#)



Q11.

Solution

Concept — General term of a binomial expansion: The binomial theorem gives a single formula for the $(r + 1)$ th term of $(x + a)^n$.

Step 1 — State the binomial term: The general term is $T_{r+1} = {}^nC_r x^{(\text{power})} a^{(\text{power})}$.

Step 2 — Power of x : The exponent of x starts at n and decreases by 1 each term, so for T_{r+1} it is $n - r$.

Step 3 — Power of a : The exponent of a starts at 0 and increases by 1 each term, so for T_{r+1} it is r .

Step 4 — Combine: $T_{r+1} = {}^nC_r x^{n-r} a^r$.

Why other options are wrong: The others swap the powers of x and a or use a wrong combination index.

Final Answer: $T_{r+1} = {}^nC_r x^{n-r} a^r \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q11](#)

Q12.

Solution

Concept — Sum of an AP: The sum of the first n terms is $S_n = \frac{n}{2} [2a + (n - 1)d]$, where a is the first term and d the common difference.

Step 1 — Find the first term: $a = 3$.

Step 2 — Find the common difference: $d = 7 - 3 = 4$.

Step 3 — Note the number of terms: $n = 10$.

Step 4 — Substitute into the formula: $S_{10} = \frac{10}{2} [2(3) + (10 - 1)(4)]$.

Step 5 — Simplify the front factor: $\frac{10}{2} = 5$.

Step 6 — Work out $2a$: $2(3) = 6$.

Step 7 — Work out $(n - 1)d$: $(10 - 1)(4) = 9 \times 4 = 36$.

Step 8 — Add inside the bracket: $6 + 36 = 42$.

Step 9 — Multiply: $S_{10} = 5 \times 42 = 210$.



Why other options are wrong: 200, 190 and 220 come from arithmetic slips in $2a + (n - 1)d$.

Final Answer: $S_{10} = 210 \Rightarrow$ D

Answer: (D) [Go Back to Q12](#)

Q13.

Solution

Concept — n th term of a GP: The n th term is $a_n = ar^{n-1}$, where a is the first term and r the common ratio.

Step 1 — Find the first term: $a = 2$.

Step 2 — Find the common ratio: $r = \frac{6}{2} = 3$.

Step 3 — Note the term required: $n = 5$.

Step 4 — Substitute into the formula: $a_5 = 2 \cdot 3^{5-1} = 2 \cdot 3^4$.

Step 5 — Evaluate the power: $3^4 = 3 \times 3 \times 3 \times 3 = 81$.

Step 6 — Multiply: $a_5 = 2 \times 81 = 162$.

Why other options are wrong: 54 is the 4th term; 486 is the 6th term; 108 is wrong.

Final Answer: $a_5 = 162 \Rightarrow$ A

Answer: (A) [Go Back to Q13](#)

Q14.

Solution

Concept — Double-angle formula: $\sin 2\theta = 2 \sin \theta \cos \theta$.

Step 1 — Note the given values: $\sin \theta = \frac{3}{5}$ and $\cos \theta = \frac{4}{5}$.

Step 2 — Substitute into the formula: $\sin 2\theta = 2 \cdot \frac{3}{5} \cdot \frac{4}{5}$.

Step 3 — Multiply the two fractions: $\frac{3}{5} \cdot \frac{4}{5} = \frac{12}{25}$.

Step 4 — Multiply by 2: $2 \cdot \frac{12}{25} = \frac{24}{25}$.

Why other options are wrong: $\frac{12}{5}$ forgets to square the denominator; $\frac{7}{25}$ is $\cos 2\theta$; $\frac{12}{25}$ drops the factor 2.



Final Answer: $\sin 2\theta = \frac{24}{25} \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q14](#)

Q15.

Solution

Concept — General solution of $\sin \theta = \sin \alpha$: The complete family of solutions is $\theta = n\pi + (-1)^n \alpha, n \in \mathbb{Z}$.

Step 1 — Recall the basic value: $\sin \frac{\pi}{6} = \frac{1}{2}$.

Step 2 — Rewrite the equation in $\sin = \sin$ form: $\sin \theta = \frac{1}{2} = \sin \frac{\pi}{6}$.

Step 3 — Identify the principal angle: $\alpha = \frac{\pi}{6}$.

Step 4 — Substitute α into the general formula: $\theta = n\pi + (-1)^n \frac{\pi}{6}$.

Why other options are wrong: The $2n\pi + \frac{\pi}{6}$ and $2n\pi \pm \frac{\pi}{6}$ forms are for cosine; $n\pi + \frac{\pi}{6}$ omits the $(-1)^n$.

Final Answer: $\theta = n\pi + (-1)^n \frac{\pi}{6} \Rightarrow \boxed{\text{D}}$

Answer: (D) [Go Back to Q15](#)

Q16.

Solution

Concept — Principal value of \tan^{-1} : The principal value of \tan^{-1} is the unique angle in $(-\frac{\pi}{2}, \frac{\pi}{2})$ whose tangent equals the given number.

Step 1 — Restate the requirement: We need the angle θ with $\tan \theta = 1$ and $\theta \in (-\frac{\pi}{2}, \frac{\pi}{2})$.

Step 2 — Recall a standard tangent value: $\tan \frac{\pi}{4} = 1$.

Step 3 — Check it lies in range: $\frac{\pi}{4}$ is inside $(-\frac{\pi}{2}, \frac{\pi}{2})$.

Step 4 — Conclude: $\tan^{-1}(1) = \frac{\pi}{4}$.

Why other options are wrong: $\frac{\pi}{6}$ gives $\frac{1}{\sqrt{3}}$; $\frac{\pi}{3}$ gives $\sqrt{3}$; $\frac{\pi}{2}$ is undefined for \tan .

Final Answer: $\tan^{-1}(1) = \frac{\pi}{4} \Rightarrow \boxed{\text{C}}$



Answer: (C) [Go Back to Q16](#)

Q17.

Solution

Concept — Angle of elevation: In the right triangle formed, the tangent of the elevation angle equals the opposite side (height) divided by the adjacent side (base distance): $\tan(\text{angle}) = \frac{\text{height}}{\text{base}}$.

Step 1 — Write the relation: $\tan 60^\circ = \frac{h}{30}$.

Step 2 — Make h the subject: Multiply both sides by 30 to get $h = 30 \tan 60^\circ$.

Step 3 — Substitute the tangent value: $\tan 60^\circ = \sqrt{3}$, so $h = 30\sqrt{3}$.

Step 4 — State the height: $h = 30\sqrt{3}$ m.

Why other options are wrong: 30 uses 45° ; $15\sqrt{3}$ halves wrongly; 60 ignores the tangent.

Final Answer: Height = $30\sqrt{3}$ m \Rightarrow **A**

Answer: (A) [Go Back to Q17](#)

Q18.

Solution

Concept — Standard limit: We evaluate $\lim_{x \rightarrow 0} \frac{1 - \cos x}{x^2}$ using the half-angle identity and the known limit $\lim_{t \rightarrow 0} \frac{\sin t}{t} = 1$.

Step 1 — Replace $1 - \cos x$: Use the identity $1 - \cos x = 2 \sin^2 \frac{x}{2}$, giving $\frac{2 \sin^2(x/2)}{x^2}$.

Step 2 — Rewrite x^2 to match the half-angle: Since $x = 2 \cdot \frac{x}{2}$, we have $x^2 = 4 \left(\frac{x}{2}\right)^2$, so the expression becomes $\frac{2 \sin^2(x/2)}{4 (x/2)^2}$.

Step 3 — Simplify the constant: $\frac{2}{4} = \frac{1}{2}$, giving $\frac{1}{2} \left(\frac{\sin(x/2)}{x/2}\right)^2$.

Step 4 — Apply the standard limit: As $x \rightarrow 0$, $\frac{\sin(x/2)}{x/2} \rightarrow 1$, so its square $\rightarrow 1$.

Step 5 — Multiply by the constant: The limit is $\frac{1}{2} \times 1 = \frac{1}{2}$.



Why other options are wrong: 1, 0 and 2 misapply the standard limit.

Final Answer: The limit is $\frac{1}{2} \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q18](#)

Q19.

Solution

Concept — Continuity at a point: For a piecewise function to be continuous at $x = 1$, the value coming from the left piece must equal the value coming from the right piece at that point.

Step 1 — Left-hand piece at $x = 1$: For $x \leq 1$, $f(x) = x + k$, so at $x = 1$ this gives $1 + k$.

Step 2 — Right-hand piece at $x = 1$: For $x > 1$, $f(x) = 3x$, so its limit as $x \rightarrow 1$ is $3(1) = 3$.

Step 3 — Set the two equal: $1 + k = 3$.

Step 4 — Solve for k : Subtract 1 from both sides, $k = 3 - 1 = 2$.

Why other options are wrong: 1, 3 and 0 do not make the two pieces meet.

Final Answer: $k = 2 \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q19](#)

Q20.

Solution

Concept — Derivative of a constant: The derivative measures the rate of change. A constant function never changes, so its derivative is 0.

Step 1 — Recognise the function type: $f(x) = 7$ gives the same output 7 for every x , so it is a constant function.

Step 2 — Apply the constant rule: The derivative of any constant c is $\frac{d}{dx}(c) = 0$.

Step 3 — Conclude: $f'(x) = 0$.

Why other options are wrong: 7 and $7x$ treat the constant as a variable term; 1 is the derivative of x .

Final Answer: $f'(x) = 0 \Rightarrow \boxed{\text{D}}$



Answer: (D) [Go Back to Q20](#)

Q21.

Solution

Concept — Product rule: When y is a product of two functions u and v , its derivative is $(uv)' = u'v + uv'$.

Step 1 — Split into two factors: Let $u = x$ and $v = \sin x$.

Step 2 — Differentiate u : $u' = \frac{d}{dx}(x) = 1$.

Step 3 — Differentiate v : $v' = \frac{d}{dx}(\sin x) = \cos x$.

Step 4 — Substitute into the product rule: $\frac{dy}{dx} = (1)(\sin x) + (x)(\cos x)$.

Step 5 — Simplify: $\frac{dy}{dx} = \sin x + x \cos x$.

Why other options are wrong: $\cos x$ and $x \cos x$ drop a term; the last option has a wrong sign.

Final Answer: $\frac{dy}{dx} = \sin x + x \cos x \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q21](#)

Q22.

Solution

Concept — Slope of the normal: The normal is perpendicular to the tangent, so its slope is the negative reciprocal of the tangent slope.

Step 1 — Differentiate the curve: $y = x^2 \Rightarrow \frac{dy}{dx} = 2x$.

Step 2 — Find the tangent slope at $x = 1$: Substitute $x = 1$: $\frac{dy}{dx} = 2(1) = 2$.

Step 3 — Take the negative reciprocal: Normal slope = $-\frac{1}{\text{tangent slope}} = -\frac{1}{2}$.

Why other options are wrong: 2 is the tangent slope; $\frac{1}{2}$ and -2 miss the reciprocal or sign.

Final Answer: Normal slope = $-\frac{1}{2} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q22](#)



Q23.

Solution

Concept — Maximum of a downward parabola: The maximum occurs at the vertex, which is the point where the derivative is zero.

Step 1 — Differentiate term by term: For $f(x) = -x^2 + 6x - 5$, $\frac{d}{dx}(-x^2) = -2x$, $\frac{d}{dx}(6x) = 6$, $\frac{d}{dx}(-5) = 0$.

Step 2 — Write the derivative: $f'(x) = -2x + 6$.

Step 3 — Set the derivative to zero: $-2x + 6 = 0$.

Step 4 — Isolate the x term: $-2x = -6$.

Step 5 — Solve for x : $x = \frac{-6}{-2} = 3$.

Step 6 — Confirm it is a maximum: $f''(x) = -2 < 0$, so the point is a maximum.

Why other options are wrong: 1 and 5 are the roots; 6 is the linear coefficient, not the vertex.

Final Answer: Maximum at $x = 3 \Rightarrow$ D

Answer: (D) [Go Back to Q23](#)

Q24.

Solution

Concept — Integral of the exponential: Integration reverses differentiation, so we look for the function whose derivative is e^x .

Step 1 — Recall the key derivative: $\frac{d}{dx}(e^x) = e^x$.

Step 2 — Reverse it: Since differentiating e^x gives e^x , integrating e^x returns e^x .

Step 3 — Add the constant of integration: $\int e^x dx = e^x + C$.

Why other options are wrong: xe^x is from a product; $\frac{e^x}{x}$ and e^{x-1} misuse rules.

Final Answer: $e^x + C \Rightarrow$ C

Answer: (C) [Go Back to Q24](#)



Q25.

Solution

Concept — Standard integral: The integrand $\frac{1}{x} = x^{-1}$ is the one power the ordinary power rule cannot handle, so it has its own special result.

Step 1 — Note why the power rule fails: The power rule $\int x^n dx = \frac{x^{n+1}}{n+1}$ breaks for $n = -1$ because it would divide by $n + 1 = 0$.

Step 2 — Use the logarithm result: The function whose derivative is $\frac{1}{x}$ is $\ln|x|$, since $\frac{d}{dx} \ln|x| = \frac{1}{x}$.

Step 3 — Add the constant of integration: $\int \frac{1}{x} dx = \ln|x| + C$.

Why other options are wrong: $-\frac{1}{x^2}$ and $\frac{1}{x^2}$ are derivatives; $\frac{x^2}{2}$ integrates x .

Final Answer: $\ln|x| + C \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q25](#)

Q26.

Solution

Concept — Definite integral: First find an antiderivative, then evaluate it at the upper limit and subtract its value at the lower limit.

Step 1 — Antiderivative of $\sin x$: $\int \sin x dx = -\cos x$, so $\int_0^\pi \sin x dx = [-\cos x]_0^\pi$.

Step 2 — Substitute the upper limit: At $x = \pi$, $-\cos \pi$.

Step 3 — Substitute the lower limit: At $x = 0$, $-\cos 0$.

Step 4 — Form the difference: $[-\cos \pi] - [-\cos 0]$.

Step 5 — Insert the cosine values: $\cos \pi = -1$ and $\cos 0 = 1$, giving $-(-1) - (-1)$.

Step 6 — Simplify: $-(-1) - (-1) = 1 + 1 = 2$.

Why other options are wrong: 0 ignores the sign change; 1 and -2 are arithmetic slips.

Final Answer: The integral = 2 $\Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q26](#)



Q27.

Solution

Concept — Area under a curve: Because $\sin x \geq 0$ for all x in $[0, \pi]$, the shaded area equals the definite integral $\int_0^{\pi} \sin x \, dx$.

Step 1 — Write the antiderivative with limits: Area = $[-\cos x]_0^{\pi}$.

Step 2 — Substitute the upper limit: At $x = \pi$, $-\cos \pi$.

Step 3 — Substitute the lower limit: At $x = 0$, $-\cos 0$.

Step 4 — Form the difference: $[-\cos \pi] - [-\cos 0]$.

Step 5 — Insert the cosine values: $\cos \pi = -1$ and $\cos 0 = 1$, giving $-(-1) - (-1)$.

Step 6 — Simplify: $1 + 1 = 2$.

Why other options are wrong: 0 and 1 misapply limits; π is the width, not the area.

Final Answer: Area = 2 \Rightarrow C

Answer: (C) [Go Back to Q27](#)

Q28.

Solution

Concept — Degree of a differential equation: After the equation is free of radicals and fractions in the derivatives, the degree is the power to which the highest-order derivative is raised.

Step 1 — Find the highest-order derivative: The orders present are $\frac{d^2y}{dx^2}$ (order 2) and $\frac{dy}{dx}$ (order 1); the highest order is $\frac{d^2y}{dx^2}$.

Step 2 — Check the equation is polynomial in derivatives: There are no radicals or fractions involving the derivatives, so no clearing is needed.

Step 3 — Read the power of the highest derivative: $\left(\frac{d^2y}{dx^2}\right)^3$ is raised to the power 3.

Step 4 — State the degree: Degree = 3.

Why other options are wrong: 1 and 2 misread the exponent; 0 is impossible for a genuine equation.

Final Answer: Degree = 3 \Rightarrow D



Answer: (D) [Go Back to Q28](#)

Q29.

Solution

Concept — Direct integration: When $\frac{dy}{dx}$ is given as a function of x alone, integrate both sides with respect to x to recover y .

Step 1 — Integrate both sides: $\frac{dy}{dx} = x$ gives $y = \int x \, dx$.

Step 2 — Apply the power rule: $\int x \, dx = \frac{x^{1+1}}{1+1} = \frac{x^2}{2}$.

Step 3 — Add the constant of integration: $y = \frac{x^2}{2} + C$.

Step 4 — Verify by differentiating: $\frac{d}{dx} \left(\frac{x^2}{2} + C \right) = x$, which matches the original equation.

Why other options are wrong: $x^2 + C$ forgets the $\frac{1}{2}$; Ce^x solves $y' = y$; $x + C$ solves $y' = 1$.

Final Answer: $y = \frac{x^2}{2} + C \Rightarrow \boxed{A}$

Answer: (A) [Go Back to Q29](#)

Q30.

Solution

Concept — Slope from two points: The slope of the line through (x_1, y_1) and (x_2, y_2) is $m = \frac{y_2 - y_1}{x_2 - x_1}$.

Step 1 — Label the points: $(x_1, y_1) = (2, 3)$ and $(x_2, y_2) = (5, 9)$.

Step 2 — Substitute into the formula: $m = \frac{9 - 3}{5 - 2}$.

Step 3 — Subtract in the numerator: $9 - 3 = 6$.

Step 4 — Subtract in the denominator: $5 - 2 = 3$.

Step 5 — Divide: $m = \frac{6}{3} = 2$.

Why other options are wrong: $\frac{1}{2}$ inverts the ratio; 3 uses the wrong difference; -2 has a wrong sign.



Final Answer: Slope = 2 \Rightarrow B

Answer: (B) [Go Back to Q30](#)

Q31.

Solution

Concept — Distance between parallel lines: For two lines $ax + by + c_1 = 0$ and $ax + by + c_2 = 0$ with the same a, b , the distance is $d = \frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}}$.

Step 1 — Read the coefficients: $a = 3, b = 4, c_1 = -5, c_2 = 5$.

Step 2 — Numerator $|c_1 - c_2|$: $|-5 - 5| = |-10| = 10$.

Step 3 — Square the coefficients: $a^2 = 9$ and $b^2 = 16$.

Step 4 — Denominator $\sqrt{a^2 + b^2}$: $\sqrt{9 + 16} = \sqrt{25} = 5$.

Step 5 — Divide: $d = \frac{10}{5} = 2$.

Why other options are wrong: 5 is the denominator; 1 and 10 skip a step.

Final Answer: Distance = 2 \Rightarrow C

Answer: (C) [Go Back to Q31](#)

Q32.

Solution

Concept — Centre of a circle: Writing the circle as $x^2 + y^2 + 2gx + 2fy + c = 0$, its centre is the point $(-g, -f)$.

Step 1 — Match the x term: Compare $-6x$ with $2gx$, so $2g = -6$.

Step 2 — Solve for g : $g = \frac{-6}{2} = -3$.

Step 3 — Match the y term: Compare $-8y$ with $2fy$, so $2f = -8$.

Step 4 — Solve for f : $f = \frac{-8}{2} = -4$.

Step 5 — Apply the centre formula: Centre = $(-g, -f) = (-(-3), -(-4)) = (3, 4)$.

Why other options are wrong: $(-3, -4)$ keeps the wrong sign; $(6, 8)$ uses the coefficients directly; $(4, 3)$ swaps coordinates.

Final Answer: Centre = $(3, 4) \Rightarrow$ D



Answer: (D) [Go Back to Q32](#)

Q33.

Solution

Concept — Directrix of $y^2 = 4ax$: A parabola in this standard form opens rightwards and has directrix $x = -a$.

Step 1 — Compare with the standard form: Match $y^2 = 8x$ with $y^2 = 4ax$, so $4a = 8$.

Step 2 — Solve for a : $a = \frac{8}{4} = 2$.

Step 3 — Apply the directrix formula: Directrix is $x = -a = -2$.

Why other options are wrong: $x = 2$ is on the focus side; $y = -2$ is horizontal; $x = -4$ uses $4a$.

Final Answer: Directrix $x = -2 \Rightarrow$ **A**

Answer: (A) [Go Back to Q33](#)

Q34.

Solution

Concept — Asymptotes of $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$: The two asymptotes are the straight lines $y = \pm \frac{b}{a}x$.

Step 1 — Read off a^2 and b^2 : Comparing with the standard form, $a^2 = 9$ and $b^2 = 4$.

Step 2 — Find a : $a = \sqrt{9} = 3$.

Step 3 — Find b : $b = \sqrt{4} = 2$.

Step 4 — Form the ratio $\frac{b}{a}$: $\frac{b}{a} = \frac{2}{3}$.

Step 5 — Write the asymptotes: $y = \pm \frac{2}{3}x$.

Why other options are wrong: $\pm \frac{3}{2}x$ inverts the ratio; $\pm \frac{4}{9}x$ and $\pm \frac{9}{4}x$ forget to take square roots.

Final Answer: $y = \pm \frac{2}{3}x \Rightarrow$ **B**

Answer: (B) [Go Back to Q34](#)



Q35.

Solution

Concept — Scalar projection: The scalar projection of \vec{a} on \vec{b} is $\frac{\vec{a} \cdot \vec{b}}{|\vec{b}|}$.

Step 1 — Multiply matching components: For $\vec{a} = 3\hat{i} + 4\hat{j}$ and $\vec{b} = \hat{i} = 1\hat{i} + 0\hat{j}$, the products are (3)(1) and (4)(0).

Step 2 — Add to get the dot product: $\vec{a} \cdot \vec{b} = 3 + 0 = 3$.

Step 3 — Find $|\vec{b}|$: $|\vec{b}| = \sqrt{1^2 + 0^2} = \sqrt{1} = 1$.

Step 4 — Divide: Projection = $\frac{3}{1} = 3$.

Why other options are wrong: 4 is the j -component; 5 is $|\vec{a}|$; 7 adds the components.

Final Answer: Projection = 3 \Rightarrow **C**

Answer: (C) [Go Back to Q35](#)

Q36.

Solution

Concept — Area of a parallelogram: The area of the parallelogram with adjacent sides \vec{a} and \vec{b} is $|\vec{a} \times \vec{b}| = |\vec{a}| |\vec{b}| \sin \theta$.

Step 1 — List the given quantities: $|\vec{a}| = 4$, $|\vec{b}| = 5$, $\theta = 30^\circ$.

Step 2 — Substitute into the formula: Area = $4 \times 5 \times \sin 30^\circ$.

Step 3 — Multiply the magnitudes: $4 \times 5 = 20$.

Step 4 — Insert the sine value: $\sin 30^\circ = \frac{1}{2}$, giving $20 \times \frac{1}{2}$.

Step 5 — Compute: $20 \times \frac{1}{2} = 10$.

Why other options are wrong: 20 forgets $\sin 30^\circ$; 5 is wrong; $20\sqrt{3}$ uses $\cos 30^\circ$ -type values.

Final Answer: Area = 10 \Rightarrow **D**

Answer: (D) [Go Back to Q36](#)



Q37.

Solution

Concept — Midpoint in 3D: The midpoint is the average of the two endpoints coordinate by coordinate: $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2} \right)$.

Step 1 — Label the endpoints: $(x_1, y_1, z_1) = (2, 4, 6)$ and $(x_2, y_2, z_2) = (4, 8, 2)$.

Step 2 — Midpoint x -coordinate: $\frac{2 + 4}{2} = \frac{6}{2} = 3$.

Step 3 — Midpoint y -coordinate: $\frac{4 + 8}{2} = \frac{12}{2} = 6$.

Step 4 — Midpoint z -coordinate: $\frac{6 + 2}{2} = \frac{8}{2} = 4$.

Step 5 — Write the midpoint: $M = (3, 6, 4)$.

Why other options are wrong: $(6, 12, 8)$ forgets to halve; $(1, 2, 2)$ and $(2, 4, 4)$ use wrong sums.

Final Answer: Midpoint = $(3, 6, 4) \Rightarrow$ B

Answer: (B) [Go Back to Q37](#)

Q38.

Solution

Concept — Mode: The mode of a data set is the value that occurs the greatest number of times.

Step 1 — Count each value in 2, 3, 3, 4, 5, 5, 5, 6: 2 appears 1 time; 3 appears 2 times; 4 appears 1 time; 5 appears 3 times; 6 appears 1 time.

Step 2 — Find the largest frequency: The highest count is 3, belonging to the value 5.

Step 3 — Conclude: Mode = 5.

Why other options are wrong: 3 appears twice; 4 and 6 appear once each.

Final Answer: Mode = 5 \Rightarrow C

Answer: (C) [Go Back to Q38](#)



Q39.

Solution

Concept — Classical probability: $P = \frac{\text{number of favourable outcomes}}{\text{total number of equally likely outcomes}}$.

Step 1 — Count the total outcomes: A single coin toss gives two outcomes, head or tail, so total = 2.

Step 2 — Count the favourable outcomes: Only one outcome is a head, so favourable = 1.

Step 3 — Form the probability: $P(\text{head}) = \frac{1}{2}$.

Why other options are wrong: 1 assumes certainty; $\frac{1}{4}$ is for two coins; 0 is impossible here.

Final Answer: $P(\text{head}) = \frac{1}{2} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q39](#)

Q40.

Solution

Concept — Conditional probability: Given that event B has occurred, the probability of A is $P(A | B) = \frac{n(A \cap B)}{n(B)}$, where the new sample space is just the outcomes in B .

Step 1 — Write the conditioning event B (even numbers): $B = \{2, 4, 6\}$.

Step 2 — Count $n(B)$: There are 3 even outcomes, so $n(B) = 3$.

Step 3 — Find outcomes that are even AND greater than 3: From $\{2, 4, 6\}$, those greater than 3 are $\{4, 6\}$.

Step 4 — Count $n(A \cap B)$: There are 2 such outcomes, so $n(A \cap B) = 2$.

Step 5 — Divide: $P = \frac{n(A \cap B)}{n(B)} = \frac{2}{3}$.

Why other options are wrong: $\frac{1}{2}$, $\frac{1}{6}$ and $\frac{1}{3}$ use the wrong sample space or count.

Final Answer: $P = \frac{2}{3} \Rightarrow \boxed{\text{D}}$

Answer: (D) [Go Back to Q40](#)



Answer Key

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

