AME CET Mathematics

Sample Paper – 6

Duration: 20 Minutes **Maximum Marks: 80**

Instructions

- This paper contains **20** Multiple Choice Questions (Single Correct Answer), modelled on the Mathematics section of **AME CET** entrance.
- Each correct answer carries **+4 marks**. Each wrong answer carries -1 **mark**. Unattempted questions carry **0 marks**.
- Only **one** option is correct per question. Choose carefully.
- Syllabus level: **Class 11 and 12 NCERT Mathematics** (Sets and Relations to Probability and Statistics).
- Use of mobile phones, calculators, or any electronic gadget is strictly prohibited.

Q1. The value of $\int_0^2 (3x^2 - 2x)\, dx$ is:

(A) 2

(B) 6

(C) 8

(D) 4

Q2. The value of $\int_1^3 (2x - 1)\, dx$ is:

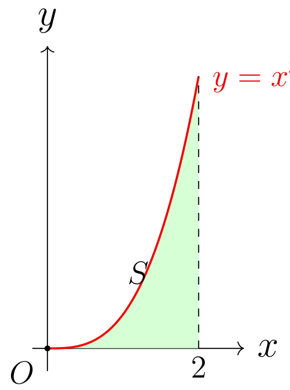
(A) 4

(B) 6

(C) 5

(D) 8

Q3. The area of the shaded region bounded by the curve $y = x^3$, the x-axis and the line $x = 2$, shown in the figure, is:



(A) 2

(B) 8

(C) 4

(D) 16

Q4. The equation of the straight line passing through $(2, 3)$ with slope 2 is:

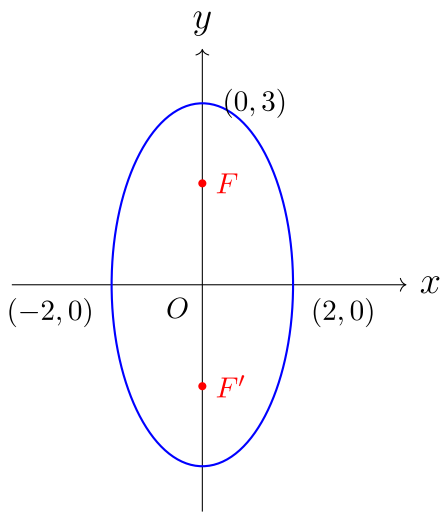
(A) $y = 2x - 1$

(B) $y = 2x + 3$

(C) $y = 2x + 1$

(D) $y = 2x - 3$

Q5. The eccentricity of the ellipse $\dfrac{x^2}{4} + \dfrac{y^2}{9} = 1$, sketched below, is:



(A) $\frac{\sqrt{5}}{2}$

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

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

(D) $\frac{\sqrt{5}}{3}$

Q6. The coordinates of the vertex of the parabola $(y-2)^2 = 4(x-1)$ are:

(A) $(2,\ 1)$

(B) $(-1,\ -2)$

(C) $(1,\ 2)$

(D) $(0,\ 0)$

Q7. If $A = \begin{pmatrix} 5 & 2 \\ 3 & 4 \end{pmatrix}$, then $\det(A)$ equals:

(A) 14

(B) 26

(C) 6

(D) -14

Q8. The transpose of the matrix $A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$ is:

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

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

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

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

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

(A) 3

(B) 0

(C) $\frac{2}{5}$

(D) ∞

Q10. If $y = \sin^2 x$, then $\frac{dy}{dx}$ is:

(A) $2\cos x$

(B) $\cos 2x$

(C) $2\sin x$

(D) $\sin 2x$

Q11. The value of $2\sin 15^\circ \cos 15^\circ$ is:

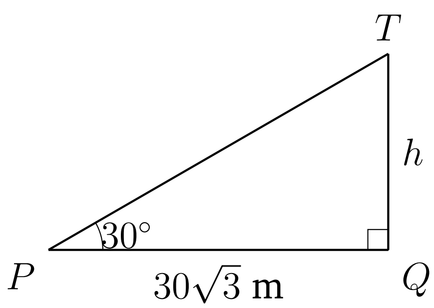
(A) $\frac{\sqrt{3}}{2}$

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

(C) $\frac{1}{\sqrt{2}}$

(D) 1

Q12. The angle of elevation of the top of a vertical tower from a point on the ground at a distance of $30\sqrt{3}$ m from its foot is 30°. The height of the tower is:



(A) $10\sqrt{3}$

(B) 90

(C) 30

(D) 15

Q13. Two fair dice are thrown together. The probability that the sum of the numbers appearing is 8 is:

(A) $\frac{1}{6}$

(B) $\frac{5}{36}$

(C) $\frac{1}{9}$

(D) $\frac{1}{12}$

Q14. For two independent events A and B, $P(A) = 0.3$ and $P(B) = 0.4$. The value of $P(A \cap B)$ is:

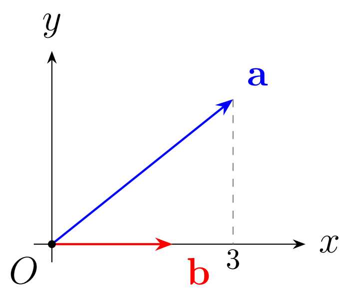
(A) 0.12

(B) 0.7

(C) 0.1

(D) 0.58

Q15. The scalar projection of the vector $\mathbf{a} = 3\hat{i} + 4\hat{j}$ on the vector $\mathbf{b} = \hat{i}$ is:



(A) 4

(B) 5

(C) 3

(D) 7

Q16. If $\mathbf{a} = 2\hat{i}$ and $\mathbf{b} = 3\hat{j}$, then $|\mathbf{a} \times \mathbf{b}|$ equals:

(A) 5

(B) 0

(C) $\sqrt{13}$

(D) 6

Q17. The value of $\binom{7}{3}$ is:

(A) 21

(B) 210

(C) 35

(D) 42

Q18. The sum to infinity of the geometric progression $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots$ is:

(A) $\frac{3}{2}$

(B) ∞

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

(D) 2

Q19. The midpoint of the line segment joining the points $(2, 4, 6)$ and $(4, 8, 10)$ is:

(A) $(6, 12, 16)$

(B) $(3, 6, 8)$

(C) $(1, 2, 2)$

(D) $(2, 4, 4)$

Q20. The order of the differential equation $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 0$ is:

(A) 2

(B) 0

(C) 1

(D) 3

Detailed Solutions

Q1.

Solution

Concept – Definite integral using the power rule:

$$\int x^n\,dx = \frac{x^{n+1}}{n+1}, \qquad \int_a^b f(x)\,dx = \left[F(x)\right]_a^b$$

Step 1 – Integrate term by term:

$$\int (3x^2 - 2x)\,dx = 3\cdot\frac{x^3}{3} - 2\cdot\frac{x^2}{2} = x^3 - x^2$$

Step 2 – Write the antiderivative with limits:

$$\int_0^2 (3x^2 - 2x)\,dx = \left[x^3 - x^2\right]_0^2$$

Step 3 – Substitute the upper limit $x = 2$:

$$2^3 - 2^2 = 8 - 4 = 4$$

Step 4 – Substitute the lower limit $x = 0$:

$$0^3 - 0^2 = 0$$

Step 5 – Subtract:

$$4 - 0 = 4$$

Why other options are wrong:

- (A) 2: integrating $2x$ incorrectly as x.
- (B) 6: dropping the $-x^2$ term and using x^3 alone gives 8, mishandled to 6.
- (C) 8: evaluating only x^3 at the limits and ignoring $-x^2$.

Answer: (D) ← Go Back to Q1

Q2.

Solution

Concept – Definite integral of a linear function:

$$\int_a^b (2x-1)\,dx = \Big[x^2 - x\Big]_a^b$$

Step 1 – Find the antiderivative:

$$\int (2x-1)\,dx = 2\cdot\frac{x^2}{2} - x = x^2 - x$$

Step 2 – Apply the limits 1 to 3:

$$\int_1^3 (2x-1)\,dx = \Big[x^2 - x\Big]_1^3$$

Step 3 – Substitute the upper limit $x = 3$:

$$3^2 - 3 = 9 - 3 = 6$$

Step 4 – Substitute the lower limit $x = 1$:

$$1^2 - 1 = 1 - 1 = 0$$

Step 5 – Subtract:

$$6 - 0 = 6$$

Why other options are wrong:

- (A) 4: using limits 0 and 2 instead of 1 and 3.
- (C) 5: an arithmetic slip in $9 - 3 - 1$.
- (D) 8: forgetting to subtract the $-x$ term at the upper limit.

Answer: (B) ← Go Back to Q2

Q3.

Solution

Concept – Area under a curve above the x-axis:

$$A = \int_a^b y\,dx$$

Step 1 – Set up the integral from $x = 0$ to $x = 2$:

$$A = \int_0^2 x^3\,dx$$

Step 2 – Find the antiderivative:

$$\int x^3\,dx = \frac{x^4}{4}$$

Step 3 – Apply the limits:

$$A = \left[\frac{x^4}{4}\right]_0^2$$

Step 4 – Substitute the upper limit $x = 2$:

$$\frac{2^4}{4} = \frac{16}{4} = 4$$

Step 5 – Substitute the lower limit and subtract:

$$4 - 0 = 4$$

Why other options are wrong:

- (A) 2: halving the correct answer.
- (B) 8: forgetting to divide by 4 and instead halving 16.
- (D) 16: leaving the result as 2^4 without dividing by 4.

Answer: (C) ← Go Back to Q3

Q4.

Solution

Concept – Point-slope form of a line:

$$y - y_1 = m(x - x_1)$$

Step 1 – Identify the point and slope:

$$(x_1, y_1) = (2, 3), \qquad m = 2$$

Step 2 – Substitute into the formula:

$$y - 3 = 2(x - 2)$$

Step 3 – Expand the right side:

$$y - 3 = 2x - 4$$

Step 4 – Solve for y:

$$y = 2x - 4 + 3 = 2x - 1$$

Why other options are wrong:

- (B) $y = 2x + 3$: using the y-intercept as 3 without the point-slope step.
- (C) $y = 2x + 1$: a sign error in $-4 + 3$.
- (D) $y = 2x - 3$: subtracting 3 instead of adding it after expansion.

Answer: (A) ← Go Back to Q4

Q5.

Solution

Concept – Eccentricity of ellipse $\frac{x^2}{A^2} + \frac{y^2}{B^2} = 1$ when $B > A$ (major axis along y):

$$c^2 = B^2 - A^2, \qquad e = \frac{c}{B}$$

Step 1 – Read off the denominators:

$$A^2 = 4, \quad B^2 = 9$$

Step 2 – Identify the larger denominator:
Since $9 > 4$, the major axis lies along the y-axis, so $B^2 = 9$ and $A^2 = 4$.

Step 3 – Compute c^2:

$$c^2 = 9 - 4 = 5$$

Step 4 – Compute c:

$$c = \sqrt{5}$$

Step 5 – Compute the eccentricity:

$$e = \frac{c}{B} = \frac{\sqrt{5}}{3}$$

Why other options are wrong:

- (A) $\frac{\sqrt{5}}{2}$: dividing by the semi-minor axis $\sqrt{4} = 2$ instead of the semi-major axis 3.
- (B) $\frac{2}{3}$: using $\frac{A}{B}$ instead of $\frac{c}{B}$.
- (C) $\frac{3}{\sqrt{5}}$: inverting the ratio.

Answer: (D) ← Go Back to Q5

Q6.

Solution

Concept – Standard parabola $(y-k)^2 = 4a(x-h)$:
This is a parabola opening rightward with vertex at (h, k).

Step 1 – Compare $(y-2)^2 = 4(x-1)$ with $(y-k)^2 = 4a(x-h)$:

$$k = 2, \qquad h = 1$$

Step 2 – State the vertex:

$$\text{Vertex} = (h, k) = (1, 2)$$

Why other options are wrong:

- (A) $(2, 1)$: swapping the h and k coordinates.
- (B) $(-1, -2)$: reading the shifts with the wrong sign.
- (D) $(0, 0)$: treating the parabola as un-shifted $y^2 = 4x$.

Answer: (C) ← Go Back to Q6

Q7.

Solution

Concept – 2×2 determinant:

$$\det\begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc$$

Step 1 – Identify the elements:

$$a = 5,\ b = 2,\ c = 3,\ d = 4$$

Step 2 – Compute ad:

$$5 \times 4 = 20$$

Step 3 – Compute bc:

$$2 \times 3 = 6$$

Step 4 – Subtract:

$$\det(A) = 20 - 6 = 14$$

Why other options are wrong:

- (B) 26: adding $ad + bc$ instead of subtracting.
- (C) 6: keeping only the off-diagonal product bc.
- (D) -14: reversing the order of subtraction.

Answer: (A) ← Go Back to Q7

Q8.

Solution

Concept – Transpose of a matrix:
The transpose A^T is obtained by interchanging rows and columns: the entry in row i, column j of A becomes the entry in row j, column i of A^T.

Step 1 – Write the matrix:

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$$

Step 2 – Make the first row of A the first column of A^T:

$$\text{Row } (1, 2) \ \rightarrow\ \text{Column } \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

Step 3 – Make the second row of A the second column of A^T:

$$\text{Row } (3,4) \;\rightarrow\; \text{Column } \begin{pmatrix} 3 \\ 4 \end{pmatrix}$$

Step 4 – Assemble A^T:

$$A^T = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$$

Why other options are wrong:

- (A): a 180° rotation of entries, not a transpose.
- (C): swapping only the main-diagonal entries.
- (D): the original matrix A unchanged.

Answer: (B) ← Go Back to Q8

Q9.

Solution

Concept – Limit of a rational function as $x \to \infty$:
Divide numerator and denominator by the highest power of x.

Step 1 – Highest power present is x^2. Divide each term by x^2:

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

Step 2 – As $x \to \infty$, the vanishing terms go to 0:

$$\frac{2}{x} \to 0, \qquad \frac{5}{x^2} \to 0$$

Step 3 – Substitute the limits:

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

Why other options are wrong:

- (B) 0: applies only when the numerator has lower degree than the denominator.
- (C) $\frac{2}{5}$: taking the ratio of the lower-order coefficients.
- (D) ∞: applies only when the numerator has higher degree.

Answer: (A) ← Go Back to Q9

Q10.

Solution

Concept – Chain rule:

$$\frac{d}{dx}\left[f(x)\right]^2 = 2f(x)\cdot f'(x)$$

Step 1 – Identify $f(x) = \sin x$:

$$y = (\sin x)^2$$

Step 2 – Apply the chain rule:

$$\frac{dy}{dx} = 2\sin x\cdot\frac{d}{dx}(\sin x) = 2\sin x\cos x$$

Step 3 – Apply the double-angle identity $2\sin x\cos x = \sin 2x$:

$$\frac{dy}{dx} = \sin 2x$$

Why other options are wrong:

- (A) $2\cos x$: differentiating as if $y = 2\sin x$.
- (B) $\cos 2x$: this is the derivative of $\frac{1}{2}\sin 2x$, not $\sin^2 x$.
- (C) $2\sin x$: forgetting to differentiate the inner $\sin x$.

Answer: (D) ← Go Back to Q10

Q11.

Solution

Concept – Double-angle identity for sine:

$$2\sin\theta\cos\theta = \sin 2\theta$$

Step 1 – Apply the identity with $\theta = 15°$:

$$2\sin 15°\cos 15° = \sin(2\times 15°) = \sin 30°$$

Step 2 – Evaluate $\sin 30°$:

$$\sin 30° = \frac{1}{2}$$

Why other options are wrong:

- (A) $\frac{\sqrt{3}}{2}$: this is $\sin 60°$, from misreading 2θ as $60°$.
- (C) $\frac{1}{\sqrt{2}}$: this is $\sin 45°$, an unrelated angle.
- (D) 1: this is $\sin 90°$, treating 2θ as $90°$.

Answer: (B) ← Go Back to Q11

Q12.

Solution

Concept – Tangent ratio in a right triangle:

$$\tan\theta = \frac{\text{opposite (height)}}{\text{adjacent (horizontal distance)}}$$

Step 1 – Set up the relation with $\theta = 30°$, distance $= 30\sqrt{3}$ and height h:

$$\tan 30° = \frac{h}{30\sqrt{3}}$$

Step 2 – Substitute $\tan 30° = \frac{1}{\sqrt{3}}$:

$$\frac{1}{\sqrt{3}} = \frac{h}{30\sqrt{3}}$$

Step 3 – Solve for h:

$$h = 30\sqrt{3} \times \frac{1}{\sqrt{3}}$$

Step 4 – Simplify (the $\sqrt{3}$ terms cancel):

$$h = 30$$

Why other options are wrong:

- (A) $10\sqrt{3}$: dividing by 3 instead of cancelling $\sqrt{3}$.
- (B) 90: multiplying $30\sqrt{3}$ by $\sqrt{3}$ (using $\tan$ upside down).
- (D) 15: halving the distance instead of using $\tan 30°$.

Answer: (C) ← Go Back to Q12

Q13.

Solution

Concept – Classical probability:

$$P = \frac{\text{favourable outcomes}}{\text{total outcomes}}$$

Step 1 – Total outcomes when two dice are thrown:

$$6 \times 6 = 36$$

Step 2 – List outcomes giving a sum of 8:

$$(2,6),\ (3,5),\ (4,4),\ (5,3),\ (6,2)$$

Step 3 – Count the favourable outcomes:

$$5 \text{ outcomes}$$

Step 4 – Compute the probability:

$$P(\text{sum} = 8) = \frac{5}{36}$$

Why other options are wrong:

- (A) $\frac{1}{6}$: this is the probability of a sum of 7 (6 outcomes).
- (C) $\frac{1}{9}$: equals $\frac{4}{36}$, missing one favourable outcome.
- (D) $\frac{1}{12}$: equals $\frac{3}{36}$, undercounting the favourable outcomes.

Answer: (B) ← Go Back to Q13

Q14.

Solution

Concept – Multiplication rule for independent events:

$$P(A \cap B) = P(A) \cdot P(B)$$

Step 1 – State the given probabilities:

$$P(A) = 0.3, \qquad P(B) = 0.4$$

Step 2 – Multiply (events are independent):

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

Step 3 – Compute the product:

$$P(A \cap B) = 0.12$$

Why other options are wrong:

- (B) 0.7: this is $P(A) + P(B)$, the sum not the product.
- (C) 0.1: an incorrect subtraction $0.4 - 0.3$.
- (D) 0.58: this is $P(A \cup B) = 0.3 + 0.4 - 0.12$, the union not the intersection.

Answer: (A) ← Go Back to Q14

Q15.

Solution

Concept – Scalar projection of a on b:

$$\text{proj} = \frac{\mathbf{a} \cdot \mathbf{b}}{|\mathbf{b}|}$$

Step 1 – Write the components:

$$\mathbf{a} = (3, 4), \qquad \mathbf{b} = (1, 0)$$

Step 2 – Compute the dot product a · b:

$$3 \times 1 + 4 \times 0 = 3$$

Step 3 – Compute the magnitude |b|:

$$|\mathbf{b}| = \sqrt{1^2 + 0^2} = 1$$

Step 4 – Divide to get the scalar projection:

$$\text{proj} = \frac{3}{1} = 3$$

Why other options are wrong:

- (A) 4: projecting onto the y-axis instead of $\mathbf{b} = \hat{\imath}$.

- (B) 5: this is $|\mathbf{a}| = \sqrt{3^2+4^2}$, not the projection.
- (D) 7: adding the components $3+4$ instead of taking the dot product with $\mathbf{b}$.

Answer: (C) ← Go Back to Q15

Q16.

Solution

Concept – Cross product of standard unit vectors:

$$\hat{i} \times \hat{j} = \hat{k}, \qquad |\mathbf{a} \times \mathbf{b}| = |\mathbf{a}||\mathbf{b}|\sin\theta$$

Step 1 – Write the vectors:

$$\mathbf{a} = 2\hat{i}, \qquad \mathbf{b} = 3\hat{j}$$

Step 2 – Compute the cross product:

$$\mathbf{a} \times \mathbf{b} = (2\hat{i}) \times (3\hat{j}) = 6(\hat{i} \times \hat{j}) = 6\hat{k}$$

Step 3 – Take the magnitude:

$$|\mathbf{a} \times \mathbf{b}| = |6\hat{k}| = 6$$

Step 4 – Check via the angle ($\hat{i} \perp \hat{j}$, so $\theta = 90°$):

$$|\mathbf{a}||\mathbf{b}|\sin 90° = 2 \times 3 \times 1 = 6 \checkmark$$

Why other options are wrong:

- (A) 5: adding the magnitudes $2+3$ instead of multiplying.
- (B) 0: this would be the result if $\mathbf{a}$ and $\mathbf{b}$ were parallel.
- (C) $\sqrt{13}$: computing $\sqrt{2^2+3^2}$, the magnitude of $\mathbf{a}+\mathbf{b}$, not the cross product.

Answer: (D) ← Go Back to Q16

Q17.

Solution

Concept – Combination (order does not matter):

$$\binom{n}{r} = \frac{n!}{r!\,(n-r)!}$$

Step 1 – Identify $n = 7$, $r = 3$:

Step 2 – Expand (cancel $4!$):

$$\binom{7}{3} = \frac{7 \times 6 \times 5}{3 \times 2 \times 1}$$

Step 3 – Compute the numerator:

$$7 \times 6 \times 5 = 210$$

Step 4 – Compute the denominator and divide:

$$\frac{210}{6} = 35$$

Why other options are wrong:

- (A) 21: this is $\binom{7}{2}$, choosing 2 instead of 3.
- (B) 210: this is the permutation ${}^{7}P_{3} = 7 \times 6 \times 5$ (order counted).
- (D) 42: dividing 210 by 5 instead of 6.

Answer: (C) ← Go Back to Q17

Q18.

Solution

Concept – Sum to infinity of a GP ($|r| < 1$):

$$S_\infty = \frac{a}{1-r}$$

Step 1 – Identify the first term and common ratio:

$$a = 1, \qquad r = \frac{1}{2}$$

Step 2 – Check the convergence condition:

$$|r| = \frac{1}{2} < 1 \quad \Rightarrow \quad \text{the sum converges.}$$

Step 3 – Substitute into the formula:

$$S_\infty = \frac{1}{1 - \frac{1}{2}}$$

Step 4 – Simplify the denominator and divide:

$$S_\infty = \frac{1}{\frac{1}{2}} = 2$$

Why other options are wrong:

- (A) $\frac{3}{2}$: summing only the first two terms $1 + \frac{1}{2}$.
- (B) ∞: incorrectly assuming the series diverges.
- (C) $\frac{1}{2}$: using $\frac{r}{1-r}$ instead of $\frac{a}{1-r}$.

Answer: (D) ← Go Back to Q18

Q19.

Solution

Concept – Midpoint of a segment in 3D:

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$$

Step 1 – Write the two points:

$$(x_1, y_1, z_1) = (2, 4, 6), \qquad (x_2, y_2, z_2) = (4, 8, 10)$$

Step 2 – Average the x-coordinates:

$$\frac{2+4}{2} = \frac{6}{2} = 3$$

Step 3 – Average the y-coordinates:

$$\frac{4+8}{2} = \frac{12}{2} = 6$$

Step 4 – Average the z-coordinates:

$$\frac{6+10}{2} = \frac{16}{2} = 8$$

Step 5 – Assemble the midpoint:

$$M = (3,\ 6,\ 8)$$

Why other options are wrong:

- (A) $(6, 12, 16)$: adding the coordinates without dividing by 2.
- (C) $(1, 2, 2)$: dividing only the first point by 2.
- (D) $(2, 4, 4)$: halving the difference instead of averaging.

Answer: (B) ← Go Back to Q19

Q20.

Solution

Concept – Order of a differential equation:
The order is the highest derivative present in the equation.

Step 1 – List the derivatives appearing in the equation:

$$\frac{d^2y}{dx^2}\ \text{(second order)}, \qquad \frac{dy}{dx}\ \text{(first order)}$$

Step 2 – Identify the highest-order derivative:

$$\frac{d^2y}{dx^2}\ \text{is the highest, of order } 2.$$

Step 3 – State the order:

$$\text{Order} = 2$$

Why other options are wrong:

- (B) 0: there are derivatives present, so the order cannot be 0.
- (C) 1: ignores the second-derivative term.
- (D) 3: no third-order derivative appears in the equation.

Answer: (A) ← Go Back to Q20

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	D	2	B	3	C	4	A	5	D
6	C	7	A	8	B	9	A	10	D
11	B	12	C	13	B	14	A	15	C
16	D	17	C	18	D	19	B	20	A