# AME CET Mathematics

## Sample Paper – 9

**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 $\int_0^4 \frac{x}{\sqrt{x^2+9}}\,dx$ is:

(A) 5

(B) 2

(C) 8

(D) 4

**Q2.** The value of $\int_0^2 e^x\,dx$ is:

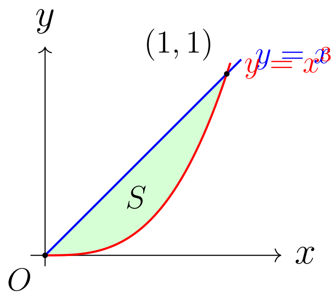
(A) $e^2 - 1$

(B) $e^2$

(C) $2e - 1$

(D) $e^2 + 1$

**Q3.** The area of the region enclosed between the curves $y = x$ and $y = x^3$ in the first quadrant (from $x = 0$ to $x = 1$), shown in the figure, is:




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

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

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

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

**Q4.** The distance of the point $(3,\ 4)$ from the line $3x + 4y - 10 = 0$ is:

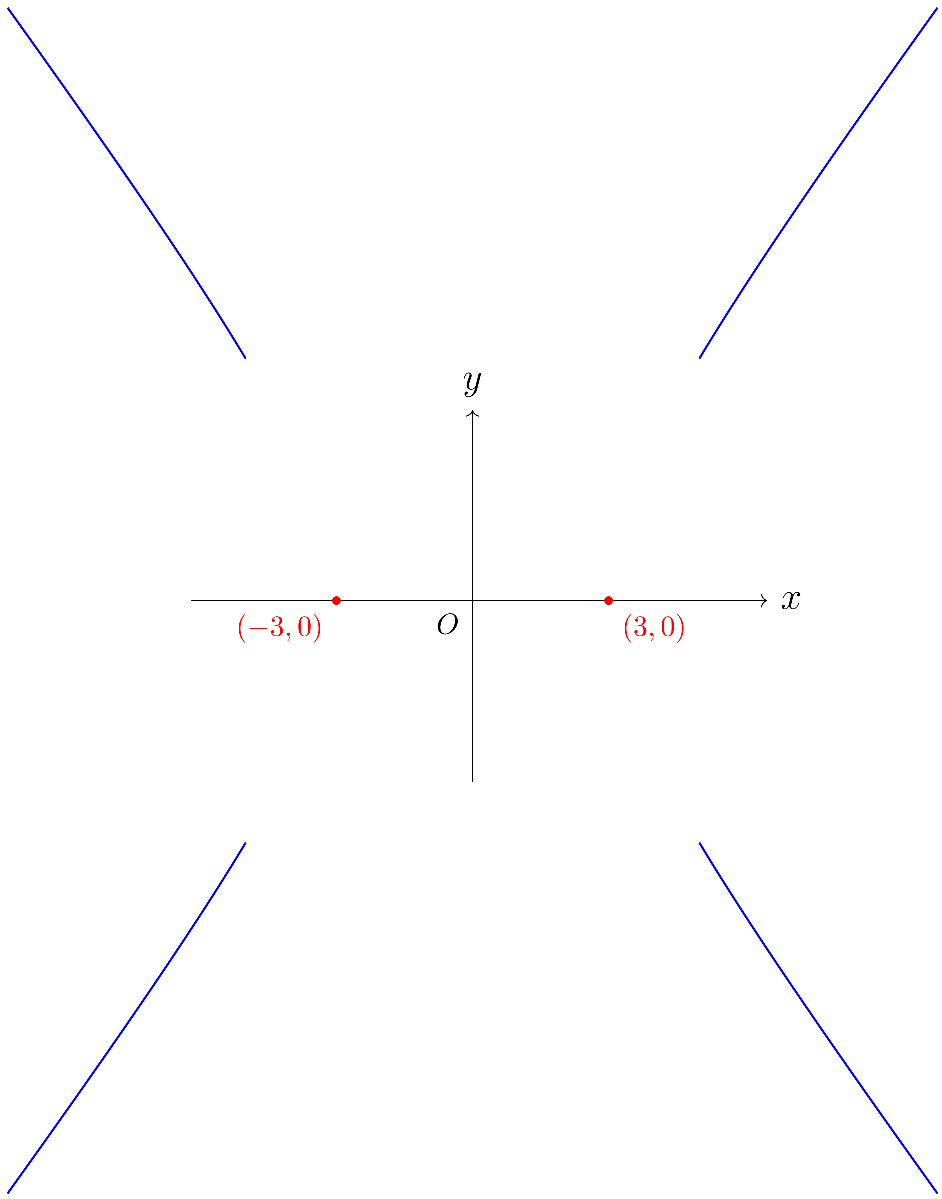
(A) $5$

(B) $\frac{15}{\sqrt{7}}$

(C) $3$

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

**Q5.** The coordinates of the vertices of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = 1$, sketched below, are:




(A) $(\pm 3,\ 0)$

(B) $(0,\ \pm 3)$

(C) $(\pm 4,\ 0)$

(D) $(\pm 5,\ 0)$

**Q6.** The coordinates of the focus of the parabola $x^2 = -4y$ are:

(A) $(0,\ 1)$

(B) $(-1,\ 0)$

(C) $(1,\ 0)$

(D) $(0,\ -1)$

**Q7.** The value of $\det\begin{pmatrix}0 & 1 & 2\\ 1 & 0 & 3\\ 2 & 3 & 0\end{pmatrix}$ is:

(A) $0$

(B) $-12$

(C) $12$

(D) $6$

**Q8.** If $A = \begin{pmatrix}0 & 1\\ 1 & 0\end{pmatrix}$, then $A^2$ equals:

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

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

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

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

**Q9.** $\lim_{x\to 3} \frac{x^2 - 9}{x^2 - x - 6}$ equals:

(A) $1$

(B) $\frac{5}{6}$

(C) $0$

(D) $\frac{6}{5}$

**Q10.** If $y = x^x$ for $x > 0$, then $\frac{dy}{dx}$ is:

(A) $x^x(1 + \ln x)$

(B) $x \cdot x^{x-1}$

(C) $x^x \ln x$

(D) $x^x$

**Q11.** The value of $\cos 105°$ is:

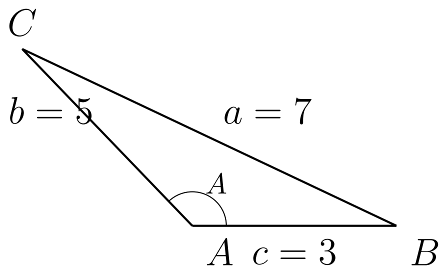
(A) $\frac{\sqrt{6}+\sqrt{2}}{4}$

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

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

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

**Q12.** In triangle $ABC$ the sides are $a = 7$, $b = 5$ and $c = 3$. The angle $A$ (opposite the side of length 7) is:




(A) $60°$

(B) $90°$

(C) $150°$

(D) $120°$

**Q13.** A fair coin is tossed 4 times. The probability of obtaining heads on all four tosses is:

(A) $\frac{1}{8}$

(B) $\frac{1}{16}$

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

(D) $\frac{1}{32}$

**Q14.** For two events $A$ and $B$, $P(A \cap B) = 0.2$ and $P(B) = 0.5$. The conditional probability $P(A \mid B)$ is:

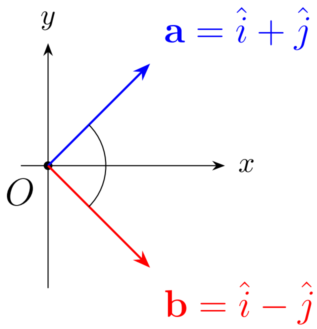
(A) $0.1$

(B) $0.7$

(C) $0.4$

(D) $0.25$

**Q15.** The angle between the vectors $\mathbf{a} = \hat{i} + \hat{j}$ and $\mathbf{b} = \hat{i} - \hat{j}$ is:




(A) $0^\circ$

(B) $45^\circ$

(C) $60^\circ$

(D) $90^\circ$

**Q16.** If $|\mathbf{a}| = 5$, $|\mathbf{b}| = 2$ and the angle between $\mathbf{a}$ and $\mathbf{b}$ is $60^\circ$, then $|\mathbf{a} \times \mathbf{b}|$ equals:

(A) $5$

(B) $5\sqrt{3}$

(C) $10$

(D) $10\sqrt{3}$

**Q17.** The number of ways to choose $2$ items from a set of $5$ items and, independently, $3$ items from another set of $4$ items is:

(A) $40$

(B) 14

(C) 20

(D) 60

**Q18.** The sum of the first 15 odd natural numbers $(1 + 3 + 5 + \cdots)$ is:

(A) 120

(B) 240

(C) 225

(D) 196

**Q19.** The direction cosines of the positive $x$-axis are:

(A) $(0,\ 1,\ 0)$

(B) $(1,\ 0,\ 0)$

(C) $(0,\ 0,\ 1)$

(D) $\left(\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{3}}\right)$

**Q20.** The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \frac{dy}{dx} = 0$ is:

(A) 1

(B) 2

(C) 6

(D) 3

## Detailed Solutions

### Q1.

**Solution**

**Concept – Substitution method:**
When the numerator is (up to a constant) the derivative of the expression under the square root, substitute that expression.

**Step 1 – Let $u = x^2 + 9$:**

$$u = x^2 + 9 \;\Rightarrow\; du = 2x\,dx \;\Rightarrow\; x\,dx = \tfrac{1}{2}\,du$$

**Step 2 – Change the limits:**

$$x = 0 \;\Rightarrow\; u = 9, \qquad x = 4 \;\Rightarrow\; u = 16 + 9 = 25$$

**Step 3 – Rewrite the integral:**

$$\int_0^4 \frac{x}{\sqrt{x^2+9}}\,dx = \frac{1}{2}\int_9^{25} u^{-1/2}\,du$$

**Step 4 – Integrate:**

$$= \frac{1}{2}\left[2\,u^{1/2}\right]_9^{25} = \left[\sqrt{u}\right]_9^{25}$$

**Step 5 – Substitute the limits:**

$$= \sqrt{25} - \sqrt{9} = 5 - 3 = 2$$

**Why other options are wrong:**

- (A) $5$: taking only $\sqrt{25}$ and forgetting to subtract the lower-limit value.
- (C) $8$: adding $5 + 3$ instead of subtracting.
- (D) $4$: a partial slip such as $\sqrt{16}$ from the upper limit alone.

**Answer: (B)** ← Go Back to Q1

## Q2.

**Solution**

**Concept – Antiderivative of $e^x$:**

$$\int e^x\,dx = e^x + C$$

**Step 1 – Apply the antidervative:**

$$\int_0^2 e^x\,dx = \left[e^x\right]_0^2$$

**Step 2 – Substitute the upper limit:**

$$e^2$$

**Step 3 – Substitute the lower limit:**

$$e^0 = 1$$

**Step 4 – Subtract:**

$$\int_0^2 e^x\,dx = e^2 - 1$$

**Why other options are wrong:**

- (B) $e^2$: forgetting the lower-limit term $e^0 = 1$.
- (C) $2e - 1$: wrongly treating $e^x$ as a linear factor of $x$.
- (D) $e^2 + 1$: sign error, adding instead of subtracting the lower limit.

**Answer: (A)** ← Go Back to Q2

## Q3.

**Solution**

**Concept – Area between two curves:**

$$A = \int_a^b \left[f(x) - g(x)\right]dx \quad \text{where } f(x) \geq g(x) \text{ on } [a, b]$$

**Step 1 – Find intersection points (set $y = x$ equal to $y = x^3$):**

$$x = x^3 \;\Rightarrow\; x(x^2 - 1) = 0 \;\Rightarrow\; x = 0,\; x = 1 \text{ (first quadrant)}$$

**Step 2 – Identify the upper curve on $[0, 1]$:**
At $x = 0.5$: line gives $0.5$, cubic gives $0.125$. So $y = x$ is above $y = x^3$.

**Step 3 – Set up the integral:**

$$A = \int_0^1 (x - x^3)\, dx$$

**Step 4 – Integrate:**

$$= \left[\frac{x^2}{2} - \frac{x^4}{4}\right]_0^1$$

**Step 5 – Evaluate:**

$$= \frac{1}{2} - \frac{1}{4} = \frac{2}{4} - \frac{1}{4} = \frac{1}{4}$$

**Why other options are wrong:**

- (B) $\frac{1}{3}$: integrating $x^2$ rather than $x - x^3$.
- (C) $\frac{1}{2}$: computing $\int_0^1 x\, dx$ alone, ignoring the cubic.
- (D) $\frac{1}{6}$: this is the area between $y = x$ and $y = x^2$, a different pair of curves.

**Answer: (A)** ← Go Back to Q3

## Q4.

**Solution**

**Concept – Distance from a point to a line:**
For the line $Ax + By + C = 0$ and point $(x_1, y_1)$,

$$d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2 + B^2}}$$

**Step 1 – Identify $A = 3$, $B = 4$, $C = -10$ and the point $(3, 4)$.**

**Step 2 – Substitute into the numerator:**

$$Ax_1 + By_1 + C = 3(3) + 4(4) - 10 = 9 + 16 - 10 = 15$$

**Step 3 – Compute the denominator:**

$$\sqrt{A^2 + B^2} = \sqrt{3^2 + 4^2} = \sqrt{9 + 16} = \sqrt{25} = 5$$

**Step 4 – Form the distance:**

$$d = \frac{|15|}{5} = 3$$

**Why other options are wrong:**

- (A) $5$: using only the denominator $\sqrt{A^2 + B^2}$ as the answer.
- (B) $\frac{15}{\sqrt{7}}$: miscalculating $\sqrt{A^2 + B^2}$ as $\sqrt{7}$.
- (D) $\frac{3}{5}$: dividing the answer by an extra factor of $5$.

**Answer: (C)** ← Go Back to Q4

## Q5.

### Solution

**Concept – Hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$:**
The transverse axis lies along the $x$-axis and the vertices are at $(\pm a,\, 0)$.

**Step 1 – Read off $a^2$ and $b^2$:**

$$a^2 = 9, \qquad b^2 = 16$$

**Step 2 – Compute $a$:**

$$a = \sqrt{9} = 3$$

**Step 3 – State the vertices:**

$$(\pm a,\, 0) = (\pm 3,\, 0)$$

**Why other options are wrong:**

- (B) $(0, \pm 3)$: vertices on the $y$-axis would belong to a hyperbola of the form $\frac{y^2}{9} - \frac{x^2}{16} = 1$.
- (C) $(\pm 4, 0)$: using $b = 4$ instead of $a$.
- (D) $(\pm 5, 0)$: this is the location of the foci, since $c = \sqrt{a^2 + b^2} = \sqrt{25} = 5$.

**Answer: (A)** ← Go Back to Q5

## Q6.

### Solution

**Concept – Standard parabola $x^2 = -4ay$:**
This opens downward, has its axis along the $y$-axis, and its focus at $(0, -a)$.

**Step 1 – Match $x^2 = -4y$ to $x^2 = -4ay$:**

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

**Step 2 – State the focus:**

$$\text{Focus} = (0, -a) = (0, -1)$$

**Why other options are wrong:**

- (A) $(0, 1)$: focus of the upward parabola $x^2 = 4y$.
- (B) $(-1, 0)$: confusing this with a horizontal parabola $y^2 = -4x$.
- (C) $(1, 0)$: focus of $y^2 = 4x$, the wrong orientation.

**Answer: (D)** ← Go Back to Q6

## Q7.

**Solution**

**Concept – Expansion along the first row:**

$$\det = a_{11}M_{11} - a_{12}M_{12} + a_{13}M_{13}$$

where each $M$ is the corresponding $2 \times 2$ minor.

**Step 1 – Write the matrix:**

$$A = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 2 & 3 & 0 \end{pmatrix}$$

**Step 2 – First-row entries:**

$$a_{11} = 0, \quad a_{12} = 1, \quad a_{13} = 2$$

**Step 3 – Compute the minors:**

$$M_{11} = \det\begin{pmatrix} 0 & 3 \\ 3 & 0 \end{pmatrix} = 0 - 9 = -9$$

$$M_{12} = \det\begin{pmatrix} 1 & 3 \\ 2 & 0 \end{pmatrix} = 0 - 6 = -6$$

$$M_{13} = \det\begin{pmatrix} 1 & 0 \\ 2 & 3 \end{pmatrix} = 3 - 0 = 3$$

**Step 4 – Combine with signs:**

$$\det A = 0(-9) - 1(-6) + 2(3) = 0 + 6 + 6 = 12$$

**Why other options are wrong:**

- (A) $0$: assuming the symmetric zero-diagonal forces a zero determinant.
- (B) $-12$: a sign error on the cofactor expansion.
- (D) $6$: dropping one of the two equal contributing terms.

**Answer: (C)** ← Go Back to Q7

## Q8.

### Solution

**Concept – Matrix multiplication:**
Entry $(i, j)$ of the product is the dot product of row $i$ with column $j$.

**Step 1 – Write the product to be computed:**

$$A^2 = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

**Step 2 – Compute each entry:**

$$(1, 1): \; 0 \cdot 0 + 1 \cdot 1 = 1$$

$$(1, 2): \; 0 \cdot 1 + 1 \cdot 0 = 0$$

$$(2, 1): \; 1 \cdot 0 + 0 \cdot 1 = 0$$

$$(2, 2): \; 1 \cdot 1 + 0 \cdot 0 = 1$$

**Step 3 – Assemble:**

$$A^2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} = I$$

**Why other options are wrong:**

- (A): this is $A$ itself, not its square.
- (C): the zero matrix would require $A$ to be nilpotent, which it is not.
- (D): obtained by adding entries instead of taking dot products.

**Answer: (B)** ← Go Back to Q8

## Q9.

**Solution**

**Concept – Removable $\frac{0}{0}$ form:**
Factor numerator and denominator, cancel the common factor, then substitute.

**Step 1 – Factor the numerator:**

$$x^2 - 9 = (x-3)(x+3)$$

**Step 2 – Factor the denominator:**

$$x^2 - x - 6 = (x-3)(x+2)$$

**Step 3 – Cancel the common factor $(x-3)$:**

$$\frac{(x-3)(x+3)}{(x-3)(x+2)} = \frac{x+3}{x+2}$$

**Step 4 – Substitute $x = 3$:**

$$\frac{3+3}{3+2} = \frac{6}{5}$$

**Why other options are wrong:**

- (A) $1$: cancelling incorrectly so the surviving factors look identical.
- (B) $\frac{5}{6}$: inverting the simplified fraction.
- (C) $0$: assuming the $\frac{0}{0}$ form evaluates to zero.

**Answer: (D)** ← Go Back to Q9

## Q10.

**Solution**

**Concept – Logarithmic differentiation:**
When the base and the exponent both contain $x$, take logarithms first.

**Step 1 – Take the natural log of both sides:**

$$\ln y = \ln\left(x^x\right) = x \ln x$$

**Step 2 – Differentiate both sides with respect to $x$ (product rule on the right):**

$$\frac{1}{y}\frac{dy}{dx} = \frac{d}{dx}\left(x \ln x\right) = 1 \cdot \ln x + x \cdot \frac{1}{x}$$

**Step 3 – Simplify the right side:**

$$\frac{1}{y}\frac{dy}{dx} = \ln x + 1$$

**Step 4 – Multiply through by $y = x^x$:**

$$\frac{dy}{dx} = x^x(1 + \ln x)$$

**Why other options are wrong:**

- (B) $x \cdot x^{x-1}$: applying the power rule, valid only for a constant exponent.
- (C) $x^x \ln x$: treating the base as a constant (exponential-only rule).
- (D) $x^x$: forgetting the bracket factor from the product rule.

**Answer: (A)** ← Go Back to Q10

## Q11.

### Solution

**Concept – Compound angle formula:**

$$\cos(P + Q) = \cos P \cos Q - \sin P \sin Q$$

**Step 1 – Write $105°$ as a sum of standard angles:**

$$105° = 60° + 45°$$

**Step 2 – Apply the formula:**

$$\cos 105° = \cos 60° \cos 45° - \sin 60° \sin 45°$$

**Step 3 – Substitute exact values:**

$$= \frac{1}{2} \cdot \frac{\sqrt{2}}{2} - \frac{\sqrt{3}}{2} \cdot \frac{\sqrt{2}}{2}$$

**Step 4 – Simplify:**

$$= \frac{\sqrt{2}}{4} - \frac{\sqrt{6}}{4} = \frac{\sqrt{2} - \sqrt{6}}{4}$$

**Why other options are wrong:**

- (A) $\frac{\sqrt{6}+\sqrt{2}}{4}$: this equals $\cos 15°$, a positive value.
- (B) $\frac{\sqrt{6}-\sqrt{2}}{4}$: this equals $\sin 15°$; also positive, so it cannot equal $\cos 105° < 0$.

- (D) $-\frac{\sqrt{6}+\sqrt{2}}{4}$: sign and term error; this would be $-\cos 15°$.

**Answer: (C)** ← Go Back to Q11

## Q12.

**Solution**

**Concept – Cosine Rule (solved for an angle):**

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

**Step 1 – Substitute $a = 7$, $b = 5$, $c = 3$:**

$$\cos A = \frac{5^2 + 3^2 - 7^2}{2(5)(3)}$$

**Step 2 – Compute each square:**

$$\cos A = \frac{25 + 9 - 49}{30}$$

**Step 3 – Simplify the numerator:**

$$\cos A = \frac{-15}{30} = -\frac{1}{2}$$

**Step 4 – Find the angle whose cosine is $-\frac{1}{2}$ (in $0°$ to $180°$):**

$$A = 120°$$

**Why other options are wrong:**

- (A) $60°$: dropping the minus sign, giving $\cos A = +\frac{1}{2}$.
- (B) $90°$: would need $a^2 = b^2 + c^2$, i.e. $49 = 34$, which is false.
- (C) $150°$: corresponds to $\cos A = -\frac{\sqrt{3}}{2}$, not $-\frac{1}{2}$.

**Answer: (D)** ← Go Back to Q12

## Q13.

### Solution

**Concept – Independent events:**
For independent tosses, multiply the probabilities of the individual outcomes.

**Step 1 – Probability of a head on one toss:**

$$P(H) = \frac{1}{2}$$

**Step 2 – All four tosses are independent, so multiply:**

$$P(\text{HHHH}) = \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$$

**Step 3 – Compute:**

$$= \left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

**Why other options are wrong:**

- (A) $\frac{1}{8}$: using $\left(\frac{1}{2}\right)^3$, i.e. only three tosses.
- (C) $\frac{1}{4}$: using $\left(\frac{1}{2}\right)^2$, only two tosses.
- (D) $\frac{1}{32}$: using $\left(\frac{1}{2}\right)^5$, one toss too many.

**Answer: (B)** ← Go Back to Q13

## Q14.

### Solution

**Concept – Conditional probability:**

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}, \qquad P(B) \neq 0$$

**Step 1 – State the given values:**

$$P(A \cap B) = 0.2, \qquad P(B) = 0.5$$

**Step 2 – Substitute into the formula:**

$$P(A \mid B) = \frac{0.2}{0.5}$$

**Step 3 – Divide:**

$$= 0.4$$

**Why other options are wrong:**

- (A) $0.1$: multiplying $0.2 \times 0.5$ instead of dividing.
- (B) $0.7$: adding $0.2 + 0.5$.
- (D) $0.25$: dividing in the wrong order, $\frac{0.5}{2}$ style slip.

**Answer: (C)** ← Go Back to Q14

## Q15.

### Solution

**Concept – Angle from the dot product:**

$$\cos\theta = \frac{\mathbf{a}\cdot\mathbf{b}}{|\mathbf{a}|\,|\mathbf{b}|}$$

**Step 1 – Write the components:**

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

**Step 2 – Compute the dot product:**

$$\mathbf{a}\cdot\mathbf{b} = (1)(1) + (1)(-1) + (0)(0) = 1 - 1 + 0 = 0$$

**Step 3 – Interpret a zero dot product:**
Since $|\mathbf{a}| \neq 0$ and $|\mathbf{b}| \neq 0$, $\cos\theta = 0$.

**Step 4 – Find the angle:**

$$\theta = 90^\circ$$

**Why other options are wrong:**

- (A) $0^\circ$: would require $\mathbf{a}$ and $\mathbf{b}$ to be parallel ($\mathbf{a}\cdot\mathbf{b} = |\mathbf{a}||\mathbf{b}|$).
- (B) $45^\circ$: would need $\cos\theta = \frac{1}{\sqrt{2}}$, not $0$.
- (C) $60^\circ$: would need $\cos\theta = \frac{1}{2}$, not $0$.

**Answer: (D)** ← Go Back to Q15

## Q16.

**Solution**

**Concept – Magnitude of cross product:**

$$|\mathbf{a} \times \mathbf{b}| = |\mathbf{a}|\,|\mathbf{b}|\sin\theta$$

**Step 1 – State given values:**

$$|\mathbf{a}| = 5, \quad |\mathbf{b}| = 2, \quad \theta = 60^\circ$$

**Step 2 – Recall $\sin 60^\circ$:**

$$\sin 60^\circ = \frac{\sqrt{3}}{2}$$

**Step 3 – Substitute:**

$$|\mathbf{a} \times \mathbf{b}| = 5 \times 2 \times \frac{\sqrt{3}}{2}$$

**Step 4 – Simplify:**

$$= 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}$$

**Why other options are wrong:**

- (A) $5$: using $\sin 30^\circ = \frac{1}{2}$ instead of $\sin 60^\circ$.
- (C) $10$: using $\sin 90^\circ = 1$.
- (D) $10\sqrt{3}$: forgetting the factor $\frac{1}{2}$ in $\sin 60^\circ$.

**Answer: (B)** ← Go Back to Q16

## Q17.

**Solution**

**Concept – Multiplication principle with combinations:**
Independent choices multiply: $\binom{5}{2} \times \binom{4}{3}$.

**Step 1 – Compute $\binom{5}{2}$:**

$$\binom{5}{2} = \frac{5 \times 4}{2 \times 1} = 10$$

**Step 2 – Compute $\binom{4}{3}$:**

$$\binom{4}{3} = \binom{4}{1} = 4$$

**Step 3 – Multiply the two counts:**

$$10 \times 4 = 40$$

**Why other options are wrong:**

- (B) $14$: adding $10 + 4$ instead of multiplying.
- (C) $20$: using $\binom{4}{3} = 2$ by mistake.
- (D) $60$: using $\binom{5}{2} = 10$ and $\binom{4}{3} = 6$ (a $\binom{4}{2}$ slip).

**Answer: (A)** ← Go Back to Q17

## Q18.

### Solution

**Concept – Sum of the first $n$ odd numbers:**

$$1 + 3 + 5 + \cdots + (2n - 1) = n^2$$

**Step 1 – Identify $n = 15$ (we want the first $15$ odd numbers).**

**Step 2 – Apply the formula:**

$$S = n^2 = 15^2$$

**Step 3 – Compute:**

$$15^2 = 225$$

**Step 4 – Cross-check with the AP sum $S_n = \frac{n}{2}(a + l)$, $a = 1$, $l = 29$:**

$$S = \frac{15}{2}(1 + 29) = \frac{15}{2} \times 30 = 225 \checkmark$$

**Why other options are wrong:**

- (A) $120$: this is $\frac{15 \times 16}{2}$, the sum of the first $15$ natural numbers.
- (B) $240$: doubling that natural-number sum.
- (D) $196 = 14^2$: using $n = 14$ instead of $15$.

**Answer: (C)** ← Go Back to Q18

## Q19.

### Solution

**Concept – Direction cosines:**

$$l = \cos\alpha, \quad m = \cos\beta, \quad n = \cos\gamma$$

where $\alpha, \beta, \gamma$ are the angles the line makes with the $x$-, $y$-, $z$-axes.

**Step 1 – Angles of the positive $x$-axis with the coordinate axes:**

$$\alpha = 0^\circ, \quad \beta = 90^\circ, \quad \gamma = 90^\circ$$

**Step 2 – Evaluate the cosines:**

$$l = \cos 0^\circ = 1$$

$$m = \cos 90^\circ = 0$$

$$n = \cos 90^\circ = 0$$

**Step 3 – Verify $l^2 + m^2 + n^2 = 1$:**

$$1 + 0 + 0 = 1 \checkmark$$

**Result:** $(l, m, n) = (1,\ 0,\ 0)$.

**Why other options are wrong:**

- (A) $(0, 1, 0)$: these are the direction cosines of the $y$-axis.
- (C) $(0, 0, 1)$: these are the direction cosines of the $z$-axis.
- (D): equal components describe the line equally inclined to all axes, not the $x$-axis.

**Answer: (B)** ← Go Back to Q19

## Q20.

**Solution**

**Concept – Degree of a differential equation:**
The degree is the power of the highest-order derivative, once the equation is written as a polynomial in its derivatives (free of fractional powers).

**Step 1 – Identify the highest-order derivative:**

$$\frac{d^2y}{dx^2} \quad \text{(order 2)}$$

**Step 2 – The equation is already polynomial in the derivatives:**

$$\left(\frac{d^2y}{dx^2}\right)^3 + \frac{dy}{dx} = 0$$

**Step 3 – Read off the power of the highest-order derivative:**

$$\text{Degree} = 3$$

**Why other options are wrong:**

- (A) $1$: this is the power of $\frac{dy}{dx}$, not of the highest-order term.
- (B) $2$: this is the *order* of the equation, not its degree.
- (C) $6$: multiplying the order $2$ by the power $3$, which is not how degree is defined.

**Answer: (D)** ← Go Back to Q20

# Answer Key

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