JEE Main Mathematics

Sample Paper – 2

Duration: 60 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **30 Questions** divided into two sections, modelled on the Mathematics section of **JEE Main**.
- **Section A (Q1–Q20):** Single Correct MCQs. Each correct answer carries **+4 marks**; each wrong answer carries $-$**1 mark**. Unattempted questions carry 0 marks.
- **Section B (Q21–Q30):** Integer Answer Type. Each correct answer carries **+4 marks**. There is **no negative marking**. Attempt any **5** of 10 questions.
- Syllabus level: **Class 11–12 (NCERT) — JEE Main Mathematics syllabus.**
- Personal calculators, log tables, mobile phones and electronic gadgets are strictly prohibited. Rough sheets will be provided at the exam centre.

Section A — Single Correct Answer Type (Q1–Q20)

*Each correct answer: **+4 marks**. Wrong answer: $-$**1 mark**. Unattempted: 0.*

Q1. If $f(x) = x + 2$ and $g(x) = x^2$, then $f(g(x))$ equals:

(A) $x + 2$

(B) $x^2 + 2$

(C) $2x + 2$

(D) $x^2 - 2$

Q2. The product of the roots of $3x^2 - 7x + 5 = 0$ is:

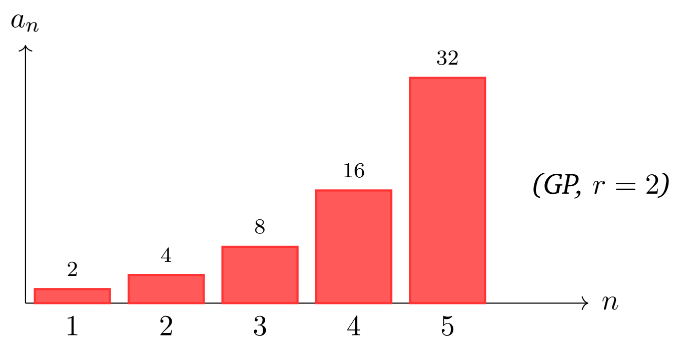
(A) $\frac{7}{3}$

(B) 5

(C) $\frac{5}{3}$

(D) 7

Q3. The sum of the first 5 terms of a G.P. with first term $a = 2$ and common ratio $r = 2$ is:



(A) 30

(B) 48

(C) 56

(D) 62

Q4. The real part of $\frac{3+4i}{1-2i}$ is:

(A) -1

(B) 1

(C) 2

(D) -2

Q5. The number of ways to select 3 persons from 5 boys and 4 girls such that at least 1 girl is included is:

(A) 70

(B) 74

(C) 60

(D) 80

Q6. The term independent of x in the expansion of $\left(x + \frac{1}{x}\right)^6$ is:

(A) 15

(B) 1

(C) 20

(D) 6

Q7. If a square matrix A satisfies $A^2 = A$ (idempotent), then A^3 equals:

(A) A^2

(B) I

(C) O

(D) A

Q8. The value of $\begin{vmatrix} 2 & 3 \\ 1 & 4 \end{vmatrix}$ is:

(A) 5

(B) -5

(C) 11

(D) -11

Q9. $\lim_{x \to \infty} \frac{3x^2 + 5}{x^2 + 1}$ equals:

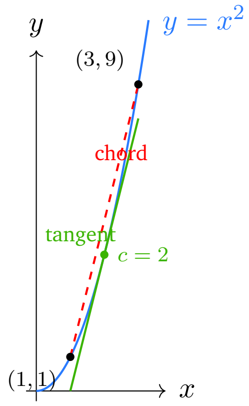
(A) 5

(B) 3

(C) ∞

(D) 1

Q10. By the Mean Value Theorem, for $f(x) = x^2$ on the interval $[1, 3]$, the value of c guaranteed by the theorem satisfies:



(A) $c = 1$

(B) $c = 3$

(C) $c = 2$

(D) $c = 4$

Q11. The maximum value of $\sin x$ for $x \in [0, 2\pi]$ is:

(A) 0

(B) -1

(C) 2

(D) 1

Q12. $\displaystyle\int \sec^2 x\, dx$ equals:

(A) $\tan x + C$

(B) $\sec x + C$

(C) $\sec^2 x + C$

(D) $-\tan x + C$

Q13. The value of $\displaystyle\int_0^{\pi} |\cos x|\, dx$ is:

(A) 0

(B) 2

(C) 1

(D) π

Q14. The general solution of $\dfrac{dy}{dx} = \dfrac{y}{x}$ is:

(A) $y = Ae^x$

(B) $y = Ax^2$

(C) $y = Ax$

(D) $y = \dfrac{A}{x}$

Q15. The slope of the line $x + \sqrt{3}\,y = 7$ is:

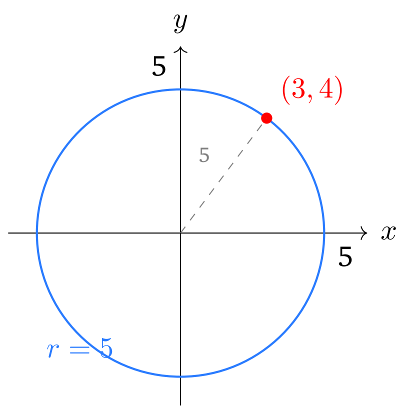
(A) $\sqrt{3}$

(B) $\dfrac{1}{\sqrt{3}}$

(C) $-\sqrt{3}$

(D) $-\dfrac{1}{\sqrt{3}}$

Q16. The equation of the circle with centre at the origin and radius 5 is:



(A) $x^2 + y^2 = 25$

(B) $x^2 + y^2 = 5$

(C) $(x - 5)^2 + y^2 = 25$

(D) $x^2 + (y - 5)^2 = 25$

Q17. The vertex of the parabola $y = (x - 2)^2 + 3$ is:

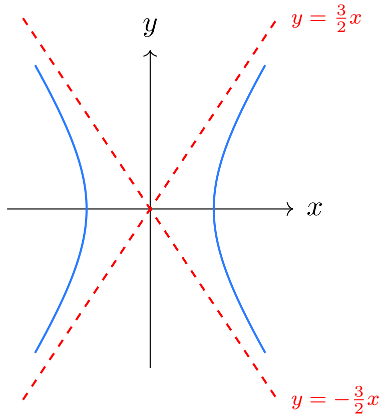
(A) $(2, -3)$

(B) $(2, 3)$

(C) $(-2, 3)$

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

Q18. The equations of the asymptotes of $\dfrac{x^2}{4} - \dfrac{y^2}{9} = 1$ are:



(A) $y = \pm 2x$

(B) $y = \pm \dfrac{2}{3}x$

(C) $y = \pm \dfrac{3}{2}x$

(D) $y = \pm 3x$

Q19. The value of $\sin \dfrac{\pi}{3} + \cos \dfrac{\pi}{6}$ is:

(A) 1

(B) $\sqrt{2}$

(C) $\dfrac{1}{2}$

(D) $\sqrt{3}$

Q20. The range of $\cos^{-1} x$ is:

(A) $[0, \pi]$

(B) $\left[-\dfrac{\pi}{2}, \dfrac{\pi}{2}\right]$

(C) $(0, \pi)$

(D) $[-1, 1]$

Section B — Integer Answer Type (Q21–Q30)

Each correct answer: ***+4 marks****. No negative marking. Attempt any* ***5*** *of 10.*

Q21. The scalar projection of $\vec{a} = (3, 4)$ onto $\vec{b} = (4, 0)$ is ______.

Q22. The distance between the points $A(1, 2, 3)$ and $B(4, 6, 3)$ is ______.

Q23. One card is drawn at random from a pack of 52 cards. The value of $52 \times P(\text{drawing an ace})$ is ______.

Q24. The mode of the data set $\{3, 3, 5, 7, 3, 8, 3\}$ is ______.

Q25. In an A.P., $a_5 = 20$ and common difference $d = 3$. The first term a_1 is ______.

Q26. The function $y = x^3 - 6x$ is decreasing for $x \in (-\sqrt{2}, \sqrt{2})$. How many integers lie in this open interval? ______.

Q27. The value of $10 \times \displaystyle\int_1^e \frac{1}{x}\,dx$ is ______.

Q28. The coefficient of x^2 in the expansion of $(2 + x)^4$ is ______.

Q29. The argument (in degrees) of the complex number $z = -1 + i\sqrt{3}$ is ______.

Q30. The trace (sum of diagonal elements) of the matrix $A + B$ where $A = \begin{pmatrix} 2 & 1 \\ 0 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 \\ 2 & 4 \end{pmatrix}$ is ______.

Detailed Solutions

Q1.

Solution

Concept — Composition of Functions: The composition $f(g(x))$ means substituting $g(x)$ in place of x in $f(x)$. Evaluate the inner function first, then apply the outer function.

Step 1 — Identify the functions: $f(x) = x + 2$ and $g(x) = x^2$.

Step 2 — Compute $f(g(x))$: Replace x with $g(x) = x^2$ in f:

$$f(g(x)) = g(x) + 2 = x^2 + 2.$$

Why other options are wrong:

- Option (A): $x + 2$ would be $f(x)$ itself, not $f(g(x))$.
- Option (C): $2x + 2$ confuses $g(x) = x^2$ with $g(x) = x$.
- Option (D): $x^2 - 2$ uses subtraction instead of addition.

Final Answer: $f(g(x)) = x^2 + 2 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Vieta's Formulas: For a quadratic $ax^2 + bx + c = 0$, the product of roots is $\frac{c}{a}$.

Step 1 — Identify coefficients: $a = 3$, $b = -7$, $c = 5$.

Step 2 — Apply Vieta's product formula:

$$\text{Product of roots} = \frac{c}{a} = \frac{5}{3}.$$

Why other options are wrong:

- Option (A): $\frac{7}{3}$ is the sum of roots $(-b/a)$, not the product.
- Option (B): 5 is the constant term c, not divided by a.
- Option (D): 7 is $|b|$, which is neither sum nor product.

Final Answer: Product of roots $= \frac{5}{3} \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Sum of a Geometric Progression: For a G.P. with first term a, common ratio $r \neq 1$, and n terms:

$$S_n = a\frac{r^n - 1}{r - 1}.$$

Step 1 — Write down the terms: The five terms are $2, 4, 8, 16, 32$.

Step 2 — Apply the formula:

$$S_5 = 2 \cdot \frac{2^5 - 1}{2 - 1} = 2 \cdot \frac{32 - 1}{1} = 2 \times 31 = 62.$$

Why other options are wrong:

- Option (A): 30 ignores the first term and sums only four terms incorrectly.
- Option (B): 48 is an arithmetic sum error.
- Option (C): 56 omits part of the last term.

Final Answer: $S_5 = 62 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Division of Complex Numbers: Multiply numerator and denominator by the conjugate of the denominator to obtain the standard form $a + bi$.

Step 1 — Multiply by conjugate:

$$\frac{3+4i}{1-2i} \cdot \frac{1+2i}{1+2i} = \frac{(3+4i)(1+2i)}{1^2 + 2^2} = \frac{(3+4i)(1+2i)}{5}.$$

Step 2 — Expand numerator:

$$(3+4i)(1+2i) = 3+6i+4i+8i^2 = 3+10i-8 = -5+10i.$$

Step 3 — Divide and identify real part:

$$\frac{-5+10i}{5} = -1+2i. \quad \text{Real part} = -1.$$

Why other options are wrong:

- Option (B): 1 is the magnitude of the real part but with wrong sign.
- Option (C): 2 is the imaginary part, not the real part.
- Option (D): -2 is the imaginary part with wrong sign.

Final Answer: Real part $= -1 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Complementary Counting: To count selections with at least one girl, subtract the number of all-boy selections from the total.

Step 1 — Total ways to choose 3 from 9 people:

$$\binom{9}{3} = \frac{9!}{3!\,6!} = 84.$$

Step 2 — Ways to choose 3 boys (no girl):

$$\binom{5}{3} = 10.$$

Step 3 — Apply complementary counting:

$$84 - 10 = 74.$$

Why other options are wrong:

- Option (A): 70 underestimates; likely subtracts wrong count.
- Option (C): 60 is incorrect complementary calculation.

- Option (D): 80 exceeds the correct count.

Final Answer: Number of ways $= 74 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Binomial Theorem, Term Independent of x: The general term in $\left(x + \dfrac{1}{x}\right)^6$ is $T_{r+1} = \binom{6}{r} x^{6-r} \cdot x^{-r} = \binom{6}{r} x^{6-2r}$.

Step 1 — Set power of x to zero:

$$6 - 2r = 0 \implies r = 3.$$

Step 2 — Compute the term:

$$T_4 = \binom{6}{3} = \frac{6!}{3!\,3!} = 20.$$

Why other options are wrong:

- Option (A): $15 = \binom{6}{2}$ corresponds to $r = 2$, not independent of x.
- Option (B): 1 would arise if $r = 6$, giving x^{-6}.
- Option (D): $6 = \binom{6}{1}$ corresponds to $r = 1$.

Final Answer: Term independent of $x = 20 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Idempotent Matrices: A matrix A is idempotent if $A^2 = A$. Higher powers collapse back to A.

Step 1 — Compute A^3 using the given property:

$$A^3 = A^2 \cdot A = A \cdot A = A^2.$$

Step 2 — Apply idempotency again:

$$A^3 = A^2 = A.$$

Why other options are wrong:

- Option (A): A^2 and A^3 are both equal to A, so technically not wrong in value, but the intended simplest form is A.
- Option (B): I (identity) holds only if A is also invertible and $A^2 = A \Rightarrow A = I$; not general.
- Option (C): O (zero matrix) would require A to be nilpotent, which contradicts idempotency for non-zero A.

Final Answer: $A^3 = A \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Determinant of a 2×2 Matrix: $\det \begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc.$

Step 1 — Apply the formula:

$$\begin{vmatrix} 2 & 3 \\ 1 & 4 \end{vmatrix} = (2)(4) - (3)(1) = 8 - 3 = 5.$$

Why other options are wrong:

- Option (B): -5 reverses the sign; would come from $bc - ad$.
- Option (C): $11 = 8 + 3$; adds instead of subtracts.
- Option (D): -11 combines wrong sign and wrong operation.

Final Answer: $\det = 5 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Limits at Infinity: For rational functions as $x \to \infty$, divide numerator and denominator by the highest power of x present.

Step 1 — Divide by x^2:

$$\lim_{x\to\infty} \frac{3x^2+5}{x^2+1} = \lim_{x\to\infty} \frac{3+5/x^2}{1+1/x^2}.$$

Step 2 — Evaluate the limit: As $x \to \infty$, $5/x^2 \to 0$ and $1/x^2 \to 0$:

$$\frac{3+0}{1+0} = 3.$$

Why other options are wrong:

- Option (A): 5 comes from just looking at the constant term in the numerator.
- Option (C): ∞ would arise if the degree of numerator exceeded denominator.
- Option (D): 1 would arise if we incorrectly set constant terms to 0 in both.

Final Answer: Limit $= 3 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Mean Value Theorem (MVT): If f is continuous on $[a,b]$ and differentiable on (a,b), then there exists $c \in (a,b)$ such that:

$$f'(c) = \frac{f(b)-f(a)}{b-a}.$$

Step 1 — Compute the average rate of change:

$$\frac{f(3)-f(1)}{3-1} = \frac{9-1}{2} = \frac{8}{2} = 4.$$

Step 2 — Set $f'(c)$ equal to this: $f'(x) = 2x$, so:

$$2c = 4 \implies c = 2.$$

Why other options are wrong:

- Option (A): $c = 1$ is the left endpoint, not in the open interval $(1, 3)$.
- Option (B): $c = 3$ is the right endpoint.
- Option (D): $c = 4$ lies outside the interval $[1, 3]$.

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

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Maximum of Sine Function: The sine function oscillates between -1 and 1; its maximum value on any interval containing $x = \pi/2$ is 1.

Step 1 — Recall values of $\sin x$ on $[0, 2\pi]$:

$$\sin 0 = 0, \quad \sin \tfrac{\pi}{2} = 1, \quad \sin \pi = 0, \quad \sin \tfrac{3\pi}{2} = -1, \quad \sin 2\pi = 0.$$

Step 2 — Identify the maximum: The maximum is 1, attained at $x = \dfrac{\pi}{2}$.

Why other options are wrong:

- Option (A): 0 is the value at endpoints and at $x = \pi$, not the maximum.
- Option (B): -1 is the minimum, not the maximum.
- Option (C): 2 exceeds the range $[-1, 1]$ of $\sin x$; impossible.

Final Answer: Maximum value of $\sin x = 1 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Standard Integral: The derivative of $\tan x$ is $\sec^2 x$, so by the reverse process:

$$\int \sec^2 x \, dx = \tan x + C.$$

Step 1 — Recall the standard result: $\dfrac{d}{dx}(\tan x) = \sec^2 x$.

Step 2 — Write the integral: $\int \sec^2 x\,dx = \tan x + C$.

Why other options are wrong:

- Option (B): $\sec x + C$ is the integral of $\sec x \tan x$, not $\sec^2 x$.
- Option (C): $\sec^2 x + C$ is not an antiderivative; it equals the integrand.
- Option (D): $-\tan x + C$ would differentiate to $-\sec^2 x$.

Final Answer: $\int \sec^2 x\,dx = \tan x + C \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Definite Integral of Absolute Value: Split the integral at points where $\cos x$ changes sign.

Step 1 — Identify sign change: $\cos x \geq 0$ on $[0, \pi/2]$ and $\cos x \leq 0$ on $[\pi/2, \pi]$.

Step 2 — Split and evaluate:

$$\int_0^{\pi} |\cos x|\,dx = \int_0^{\pi/2} \cos x\,dx + \int_{\pi/2}^{\pi} (-\cos x)\,dx.$$

$$= [\sin x]_0^{\pi/2} + [-\sin x]_{\pi/2}^{\pi} = (1-0) + (0-(-1)) = 1 + 1 = 2.$$

Why other options are wrong:

- Option (A): 0 results from integrating $\cos x$ without the absolute value (positive and negative parts cancel).
- Option (C): 1 counts only half the interval.
- Option (D): π is the length of the interval, not the integral value.

Final Answer: $\int_0^{\pi} |\cos x|\,dx = 2 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Separable Differential Equations: Rearrange so all y terms are on one side and all x terms on the other, then integrate both sides.

Step 1 — Separate variables:

$$\frac{dy}{y} = \frac{dx}{x}.$$

Step 2 — Integrate both sides:

$$\ln|y| = \ln|x| + \ln|A| \implies \ln|y| = \ln|Ax|.$$

Step 3 — Exponentiate:

$$y = Ax.$$

Why other options are wrong:

- Option (A): $y = Ae^x$ solves $dy/dx = y$, not $dy/dx = y/x$.
- Option (B): $y = Ax^2$ would require $dy/dx = 2Ax = 2y/x$, not y/x.
- Option (D): $y = A/x$ would give $dy/dx = -A/x^2 = -y/x$, the wrong sign.

Final Answer: General solution: $y = Ax \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Slope of a Line in Standard Form: Rewrite the equation in slope-intercept form $y = mx + c$ to identify slope m.

Step 1 — Rearrange $x + \sqrt{3}\,y = 7$:

$$\sqrt{3}\,y = -x + 7 \implies y = -\frac{1}{\sqrt{3}}x + \frac{7}{\sqrt{3}}.$$

Step 2 — Read off the slope:

$$m = -\frac{1}{\sqrt{3}}.$$

Why other options are wrong:

- Option (A): $\sqrt{3}$ is the slope of a line perpendicular to this one.

- Option (B): $1/\sqrt{3}$ has the right magnitude but wrong sign.
- Option (C): $-\sqrt{3}$ is the negative reciprocal; it confuses a and b.

Final Answer: Slope $= -\dfrac{1}{\sqrt{3}} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Equation of a Circle: A circle with centre (h, k) and radius r has equation $(x-h)^2 + (y-k)^2 = r^2$. For centre at origin: $x^2 + y^2 = r^2$.

Step 1 — Substitute given values: Centre $= (0, 0)$, $r = 5$:

$$x^2 + y^2 = 5^2 = 25.$$

Step 2 — Verify with a point on the circle: Point $(3, 4)$: $3^2 + 4^2 = 9 + 16 = 25$. ✓

Why other options are wrong:

- Option (B): $x^2 + y^2 = 5$ would give radius $\sqrt{5}$, not 5.
- Option (C): $(x-5)^2 + y^2 = 25$ has centre $(5, 0)$, not the origin.
- Option (D): $x^2 + (y-5)^2 = 25$ has centre $(0, 5)$, not the origin.

Final Answer: $x^2 + y^2 = 25 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — Vertex of a Parabola in Vertex Form: For $y = (x-h)^2 + k$, the vertex is at (h, k).

Step 1 — Identify h and k: Comparing $y = (x-2)^2 + 3$ with $y = (x-h)^2 + k$:

$$h = 2, \quad k = 3.$$

Step 2 — State the vertex: Vertex $= (2, 3)$.

Why other options are wrong:

- Option (A): $(2, -3)$ incorrectly negates k.
- Option (C): $(-2, 3)$ incorrectly negates h.
- Option (D): $(-2, -3)$ negates both h and k incorrectly.

Final Answer: Vertex $= (2, 3) \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Asymptotes of a Hyperbola: For $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$, the asymptotes are $y = \pm\frac{b}{a}x$.

Step 1 — Identify a and b: $a^2 = 4 \Rightarrow a = 2$; $b^2 = 9 \Rightarrow b = 3$.

Step 2 — Write the asymptotes:

$$y = \pm\frac{b}{a}x = \pm\frac{3}{2}x.$$

Why other options are wrong:

- Option (A): $y = \pm 2x$ uses a instead of b/a.
- Option (B): $y = \pm\frac{2}{3}x$ inverts the ratio b/a.
- Option (D): $y = \pm 3x$ uses b instead of b/a.

Final Answer: Asymptotes: $y = \pm\frac{3}{2}x \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Standard Trigonometric Values: $\sin(\pi/3) = \sqrt{3}/2$ and $\cos(\pi/6) = \sqrt{3}/2$ are standard exact values from the unit circle.

Step 1 — Recall exact values:

$$\sin\frac{\pi}{3} = \frac{\sqrt{3}}{2}, \qquad \cos\frac{\pi}{6} = \frac{\sqrt{3}}{2}.$$

Step 2 — Add:

$$\sin\frac{\pi}{3}+\cos\frac{\pi}{6}=\frac{\sqrt{3}}{2}+\frac{\sqrt{3}}{2}=\sqrt{3}.$$

Why other options are wrong:

- Option (A): 1 would result from $\sin(\pi/6)+\cos(\pi/3)=1/2+1/2$.
- Option (B): $\sqrt{2}$ does not arise from these two values.
- Option (C): $1/2$ is each individual term before addition, not their sum.

Final Answer: $\sin\frac{\pi}{3}+\cos\frac{\pi}{6}=\sqrt{3}\Rightarrow\boxed{D}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Range of Inverse Trigonometric Functions: The range of the principal value branch of $\cos^{-1}$ is defined to be $[0,\pi]$ to make it a bijection.

Step 1 — Recall the standard definition: $\cos^{-1}:[-1,1]\to[0,\pi]$ is the principal value branch.

Step 2 — State the range: Range of $\cos^{-1}x=[0,\pi]$.

Why other options are wrong:

- Option (B): $[-\pi/2,\pi/2]$ is the range of $\sin^{-1}x$, not $\cos^{-1}x$.
- Option (C): $(0,\pi)$ is open; the boundary values 0 and π are in the range.
- Option (D): $[-1,1]$ is the *domain* of $\cos^{-1}x$, not its range.

Final Answer: Range of $\cos^{-1}x=[0,\pi]\Rightarrow\boxed{A}$

Answer: (A) Go Back to Q20

Section B — Integer Answer Type Solutions

Q21.

Solution

Concept — Scalar Projection: The scalar projection of $\vec{a}$ onto $\vec{b}$ is $\dfrac{\vec{a}\cdot\vec{b}}{|\vec{b}|}$.

Step 1 — Compute the dot product:

$$\vec{a}\cdot\vec{b} = (3)(4) + (4)(0) = 12.$$

Step 2 — Compute $|\vec{b}|$:

$$|\vec{b}| = \sqrt{4^2 + 0^2} = 4.$$

Step 3 — Divide:

$$\text{Scalar projection} = \frac{12}{4} = 3.$$

Final Answer: Scalar projection $= 3$

$\boxed{\textbf{Answer: (3)}}$ Go Back to Q21

Q22.

Solution

Concept — Distance Formula in 3D: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$.

Step 1 — Compute differences:

$$\Delta x = 4 - 1 = 3, \quad \Delta y = 6 - 2 = 4, \quad \Delta z = 3 - 3 = 0.$$

Step 2 — Apply formula:

$$d = \sqrt{3^2 + 4^2 + 0^2} = \sqrt{9 + 16} = \sqrt{25} = 5.$$

Final Answer: Distance $= 5$

$\boxed{\textbf{Answer: (5)}}$ Go Back to Q22

Q23.

Solution

Concept — Classical Probability: $P(\text{event}) = \dfrac{\text{favourable outcomes}}{\text{total outcomes}}$.

Step 1 — Find P(ace): There are 4 aces in 52 cards:

$$P(\text{ace}) = \frac{4}{52}.$$

Step 2 — Compute the required value:

$$52 \times P(\text{ace}) = 52 \times \frac{4}{52} = 4.$$

Final Answer: $52 \times P(\text{ace}) = 4$

Answer: (4) Go Back to Q23

Q24.

Solution

Concept — Mode of a Data Set: The mode is the value that appears most frequently.

Step 1 — Count frequencies: Data: $\{3, 3, 5, 7, 3, 8, 3\}$.

$$3 \text{ appears } 4 \text{ times}, \quad 5 \text{ appears } 1 \text{ time}, \quad 7 \text{ appears } 1 \text{ time}, \quad 8 \text{ appears } 1 \text{ time}.$$

Step 2 — Identify mode: The most frequent value is 3.

Final Answer: Mode $= 3$

Answer: (3) Go Back to Q24

Q25.

Solution

Concept — n-th Term of an A.P.: $a_n = a_1 + (n-1)d$.

Step 1 — Write the equation for a_5:

$$a_5 = a_1 + 4d = a_1 + 4(3) = a_1 + 12.$$

Step 2 — Solve for a_1:

$$a_1 + 12 = 20 \implies a_1 = 8.$$

Final Answer: First term $a_1 = 8$

$\boxed{\text{Answer: (8)}}$ Go Back to Q25

Q26.

Solution

Concept — Integers in an Open Interval: Count integers strictly between $-\sqrt{2}$ and $\sqrt{2}$.

Step 1 — Evaluate bounds: $\sqrt{2} \approx 1.414$, so the interval is $(-1.414,\ 1.414)$.

Step 2 — List integers in the interval:

$$-1, \quad 0, \quad 1.$$

That is 3 integers.

Step 3 — Verify decreasing condition: $y' = 3x^2 - 6 = 3(x^2 - 2) < 0$ for $x^2 < 2$, i.e. $x \in (-\sqrt{2}, \sqrt{2})$. Confirmed.

Final Answer: Number of integers $= 3$

$\boxed{\text{Answer: (3)}}$ Go Back to Q26

Q27.

Solution

Concept — Definite Integral of $1/x$: $\int_1^e \frac{1}{x}\,dx = [\ln x]_1^e = \ln e - \ln 1 = 1 - 0 = 1.$

Step 1 — Evaluate the integral:

$$\int_1^e \frac{1}{x}\,dx = \ln e - \ln 1 = 1.$$

Step 2 — Multiply by 10:

$$10 \times 1 = 10.$$

Final Answer: $10 \times \int_1^e \frac{1}{x}\,dx = 10$

$\boxed{\text{Answer: (10)}}$ Go Back to Q27

Q28.

Solution

Concept — Binomial Expansion Coefficient: General term of $(2+x)^4$ is $T_{r+1} = \binom{4}{r}2^{4-r}x^r$.

Step 1 — Find r for the x^2 term: Set $r = 2$.

Step 2 — Compute the coefficient:

$$\binom{4}{2} \cdot 2^{4-2} = 6 \times 4 = 24.$$

Final Answer: Coefficient of $x^2 = 24$

Answer: (24) Go Back to Q28

Q29.

Solution

Concept — Argument of a Complex Number: For $z = a + bi$, the argument is measured from the positive real axis. When $a < 0$ and $b > 0$ (second quadrant): $\arg(z) = 180° - \arctan(|b/a|)$.

Step 1 — Identify components: $z = -1 + i\sqrt{3}$; $a = -1$, $b = \sqrt{3}$.

Step 2 — Compute the reference angle:

$$\arctan\left(\frac{\sqrt{3}}{1}\right) = 60°.$$

Step 3 — Adjust for second quadrant:

$$\arg(z) = 180° - 60° = 120°.$$

Final Answer: Argument $= 120$ degrees

Answer: (120) Go Back to Q29

Q30.

Solution

Concept — Trace of a Matrix: The trace is the sum of diagonal entries. $\mathrm{tr}(A+B) = \mathrm{tr}(A) + \mathrm{tr}(B)$.

Step 1 — Compute $A + B$:

$$A + B = \begin{pmatrix} 2+1 & 1+0 \\ 0+2 & 3+4 \end{pmatrix} = \begin{pmatrix} 3 & 1 \\ 2 & 7 \end{pmatrix}.$$

Step 2 — Sum the diagonal entries:

$$\mathrm{tr}(A+B) = 3 + 7 = 10.$$

Final Answer: Trace of $A + B = 10$

Answer: (10) Go Back to Q30

Answer Key

Section A — MCQ Answers (Q1–Q20)

1	B	2	C	3	D	4	A	5	B
6	C	7	D	8	A	9	B	10	C
11	D	12	A	13	B	14	C	15	D
16	A	17	B	18	C	19	D	20	A
21	3	22	5	23	4	24	3	25	8
26	3	27	10	28	24	29	120	30	10

Section B — Integer Answers (Q21–Q30)