AME CET Mathematics

Sample Paper – 10

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 $\int_0^{\pi/3} \sin x \, dx$ is:

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

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

(C) 1

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

Q2. The value of $\int_0^{1} (3x^2 + 2x) \, dx$ is:

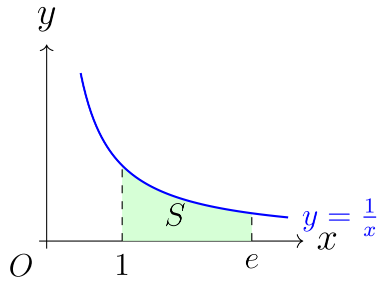
(A) 1

(B) 3

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

(D) 2

Q3. The area of the shaded region bounded by the curve $y = \frac{1}{x}$, the x-axis, and the lines $x = 1$ and $x = e$, shown below, is:



(A) 1

(B) e

(C) $e - 1$

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

Q4. The equation of the circle with centre $(-1, 2)$ and radius 4 is:

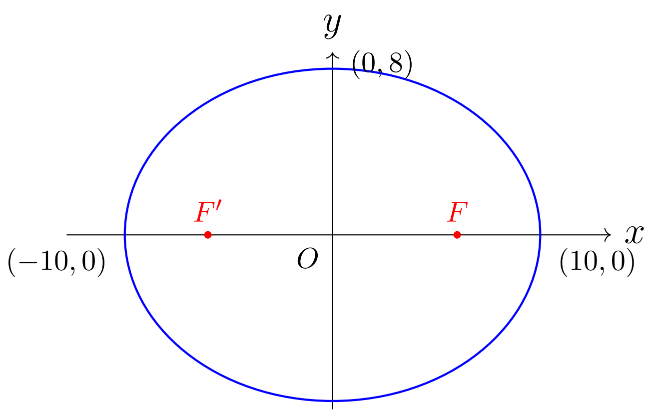
(A) $x^2 + y^2 - 2x + 4y - 11 = 0$

(B) $x^2 + y^2 + 2x + 4y - 11 = 0$

(C) $x^2 + y^2 + 2x - 4y - 11 = 0$

(D) $x^2 + y^2 + 2x - 4y + 11 = 0$

Q5. The eccentricity of the ellipse $\frac{x^2}{100} + \frac{y^2}{64} = 1$, sketched below, is:



(A) $\frac{4}{5}$

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

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

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

Q6. The length of the latus rectum of the parabola $y^2 = 4x$ is:

(A) 4

(B) 2

(C) 1

(D) 8

Q7. If $A = \begin{pmatrix} 6 & 1 \\ 2 & 3 \end{pmatrix}$, then $\det(A)$ equals:

(A) 20

(B) 18

(C) -16

(D) 16

Q8. If $A = \begin{pmatrix} 4 & 3 \\ 1 & 1 \end{pmatrix}$, then A^{-1} equals:

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

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

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

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

Q9. $\lim_{x \to 0} \frac{\ln(1+x)}{x}$ equals:

(A) 1

(B) 0

(C) ∞

(D) e

Q10. If $y = \cos 3x$, then $\frac{dy}{dx}$ is:

(A) $3\sin 3x$

(B) $-3\sin 3x$

(C) $-\sin 3x$

(D) $3\cos 3x$

Q11. The value of $1 + \tan^2 45°$ is:

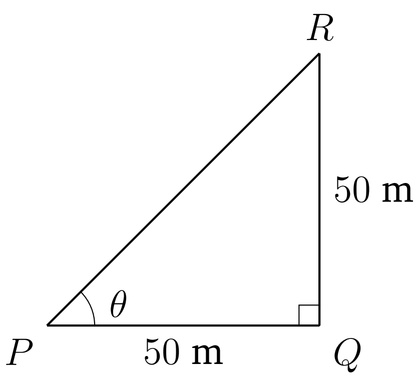
(A) 1

(B) 0

(C) 2

(D) $\sqrt{2}$

Q12. A vertical tower is 50 m tall. From a point on the ground 50 m away from its foot, the angle of elevation θ of the top of the tower is:



(A) $30°$

(B) $60°$

(C) $90°$

(D) $45°$

Q13. A fair die is thrown once. The probability of getting a prime number is:

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

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

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

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

Q14. In a room of 6 people, each person shakes hands with every other person exactly once. The total number of handshakes is:

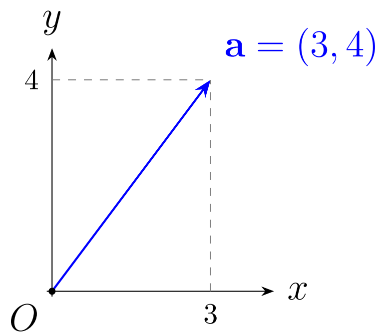
(A) 15

(B) 30

(C) 36

(D) 12

Q15. The unit vector in the direction of the vector $\mathbf{a} = 3\hat{\imath} + 4\hat{\jmath}$, shown below, is:



(A) $\left(\frac{4}{5}, \frac{3}{5}\right)$

(B) $(3,\ 4)$

(C) $\left(\frac{3}{5}, \frac{4}{5}\right)$

(D) $\left(\frac{3}{7}, \frac{4}{7}\right)$

Q16. If $|\mathbf{a}| = 3$, $|\mathbf{b}| = 4$ and $\mathbf{a} \cdot \mathbf{b} = 6$, then $|\mathbf{a} \times \mathbf{b}|$ equals:

(A) 12

(B) 6

(C) $3\sqrt{3}$

(D) $6\sqrt{3}$

Q17. The value of $\binom{9}{2}$ is:

(A) 72

(B) 36

(C) 18

(D) 81

Q18. The geometric mean of 4 and 9 is:

(A) 6

(B) 6.5

(C) 13

(D) 36

Q19. The distance between the points $(0, 0, 0)$ and $(2, 3, 6)$ is:

(A) 11

(B) $\sqrt{41}$

(C) 7

(D) 6

Q20. The general solution of the differential equation $\frac{dy}{dx} = \sec^2 x$ is:

(A) $y = \sec x + C$

(B) $y = \sec x \tan x + C$

(C) $y = 2\sec^2 x \tan x + C$

(D) $y = \tan x + C$

Detailed Solutions

Q1.

Solution

Concept – Definite integral of $\sin x$:

$$\int \sin x \, dx = -\cos x + C$$

Step 1 – Write the antiderivative:

$$\int_0^{\pi/3} \sin x \, dx = \Big[-\cos x\Big]_0^{\pi/3}$$

Step 2 – Substitute the upper limit:

$$-\cos\frac{\pi}{3} = -\frac{1}{2}$$

Step 3 – Substitute the lower limit:

$$-\cos 0 = -1$$

Step 4 – Subtract (upper minus lower):

$$-\frac{1}{2} - (-1) = -\frac{1}{2} + 1 = \frac{1}{2}$$

Why other options are wrong:

- (A) $\frac{\sqrt{3}}{2}$: this is $\sin\frac{\pi}{3}$, not the evaluated integral.
- (C) 1: forgetting the $-\cos\frac{\pi}{3}$ contribution at the top limit.
- (D) $\frac{3}{2}$: sign error giving $1 + \frac{1}{2}$ instead of $-\frac{1}{2} + 1$.

Answer: (B) ← Go Back to Q1

Q2.

Solution

Concept – Power rule for integration:

$$\int x^n \, dx = \frac{x^{n+1}}{n+1} + C$$

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 – Apply the limits 0 to 1:

$$\left[x^3 + x^2\right]_0^1$$

Step 3 – Substitute the upper limit $x = 1$:

$$1^3 + 1^2 = 1 + 1 = 2$$

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

$$0^3 + 0^2 = 0$$

Step 5 – Subtract:

$$2 - 0 = 2$$

Why other options are wrong:

- (A) 1: integrating only the first term $3x^2$.
- (B) 3: leaving the coefficients un-divided, e.g. $3 \cdot 1^3$ wrongly.
- (C) $\frac{5}{2}$: arithmetic slip in adding the two parts.

Answer: (D) ← Go Back to Q2

Q3.

Solution

Concept – Area under a curve:

$$A = \int_a^b f(x)\,dx \quad \text{for } f(x) \geq 0 \text{ on } [a, b]$$

Step 1 – Set up the integral with $f(x) = \frac{1}{x}$, $a = 1$, $b = e$:

$$A = \int_1^e \frac{1}{x}\,dx$$

Step 2 – Recall the antiderivative of $\frac{1}{x}$:

$$\int \frac{1}{x}\,dx = \ln|x| + C$$

Step 3 – Apply the limits:

$$A = \Big[\ln x\Big]_1^e = \ln e - \ln 1$$

Step 4 – Evaluate the logarithms:

$$\ln e = 1, \qquad \ln 1 = 0$$

Step 5 – Subtract:

$$A = 1 - 0 = 1$$

Why other options are wrong:

- (B) e: confusing $\ln e$ with e itself.
- (C) $e - 1$: this is $\int_1^e e^x$-type result, not $\int \frac{1}{x}$.
- (D) $\frac{1}{e}$: evaluating $\frac{1}{x}$ at $x = e$ rather than integrating.

Answer: (A) ← Go Back to Q3

Q4.

Solution

Concept – Standard circle equation:
$(x - h)^2 + (y - k)^2 = r^2$ for centre (h, k) and radius r.

Step 1 – Write the equation with centre $(-1, 2)$, $r = 4$:

$$(x + 1)^2 + (y - 2)^2 = 16$$

Step 2 – Expand $(x + 1)^2$:

$$x^2 + 2x + 1$$

Step 3 – Expand $(y - 2)^2$:

$$y^2 - 4y + 4$$

Step 4 – Collect all terms:

$$x^2 + 2x + 1 + y^2 - 4y + 4 = 16$$

$$x^2 + y^2 + 2x - 4y + 5 = 16$$

Step 5 – Rearrange to general form:

$$x^2 + y^2 + 2x - 4y - 11 = 0$$

Why other options are wrong:

- (A) has $-2x$: wrong sign on the x-coefficient (would need centre $x = +1$).
- (B) has $+4y$: wrong sign on the y-coefficient (would need centre $y = -2$).
- (D) has $+11$: constant not moved correctly across the equality.

Answer: (C) ← Go Back to Q4

Q5.

Solution

Concept – Eccentricity of ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ with $a > b$:

$$c^2 = a^2 - b^2, \qquad e = \frac{c}{a}$$

Step 1 – Read off a^2 and b^2:

$$a^2 = 100, \quad b^2 = 64$$

Step 2 – Compute c^2:

$$c^2 = 100 - 64 = 36$$

Step 3 – Compute c and a:

$$c = 6, \qquad a = \sqrt{100} = 10$$

Step 4 – Compute eccentricity:

$$e = \frac{c}{a} = \frac{6}{10} = \frac{3}{5}$$

Why other options are wrong:

- (A) $\frac{4}{5}$: using b/a wrongly or $\sqrt{1 - (c/a)^2}$.
- (C) $\frac{5}{3}$: inverting the ratio (this exceeds 1, impossible for an ellipse).
- (D) $\frac{2}{5}$: arithmetic slip in c.

Answer: (B) ← Go Back to Q5

Q6.

Solution

Concept – Standard parabola $y^2 = 4ax$:
The length of the latus rectum is $4a$.

Step 1 – Match $y^2 = 4x$ to $y^2 = 4ax$:

$$4a = 4 \;\Rightarrow\; a = 1$$

Step 2 – Compute the latus rectum:

$$\text{Latus rectum} = 4a = 4(1) = 4$$

Why other options are wrong:

- (B) 2: confusing the latus rectum with $2a$.
- (C) 1: reporting a instead of $4a$.
- (D) 8: doubling the correct value.

Answer: (A) ← Go Back to Q6

Q7.

Solution

Concept – 2×2 determinant:

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

Step 1 – Identify elements:

$$a = 6,\; b = 1,\; c = 2,\; d = 3$$

Step 2 – Compute ad and bc:

$$ad = 6 \times 3 = 18, \qquad bc = 1 \times 2 = 2$$

Step 3 – Subtract:

$$\det(A) = 18 - 2 = 16$$

Why other options are wrong:

- (A) 20: adding instead of subtracting $(18+2)$.
- (B) 18: forgetting to subtract bc.
- (C) -16: sign error in the subtraction order.

Answer: (D) ← Go Back to Q7

Q8.

Solution

Concept – 2×2 matrix inverse:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}^{-1} = \frac{1}{ad-bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$

Step 1 – Compute $\det(A)$:

$$\det(A) = 4 \times 1 - 3 \times 1 = 4 - 3 = 1$$

Step 2 – Form the adjugate (swap main diagonal, negate off-diagonal):

$$\text{adj}(A) = \begin{pmatrix} 1 & -3 \\ -1 & 4 \end{pmatrix}$$

Step 3 – Divide by $\det(A) = 1$:

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

Step 4 – Verify $A \cdot A^{-1} = I$:

$$\begin{pmatrix} 4 & 3 \\ 1 & 1 \end{pmatrix}\begin{pmatrix} 1 & -3 \\ -1 & 4 \end{pmatrix} = \begin{pmatrix} 4-3 & -12+12 \\ 1-1 & -3+4 \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \checkmark$$

Why other options are wrong:

- (A): no sign change on the off-diagonal elements.
- (B): main-diagonal entries were not swapped.
- (D): all signs reversed incorrectly.

Answer: (C) ← Go Back to Q8

Q9.

Solution

Concept – Standard logarithmic limit:

$$\lim_{x\to 0}\frac{\ln(1+x)}{x}=1$$

Step 1 – Note the form at $x=0$ is $\frac{0}{0}$ (indeterminate):

$$\ln(1+0)=0, \qquad \text{denominator}=0$$

Step 2 – Use the series expansion of $\ln(1+x)$ near 0:

$$\ln(1+x)=x-\frac{x^2}{2}+\frac{x^3}{3}-\cdots$$

Step 3 – Divide by x:

$$\frac{\ln(1+x)}{x}=1-\frac{x}{2}+\frac{x^2}{3}-\cdots$$

Step 4 – Take the limit as $x\to 0$ (all higher terms vanish):

$$\lim_{x\to 0}\frac{\ln(1+x)}{x}=1$$

Why other options are wrong:

- (B) 0: substituting numerator $=0$ while ignoring the denominator.
- (C) ∞: mis-reading the $\frac{0}{0}$ form as $\frac{1}{0}$.
- (D) e: confusing this with $\lim(1+x)^{1/x}=e$.

Answer: (A) ← Go Back to Q9

Q10.

Solution

Concept – Chain rule:

$$\frac{d}{dx}\left[\cos(u)\right]=-\sin(u)\cdot\frac{du}{dx}$$

Step 1 – Identify the inner function $u=3x$:

$$y=\cos 3x$$

Step 2 – Differentiate the inner function:

$$\frac{du}{dx} = \frac{d}{dx}(3x) = 3$$

Step 3 – Apply the chain rule:

$$\frac{dy}{dx} = -\sin(3x) \cdot 3 = -3\sin 3x$$

Why other options are wrong:

- (A) $3\sin 3x$: missing the negative sign from $\frac{d}{dx}\cos$.
- (C) $-\sin 3x$: forgetting the factor 3 from the chain rule.
- (D) $3\cos 3x$: differentiating as if $y = \sin 3x$.

Answer: (B) ← Go Back to Q10

Q11.

Solution

Concept – Pythagorean identity:

$$1 + \tan^2\theta = \sec^2\theta$$

Step 1 – Recall $\tan 45°$:

$$\tan 45° = 1$$

Step 2 – Square it:

$$\tan^2 45° = 1^2 = 1$$

Step 3 – Add 1:

$$1 + \tan^2 45° = 1 + 1 = 2$$

Step 4 – Check via the identity:

$$1 + \tan^2 45° = \sec^2 45° = (\sqrt{2})^2 = 2\checkmark$$

Why other options are wrong:

- (A) 1: using $\tan 45° = 0$.
- (B) 0: treating $\tan^2 45° = -1$ (impossible).
- (D) $\sqrt{2}$: reporting $\sec 45°$ instead of $\sec^2 45°$.

Answer: (C) ← Go Back to Q11

Q12.

Solution

Concept – Tangent ratio in a right triangle:

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

Step 1 – Identify the sides. Height (opposite) $= 50$ m, horizontal distance (adjacent) $= 50$ m:

$$\tan\theta = \frac{50}{50}$$

Step 2 – Simplify:

$$\tan\theta = 1$$

Step 3 – Find θ whose tangent is 1:

$$\theta = \tan^{-1}(1) = 45^\circ$$

Why other options are wrong:

- (A) 30°: $\tan 30^\circ = \frac{1}{\sqrt{3}} \neq 1$.
- (B) 60°: $\tan 60^\circ = \sqrt{3} \neq 1$.
- (C) 90°: $\tan 90^\circ$ is undefined; would need zero horizontal distance.

Answer: (D) ← Go Back to Q12

Q13.

Solution

Concept – Classical probability:

$$P(E) = \frac{\text{number of favourable outcomes}}{\text{total number of outcomes}}$$

Step 1 – List the sample space of a die:

$$\{1, 2, 3, 4, 5, 6\} \quad \Rightarrow \quad \text{total outcomes} = 6$$

Step 2 – Identify the prime numbers on a die:

$$2,\ 3,\ 5 \quad \Rightarrow \quad \text{favourable outcomes} = 3$$

Step 3 – Compute the probability:

$$P(\text{prime}) = \frac{3}{6} = \frac{1}{2}$$

Why other options are wrong:

- (A) $\frac{1}{3}$: counting only 2 primes.
- (C) $\frac{2}{3}$: counting 4 outcomes (e.g. including 1).
- (D) $\frac{1}{6}$: counting a single outcome only.

Answer: (B) ← Go Back to Q13

Q14.

Solution

Concept – A handshake pairs two people; order does not matter:

$$\text{Number of handshakes} = \binom{n}{2} = \frac{n(n-1)}{2}$$

Step 1 – Set $n = 6$:

$$\binom{6}{2} = \frac{6 \times 5}{2}$$

Step 2 – Compute the numerator:

$$6 \times 5 = 30$$

Step 3 – Divide by 2:

$$\frac{30}{2} = 15$$

Why other options are wrong:

- (B) 30: using $n(n-1)$ without dividing by 2 (counts each handshake twice).
- (C) 36: using $n^2 = 6^2$ (includes self-handshakes and ordering).
- (D) 12: using $2n$ instead of the combination.

Answer: (A) ← Go Back to Q14

Q15.

Solution

Concept – Unit vector:

$$\hat{\mathbf{a}} = \frac{\mathbf{a}}{|\mathbf{a}|}$$

Step 1 – Write the components of $\mathbf{a} = 3\hat{\imath} + 4\hat{\jmath}$:

$$\mathbf{a} = (3,\ 4)$$

Step 2 – Compute the magnitude:

$$|\mathbf{a}| = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

Step 3 – Divide each component by the magnitude:

$$\hat{\mathbf{a}} = \left(\frac{3}{5}, \frac{4}{5}\right)$$

Step 4 – Verify it is a unit vector:

$$\left(\frac{3}{5}\right)^2 + \left(\frac{4}{5}\right)^2 = \frac{9}{25} + \frac{16}{25} = \frac{25}{25} = 1\checkmark$$

Why other options are wrong:

- (A) $\left(\frac{4}{5}, \frac{3}{5}\right)$: components swapped.
- (B) $(3, 4)$: this is $\mathbf{a}$ itself, not divided by its magnitude.
- (D) $\left(\frac{3}{7}, \frac{4}{7}\right)$: dividing by $3 + 4 = 7$ instead of $\sqrt{3^2 + 4^2} = 5$.

Answer: (C) ← Go Back to Q15

Q16.

Solution

Concept – Relation between dot and cross products:

$$|\mathbf{a} \times \mathbf{b}| = \sqrt{|\mathbf{a}|^2|\mathbf{b}|^2 - (\mathbf{a} \cdot \mathbf{b})^2}$$

Step 1 – State the given values:

$$|\mathbf{a}| = 3, \quad |\mathbf{b}| = 4, \quad \mathbf{a} \cdot \mathbf{b} = 6$$

Step 2 – Compute $|\mathrm{a}|^2|\mathrm{b}|^2$:

$$3^2 \times 4^2 = 9 \times 16 = 144$$

Step 3 – Compute $(\mathrm{a}\cdot\mathrm{b})^2$:

$$6^2 = 36$$

Step 4 – Subtract and take the square root:

$$|\mathbf{a} \times \mathbf{b}| = \sqrt{144 - 36} = \sqrt{108}$$

Step 5 – Simplify the surd:

$$\sqrt{108} = \sqrt{36 \times 3} = 6\sqrt{3}$$

Why other options are wrong:

- (A) 12: using $|\mathrm{a}||\mathrm{b}|$ as if $\sin\theta = 1$.
- (B) 6: stopping at $\mathbf{a}\cdot\mathbf{b}$ without the cross-product formula.
- (C) $3\sqrt{3}$: halving the correct value without justification.

Answer: (D) ← Go Back to Q16

Q17.

Solution

Concept – Combination (order does not matter):

$$\binom{n}{r} = \frac{n!}{r!\,(n-r)!} = \frac{n(n-1)}{2} \quad \text{for } r = 2$$

Step 1 – Identify $n = 9$, $r = 2$:

Step 2 – Expand:

$$\binom{9}{2} = \frac{9 \times 8}{2 \times 1}$$

Step 3 – Compute numerator:

$$9 \times 8 = 72$$

Step 4 – Divide:

$$\frac{72}{2} = 36$$

Why other options are wrong:

- (A) 72: computing 9×8 (permutations) without dividing by $2!$.
- (C) 18: dividing 36 by 2 again.
- (D) 81: using 9^2 instead of the combination.

Answer: (B) ← Go Back to Q17

Q18.

Solution

Concept – Geometric mean of two numbers:

$$\text{GM} = \sqrt{a\,b}$$

Step 1 – Identify $a = 4$, $b = 9$:

Step 2 – Compute the product:

$$a\,b = 4 \times 9 = 36$$

Step 3 – Take the square root:

$$\text{GM} = \sqrt{36} = 6$$

Why other options are wrong:

- (B) 6.5: this is the arithmetic mean $\frac{4+9}{2}$, not the geometric mean.
- (C) 13: this is the sum $4 + 9$, not the mean.
- (D) 36: forgetting to take the square root of the product.

Answer: (A) ← Go Back to Q18

Q19.

Solution

Concept – Distance formula in 3D:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

Step 1 – Identify the coordinates:

$$(x_1, y_1, z_1) = (0, 0, 0), \quad (x_2, y_2, z_2) = (2, 3, 6)$$

Step 2 – Compute the squared differences:

$$(2-0)^2 = 4, \quad (3-0)^2 = 9, \quad (6-0)^2 = 36$$

Step 3 – Sum them:

$$4 + 9 + 36 = 49$$

Step 4 – Take the square root:

$$d = \sqrt{49} = 7$$

Why other options are wrong:

- (A) 11: adding the coordinates $2 + 3 + 6$ instead of using the formula.
- (B) $\sqrt{41}$: omitting one squared term, e.g. $4 + 1 + 36$.
- (D) 6: taking only the largest coordinate.

Answer: (C) ← Go Back to Q19

Q20.

Solution

Concept – Direct integration:
When $\frac{dy}{dx} = f(x)$, integrate both sides with respect to x.

Step 1 – Separate the differentials:

$$dy = \sec^2 x\, dx$$

Step 2 – Integrate both sides:

$$\int dy = \int \sec^2 x\, dx$$

Step 3 – Recall the standard antiderivative:

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

Step 4 – Write the general solution:

$$y = \tan x + C$$

Why other options are wrong:

- (A) $y = \sec x + C$: $\frac{d}{dx} \sec x = \sec x \tan x$, not $\sec^2 x$.
- (B) $y = \sec x \tan x + C$: this is itself a derivative, not the antiderivative of $\sec^2 x$.
- (C) $y = 2\sec^2 x \tan x + C$: this is the derivative of $\sec^2 x$, the wrong direction.

Answer: (D) ← Go Back to Q20

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	A	10	B
11	C	12	D	13	B	14	A	15	C
16	D	17	B	18	A	19	C	20	D