MAH MCA CET Mathematics & Statistics

Sample Paper – 1

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 sum to infinity of a geometric progression with first term $a = 3$ and common ratio $r = \frac{1}{2}$ is:

(A) 3

(B) 4

(C) 6

(D) 8

Q2. Simplify: $\log_2 8 + \log_2 4$

(A) 5

(B) 12

(C) 32

(D) 4

Q3. In the binomial expansion of $(1+x)^5$, the coefficient of x^3 is:

(A) 5

(B) 15

(C) 20

(D) 10

Q4. For the quadratic equation $x^2 - 5x + 6 = 0$, the sum and product of roots are, respectively:

(A) Sum $= 5$, Product $= -6$

(B) Sum $= 5$, Product $= 6$

(C) Sum $= -5$, Product $= 6$

(D) Sum $= 6$, Product $= 5$

Q5. The number of ways to arrange 5 distinct books on a shelf is:

(A) 120

(B) 60

(C) 24

(D) 720

Q6. The value of $\binom{8}{3}$ is:

(A) 28

(B) 48

(C) 56

(D) 70

Q7. Using the chain rule, the derivative of $\ln(\sin x)$ with respect to x is:

(A) $\tan x$

(B) $\cot x$

(C) $-\cot x$

(D) $\csc x$

Q8. Evaluate $\int x\, e^x\, dx$ using integration by parts:

(A) $x\, e^x + C$

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

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

(D) $e^x(x-1) + C$

Q9. Find $\lim_{x \to 0} \frac{\sin 3x}{x}$:

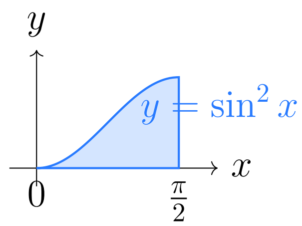
(A) 3

(B) 1

(C) 0

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

Q10. The shaded region below represents the area under $y = \sin^2 x$ from 0 to $\frac{\pi}{2}$.



Find the value of $\int_0^{\pi/2} \sin^2 x\, dx$:

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

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

(C) $\frac{\pi}{4}$

(D) π

Q11. Solve the differential equation $\dfrac{dy}{dx} = \dfrac{y}{x}$ by separating variables. The general solution is:

(A) $y = x + C$

(B) $y = Ax$ (where A is an arbitrary constant)

(C) $y = x^2$

(D) $y = Ae^x$

Q12. Find all stationary points of $f(x) = x^3 - 3x + 2$:

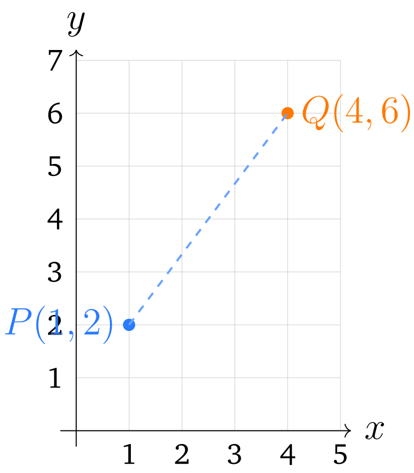
(A) $x = 1$ and $x = -1$

(B) $x = 0$ only

(C) $x = 3$

(D) $x = 1$ only

Q13. The diagram shows two points $P(1, 2)$ and $Q(4, 6)$ on a coordinate grid.



The distance PQ is:

(A) 3

(B) 4

(C) $\sqrt{7}$

(D) 5

Q14. The equation of the straight line passing through the points $(2, 3)$ and $(4, 7)$ is:

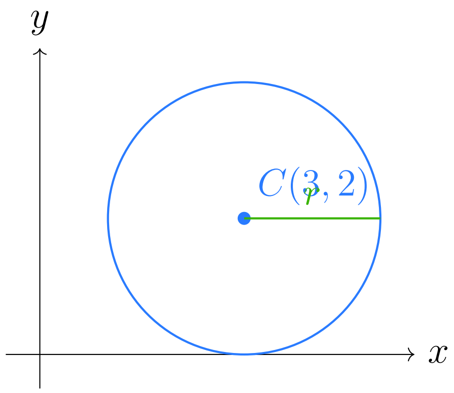
(A) $y = x + 1$

(B) $y = 3x - 3$

(C) $y = 2x - 1$

(D) $y = x + 5$

Q15. For the circle $x^2 + y^2 - 6x - 4y + 9 = 0$, the diagram below shows the center and radius after completing the square.



The center and radius of the circle are:

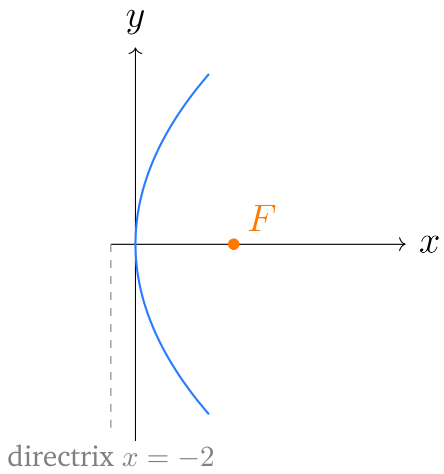
(A) Center $(3, 2)$, radius 2

(B) Center $(-3, -2)$, radius 4

(C) Center $(3, 2)$, radius 4

(D) Center $(6, 4)$, radius 3

Q16. The parabola $y^2 = 8x$ is shown below with its focus F marked.



The coordinates of the focus of the parabola $y^2 = 8x$ are:

(A) $(0,\ 2)$

(B) $(2,\ 0)$

(C) $(4,\ 0)$

(D) $(0,\ 4)$

Q17. The midpoint of the line segment joining the points $(-2, 5)$ and $(4, -3)$ is:

(A) $(2,\ 2)$

(B) $(-1,\ 1)$

(C) $(3,\ 4)$

(D) $(1,\ 1)$

Q18. Compute the determinant of the matrix shown below:

$$\begin{vmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 1 & 0 & 6 \end{vmatrix}$$

(A) 12

(B) 22

(C) 30

(D) 18

Q19. Find the product of the matrices $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} 5 & 6 \\ 7 & 8 \end{pmatrix}$:

(A) $\begin{pmatrix} 12 & 14 \\ 26 & 30 \end{pmatrix}$

(B) $\begin{pmatrix} 5 & 12 \\ 21 & 32 \end{pmatrix}$

(C) $\begin{pmatrix} 19 & 22 \\ 43 & 50 \end{pmatrix}$

(D) $\begin{pmatrix} 17 & 20 \\ 39 & 46 \end{pmatrix}$

Q20. Find the inverse of the matrix $M = \begin{pmatrix} 3 & 1 \\ 5 & 2 \end{pmatrix}$:

(A) $\begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix}$

(B) $\begin{pmatrix} 3 & -1 \\ -5 & 2 \end{pmatrix}$

(C) $\begin{pmatrix} 2 & 1 \\ 5 & 3 \end{pmatrix}$

(D) $\begin{pmatrix} 1/3 & -1/5 \\ -1 & 1/2 \end{pmatrix}$

Q21. Using Cramer's rule, solve the system of equations:
$2x + y = 5$ and $x - y = 1$.

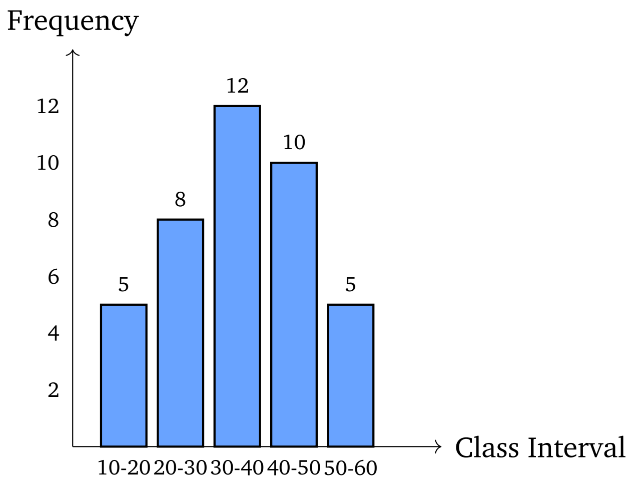
(A) $x = 1,\ y = 3$

(B) $x = 3,\ y = -1$

(C) $x = 2,\ y = -1$

(D) $x = 2,\ y = 1$

Q22. The frequency distribution of marks scored by 40 students is given below. The bar chart represents the data:



Using the midpoint method, the mean of the distribution is:

(A) 30

(B) 32.5

(C) 35.5

(D) 38

Q23. Two independent events A and B have probabilities $P(A) = 0.4$ and $P(B) = 0.3$. Find $P(A \cup B)$:

(A) 0.70

(B) 0.58

(C) 0.12

(D) 0.52

Q24. A random variable X follows a Binomial distribution with $n = 5$ and $p = 0.3$. Find $P(X = 2)$:

(A) 0.3087

(B) 0.1323

(C) 0.2646

(D) 0.0284

Q25. Which of the following statements about Karl Pearson's correlation coefficient r is **correct**?

(A) It measures causation between two variables

(B) $r > 1$ is possible for a very strong correlation

(C) $r = 0$ always implies the two variables are independent

(D) r always lies in the interval $[-1, 1]$

Q26. Find the standard deviation of the data set $\{2, 4, 6, 8, 10\}$:

(A) 2

(B) $2\sqrt{2}$

(C) 4

(D) $\sqrt{10}$

Q27. Using the identity $\sin(A + B) = \sin A \cos B + \cos A \sin B$, find the exact value of $\sin 75$:

(A) $\dfrac{\sqrt{6}+\sqrt{2}}{4}$

(B) $\dfrac{\sqrt{6}-\sqrt{2}}{4}$

(C) $\dfrac{\sqrt{3}}{2}$

(D) $\dfrac{\sqrt{3}+1}{4}$

Q28. Using the identity $\cos(A + B) = \cos A \cos B - \sin A \sin B$, the exact value of $\cos 75$ is:

(A) $\dfrac{\sqrt{6}+\sqrt{2}}{4}$

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

(C) $\dfrac{\sqrt{6}-\sqrt{2}}{4}$

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

Q29. The range (principal value branch) of the function $\sin^{-1}(x)$ is:

(A) $[0, \pi]$

(B) $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

(C) $[-1, 1]$

(D) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$

Q30. In a triangle, the sine rule states $\frac{a}{\sin A} = \frac{b}{\sin B}$. If $a = 6$, $A = 30$, and $B = 60$, find side b:

(A) 3

(B) $6\sqrt{3}$

(C) $3\sqrt{3}$

(D) 12

Detailed Solutions

Q1.

Solution

Concept — Sum of Infinite Geometric Progression: For an infinite GP with first term a and common ratio $|r| < 1$, the sum to infinity is $S_\infty = \dfrac{a}{1-r}$.

Step 1 — Identify parameters: Here $a = 3$ and $r = \dfrac{1}{2}$. Since $|r| = \dfrac{1}{2} < 1$, the series converges.

Step 2 — Apply formula:

$$S_\infty = \frac{3}{1-\frac{1}{2}} = \frac{3}{\frac{1}{2}} = 3 \times 2 = 6.$$

Why other options are wrong:

- Option A (3): This is just the first term a, not the sum.
- Option B (4): Confuses partial sums; $S_2 = 3 + 1.5 = 4.5 \neq 4$.
- Option D (8): Would require $r = 5/8$, not $1/2$.

Final Answer: $S_\infty = 6 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 1

Q2.

Solution

Concept — Logarithm Laws: Using the law $\log_b(m) + \log_b(n) = \log_b(mn)$, and $\log_b(b^k) = k$.

Step 1 — Evaluate each term: $\log_2 8 = \log_2 2^3 = 3$ and $\log_2 4 = \log_2 2^2 = 2$.

Step 2 — Add the results:

$$\log_2 8 + \log_2 4 = 3 + 2 = 5.$$

Why other options are wrong:

- Option B (12): Incorrectly multiplies $3 \times 4 = 12$ instead of adding logarithms.
- Option C (32): Result of $\log_2(8 \times 4) = \log_2 32 = 5$, not 32 itself.
- Option D (4): Off-by-one; forgets that $\log_2 8 = 3$, not 2.

Final Answer: $\log_2 8 + \log_2 4 = 5 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q 2

Q3.

Solution

Concept — Binomial Theorem: The general term in the expansion of $(1+x)^n$ is $T_{r+1} = \binom{n}{r}x^r$. The coefficient of x^r is $\binom{n}{r}$.

Step 1 — Identify r: For the coefficient of x^3, set $r = 3$ with $n = 5$.

Step 2 — Compute:

$$\binom{5}{3} = \frac{5!}{3!\,2!} = \frac{5 \times 4}{2 \times 1} = 10.$$

Why other options are wrong:

- Option A (5): This is $\binom{5}{1}$, the coefficient of x^1.
- Option B (15): This is $\binom{6}{2}$, not relevant here.
- Option C (20): This is $\binom{6}{3}$, for a degree-6 expansion.

Final Answer: Coefficient of $x^3 = 10 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q 3

Q4.

Solution

Concept — Vieta's Formulae: For $ax^2 + bx + c = 0$, sum of roots $= -b/a$ and product of roots $= c/a$.

Step 1 — Identify coefficients: $x^2 - 5x + 6 = 0$ gives $a = 1$, $b = -5$, $c = 6$.

Step 2 — Apply Vieta's formulae:

$$\text{Sum} = \frac{-(-5)}{1} = 5, \qquad \text{Product} = \frac{6}{1} = 6.$$

Why other options are wrong:

- Option A: Product $= -6$ is wrong; $c = +6$.
- Option C: Sum $= -5$ ignores the negative of b/a.
- Option D: Swaps sum and product values.

Final Answer: Sum $= 5$, Product $= 6 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 4

Q5.

Solution

Concept — Fundamental Counting Principle / Permutations: The number of ways to arrange n distinct objects in a line is $n!$ (n factorial).

Step 1 — Set up: We have 5 distinct books and 5 positions on the shelf.

Step 2 — Calculate:

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120.$$

Why other options are wrong:

- Option B (60): $5!/2 = 60$; arises from incorrectly treating two books as identical.
- Option C (24): This is $4! = 24$, for only 4 books.
- Option D (720): This is $6! = 720$, for 6 books.

Final Answer: $5! = 120 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 5

Q6.

Solution

Concept — Combinations: $\binom{n}{r} = \dfrac{n!}{r!\,(n-r)!}$ counts the number of ways to choose r items from n without regard to order.

Step 1 — Apply with $n = 8$, $r = 3$:

$$\binom{8}{3} = \frac{8!}{3! \cdot 5!} = \frac{8 \times 7 \times 6}{3 \times 2 \times 1} = \frac{336}{6} = 56.$$

Why other options are wrong:

- Option A (28): This is $\binom{8}{2}$.
- Option B (48): Not a valid combination value for $n = 8$.
- Option D (70): This is $\binom{8}{4}$.

Final Answer: $\binom{8}{3} = 56 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 6

Q7.

Solution

Concept — Chain Rule: If $y = \ln(f(x))$, then $\dfrac{dy}{dx} = \dfrac{f'(x)}{f(x)}$.

Step 1 — Identify $f(x)$: Here $f(x) = \sin x$, so $f'(x) = \cos x$.

Step 2 — Apply:

$$\frac{d}{dx}[\ln(\sin x)] = \frac{\cos x}{\sin x} = \cot x.$$

Why other options are wrong:

- Option A ($\tan x$): That is $\sin x / \cos x$; the ratio is inverted.
- Option C ($-\cot x$): Would correspond to $\frac{d}{dx}[\ln(\cos x)]$.
- Option D ($\csc x$): $\csc x = 1/\sin x$; not the derivative here.

Final Answer: $\dfrac{d}{dx}[\ln(\sin x)] = \cot x \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 7

Q8.

Solution

Concept — Integration by Parts: $\displaystyle\int u\,dv = uv - \int v\,du$. Choose u to be the algebraic part.

Step 1 — Choose u and dv: Let $u = x \Rightarrow du = dx$. Let $dv = e^x dx \Rightarrow v = e^x$.

Step 2 — Apply the formula:

$$\int x\,e^x\,dx = x\,e^x - \int e^x\,dx = x\,e^x - e^x + C = e^x(x-1) + C.$$

Why other options are wrong:

- Option A ($xe^x + C$): Forgets to subtract $\int v\,du$.
- Option B ($e^x(x+1) + C$): Sign error; subtraction becomes addition.
- Option C ($x^2e^x/2 + C$): Treats e^x as a power function, which is incorrect.

Final Answer: $\int xe^x dx = e^x(x-1)+C \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 8

Q9.

Solution

Concept — Standard Trigonometric Limit: $\lim_{x\to 0} \frac{\sin x}{x} = 1$. This extends to $\lim_{x\to 0} \frac{\sin kx}{x} = k$.

Step 1 — Rewrite:

$$\lim_{x\to 0} \frac{\sin 3x}{x} = \lim_{x\to 0} \frac{\sin 3x}{3x} \cdot 3 = 1 \cdot 3 = 3.$$

Why other options are wrong:

- Option B (1): Forgets the factor 3 in the argument.
- Option C (0): $\sin 3x \to 0$ but so does x; the ratio is not 0.
- Option D $(1/3)$: Inverts the factor; $\lim \frac{x}{\sin 3x} = \frac{1}{3}$, not the given limit.

Final Answer: $\lim_{x\to 0} \frac{\sin 3x}{x} = 3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 9

Q10.

Solution

Concept — Half-Angle Identity for Integration: Use $\sin^2 x = \frac{1-\cos 2x}{2}$ to reduce the power.

Step 1 — Substitute:

$$\int_0^{\pi/2} \sin^2 x\, dx = \int_0^{\pi/2} \frac{1-\cos 2x}{2}\, dx = \frac{1}{2}\left[x - \frac{\sin 2x}{2}\right]_0^{\pi/2}.$$

Step 2 — Evaluate bounds:

$$\frac{1}{2}\left[\left(\frac{\pi}{2} - \frac{\sin \pi}{2}\right) - \left(0 - \frac{\sin 0}{2}\right)\right] = \frac{1}{2} \cdot \frac{\pi}{2} = \frac{\pi}{4}.$$

Why other options are wrong:

- Option A ($\pi/2$): $\int_0^{\pi/2} 1\,dx = \pi/2$; forgets the $\sin^2$ reduces the value.
- Option B ($1/2$): Confuses with $\int_0^1 x\,dx$.
- Option D (π): Doubles the correct answer.

Final Answer: $\int_0^{\pi/2} \sin^2 x\,dx = \frac{\pi}{4} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 10

Q11.

Solution

Concept — Separation of Variables: Rewrite the ODE so all y terms are on one side and all x terms on the other, then integrate both sides.

Step 1 — Separate:

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

Step 2 — Integrate both sides:

$$\ln|y| = \ln|x| + k \implies |y| = e^k|x| \implies y = Ax,$$

where $A = \pm e^k$ is an arbitrary constant.

Why other options are wrong:

- Option A ($y = x + C$): Comes from integrating $dy = dx$, which is $dy/dx = 1$, not y/x.
- Option C ($y = x^2$): Would require $dy/dx = 2x$, a different equation.
- Option D ($y = Ae^x$): Solution of $dy/dx = y$, not $dy/dx = y/x$.

Final Answer: $y = Ax \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 11

Q12.

Solution

Concept — Stationary Points: A stationary point occurs where $f'(x) = 0$.

Step 1 — Differentiate:

$$f'(x) = 3x^2 - 3.$$

Step 2 — Set $f'(x) = 0$ and solve:

$$3x^2 - 3 = 0 \implies x^2 = 1 \implies x = \pm 1.$$

Both $x = 1$ and $x = -1$ are stationary points. $f(1) = 1 - 3 + 2 = 0$ (local min); $f(-1) = -1 + 3 + 2 = 4$ (local max).

Why other options are wrong:

- Option B ($x = 0$): $f'(0) = -3 \neq 0$.
- Option C ($x = 3$): $f'(3) = 24 \neq 0$.
- Option D ($x = 1$ only): Misses the second root $x = -1$.

Final Answer: Stationary points at $x = \pm 1 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 12

Q13.

Solution

Concept — Distance Formula: The distance between (x_1, y_1) and (x_2, y_2) is $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

Step 1 — Substitute: $P(1, 2)$ and $Q(4, 6)$:

$$d = \sqrt{(4-1)^2 + (6-2)^2} = \sqrt{9 + 16} = \sqrt{25}.$$

Step 2 — Simplify: $\sqrt{25} = 5$.

Why other options are wrong:

- Option A (3): Only the horizontal difference $|4 - 1| = 3$.
- Option B (4): Only the vertical difference $|6 - 2| = 4$.
- Option C ($\sqrt{7}$): Arithmetic error in squaring the differences.

Final Answer: $PQ = 5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 13

Q14.

Solution

Concept — Equation of a Line (Two-Point Form): Slope $m = \dfrac{y_2 - y_1}{x_2 - x_1}$; then $y - y_1 = m(x - x_1)$.

Step 1 — Find slope:

$$m = \frac{7-3}{4-2} = \frac{4}{2} = 2.$$

Step 2 — Write equation using point $(2, 3)$:

$$y - 3 = 2(x - 2) \implies y = 2x - 4 + 3 = 2x - 1.$$

Why other options are wrong:

- Option A ($y = x + 1$): Slope $= 1$, not 2.
- Option B ($y = 3x - 3$): Slope $= 3$; would give $y(2) = 3$, $y(4) = 9 \neq 7$.
- Option D ($y = x + 5$): Slope $= 1$ and wrong intercept.

Final Answer: $y = 2x - 1 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 14

Q15.

Solution

Concept — Standard Form of a Circle: Complete the square to write $x^2 + y^2 + Dx + Ey + F = 0$ as $(x - h)^2 + (y - k)^2 = r^2$.

Step 1 — Complete the square:

$$(x^2 - 6x + 9) + (y^2 - 4y + 4) = -9 + 9 + 4 \implies (x - 3)^2 + (y - 2)^2 = 4.$$

Step 2 — Read off center and radius: Center $= (3, 2)$, $r^2 = 4 \Rightarrow r = 2$.

Why other options are wrong:

- Option B: Center should be $(+3, +2)$, not $(-3, -2)$.
- Option C: Radius $= 2$, not 4; $r^2 = 4$, so $r = 2$.

- Option D: Center $(6, 4)$ uses D, E directly without halving.

Final Answer: Center $(3, 2)$, radius $2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 15

Q16.

Solution

Concept — Focus of a Parabola: For the standard parabola $y^2 = 4ax$, the focus is at $(a, 0)$.

Step 1 — Compare with standard form:

$$y^2 = 8x \implies 4a = 8 \implies a = 2.$$

Step 2 — State the focus: Focus $= (a, 0) = (2, 0)$.

Why other options are wrong:

- Option A ($(0, 2)$): Swaps x and y coordinates of the focus.
- Option C ($(4, 0)$): Uses $4a = 8$ directly instead of $a = 2$.
- Option D ($(0, 4)$): Confuses with a parabola opening upward.

Final Answer: Focus $= (2, 0) \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 16

Q17.

Solution

Concept — Midpoint Formula: The midpoint of a segment joining (x_1, y_1) and (x_2, y_2) is $\left(\dfrac{x_1 + x_2}{2}, \dfrac{y_1 + y_2}{2}\right)$.

Step 1 — Substitute:

$$M = \left(\frac{-2 + 4}{2}, \frac{5 + (-3)}{2}\right) = \left(\frac{2}{2}, \frac{2}{2}\right) = (1,\ 1).$$

Why other options are wrong:

- Option A ($(2, 2)$): Uses $(-2 + 4) = 2$ without dividing by 2 in y.
- Option B ($(-1, 1)$): Computes $(-2 + 0)/2 = -1$; arithmetic error on x.

- Option C ($(3, 4)$): Neither coordinate matches the correct midpoint.

Final Answer: Midpoint $= (1, 1) \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 17

Q18.

Solution

Concept — Determinant Expansion (Cofactor): Expand along the first row: $\det(A) = a_{11}C_{11} + a_{12}C_{12} + a_{13}C_{13}$.

Step 1 — Expand:

$$\det = 1 \cdot \begin{vmatrix} 4 & 5 \\ 0 & 6 \end{vmatrix} - 2 \cdot \begin{vmatrix} 0 & 5 \\ 1 & 6 \end{vmatrix} + 3 \cdot \begin{vmatrix} 0 & 4 \\ 1 & 0 \end{vmatrix}.$$

Step 2 — Compute 2×2 determinants:

$$= 1(24 - 0) - 2(0 - 5) + 3(0 - 4) = 24 + 10 - 12 = 22.$$

Why other options are wrong:

- Option A (12): Omits the cofactor signs; partial calculation.
- Option C (30): Arithmetic error; incorrectly adds without the subtraction.
- Option D (18): Sign error on the second cofactor term.

Final Answer: $\det = 22 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 18

Q19.

Solution

Concept — Matrix Multiplication: $(AB)_{ij} = \sum_k A_{ik}B_{kj}$. For 2×2 matrices, each entry is computed as row $\times$ column dot product.

Step 1 — Compute each entry of AB:

$$(AB)_{11} = 1 \cdot 5 + 2 \cdot 7 = 5 + 14 = 19, \quad (AB)_{12} = 1 \cdot 6 + 2 \cdot 8 = 6 + 16 = 22,$$
$$(AB)_{21} = 3 \cdot 5 + 4 \cdot 7 = 15 + 28 = 43, \quad (AB)_{22} = 3 \cdot 6 + 4 \cdot 8 = 18 + 32 = 50.$$

Step 2 — Write the result:

$$AB = \begin{pmatrix} 19 & 22 \\ 43 & 50 \end{pmatrix}.$$

Why other options are wrong:

- Option A: Entry-wise addition, not multiplication.
- Option B: Only multiplies diagonal entries.
- Option D: Arithmetic errors in the dot products.

Final Answer: $AB = \begin{pmatrix} 19 & 22 \\ 43 & 50 \end{pmatrix} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 19

Q20.

Solution

Concept — Inverse of a 2×2 Matrix: $M^{-1} = \dfrac{1}{\det(M)} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$ for $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$.

Step 1 — Compute the determinant:

$$\det(M) = 3 \cdot 2 - 1 \cdot 5 = 6 - 5 = 1.$$

Step 2 — Apply the inverse formula:

$$M^{-1} = \frac{1}{1} \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix} = \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix}.$$

Why other options are wrong:

- Option B: Keeps original a, d entries instead of swapping them.
- Option C: Does not negate the off-diagonal elements.
- Option D: Uses reciprocals of entries; that is not the formula for a matrix inverse.

Final Answer: $M^{-1} = \begin{pmatrix} 2 & -1 \\ -5 & 3 \end{pmatrix} \Rightarrow \boxed{\text{A}}$

$\boxed{\text{Answer: (A)}}$ Go Back to Q 20

Q21.

Solution

Concept — Cramer's Rule: For $ax+by=e$, $cx+dy=f$: $D=ad-bc$, $D_x=ed-bf$, $D_y=af-ce$; solution $x=D_x/D$, $y=D_y/D$.

Step 1 — Form the determinants:

$$D=\begin{vmatrix}2 & 1\\ 1 & -1\end{vmatrix}=-2-1=-3.$$

$$D_x=\begin{vmatrix}5 & 1\\ 1 & -1\end{vmatrix}=-5-1=-6.$$

$$D_y=\begin{vmatrix}2 & 5\\ 1 & 1\end{vmatrix}=2-5=-3.$$

Step 2 — Solve:

$$x=\frac{D_x}{D}=\frac{-6}{-3}=2,\qquad y=\frac{D_y}{D}=\frac{-3}{-3}=1.$$

Why other options are wrong:

- Option A $(x=1, y=3)$: Check: $2(1)+3=5$ ✓but $1-3=-2\neq 1$.
- Option B $(x=3, y=-1)$: $3-(-1)=4\neq 1$.
- Option C $(x=2, y=-1)$: $2-(-1)=3\neq 1$.

Final Answer: $x=2,\ y=1 \Rightarrow \boxed{\text{D}}$

$\boxed{\text{Answer: (D)}}$ Go Back to Q 21

Q22.

Solution

Concept — Mean of Grouped Data: $\bar{x}=\dfrac{\sum f_i x_i}{\sum f_i}$, where x_i is the class midpoint and f_i is the frequency.

Step 1 — Compute midpoints and $f_i x_i$:

Class	Midpoint x_i	Freq f_i	$f_i x_i$
10–20	15	5	75
20–30	25	8	200
30–40	35	12	420
40–50	45	10	450
50–60	55	5	275
		$\sum f_i = 40$	$\sum f_i x_i = 1420$

Step 2 — Compute mean:

$$\bar{x} = \frac{1420}{40} = 35.5.$$

Why other options are wrong:

- Option A (30): Uses only the third class midpoint.
- Option B (32.5): Average of first and last midpoint only.
- Option D (38): Ignores the weighting by frequencies.

Final Answer: Mean $= 35.5 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 22

Q23.

Solution

Concept — Addition Rule for Independent Events: If A and B are independent, $P(A \cap B) = P(A) \cdot P(B)$, and $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.

Step 1 — Compute $P(A \cap B)$:

$$P(A \cap B) = 0.4 \times 0.3 = 0.12.$$

Step 2 — Compute $P(A \cup B)$:

$$P(A \cup B) = 0.4 + 0.3 - 0.12 = 0.58.$$

Why other options are wrong:

- Option A (0.70): Simply adds $P(A) + P(B)$; forgets to subtract $P(A \cap B)$.
- Option C (0.12): This is only $P(A \cap B)$, not $P(A \cup B)$.
- Option D (0.52): Arithmetic error; $0.4 + 0.3 - 0.18 = 0.52$ uses wrong product.

Final Answer: $P(A \cup B) = 0.58 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 23

Q24.

Solution

Concept — Binomial Distribution: $P(X = k) = \binom{n}{k} p^k (1-p)^{n-k}$.

Step 1 — Identify parameters: $n = 5$, $p = 0.3$, $q = 1 - p = 0.7$, $k = 2$.

Step 2 — Compute:

$$P(X = 2) = \binom{5}{2}(0.3)^2(0.7)^3 = 10 \times 0.09 \times 0.343 = 10 \times 0.03087 = 0.3087.$$

Why other options are wrong:

- Option B (0.1323): This is $P(X = 3) = \binom{5}{3}(0.3)^3(0.7)^2$.
- Option C (0.2646): Arithmetic error; miscomputes $(0.7)^3$.
- Option D (0.0284): This is $P(X = 4)$ or $P(X = 5)$ range.

Final Answer: $P(X = 2) = 0.3087 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 24

Q25.

Solution

Concept — Karl Pearson's Correlation Coefficient: Defined as $r = \dfrac{\text{Cov}(X, Y)}{\sigma_X \sigma_Y}$, it measures the linear association between two variables and always satisfies $-1 \leq r \leq 1$.

Step 1 — Evaluate each statement:

- *Causation*: Correlation is not causation; r measures association only.
- $r > 1$: By the Cauchy–Schwarz inequality, $|r| \leq 1$ always.
- $r = 0$ *implies independence*: True only for normal distributions; $r = 0$ generally means *no linear* relationship.
- $r \in [-1, 1]$: Always true by definition.

Step 2 — Identify correct statement: Option D is the correct and universally valid statement.

Why other options are wrong:

- Option A: Correlation $\neq$ causation; classic statistical fallacy.
- Option B: $|r| > 1$ is mathematically impossible.
- Option C: $r = 0$ can coexist with non-linear dependence (e.g., $Y = X^2$).

Final Answer: r lies in $[-1, 1] \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 25

Q26.

Solution

Concept — Standard Deviation: $\sigma = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}$.

Step 1 — Find the mean:

$$\bar{x} = \frac{2+4+6+8+10}{5} = \frac{30}{5} = 6.$$

Step 2 — Compute deviations squared and variance:

$$(2-6)^2 + (4-6)^2 + (6-6)^2 + (8-6)^2 + (10-6)^2 = 16+4+0+4+16 = 40.$$

$$\text{Variance} = \frac{40}{5} = 8. \quad \sigma = \sqrt{8} = 2\sqrt{2}.$$

Why other options are wrong:

- Option A (2): $\sqrt{4} = 2$; incorrectly computes variance as 4.
- Option C (4): Confuses variance (8) with standard deviation.
- Option D ($\sqrt{10}$): Arithmetic error in summing squared deviations.

Final Answer: $\sigma = 2\sqrt{2} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 26

Q27.

Solution

Concept — Addition Formula for Sine: $\sin(A+B) = \sin A\cos B + \cos A\sin B$.

Step 1 — Express $75 = 45 + 30$**:**

$$\sin 75 = \sin(45+30) = \sin 45\cos 30 + \cos 45\sin 30.$$

Step 2 — Substitute known values:

$$\sin 75 = \frac{\sqrt{2}}{2}\cdot\frac{\sqrt{3}}{2} + \frac{\sqrt{2}}{2}\cdot\frac{1}{2} = \frac{\sqrt{6}}{4} + \frac{\sqrt{2}}{4} = \frac{\sqrt{6}+\sqrt{2}}{4}.$$

Why other options are wrong:

- Option B: $(\sqrt{6}-\sqrt{2})/4 = \cos 75$, not $\sin 75$.
- Option C $(\sqrt{3}/2)$: This is $\sin 60$, not $\sin 75$.
- Option D: Missing the $\sqrt{2}$ factor; incorrect partial expansion.

Final Answer: $\sin 75 = \dfrac{\sqrt{6}+\sqrt{2}}{4} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q 27**

Q28.

Solution

Concept — Addition Formula for Cosine: $\cos(A+B) = \cos A\cos B - \sin A\sin B$.

Step 1 — Express $75 = 45 + 30$**:**

$$\cos 75 = \cos(45+30) = \cos 45\cos 30 - \sin 45\sin 30.$$

Step 2 — Substitute known values:

$$\cos 75 = \frac{\sqrt{2}}{2}\cdot\frac{\sqrt{3}}{2} - \frac{\sqrt{2}}{2}\cdot\frac{1}{2} = \frac{\sqrt{6}}{4} - \frac{\sqrt{2}}{4} = \frac{\sqrt{6}-\sqrt{2}}{4}.$$

Why other options are wrong:

- Option A: $(\sqrt{6}+\sqrt{2})/4 = \sin 75$; sign between terms is wrong.
- Option B $(\sqrt{3}/2)$: This is $\cos 30$, not $\cos 75$.
- Option D $(1/2)$: This is $\cos 60$.

Final Answer: $\cos 75 = \dfrac{\sqrt{6}-\sqrt{2}}{4} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 28

Q29.

Solution

Concept — Inverse Trigonometric Functions: The principal value branch of $\sin^{-1}$ is chosen so that it is a one-to-one function. Its range (output set) is the closed interval $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

Step 1 — Recall the definition: $y = \sin^{-1}(x)$ means $\sin y = x$ with y restricted to $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ so that the inverse is well-defined.

Step 2 — Identify the range: The range is the closed interval $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

Why other options are wrong:

- Option A ($[0, \pi]$): This is the range of $\cos^{-1}(x)$.
- Option B (open interval): The endpoints $\pm\pi/2$ are included (e.g., $\sin^{-1}(1) = \pi/2$).
- Option C ($[-1, 1]$): This is the *domain* of $\sin^{-1}$, not the range.

Final Answer: Range of $\sin^{-1}(x)$ is $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 29

Q30.

Solution

Concept — Sine Rule: In a triangle, $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$.

Step 1 — Set up the proportion:

$$\frac{a}{\sin A} = \frac{b}{\sin B} \implies \frac{6}{\sin 30} = \frac{b}{\sin 60}.$$

Step 2 — Solve for b:

$$b = \frac{6 \sin 60}{\sin 30} = \frac{6 \cdot \frac{\sqrt{3}}{2}}{\frac{1}{2}} = \frac{3\sqrt{3}}{\frac{1}{2}} = 6\sqrt{3}.$$

Why other options are wrong:

- Option A (3): Only computes numerator $6 \cdot \sin 30 = 3$; ignores $\sin 60$.
- Option C $(3\sqrt{3})$: Forgets to divide by $\sin 30 = 1/2$, so divides by 1 instead.
- Option D (12): Uses $\sin 60/\sin 30 = \sqrt{3}$ but multiplies by 12 not 6.

Final Answer: $b = 6\sqrt{3} \Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q 30**

Answer Key

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