MAH MCA CET Mathematics & Statistics

Sample Paper – 3

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. In a Geometric Progression, the first term is $a = 2$ and the common ratio is $r = 3$. What is the 8^{th} term of the progression?

(A) 2187

(B) 6561

(C) 1458

(D) 4374

Q2. Simplify: $\log(100) - \log(10) + \log(1)$.

(A) 2

(B) 1

(C) 0

(D) 3

Q3. The sum of all the binomial coefficients in the expansion of $(1+x)^{10}$ is:

(A) 512

(B) 2048

(C) 1024

(D) 256

Q4. If α and β are the roots of the equation $x^2 - 4x + 1 = 0$, find the value of $\alpha^2 + \beta^2$.

(A) 14

(B) 16

(C) 12

(D) 18

Q5. How many 3-letter words (with repetition allowed) can be formed using the letters $\{A, B, C, D\}$?

(A) 24

(B) 12

(C) 64

(D) 256

Q6. The largest binomial coefficient in the expansion of $(1+x)^6$ is:

(A) 6

(B) 15

(C) 10

(D) 20

Q7. Given $x^2 + y^2 = 25$, find $\dfrac{dy}{dx}$ using implicit differentiation.

(A) $-\dfrac{x}{y}$

(B) $\dfrac{x}{y}$

(C) $-\dfrac{y}{x}$

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

Q8. Evaluate $\displaystyle\int \frac{1}{4+x^2}\,dx$.

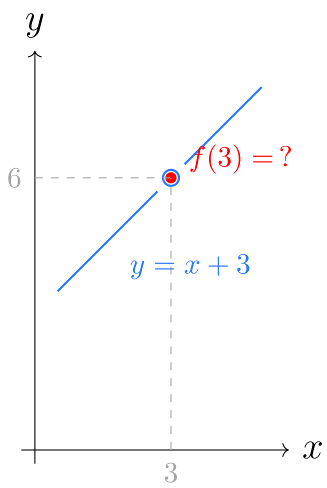
(A) $\dfrac{1}{4}\tan^{-1}\left(\dfrac{x}{4}\right)+C$

(B) $\dfrac{1}{2}\tan^{-1}\left(\dfrac{x}{2}\right)+C$

(C) $\tan^{-1}\left(\dfrac{x}{2}\right)+C$

(D) $\dfrac{1}{2}\tan^{-1}\left(\dfrac{x}{4}\right)+C$

Q9. The function $f(x)=\dfrac{x^2-9}{x-3}$ is undefined at $x=3$. For f to be **continuous** at $x=3$, the value of $f(3)$ must be:



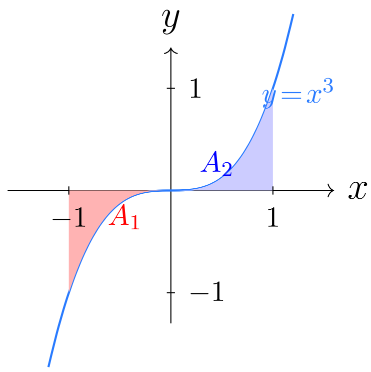
(A) 3

(B) 9

(C) 6

(D) 0

Q10. Using the odd-function property of definite integrals, evaluate $\displaystyle\int_{-1}^{1} x^3\,dx$.



(A) 2

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

(C) $\frac{1}{4}$

(D) 0

Q11. Solve the separable differential equation $\frac{dy}{dx} = \frac{x+1}{y-1}$. The general solution is:

(A) $y^2 - 2y = x^2 + 2x + C$

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

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

(D) $y - 1 = x + 1 + C$

Q12. The position of a particle at time t is given by $s = t^3 - 6t^2 + 9t$. The velocity of the particle at $t = 2$ is:

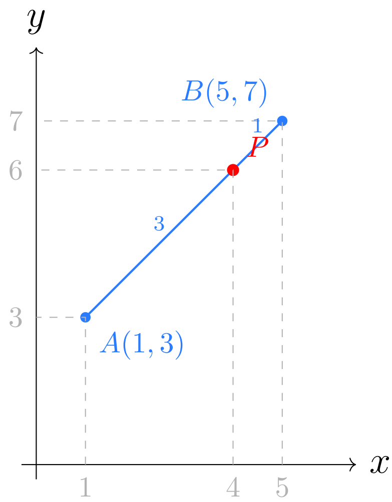
(A) 0

(B) -3

(C) 3

(D) 6

Q13. Find the coordinates of the point P that divides the segment joining $A(1, 3)$ and $B(5, 7)$ **internally** in the ratio $3 : 1$.



(A) $(3,\ 5)$

(B) $(2,\ 4)$

(C) $(4,\ 6)$

(D) $(5,\ 7)$

Q14. Find the acute angle θ between the lines $y = 2x + 1$ and $y = 3x + 2$.

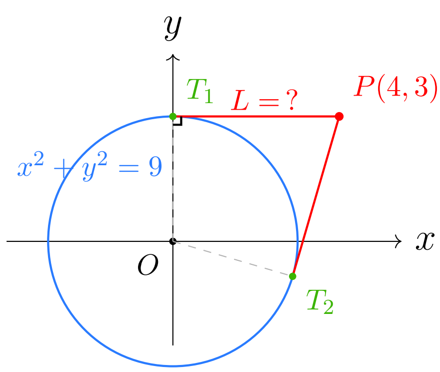
(A) $\tan^{-1}\left(\frac{1}{6}\right)$

(B) $\tan^{-1}\left(\frac{1}{5}\right)$

(C) 45°

(D) $\tan^{-1}\left(\frac{1}{7}\right)$

Q15. Find the length of the tangent from the point $P(4,\ 3)$ to the circle $x^2 + y^2 = 9$.



(A) 3

(B) 4

(C) 5

(D) $\sqrt{7}$

Q16. The equations of the asymptotes of the hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$ are:

(A) $y = \pm\frac{3}{4}x$

(B) $y = \pm\frac{4}{3}x$

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

(D) $y = \pm\frac{9}{16}x$

Q17. The reflection of the point $(3, -2)$ about the y-axis is:

(A) $(3, 2)$

(B) $(-3, 2)$

(C) $(-3, -2)$

(D) $(3, -2)$

Q18. The expansion of $\begin{vmatrix} a & b & c \\ d & e & f \\ g & h & i \end{vmatrix}$ along the first row equals:

(A) $a(ei + fh) - b(di - fg) + c(dh - eg)$

(B) $a(ei - fh) + b(di - fg) + c(dh - eg)$

(C) $a(ei - fh) - b(di - fg) - c(dh - eg)$

(D) $a(ei - fh) - b(di - fg) + c(dh - eg)$

Q19. For matrices A and B of compatible dimensions, which of the following is **always** true?

(A) $(AB)^T = A^T B^T$

(B) $(AB)^T = B^T A^T$

(C) $(AB)^T = A^T B$

(D) $(AB)^T = B\,A^T$

Q20. Which of the following matrices is **symmetric**?

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

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

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

(D) $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$

Q21. For the system $2x + y = 3$ and $4x + 2y = k$ to be **consistent** (to have at least one solution), the value of k must be:

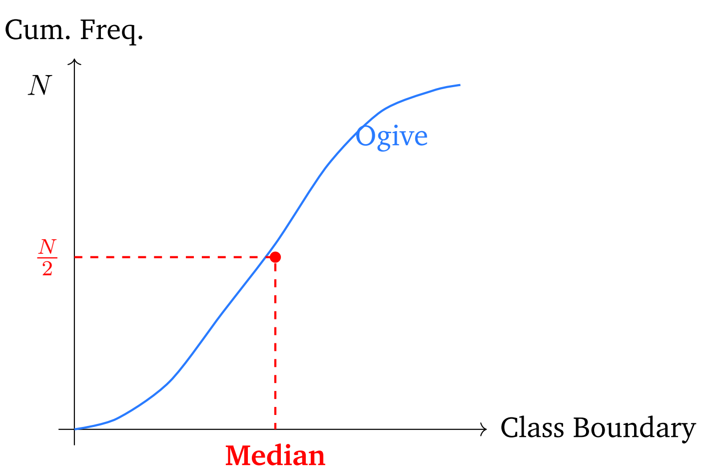
(A) $k = 3$

(B) $k = 12$

(C) $k = 6$

(D) $k = 9$

Q22. In the ogive (cumulative frequency curve) shown, the **median** of the distribution is obtained by:



(A) Drawing a horizontal line at N on the y-axis and reading the x-value

(B) Drawing a horizontal line at $\frac{N}{2}$ on the y-axis and reading the corresponding x-value

(C) Identifying the class with the highest frequency

(D) Reading the x-value at the topmost point of the curve

Q23. If $P(A) = 0.5$, $P(B) = 0.4$, and $P(A \cap B) = 0.2$, find $P(A \cup B)$.

(A) 0.6

(B) 0.9

(C) 0.5

(D) 0.7

Q24. For a Binomial distribution with parameters $n = 10$ and $p = 0.3$, the mean $E(X)$ is:

(A) 0.3

(B) 7

(C) 3

(D) 30

Q25. Which of the following best describes a scatter diagram showing a **strong positive correlation** between variables X and Y?

(A) Data points cluster along a line sloping from lower-left to upper-right

(B) Data points cluster along a line sloping from upper-left to lower-right

(C) Data points are scattered randomly with no discernible pattern

(D) Data points form a circular cluster with no directional trend

Q26. Calculate the mean deviation from the mean for the data set $\{5,\ 10,\ 15,\ 20,\ 25\}$.

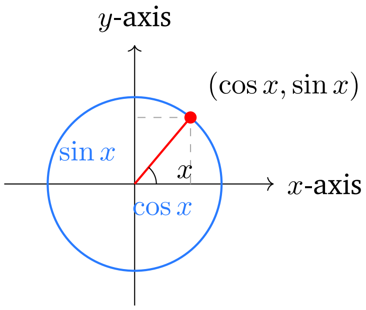
(A) 5

(B) 6

(C) 7

(D) 8

Q27. Using $a^3 + b^3 = (a+b)(a^2 - ab + b^2)$ and $\sin^2 x + \cos^2 x = 1$, the correct factored form of $\sin^3 x + \cos^3 x$ is:



(A) $(\sin x + \cos x)(1 - \sin x \cos x)$

(B) $(\sin x + \cos x)(1 + \sin x \cos x)$

(C) $(\sin x - \cos x)(1 - \sin x \cos x)$

(D) $(\sin x - \cos x)(1 + \sin x \cos x)$

Q28. Using the identity $\sin(A - B) = \sin A \cos B - \cos A \sin B$, the exact value of $\sin 15°$ is:

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

(B) $\dfrac{\sqrt{3}-1}{2}$

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

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

Q29. Using $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\dfrac{x+y}{1-xy}\right)$ (valid when $xy < 1$), evaluate $\tan^{-1}\left(\dfrac{1}{2}\right) + \tan^{-1}\left(\dfrac{1}{3}\right)$.

(A) $\dfrac{\pi}{3}$

(B) $\frac{\pi}{6}$

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

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

Q30. The area of a triangle with sides $a = 6$, $b = 8$ and included angle $C = 30^\circ$ is:

(A) 24 sq. units

(B) 12 sq. units

(C) 6 sq. units

(D) 48 sq. units

Detailed Solutions

Q1.

Solution

Concept — Geometric Progression: The n-th term of a GP with first term a and common ratio r is $T_n = a\,r^{n-1}$.

Step 1 — Identify values: $a = 2,\ r = 3,\ n = 8$.

Step 2 — Apply formula:

$$T_8 = 2 \times 3^7 = 2 \times 2187 = 4374.$$

Why other options are wrong:

- Option A ($2187 = 3^7$): forgot to multiply by $a = 2$.
- Option B ($6561 = 3^8$): used exponent n instead of $n - 1$.
- Option C ($1458 = 2 \times 3^6$): computed T_7 with exponent one short.

Final Answer: $T_8 = 4374 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 1

Q2.

Solution

Concept — Logarithm Laws (base 10): $\log_{10}(10^k) = k$ and $\log_{10}(1) = 0$.

Step 1 — Evaluate each term: $\log(100) = \log(10^2) = 2;\quad \log(10) = 1;\quad \log(1) = 0$.

Step 2 — Combine:

$$\log(100) - \log(10) + \log(1) = 2 - 1 + 0 = 1.$$

Why other options are wrong:

- Option A (2): returns only $\log(100)$; ignores the subtraction and $\log(1)$.
- Option C (0): confuses $\log(1) = 0$ with the whole expression.
- Option D (3): adds instead of subtracts $\log(10)$.

Final Answer: $1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 2

Q3.

Solution

Concept — Sum of Binomial Coefficients: Substituting $x = 1$ in $(1 + x)^n$ gives $\sum_{k=0}^{n} \binom{n}{k} = 2^n$.

Step 1 — Set $x = 1$: $(1 + 1)^{10} = 2^{10}$.

Step 2 — Compute: $2^{10} = 1024$.

Why other options are wrong:

- Option A ($512 = 2^9$): off by one in the exponent.
- Option B ($2048 = 2^{11}$): exponent too large by one.
- Option D ($256 = 2^8$): uses exponent 8 instead of 10.

Final Answer: $2^{10} = 1024 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 3

Q4.

Solution

Concept — Vieta's Formulae: For roots α, β of $x^2 - px + q = 0$: $\alpha + \beta = p$ and $\alpha\beta = q$.

Step 1 — Read Vieta values from $x^2 - 4x + 1 = 0$: $\alpha + \beta = 4, \quad \alpha\beta = 1$.

Step 2 — Use the identity $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$:

$$\alpha^2 + \beta^2 = 4^2 - 2(1) = 16 - 2 = 14.$$

Why other options are wrong:

- Option B (16): forgot to subtract $2\alpha\beta$.
- Option C (12): subtracted 4 instead of $2\alpha\beta = 2$.
- Option D (18): added $2\alpha\beta$ instead of subtracting.

Final Answer: $\alpha^2 + \beta^2 = 14 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 4

Q5.

Solution

Concept — Permutation with Repetition: The number of r-length sequences from an alphabet of n symbols (repetition allowed) is n^r.

Step 1 — Identify values: $n = 4$ (letters A, B, C, D), $r = 3$.

Step 2 — Apply formula:

$$4^3 = 64.$$

Each of the three positions independently has 4 choices.

Why other options are wrong:

- Option A ($24 = 4 \times 3 \times 2$): permutation *without* repetition $P(4, 3)$.
- Option B (12): no valid combinatorial interpretation here.
- Option D ($256 = 4^4$): uses 4 positions instead of 3.

Final Answer: $4^3 = 64 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 5

Q6.

Solution

Concept — Largest Binomial Coefficient: For even n, the largest coefficient in $(1 + x)^n$ is the middle one, $\binom{n}{n/2}$.

Step 1 — List all coefficients of $(1 + x)^6$:

$$\binom{6}{0} = 1, \binom{6}{1} = 6, \binom{6}{2} = 15, \binom{6}{3} = 20, \binom{6}{4} = 15, \binom{6}{5} = 6, \binom{6}{6} = 1.$$

Step 2 — Identify the maximum: The middle coefficient $\binom{6}{3} = 20$ is the largest.

Why other options are wrong:

- Option A ($6 = \binom{6}{1}$): coefficient of x; not the largest.
- Option B ($15 = \binom{6}{2}$): second largest, not the maximum.
- Option C (10): not a coefficient in this expansion at all.

Final Answer: $\binom{6}{3} = 20 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 6

Q7.

Solution

Concept — Implicit Differentiation: Differentiate both sides w.r.t. x, treating y as a function of x and applying the chain rule to y^2.

Step 1 — Differentiate $x^2 + y^2 = 25$:

$$2x + 2y\,\frac{dy}{dx} = 0.$$

Step 2 — Isolate dy/dx:

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

Why other options are wrong:

- Option B (x/y): missing the negative sign.
- Option C ($-y/x$): x and y swapped in the ratio.
- Option D (y/x): both sign and ratio are incorrect.

Final Answer: $\dfrac{dy}{dx} = -\dfrac{x}{y} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 7

Q8.

Solution

Concept — Standard Arctan Integral: $\displaystyle\int \frac{1}{a^2 + x^2}\,dx = \frac{1}{a}\tan^{-1}\!\left(\frac{x}{a}\right) + C.$

Step 1 — Identify a: Write $4 + x^2 = 2^2 + x^2$, so $a = 2$.

Step 2 — Apply formula:

$$\int \frac{1}{4 + x^2}\,dx = \frac{1}{2}\tan^{-1}\!\left(\frac{x}{2}\right) + C.$$

Why other options are wrong:

- Option A: uses $a = 4$ (a^2 instead of a) in both the factor and the argument.
- Option C: omits the $1/a = 1/2$ factor in front of $\tan^{-1}$.
- Option D: correct factor $1/2$ but wrong argument $x/4$ (using $a = 4$).

Final Answer: $\dfrac{1}{2}\tan^{-1}\!\left(\dfrac{x}{2}\right) + C \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 8

Q9.

Solution

Concept — Continuity (Removable Discontinuity): f is continuous at $x = c$ iff $\lim_{x\to c} f(x) = f(c)$.

Step 1 — Compute the limit at $x = 3$:

$$\lim_{x\to 3} \frac{x^2 - 9}{x - 3} = \lim_{x\to 3} \frac{(x-3)(x+3)}{x-3} = \lim_{x\to 3}(x+3) = 6.$$

Step 2 — Determine $f(3)$: For continuity, $f(3)$ must equal the limit:

$$f(3) = 6.$$

The graph (open circle at $(3, 6)$) is then filled by defining $f(3) = 6$, removing the hole.

Why other options are wrong:

- Option A ($f(3) = 3$): equals $f(0)$; the limit at $x = 3$ is 6, not 3.
- Option B ($f(3) = 9$): equals 3^2; confuses x^2 with $x + 3$ at $x = 3$.
- Option D ($f(3) = 0$): makes the function discontinuous.

Final Answer: $f(3) = 6 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 9

Q10.

Solution

Concept — Odd Function Integral Property: If $f(x)$ is odd (i.e., $f(-x) = -f(x)$), then $\int_{-a}^{a} f(x)\,dx = 0$.

Step 1 — Verify $f(x) = x^3$ is odd: $f(-x) = (-x)^3 = -x^3 = -f(x)$. ✓

Step 2 — Apply the property:

$$\int_{-1}^{1} x^3\,dx = 0.$$

The figure shows A_1 (negative area from -1 to 0) equals A_2 (positive area from 0

to 1) in magnitude; they cancel exactly.

Why other options are wrong:

- Option A (2): incorrectly doubles A_2 without accounting for sign of A_1.
- Option B (1/2): equals $\int_0^1 x\,dx$, a different integrand.
- Option C (1/4): equals $\int_0^1 x^3\,dx = 1/4$; the half-integral, not the full symmetric one.

Final Answer: $\int_{-1}^{1} x^3\,dx = 0 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 10

Q11.

Solution

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

Step 1 — Separate variables:

$$(y-1)\,dy = (x+1)\,dx.$$

Step 2 — Integrate both sides:

$$\int (y-1)\,dy = \int (x+1)\,dx \implies \frac{y^2}{2} - y = \frac{x^2}{2} + x + C.$$

Multiplying through by 2:

$$y^2 - 2y = x^2 + 2x + C_1.$$

(The constant $C_1 = 2C$ is still an arbitrary constant.)

Why other options are wrong:

- Option B: signs on both integrated results are wrong.
- Option C: integrates incorrectly, giving coefficient 1 instead of 2 on each variable.
- Option D: does not integrate; merely rearranges the ODE itself.

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

Answer: (A) Go Back to Q 11

Q12.

Solution

Concept — Velocity as Derivative: Instantaneous velocity $v = \dfrac{ds}{dt}$.

Step 1 — Differentiate $s = t^3 - 6t^2 + 9t$:

$$v = \frac{ds}{dt} = 3t^2 - 12t + 9.$$

Step 2 — Substitute $t = 2$:

$$v\big|_{t=2} = 3(4) - 12(2) + 9 = 12 - 24 + 9 = -3.$$

Why other options are wrong:

- Option A (0): velocity is zero at $t = 1$ and $t = 3$ (stationary points), not at $t = 2$.
- Option C (3): sign error; forgot the subtraction gives a net negative result.
- Option D (6): evaluates $s(2) - s(0)$, a displacement, not the instantaneous velocity.

Final Answer: $v(2) = -3 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 12

Q13.

Solution

Concept — Section Formula (Internal Division): Point dividing (x_1, y_1) to (x_2, y_2) in ratio $m : n$ internally:

$$P = \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n} \right).$$

Step 1 — Identify values: $(x_1, y_1) = (1, 3)$, $(x_2, y_2) = (5, 7)$, $m : n = 3 : 1$.

Step 2 — Compute:

$$P_x = \frac{3(5) + 1(1)}{4} = \frac{16}{4} = 4, \qquad P_y = \frac{3(7) + 1(3)}{4} = \frac{24}{4} = 6.$$

So $P = (4, 6)$.

Why other options are wrong:

- Option A $(3, 5)$: result of using ratio $2 : 2$ (midpoint shifted incorrectly).
- Option B $(2, 4)$: uses endpoints in the wrong order with incorrect ratio.
- Option D $(5, 7)$: is the endpoint B itself, not an interior point.

Final Answer: $P = (4, 6) \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 13

Q14.

Solution

Concept — Angle Between Two Lines: If lines have slopes m_1 and m_2, the acute angle satisfies $\tan\theta = \left|\dfrac{m_2 - m_1}{1 + m_1 m_2}\right|$.

Step 1 — Extract slopes: $m_1 = 2$ (from $y = 2x + 1$), $m_2 = 3$ (from $y = 3x + 2$).

Step 2 — Compute:

$$\tan\theta = \left|\frac{3-2}{1+2\cdot 3}\right| = \left|\frac{1}{7}\right| = \frac{1}{7} \implies \theta = \tan^{-1}\left(\frac{1}{7}\right).$$

Why other options are wrong:

- Option A $(\tan^{-1}(1/6))$: denominator should be $1 + m_1 m_2 = 7$, not 6.
- Option B $(\tan^{-1}(1/5))$: arithmetic error in computing $1 + 6 = 7$.
- Option C $(45°)$: requires $\tan\theta = 1$, i.e., $|m_2 - m_1| = |1 + m_1 m_2|$; here $1 \neq 7$.

Final Answer: $\theta = \tan^{-1}(1/7) \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 14

Q15.

Solution

Concept — Length of Tangent from External Point: For circle $x^2 + y^2 = r^2$, the tangent length from (x_1, y_1) is $L = \sqrt{x_1^2 + y_1^2 - r^2}$.

Step 1 — Substitute: $(x_1, y_1) = (4, 3)$, $r^2 = 9$.

Step 2 — Compute:

$$L = \sqrt{4^2 + 3^2 - 9} = \sqrt{16 + 9 - 9} = \sqrt{16} = 4.$$

The two tangent points are $T_1 = (0, 3)$ and $T_2 = (2.88, -0.84)$, each at distance 4 from P.

Why other options are wrong:

- Option A (3): equals the radius r, not the tangent length.
- Option C (5): equals $OP = \sqrt{16 + 9} = 5$ (centre-to-P distance).
- Option D ($\sqrt{7}$): incorrect arithmetic ($\sqrt{16 + 9 - 9} \neq \sqrt{7}$).

Final Answer: $L = 4 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 15

Q16.

Solution

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

Step 1 — Extract a and b: $a^2 = 16 \Rightarrow a = 4; \quad b^2 = 9 \Rightarrow b = 3.$

Step 2 — Write asymptotes:

$$y = \pm\frac{b}{a}x = \pm\frac{3}{4}x.$$

Why other options are wrong:

- Option B ($\pm\frac{4}{3}x$): swaps a and b in the ratio.
- Option C ($\pm\frac{3}{2}x$): uses $b/\sqrt{a^2 - b^2}$ or some other incorrect combination.
- Option D ($\pm\frac{9}{16}x$): uses b^2/a^2 instead of b/a.

Final Answer: $y = \pm\frac{3}{4}x \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 16

Q17.

Solution

Concept — Reflection About the y-Axis: Reflecting (x, y) about the y-axis negates only the x-coordinate: $(x, y) \mapsto (-x, y)$.

Step 1 — Apply the reflection: $(3, -2) \xrightarrow{\text{reflect}} (-3, -2)$.

Step 2 — Verify: The y-axis acts as a mirror; the perpendicular distance $|x| = 3$ is preserved on the other side; $y = -2$ is unchanged.

Why other options are wrong:

- Option A $(3, 2)$: reflection about the x-axis (negates y, not x).
- Option B $(-3, 2)$: negates both coordinates (reflection through the origin).
- Option D $(3, -2)$: the original point; no transformation applied.

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

$\boxed{\textbf{Answer: (C)}}$ Go Back to Q 17

Q18.

Solution

Concept — Cofactor Expansion Along Row 1: The sign pattern for the first row is $+, -, +$. Each element multiplies the 2×2 minor formed by deleting its row and column.

Step 1 — Write minors: $M_{11} = ei - fh, \quad M_{12} = di - fg, \quad M_{13} = dh - eg.$

Step 2 — Assemble with signs:

$$\det = a(ei - fh) - b(di - fg) + c(dh - eg).$$

Why other options are wrong:

- Option A: first minor has $ei + fh$ (wrong sign inside).
- Option B: all three terms have $+$ sign; misses the alternating $+, -, +$ pattern.
- Option C: last term carries $-c$; the sign for position $(1, 3)$ is $+$.

Final Answer: $a(ei - fh) - b(di - fg) + c(dh - eg) \Rightarrow \boxed{\text{D}}$

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q 18

Q19.

Solution

Concept — Reversal Rule for Transposes: $(AB)^T = B^T A^T$ — transposing a product *reverses* the order.

Step 1 — Verify with 2×2 example: Let $A = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$, $B = \begin{pmatrix} 1 & 0 \\ 3 & 1 \end{pmatrix}$.

$$AB = \begin{pmatrix} 7 & 2 \\ 3 & 1 \end{pmatrix}, \quad (AB)^T = \begin{pmatrix} 7 & 3 \\ 2 & 1 \end{pmatrix}.$$

$$A^T = \begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}, \; B^T = \begin{pmatrix} 1 & 3 \\ 0 & 1 \end{pmatrix}; \quad B^T A^T = \begin{pmatrix} 7 & 3 \\ 2 & 1 \end{pmatrix}. \checkmark$$

Step 2 — Confirm rule: $(AB)^T = B^T A^T$ holds; the same example shows $A^T B^T \neq (AB)^T$.

Why other options are wrong:

- Option A: order not reversed; $(AB)^T \neq A^T B^T$ in general.
- Options C, D: partially reversed or mixed; violate the reversal rule.

Final Answer: $(AB)^T = B^T A^T \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 19

Q20.

Solution

Concept — Symmetric Matrix: A is symmetric if $A = A^T$, equivalently $a_{ij} = a_{ji}$ for all i, j.

Step 1 — Check each option:

- Option A: $\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix}$: $a_{12} = 2 = a_{21} = 2$. **Symmetric.** $\checkmark$
- Option B: $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$: $a_{12} = 2 \neq a_{21} = 3$. Not symmetric.
- Option C: $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$: $A^T = -A$ (skew-symmetric, not symmetric).
- Option D: $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$: $a_{12} = 0 \neq a_{21} = 2$. Not symmetric.

Step 2 — Conclusion: Only Option A satisfies $A = A^T$.

Final Answer: $\begin{pmatrix} 1 & 2 \\ 2 & 3 \end{pmatrix} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 20

Q21.

Solution

Concept — Consistency of a Linear System: Two equations represent either intersecting, parallel, or coincident lines. For infinitely many solutions (consistent and dependent), corresponding ratios of coefficients and constants must all be equal.

Step 1 — Observe structure: $4x + 2y = 2(2x + y)$, so the left-hand sides are in ratio $2 : 1$.

Step 2 — Apply ratio condition for coincident lines: For consistency (infinitely many solutions), the right-hand sides must also be in ratio $2 : 1$:

$$k = 2 \times 3 = 6.$$

Why other options are wrong:

- Option A ($k = 3$): gives RHS ratio $3 : 3 = 1 : 1$, making the lines contradictory (parallel).
- Option B ($k = 12$): RHS ratio becomes $12 : 3 = 4 : 1 \neq 2 : 1$; lines are inconsistent.
- Option D ($k = 9$): ratio $9 : 3 = 3 : 1 \neq 2 : 1$; system is inconsistent.

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

Answer: (C) Go Back to Q 21

Q22.

Solution

Concept — Median from an Ogive: An ogive plots cumulative frequency against upper class boundaries. The median is the value of the variable at the 50^{th} percentile, i.e., at cumulative frequency $N/2$.

Step 1 — Locate $N/2$ on the y-axis: Draw a horizontal line from $y = N/2$ until it intersects the ogive curve.

Step 2 — Read the x-value: Drop a perpendicular from the intersection point to the x-axis; that x-value is the median.

Why other options are wrong:

- Option A: line at N gives the total count (maximum), not the midpoint.
- Option C: the class with highest frequency gives the *mode*, not the median.
- Option D: the topmost point marks the end of the distribution, not the median.

Final Answer: Horizontal at $N/2$, read x from ogive $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 22

Q23.

Solution

Concept — Addition Theorem of Probability:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B).$$

Step 1 — Substitute given values:

$$P(A \cup B) = 0.5 + 0.4 - 0.2 = 0.7.$$

Step 2 — Sanity check: $0.7 \in [0, 1]$ and $P(A \cup B) \geq \max(0.5, 0.4) = 0.5$. ✓

Why other options are wrong:

- Option A (0.6): subtracts $P(B)$ instead of $P(A \cap B)$, or makes an arithmetic slip.
- Option B (0.9): simply adds all three probabilities without subtracting the intersection.
- Option C (0.5): equals $P(A)$ only; ignores $P(B)$ and $P(A \cap B)$.

Final Answer: $P(A \cup B) = 0.7 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 23

Q24.

Solution

Concept — Mean of Binomial Distribution: If $X \sim B(n, p)$, then $E(X) = np$.

Step 1 — Identify parameters: $n = 10$, $p = 0.3$.

Step 2 — Compute mean:

$$E(X) = np = 10 \times 0.3 = 3.$$

Why other options are wrong:

- Option A (0.3): equals p alone, not np.
- Option B (7): equals $nq = 10 \times 0.7$; the expected number of *failures*, not successes.
- Option D (30): equals $n/p = 10/0.3 \approx 33$; an incorrect formula.

Final Answer: $E(X) = 3 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 24

Q25.

Solution

Concept — Positive Correlation: Variables X and Y are *positively* correlated when increases in X are accompanied by increases in Y. The scatter diagram slopes *upward* from left to right (lower-left to upper-right).

Step 1 — Identify the upward slope: Strong positive correlation means the data cloud is elongated along a line with positive gradient.

Step 2 — Match the description: Points trending from lower-left to upper-right correspond to a positive (ascending) linear pattern.

Why other options are wrong:

- Option B: upper-left to lower-right is a *downward* slope — negative correlation.
- Option C: random scatter with no pattern indicates *zero* (no) correlation.

- Option D: a circular cluster shows no directional trend; correlation is approximately zero.

Final Answer: Points from lower-left to upper-right $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q 25

Q26.

Solution

Concept — Mean Deviation from Mean: $\text{MD} = \frac{1}{n}\sum_{i=1}^{n} |x_i - \bar{x}|$.

Step 1 — Compute the mean:

$$\bar{x} = \frac{5 + 10 + 15 + 20 + 25}{5} = \frac{75}{5} = 15.$$

Step 2 — Compute absolute deviations and their mean:

$$|5 - 15| + |10 - 15| + |15 - 15| + |20 - 15| + |25 - 15| = 10 + 5 + 0 + 5 + 10 = 30.$$

$$\text{MD} = \frac{30}{5} = 6.$$

Why other options are wrong:

- Option A (5): equals the common difference of the AP, not the mean deviation.
- Option C (7): off by 1; arithmetic error in summing the deviations.
- Option D (8): would require a total deviation of 40; incorrect.

Final Answer: $\text{MD} = 6 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q 26

Q27.

Solution

Concept — Sum of Cubes + Pythagorean Identity: $a^3+b^3=(a+b)(a^2-ab+b^2)$ and $\sin^2 x+\cos^2 x=1$.

Step 1 — Apply sum-of-cubes with $a=\sin x$, $b=\cos x$:

$$\sin^3 x+\cos^3 x=(\sin x+\cos x)(\sin^2 x-\sin x\cos x+\cos^2 x).$$

Step 2 — Simplify using Pythagorean identity:

$$\sin^2 x+\cos^2 x=1 \implies (\sin x+\cos x)(1-\sin x\cos x).$$

Why other options are wrong:

- Option B: sign inside the second factor is $+\sin x\cos x$; correct identity gives $-\sin x\cos x$.
- Option C: uses $(\sin x-\cos x)$; that comes from the *difference* of cubes.
- Option D: combines both errors — difference factor and wrong sign.

Final Answer: $(\sin x+\cos x)(1-\sin x\cos x) \Rightarrow \boxed{\text{A}}$

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

Q28.

Solution

Concept — Sine Subtraction Formula: $\sin(A-B)=\sin A\cos B-\cos A\sin B$.

Step 1 — Express $15^\circ=45^\circ-30^\circ$:

$$\sin 15^\circ=\sin 45^\circ\cos 30^\circ-\cos 45^\circ\sin 30^\circ.$$

Step 2 — Substitute exact values:

$$\sin 15^\circ=\frac{\sqrt{2}}{2}\cdot\frac{\sqrt{3}}{2}-\frac{\sqrt{2}}{2}\cdot\frac{1}{2}=\frac{\sqrt{6}}{4}-\frac{\sqrt{2}}{4}=\frac{\sqrt{6}-\sqrt{2}}{4}.$$

Why other options are wrong:

- Option A $\left(\frac{\sqrt{6}+\sqrt{2}}{4}\right)$: uses addition instead of subtraction; equals $\cos 15^\circ$.

- Option B $\left(\frac{\sqrt{3}-1}{2}\right)$: incorrect simplification (missing $\sqrt{2}$ factor).
- Option C $\left(\frac{\sqrt{3}+1}{4}\right)$: drops $\sqrt{2}$ from numerator terms.

Final Answer: $\sin 15^\circ = \dfrac{\sqrt{6}-\sqrt{2}}{4} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q 28

Q29.

Solution

Concept — Inverse Tangent Addition: $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\dfrac{x+y}{1-xy}\right)$ when $xy < 1$.

Step 1 — Check xy: $xy = \dfrac{1}{2} \cdot \dfrac{1}{3} = \dfrac{1}{6} < 1$. Formula applies.

Step 2 — Compute:

$$\tan^{-1}\left(\frac{1}{2}\right) + \tan^{-1}\left(\frac{1}{3}\right) = \tan^{-1}\left(\frac{\frac{1}{2}+\frac{1}{3}}{1-\frac{1}{6}}\right) = \tan^{-1}\left(\frac{\frac{5}{6}}{\frac{5}{6}}\right) = \tan^{-1}(1) = \frac{\pi}{4}.$$

Why other options are wrong:

- Option A $(\pi/3)$: would require $\tan(\pi/3) = \sqrt{3}$; here the argument is 1.
- Option B $(\pi/6)$: would require $\tan(\pi/6) = 1/\sqrt{3}$; not the case.
- Option D $(\pi/2)$: $\tan(\pi/2)$ is undefined; the formula gives a finite value.

Final Answer: $\tan^{-1}(1/2) + \tan^{-1}(1/3) = \dfrac{\pi}{4} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q 29

Q30.

Solution

Concept — Area of Triangle (Included Angle): Area $= \dfrac{1}{2}ab\sin C$, where a, b are two sides and C is the included angle.

Step 1 — Identify values: $a = 6$, $b = 8$, $C = 30^\circ$, $\sin 30^\circ = \frac{1}{2}$.

Step 2 — Compute:

$$\text{Area} = \frac{1}{2} \times 6 \times 8 \times \sin 30^\circ = \frac{1}{2} \times 48 \times \frac{1}{2} = 12 \text{ sq. units}.$$

Why other options are wrong:

- Option A (24): omits the second $\frac{1}{2}$ (either the formula's $\frac{1}{2}$ or $\sin 30^\circ = \frac{1}{2}$).
- Option C (6): divides by ab instead of multiplying; or uses $C = 90^\circ$ incorrectly.
- Option D (48): equals $ab = 6 \times 8$; forgets both the $\frac{1}{2}$ factor and $\sin C$.

Final Answer: Area $= 12$ sq. units $\Rightarrow \boxed{\text{B}}$

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

Answer Key

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