MAH MCA CET Mathematics & Statistics

Sample Paper – 2

Duration: 27 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Mathematics & Statistics portion of **MAH MCA CET** entrance.
- Each correct answer carries **+2 marks**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 12 level — Algebra, Calculus, Coordinate Geometry, Matrices, Statistics & Probability, Trigonometry.**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The 10th term of the arithmetic progression $2,\ 5,\ 8,\ 11,\ \ldots$ is:

(A) 26

(B) 29

(C) 32

(D) 35

Q2. If $\log_3 x = 4$, then the value of x is:

(A) 12

(B) 27

(C) 64

(D) 81

Q3. The middle term in the expansion of $\left(x + \dfrac{1}{x}\right)^6$ is:

(A) 20

(B) 15

(C) 25

(D) 10

Q4. The complete factorization of $x^3 - 6x^2 + 11x - 6$ is:

(A) $(x+1)(x+2)(x+3)$

(B) $(x-1)(x+2)(x-3)$

(C) $(x-1)(x-2)(x-3)$

(D) $(x+1)(x-2)(x+3)$

Q5. In how many ways can 6 people be seated around a circular table?

(A) 720

(B) 120

(C) 360

(D) 60

Q6. The simplified value of $(16)^{3/4}$ is:

(A) 8

(B) 12

(C) 4

(D) 16

Q7. Evaluate $\int \frac{2x}{1+x^2}\,dx$:

(A) $\frac{2}{1+x^2} + C$

(B) $(1+x^2)^2 + C$

(C) $2x^2 + C$

(D) $\ln(1+x^2) + C$

Q8. Using L'Hôpital's rule (or otherwise), find $\lim_{x \to 2} \frac{x^2-4}{x-2}$:

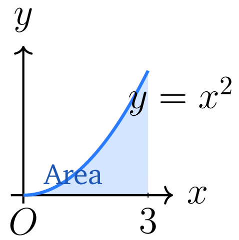
(A) 0

(B) 2

(C) 4

(D) 8

Q9. The area bounded by the curve $y = x^2$, the x-axis, and the lines $x = 0$ and $x = 3$ is:



(A) 6

(B) 9

(C) 12

(D) 27

Q10. The general solution of the differential equation $\frac{dy}{dx} + y = e^x$ (using integrating factor) is:

(A) $y = \frac{e^x}{2} + Ce^{-x}$

(B) $y = e^x + Ce^{-x}$

(C) $y = 2e^x + Ce^{-x}$

(D) $y = \frac{e^x}{2} + Ce^x$

Q11. The local maximum value of $f(x) = -x^2 + 4x - 1$ is:

(A) 1

(B) 2

(C) 4

(D) 3

Q12. The partial fraction decomposition of $\dfrac{1}{(x-1)(x+2)}$ is:

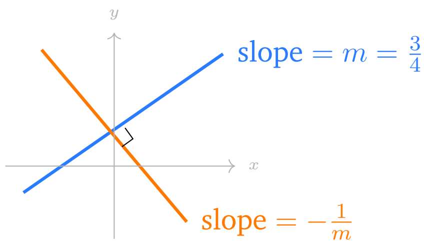
(A) $\dfrac{1}{x-1} - \dfrac{1}{x+2}$

(B) $\dfrac{1}{2(x-1)} - \dfrac{1}{2(x+2)}$

(C) $\dfrac{1}{3(x-1)} - \dfrac{1}{3(x+2)}$

(D) $\dfrac{1}{3(x-1)} + \dfrac{1}{3(x+2)}$

Q13. The slope of the line perpendicular to $3x - 4y = 7$ is:



(A) $-\dfrac{4}{3}$

(B) $\dfrac{3}{4}$

(C) $\dfrac{4}{3}$

(D) $-\dfrac{3}{4}$

Q14. The perpendicular distance from the point $(3,\ 4)$ to the line $3x+4y-10 = 0$ is:

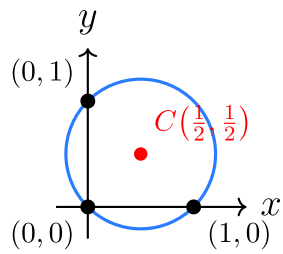
(A) 2

(B) 3

(C) 4

(D) 5

Q15. The equation of the circle passing through the points $(1,\ 0)$, $(0,\ 1)$ and $(0,\ 0)$ is:



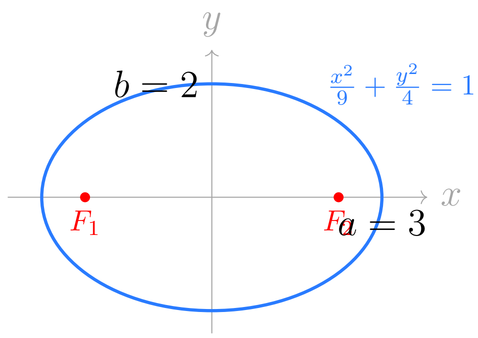
(A) $x^2 + y^2 = 1$

(B) $x^2 + y^2 + x + y = 0$

(C) $x^2 + y^2 = x + y + 1$

(D) $x^2 + y^2 - x - y = 0$

Q16. The eccentricity of the ellipse $\dfrac{x^2}{9} + \dfrac{y^2}{4} = 1$ is:



(A) $\dfrac{\sqrt{5}}{4}$

(B) $\dfrac{2}{3}$

(C) $\dfrac{\sqrt{5}}{3}$

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

Q17. The coordinates of the point of intersection of the lines $x + y = 5$ and $2x - y = 1$ are:

(A) $(2,\ 3)$

(B) $(3,\ 2)$

(C) $(1,\ 4)$

(D) $(4,\ 1)$

Q18. The adjoint of the matrix $A = \begin{pmatrix} 2 & -3 \\ 1 & 4 \end{pmatrix}$ is:

(A) $\begin{pmatrix} 4 & -3 \\ -1 & 2 \end{pmatrix}$

(B) $\begin{pmatrix} -2 & 3 \\ -1 & 4 \end{pmatrix}$

(C) $\begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$

(D) $\begin{pmatrix} 2 & -3 \\ 1 & 4 \end{pmatrix}$

Q19. The value of k for which the matrix $\begin{pmatrix} k & 2 \\ 3 & 6 \end{pmatrix}$ is singular is:

(A) 3

(B) 2

(C) -1

(D) 1

Q20. Using row operations, the value of $\begin{vmatrix} 1 & 3 & 0 \\ 2 & 6 & 4 \\ -1 & 0 & 2 \end{vmatrix}$ is:

(A) 12

(B) -12

(C) 0

(D) 24

Q21. The solution of the system $AX = B$ where $A = \begin{pmatrix} 2 & 1 \\ 5 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} 4 \\ 7 \end{pmatrix}$ is:

(A) $x = 5,\ y = -6$

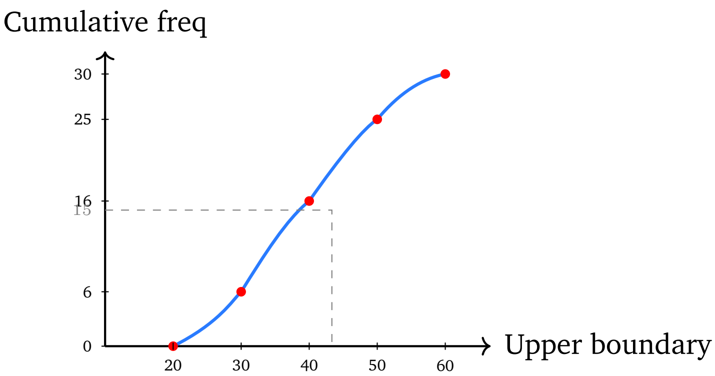
(B) $x = 5,\ y = 6$

(C) $x = -5,\ y = 6$

(D) $x = -5,\ y = -6$

Q22. The following frequency distribution is given. Using the cumulative frequency (ogive) method, find the median.

Class Interval	Frequency
$20 - 30$	6
$30 - 40$	10
$40 - 50$	9
$50 - 60$	5
Total	**30**



(A) 35

(B) 37

(C) 40

(D) 39

Q23. If $P(A \cap B) = 0.15$ and $P(B) = 0.5$, then $P(A \mid B)$ equals:

(A) 0.5

(B) 0.15

(C) 0.3

(D) 0.75

Q24. For a Poisson distribution with parameter $\lambda = 3$, the probability $P(X = 2)$ is:

(A) e^{-3}

(B) $\dfrac{9e^{-3}}{2}$

(C) $3e^{-3}$

(D) $9e^{-3}$

Q25. For the frequency distribution below, find the **mode** using Mode $= L + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$:

Class	Frequency
$10 - 20$	3
$20 - 30$	6
$30 - 40$	15
$40 - 50$	9

(A) 36

(B) 34

(C) 38

(D) 40

Q26. A discrete random variable X takes values $\{1, 2, 3, 4, 5\}$, each with probability $\frac{1}{5}$. The variance of X is:

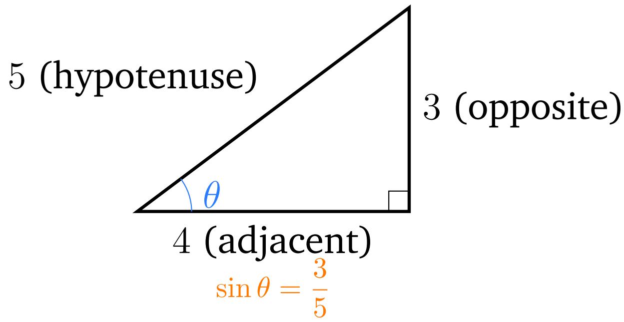
(A) 1

(B) 3

(C) 4

(D) 2

Q27. Given $\sin\theta = \frac{3}{5}$ and using $\cos 2\theta = 1 - 2\sin^2\theta$, find $\cos 2\theta$:



(A) $-\frac{7}{25}$

(B) $\frac{7}{25}$

(C) $\frac{24}{25}$

(D) $-\frac{24}{25}$

Q28. Using $\tan(A-B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$, the value of $\tan 15$ is:

(A) $2 - \sqrt{3}$

(B) $2 + \sqrt{3}$

(C) $\sqrt{3} - 1$

(D) $\sqrt{3} + 1$

Q29. In a triangle ABC with sides $a = 5$, $b = 7$, $c = 8$, using the cosine rule $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$, angle A equals:

(A) $\cos^{-1}\left(\frac{11}{16}\right)$

(B) $\cos^{-1}\left(\frac{1}{2}\right)$

(C) $\cos^{-1}\left(\frac{11}{14}\right)$

(D) $\cos^{-1}\left(\frac{5}{14}\right)$

Q30. The general solution of $\sin x = \frac{1}{2}$ is:

(A) $x = 2n\pi \pm \frac{\pi}{6}$

(B) $x = n\pi \pm \frac{\pi}{6}$

(C) $x = 2n\pi + \frac{\pi}{6}$

(D) $x = n\pi + (-1)^n \frac{\pi}{6}, n \in \mathbb{Z}$

Detailed Solutions

Q1.

Solution

Concept — Arithmetic Progression: The n-th term of an AP with first term a and common difference d is $T_n = a + (n-1)d$.

Step 1 — Identify parameters: $a = 2$, $d = 5 - 2 = 3$, $n = 10$.

Step 2 — Compute: $T_{10} = 2 + (10-1) \times 3 = 2 + 27 = 29$.

Why other options are wrong:

- Option A (26): Uses $n = 9$ mistakenly, giving $2 + 24 = 26$.
- Option C (32): Uses $d = 3$ and $n = 11$, giving $2 + 30 = 32$.
- Option D (35): Computes $a + nd = 2 + 30 = 32$ or uses $d = 3.5$.

Final Answer: $T_{10} = 29 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Logarithm: $\log_b x = n \iff x = b^n$.

Step 1 — Apply definition: $\log_3 x = 4 \Rightarrow x = 3^4$.

Step 2 — Compute: $3^4 = 3 \times 3 \times 3 \times 3 = 81$.

Why other options are wrong:

- Option A (12): Confuses $\log_3 x = 4$ with $3 \times 4 = 12$.
- Option B (27): $3^3 = 27$ (uses exponent 3 instead of 4).
- Option C (64): $4^3 = 64$ (swaps base and exponent).

Final Answer: $x = 81 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Binomial Theorem: For $(x+y)^n$, the $(r+1)$-th term is $T_{r+1} = \binom{n}{r}x^{n-r}y^r$. The middle term of $(x+y)^6$ (even n) is T_4 (i.e. $r=3$).

Step 1 — Write the general term: $T_{r+1} = \binom{6}{r}x^{6-r}\left(\frac{1}{x}\right)^r = \binom{6}{r}x^{6-2r}$.

Step 2 — Middle term ($r=3$): $T_4 = \binom{6}{3}x^{6-6} = 20 \cdot x^0 = 20$.

Why other options are wrong:

- Option B (15): $\binom{6}{2} = 15$; uses $r=2$ instead of $r=3$.
- Option C (25): Not a valid binomial coefficient here.
- Option D (10): $\binom{5}{2} = 10$; applies to a different expansion.

Final Answer: Middle term $= 20 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Polynomial Factorization: Find rational roots using the rational root theorem, then factor out.

Step 1 — Test $x=1$: $1-6+11-6=0$ ✓ $\Rightarrow (x-1)$ is a factor.

Step 2 — Divide and factor further: $x^3-6x^2+11x-6 = (x-1)(x^2-5x+6) = (x-1)(x-2)(x-3)$.

Why other options are wrong:

- Option A: $(x+1)(x+2)(x+3)$ gives positive roots, but $p(1) \neq 0$.
- Option B: $(x-1)(x+2)(x-3) = x^3-2x^2-5x+6 \neq$ the given polynomial.
- Option D: $(x+1)(x-2)(x+3)$ gives a different product.

Final Answer: $(x-1)(x-2)(x-3) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Circular Permutations: The number of ways to arrange n distinct objects in a circle is $(n-1)!$ (one position is fixed to remove rotational symmetry).

Step 1 — Apply formula: $n = 6$, so arrangements $= (6-1)! = 5!$.

Step 2 — Compute: $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$.

Why other options are wrong:

- Option A (720): $6! = 720$ counts linear arrangements, not circular.
- Option C (360): $6!/2 = 360$ applies only when clockwise and anticlockwise are the same.
- Option D (60): $5!/2 = 60$ wrongly treats the arrangement as a necklace.

Final Answer: 120 ways $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Fractional Indices: $a^{m/n} = \left(a^{1/n}\right)^m = \left(\sqrt[n]{a}\right)^m$.

Step 1 — Rewrite base: $16 = 2^4$, so $(16)^{3/4} = (2^4)^{3/4}$.

Step 2 — Apply power rule: $(2^4)^{3/4} = 2^{4\times 3/4} = 2^3 = 8$.

Why other options are wrong:

- Option B (12): Incorrectly adds $16 \times (3/4) = 12$.
- Option C (4): Computes $\sqrt[4]{16} = 2$ then squares to get 4; error in exponent.
- Option D (16): Leaves the base unchanged (exponent ignored).

Final Answer: $(16)^{3/4} = 8 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Integration by Substitution: When the numerator is the derivative of the denominator, $\int \frac{f'(x)}{f(x)}\,dx = \ln|f(x)| + C$.

Step 1 — Identify substitution: Let $u = 1 + x^2 \Rightarrow du = 2x\,dx$.

Step 2 — Integrate: $\displaystyle\int \frac{2x}{1+x^2}\,dx = \int \frac{du}{u} = \ln|u| + C = \ln(1+x^2) + C.$

Why other options are wrong:

- Option A: $\frac{2}{1+x^2} + C$ is the derivative of the integrand, not its antiderivative.
- Option B: $(1+x^2)^2 + C$ would arise from $\int 4x(1+x^2)\,dx$.
- Option C: $2x^2 + C$ ignores the denominator.

Final Answer: $\ln(1+x^2) + C \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — L'Hôpital's Rule / Factoring: For $\frac{0}{0}$ indeterminate forms, differentiate numerator and denominator, or factor.

Step 1 — Factor the numerator: $\displaystyle\frac{x^2-4}{x-2} = \frac{(x-2)(x+2)}{x-2} = x+2$ for $x \neq 2$.

Step 2 — Take the limit: $\lim_{x\to 2}(x+2) = 4$.

Why other options are wrong:

- Option A (0): Direct substitution before cancellation gives $0/0$, not 0.
- Option B (2): Only evaluates the numerator factor $(x-2)$ at $x = 2$.
- Option D (8): Wrongly evaluates x^2 at $x = 2$ ignoring the denominator.

Final Answer: Limit $= 4 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Definite Integration for Area: Area between $y = f(x)$, the x-axis, and $x = a, b$ is $\int_a^b f(x)\,dx$.

Step 1 — Set up integral: Area $= \int_0^3 x^2\,dx$.

Step 2 — Evaluate: $\left[\frac{x^3}{3}\right]_0^3 = \frac{27}{3} - 0 = 9$.

Why other options are wrong:

- Option A (6): Uses $\frac{1}{2} \times 3 \times 4$ (area of triangle approximation).
- Option C (12): Evaluates $4 \times 3 = 12$ (rectangle approximation).
- Option D (27): Computes $3^3 = 27$ without dividing by 3.

Final Answer: Area $= 9$ sq. units $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Linear First-Order ODE: For $\frac{dy}{dx} + P(x)y = Q(x)$, the integrating factor is $\mu = e^{\int P\,dx}$, giving $y \cdot \mu = \int Q \cdot \mu\,dx + C$.

Step 1 — Find I.F.: $P = 1 \Rightarrow \mu = e^{\int 1\,dx} = e^x$.

Step 2 — Multiply and integrate: $\frac{d}{dx}(ye^x) = e^x \cdot e^x = e^{2x}$, so $ye^x = \frac{e^{2x}}{2} + C$, giving $y = \frac{e^x}{2} + Ce^{-x}$.

Why other options are wrong:

- Option B: $y = e^x + Ce^{-x}$ omits the $\frac{1}{2}$ factor from integrating e^{2x}.
- Option C: $y = 2e^x + Ce^{-x}$ uses $\int e^{2x}dx = 2e^{2x}$ (sign error).
- Option D: Ce^x instead of Ce^{-x} uses the wrong homogeneous solution.

Final Answer: $y = \frac{e^x}{2} + Ce^{-x} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Local Maxima: Set $f'(x) = 0$; if $f''(x) < 0$ at that point, it is a local maximum. The maximum *value* is $f(x^*)$.

Step 1 — Differentiate and solve: $f'(x) = -2x + 4 = 0 \Rightarrow x = 2$.

Step 2 — Verify and evaluate: $f''(x) = -2 < 0$ (maximum). $f(2) = -(4)+4(2) - 1 = -4 + 8 - 1 = 3$.

Why other options are wrong:

- Option A (1): $f(0) = -1$ or evaluation error.
- Option B (2): Reports the x-coordinate of the critical point, not the value.
- Option C (4): Computes $4(2) - 4 = 4$, ignoring the $-x^2$ term.

Final Answer: Local maximum value $= 3 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Partial Fractions: Write $\frac{1}{(x-1)(x+2)} = \frac{A}{x-1} + \frac{B}{x+2}$ and solve for A, B.

Step 1 — Multiply through: $1 = A(x + 2) + B(x - 1)$.

Step 2 — Substitute roots: $x = 1$: $1 = 3A \Rightarrow A = \frac{1}{3}$. $x = -2$: $1 = -3B \Rightarrow B = -\frac{1}{3}$.

Result: $\frac{1}{3(x-1)} - \frac{1}{3(x+2)}$.

Why other options are wrong:

- Option A: $A = 1, B = -1$; check: at $x = 0$: $\frac{-1}{-1} + \frac{1}{2} = \frac{3}{2} \neq \frac{-1}{2}$.
- Option B: Uses denominator 2 instead of 3; from $1/(1-(-2)) = 1/3$ not $1/2$.
- Option D: Both terms positive; the partial fraction for B is negative.

Final Answer: $\frac{1}{3(x-1)} - \frac{1}{3(x+2)} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Perpendicular Slopes: Two lines are perpendicular iff the product of their slopes is -1, i.e. $m_1 \cdot m_2 = -1$.

Step 1 — Find slope of given line: $3x - 4y = 7 \Rightarrow y = \frac{3}{4}x - \frac{7}{4}$, slope $m_1 = \frac{3}{4}$.

Step 2 — Find perpendicular slope: $m_2 = -\dfrac{1}{m_1} = -\dfrac{4}{3}$.

Why other options are wrong:

- Option B $(3/4)$: This is the slope of the given line, not the perpendicular.
- Option C $(4/3)$: Positive reciprocal; product $= \frac{3}{4} \cdot \frac{4}{3} = 1 \neq -1$.
- Option D $(-3/4)$: Negative but not the reciprocal; $\frac{3}{4} \cdot (-\frac{3}{4}) \neq -1$.

Final Answer: Slope of perpendicular $= -\dfrac{4}{3} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Distance from Point to Line: $d = \dfrac{|ax_0 + by_0 + c|}{\sqrt{a^2 + b^2}}$ for the line $ax + by + c = 0$.

Step 1 — Identify parameters: $a = 3$, $b = 4$, $c = -10$; point $(x_0, y_0) = (3, 4)$.

Step 2 — Substitute: $d = \dfrac{|3(3) + 4(4) - 10|}{\sqrt{9 + 16}} = \dfrac{|9 + 16 - 10|}{5} = \dfrac{15}{5} = 3$.

Why other options are wrong:

- Option A (2): Subtracts incorrectly; $|25 - 10|/5 = 3$ not 2.
- Option C (4): Uses $\sqrt{25} = 5$ in the numerator instead of denominator.
- Option D (5): Reports $\sqrt{a^2 + b^2} = 5$, the denominator, not the distance.

Final Answer: Distance $= 3$ units $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Circle through Three Points: General equation $x^2+y^2+Dx+Ey+F = 0$; substitute each point to get a system.

Step 1 — Substitute $(0,0)$**:** $0+0+0+0+F=0 \Rightarrow F=0$.

Step 2 — Substitute $(1,0)$ **and** $(0,1)$**:** $1+D=0 \Rightarrow D=-1; \quad 1+E=0 \Rightarrow E=-1$.

Equation: $x^2+y^2-x-y=0$. Centre $=(\frac{1}{2},\frac{1}{2})$, radius $=\frac{1}{\sqrt{2}}$.

Why other options are wrong:

- Option A: $x^2+y^2=1$ is the unit circle; it does not pass through $(0,0)$.
- Option B: $x^2+y^2+x+y=0$ gives centre $(-\frac{1}{2},-\frac{1}{2})$; fails $(1,0)$.
- Option C: $x^2+y^2=x+y+1$ fails $(0,0)$ since $0=0+0+1$.

Final Answer: $x^2+y^2-x-y=0 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Eccentricity of Ellipse: For $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ with $a>b$: $c^2=a^2-b^2$, $e=\frac{c}{a}$.

Step 1 — Read parameters: $a^2=9$, $b^2=4$, so $a=3$, $b=2$.

Step 2 — Compute: $c^2=9-4=5 \Rightarrow c=\sqrt{5}$. $e=\frac{\sqrt{5}}{3}$.

Why other options are wrong:

- Option A ($\sqrt{5}/4$): Uses denominator $b^2=4$ instead of $a=3$.
- Option B ($2/3$): Uses $c=b=2$ instead of $c=\sqrt{5}$.
- Option D ($1/3$): Uses $c=1$ (incorrect $c^2=1$).

Final Answer: $e=\frac{\sqrt{5}}{3} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Simultaneous Equations: Add/subtract equations to eliminate a variable.

Step 1 — Add the equations: $(x + y) + (2x - y) = 5 + 1 \Rightarrow 3x = 6 \Rightarrow x = 2$.

Step 2 — Substitute: $x + y = 5 \Rightarrow 2 + y = 5 \Rightarrow y = 3$. Point: $(2, 3)$.

Why other options are wrong:

- Option B ($(3, 2)$): Swaps x and y; $3 + 2 = 5$ checks, but $2(3) - 2 = 4 \neq 1$.
- Option C ($(1, 4)$): $2(1) - 4 = -2 \neq 1$.
- Option D ($(4, 1)$): $4 + 1 = 5$ but $2(4) - 1 = 7 \neq 1$.

Final Answer: Intersection point $= (2, 3) \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Adjoint of a 2×2 Matrix: For $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$, $\text{adj}(A) = \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$.

Step 1 — Identify elements: $a = 2$, $b = -3$, $c = 1$, $d = 4$.

Step 2 — Write adjoint: $\text{adj}(A) = \begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix}$.

Why other options are wrong:

- Option A: Keeps $b = -3$ instead of negating to $+3$.
- Option B: Negates all elements of the original matrix (not the adjoint rule).
- Option D: Is just the original matrix A itself.

Final Answer: $\text{adj}(A) = \begin{pmatrix} 4 & 3 \\ -1 & 2 \end{pmatrix} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Singular Matrix: A matrix is singular iff its determinant equals zero.

Step 1 — Compute determinant: $\det\begin{pmatrix} k & 2 \\ 3 & 6 \end{pmatrix} = 6k - 6.$

Step 2 — Set to zero: $6k - 6 = 0 \Rightarrow k = 1.$

Why other options are wrong:

- Option A (3): $6(3) - 6 = 12 \neq 0.$
- Option B (2): $6(2) - 6 = 6 \neq 0.$
- Option C (-1): $6(-1) - 6 = -12 \neq 0.$

Final Answer: $k = 1 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — Determinant by Cofactor Expansion: Expand along the first row.

Step 1 — Expand: $\det = 1 \cdot (6 \cdot 2 - 4 \cdot 0) - 3 \cdot (2 \cdot 2 - 4 \cdot (-1)) + 0.$

Step 2 — Compute: $= 1(12) - 3(4 + 4) + 0 = 12 - 24 = -12.$

Why other options are wrong:

- Option A (12): Forgets the negative sign in cofactor expansion for the $(1, 2)$ element.
- Option C (0): Arises from mistakenly using row reduction that zeroes all but one row.
- Option D (24): Computes $|12| + |12| = 24$ without proper signed summation.

Final Answer: $\det = -12 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Matrix Inverse Method: $X = A^{-1}B$. For 2×2: $A^{-1} = \frac{1}{\det A}\,\text{adj}(A)$.

Step 1 — Compute $\det A$ **and** A^{-1}**:** $\det A = 6 - 5 = 1$. $A^{-1} = \begin{pmatrix} 3 & -1 \\ -5 & 2 \end{pmatrix}$.

Step 2 — Multiply: $X = \begin{pmatrix} 3 & -1 \\ -5 & 2 \end{pmatrix}\begin{pmatrix} 4 \\ 7 \end{pmatrix} = \begin{pmatrix} 12-7 \\ -20+14 \end{pmatrix} = \begin{pmatrix} 5 \\ -6 \end{pmatrix}$.

Why other options are wrong:

- Option B: $y = 6$ has a sign error; $-5(4) + 2(7) = -6$, not $+6$.
- Option C/D: $x = -5$ arises from using an incorrect adjoint.

Final Answer: $x = 5,\ y = -6 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Median (Interpolation Formula): Median $= L + \dfrac{\frac{n}{2} - cf}{f} \times h$, where L = lower boundary of median class, cf = cumulative frequency before it, f = frequency of median class, h = class width.

Step 1 — Find median class: $n = 30$, $n/2 = 15$. Cumulative frequencies: 6, 16, 25, 30. The value 15 first exceeds $cf = 6$ in the class 30–40 (cf jumps to 16). Median class: 30–40.

Step 2 — Apply formula: $L = 30$, $cf = 6$, $f = 10$, $h = 10$.

$$\text{Median} = 30 + \frac{15-6}{10} \times 10 = 30 + 9 = 39.$$

Why other options are wrong:

- Option A (35): Uses $n/2 = 15$ in the class 20–30 incorrectly.
- Option B (37): Arithmetic error in interpolation fraction.
- Option C (40): Uses $L = 40$ (next class boundary) by mistake.

Final Answer: Median $= 39 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

Concept — Conditional Probability: $P(A \mid B) = \dfrac{P(A \cap B)}{P(B)}$.

Step 1 — Substitute values: $P(A \mid B) = \dfrac{0.15}{0.5}$.

Step 2 — Simplify: $= \dfrac{15}{50} = 0.3$.

Why other options are wrong:

- Option A (0.5): Reports $P(B)$ itself.
- Option B (0.15): Reports $P(A \cap B)$ without dividing by $P(B)$.
- Option D (0.75): Adds $0.5 + 0.25$ (Bayes error) instead of dividing.

Final Answer: $P(A \mid B) = 0.3 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Poisson Distribution: $P(X = k) = \dfrac{e^{-\lambda}\lambda^k}{k!}$.

Step 1 — Substitute $\lambda = 3$, $k = 2$: $P(X = 2) = \dfrac{e^{-3} \cdot 3^2}{2!} = \dfrac{9e^{-3}}{2}$.

Step 2 — Verify: $3^2 = 9$, $2! = 2$, so the result is $\dfrac{9e^{-3}}{2}$.

Why other options are wrong:

- Option A (e^{-3}): Is $P(X = 0)$ with $k = 0$.
- Option C $(3e^{-3})$: Is $P(X = 1)$ with $\lambda^1/1! = 3$.
- Option D $(9e^{-3})$: Forgets to divide by $2! = 2$.

Final Answer: $P(X = 2) = \dfrac{9e^{-3}}{2} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q24

Q25.

Solution

Concept — Mode of Grouped Data: Mode $= L + \dfrac{f_1 - f_0}{2f_1 - f_0 - f_2} \times h$, where L = lower boundary of modal class (highest frequency), f_1, f_0, f_2 = frequencies of modal, preceding, and succeeding classes.

Step 1 — Identify modal class: Highest frequency is 15 (class 30–40). $L = 30$, $f_1 = 15$, $f_0 = 6$, $f_2 = 9$, $h = 10$.

Step 2 — Compute: Mode $= 30 + \dfrac{15-6}{2(15)-6-9} \times 10 = 30 + \dfrac{9}{30-15} \times 10 = 30 + \dfrac{9}{15} \times 10 = 30 + 6 = 36$.

Why other options are wrong:

- Option B (34): Arithmetic error in denominator $(2f_1 - f_0 - f_2)$.
- Option C (38): Uses $f_2 = 9$ instead of f_0 in numerator.
- Option D (40): Uses the class boundary of the next class as the mode.

Final Answer: Mode $= 36 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Variance of Discrete RV: Var$(X) = E(X^2) - [E(X)]^2$.

Step 1 — Compute $E(X)$: $E(X) = \dfrac{1}{5}(1+2+3+4+5) = \dfrac{15}{5} = 3$.

Step 2 — Compute $E(X^2)$ and variance: $E(X^2) = \dfrac{1}{5}(1+4+9+16+25) = \dfrac{55}{5} = 11$. Var$(X) = 11 - 9 = 2$.

Why other options are wrong:

- Option A (1): Uses Var$(X) = E(X) - [E(X)]^2 = 3 - 9$ (incorrect formula).
- Option B (3): Reports $E(X)$ as the variance.
- Option C (4): Computes $E(X^2) - E(X) = 11 - 7 = 4$ (wrong subtraction).

Final Answer: Var$(X) = 2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Double Angle Formula: $\cos 2\theta = 1 - 2\sin^2\theta$.

Step 1 — Substitute: $\sin\theta = \frac{3}{5} \Rightarrow \sin^2\theta = \frac{9}{25}$.

Step 2 — Compute: $\cos 2\theta = 1 - 2 \cdot \frac{9}{25} = 1 - \frac{18}{25} = \frac{7}{25}$.

Why other options are wrong:

- Option A $(-7/25)$: Sign error; $1 - 18/25 = +7/25$.
- Option C $(24/25)$: Is $\cos\theta$ via Pythagorean identity, not $\cos 2\theta$.
- Option D $(-24/25)$: Is $-\cos\theta$ or $\cos 2\theta$ for a different angle.

Final Answer: $\cos 2\theta = \frac{7}{25} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Tangent Difference Formula: $\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$.

Step 1 — Write $15 = 45 - 30$: $\tan 45 = 1$, $\tan 30 = \frac{1}{\sqrt{3}}$.

Step 2 — Substitute and simplify:

$$\tan 15 = \frac{1 - \frac{1}{\sqrt{3}}}{1 + \frac{1}{\sqrt{3}}} = \frac{\sqrt{3} - 1}{\sqrt{3} + 1} = \frac{(\sqrt{3} - 1)^2}{(\sqrt{3})^2 - 1^2} = \frac{4 - 2\sqrt{3}}{2} = 2 - \sqrt{3}.$$

Why other options are wrong:

- Option B $(2 + \sqrt{3})$: Is $\tan 75$ (complementary angle).
- Option C $(\sqrt{3} - 1)$: Omits the rationalization step.
- Option D $(\sqrt{3} + 1)$: Adds instead of subtracts in the numerator.

Final Answer: $\tan 15 = 2 - \sqrt{3} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Cosine Rule: $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$.

Step 1 — Substitute: $a = 5$, $b = 7$, $c = 8$.

$$\cos A = \frac{49 + 64 - 25}{2 \cdot 7 \cdot 8} = \frac{88}{112} = \frac{11}{14}.$$

Step 2 — Conclude: $A = \cos^{-1}\left(\dfrac{11}{14}\right)$.

Why other options are wrong:

- Option A ($\cos^{-1}(11/16)$): Denominator uses $2bc = 2 \cdot 8 \cdot 8$; wrong side length.
- Option B ($\cos^{-1}(1/2)$): Would give $A = 60$; holds only when $a^2 = b^2 + c^2 - bc$.
- Option D ($\cos^{-1}(5/14)$): Puts a^2 in numerator rather than $b^2 + c^2 - a^2$.

Final Answer: $A = \cos^{-1}\left(\dfrac{11}{14}\right) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — General Solution of $\sin x = k$**:** $\sin x = \sin\alpha \Rightarrow x = n\pi + (-1)^n\alpha$, $n \in \mathbb{Z}$.

Step 1 — Identify α**:** $\sin x = \dfrac{1}{2} = \sin\dfrac{\pi}{6}$, so $\alpha = \dfrac{\pi}{6}$.

Step 2 — Write general solution: $x = n\pi + (-1)^n\dfrac{\pi}{6}$, $n \in \mathbb{Z}$.

This covers both $x = \dfrac{\pi}{6}$ (even n) and $x = \pi - \dfrac{\pi}{6} = \dfrac{5\pi}{6}$ (odd n).

Why other options are wrong:

- Option A ($2n\pi \pm \pi/6$): Is the general solution for $\cos x = \cos\frac{\pi}{6}$, not sin.
- Option B ($n\pi \pm \pi/6$): The $\pm$ form loses the alternating sign; it includes extraneous solutions such as $n\pi + \pi/6$ for odd n (which is in the third/fourth quadrant).
- Option C ($2n\pi + \pi/6$): Only captures one of the two principal solutions per period.

Final Answer: $x = n\pi + (-1)^n \frac{\pi}{6}, n \in \mathbb{Z} \Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ **Go Back to Q30**

Answer Key

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