CBSE Class 12 Mathematics: Sample Paper 2

Based on NCERT · the board's 2026-27 pattern | Time: 3 hours · **Maximum marks: 80**

1. This question paper contains 38 questions. All questions are compulsory.
2. Section A has 20 questions of 1 mark each: 18 multiple-choice and 2 assertion-reason. Section B has 5 very short answer questions of 2 marks, Section C 6 short answer questions of 3 marks, Section D 4 long answer questions of 5 marks and Section E 3 case study-based questions of 4 marks.
3. There is no overall choice. Internal choice is given in 2 questions in Section B, 3 in Section C, 2 in Section D and one part each of 2 questions in Section E; attempt only one of the alternatives.
4. Calculators are not allowed.
5. For the assertion-reason questions, choose: (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.

Section A (20 × 1 mark)

1. In a town in Assam, the probability that it rains on a given morning is 0.3, and the probability that the school bus is late on a rainy morning is 0.6. The probability that on a given morning it rains and the bus is late is [1]

(a) 0.9 (b) 0.18
(c) 0.5 (d) 0.42

2. If $f(x) < 0$ for every x in $[a, b]$, then the area of the region bounded by $y = f(x)$, the x-axis and the ordinates $x = a$ and $x = b$ is [1]

(a) $\int_a^b f(x)\,dx$ (b) $-\int_a^b f(x)\,dx$
(c) $\int_a^b f(-x)\,dx$ (d) $-\int_b^a f(x)\,dx$

3. If $\vec{a} = 3\hat{i} - 2\hat{j} + \hat{k}$ and $\vec{b} = 2\hat{i} + 4\hat{j} - \hat{k}$, then $\vec{a} \cdot \vec{b}$ is [1]

(a) 13 (b) 3
(c) −1 (d) −3

4. A spinner has 8 equal sectors numbered 1 to 8 and is spun once. E is the event 'the number is even', and G is an event made up of four of the eight numbers. E and G are independent exactly when the number of even numbers in G is [1]

(a) 2 (b) 4
(c) 1 (d) 3

5. The general solution of $\frac{dy}{dx} = \frac{2xy}{1 + x^2}$, $y > 0$, is [1]

(a) $y = 1 + x^2 + C$ (b) $y = C(1 + x^2)^2$
(c) $y = C(1 + x^2)$ (d) $y = C \log (1 + x^2)$

6. In $A = \{1, 2, 3, \ldots, 20\}$, $R = \{(a, b) : a - b \text{ is divisible by } 6\}$ is an equivalence relation. The number of equivalence classes of R that contain exactly 4 elements is [1]

(a) 4 (b) 6
(c) 2 (d) 3

7. Which of the following points lies on the line $\frac{x-3}{2} = \frac{y+1}{-5} = \frac{z-4}{6}$? [1]

(a) (5, −4, 10) (b) (3, 1, 4)
(c) (2, −5, 6) (d) (5, −6, 10)

8. The feasible region of a system of linear inequalities is said to be bounded if [1]

(a) it can be enclosed within a circle (b) it contains the origin
(c) it has at most four corner points (d) it lies in the first quadrant

9. For a real function f and a point c in its domain, which statement is always true? [1]

(a) If f is continuous at c, then f is differentiable at c (b) If f is differentiable at c, then f is continuous at c
(c) If f is not differentiable at c, then f is not continuous at c (d) If f is continuous at c, then $f'(c) = 0$

10. The function $f(x) = 5 - 2x^3$ on R is [1]

(a) strictly increasing (b) strictly decreasing
(c) constant (d) neither increasing nor decreasing

11. A is a square matrix of order 3 with $|A| = 4$. Then $|2A|$ is [1]

(a) 16 (b) 64
(c) 8 (d) 32

12. $\int \frac{dx}{x^2 + 25}$ equals [1]

(a) $\frac{1}{25}\tan^{-1}\frac{x}{5} + C$ (b) $\frac{1}{5}\tan^{-1}\frac{x}{5} + C$
(c) $\tan^{-1}\frac{x}{5} + C$ (d) $\frac{1}{10}\log\left|\frac{x-5}{x+5}\right| + C$

13. A bounded feasible region has corner points (2, 1), (5, 1), (5, 4) and (1, 3). The minimum value of $Z = 4x + 3y$ on the region is [1]

(a) 11 (b) 13
(c) 23 (d) 32

14. The vectors $2\hat{i} + \lambda\hat{j} - 3\hat{k}$ and $4\hat{i} - \hat{j} + 2\hat{k}$ are perpendicular when λ equals [1]

(a) 2 (b) −2
(c) 14 (d) −14

15. In the set A = {1, 2, 3, 4, 5}, which of the following is the empty relation? [1]

(a) $R = \{(a, b) : a + b \geq 2\}$ (b) $R = \{(a, b) : a + b = 11\}$
(c) $R = \{(a, b) : a - b = 4\}$ (d) $R = \{(a, b) : ab = 5\}$

16. If $\cos^{-1} x = 5\pi/6$, then $\sin^{-1} x$ equals [1]

(a) π/3 (b) −π/3
(c) −π/6 (d) 2π/3

17. A parcel from Surat to Shillong passes through three hubs. The probability that it clears the first hub on time is 0.9; given that it has cleared the first on time, the probability that it clears the second on time is 0.8; given that it has cleared both on time, the probability that it clears the third on time is 0.75. The probability that it clears all three hubs on time is [1]

(a) 0.75 (b) 0.72
(c) 0.005 (d) 0.54

18. A line through the origin is perpendicular to the z-axis, makes an angle of 30° with the positive direction of the x-axis and an acute angle with the positive direction of the y-axis. Its direction cosines are [1]

(a) $\frac{\sqrt{3}}{2}, 0, \frac{1}{2}$ (b) $\frac{1}{2}, \frac{\sqrt{3}}{2}, 0$

(c) $\frac{\sqrt{3}}{2}, \frac{1}{2}, 0$ (d) $\frac{\sqrt{3}}{2}, \frac{1}{2}, 1$

19. Assertion (A): $f(x) = x^3 - 4x + 7$ is continuous at $x = 2$. Reason (R): Every polynomial function is continuous. [1]

(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) A is false, but R is true.

20. Assertion (A): The differential equation $\frac{dy}{dx} = \frac{y - x}{y + x}$ is homogeneous. Reason (R): The function $x^2 - 3xy + y^2$ is a homogeneous function of degree 2. [1]

(a) Both A and R are true, and R is the correct explanation of A.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true, but R is false.

(d) A is false, but R is true.

Section B (5 × 2 marks)

21. A nursery in Pune sells seed packets of two varieties: 70% are of variety X and 30% of variety Y. A seed of variety X germinates with probability 0.8 and one of variety Y with probability 0.6. A seed is taken at random from the nursery's stock. Find the probability that it does not germinate. [2]

Or *In a school library in Mysuru, 40% of the books are fiction. In a month, a fiction book is borrowed with probability 0.3 and any other book with probability 0.1. A book is picked at random from the shelves. Find the probability that it was borrowed in the month.*

22. Find the value of $\tan^{-1}(\tan 2) + \cos^{-1}(\cos 5)$, the angles being in radians. [2]

23. If $|\vec{a}| = 5$, $|\vec{b}| = 3$ and $|\vec{a} - \vec{b}| = 7$, find $|\vec{a} + \vec{b}|$. [2]

24. If $x = e^t + e^{-t}$ and $y = e^t - e^{-t}$, show that $\frac{dy}{dx} = \frac{x}{y}$. [2]

25. Find x, y and z if the matrix $\begin{bmatrix} 0 & 2x - 1 & 4 \\ 3 & 0 & y + 2 \\ z & -5 & 0 \end{bmatrix}$ is skew symmetric. [2]

Or *Find a, b and c if the matrix* $\begin{bmatrix} 0 & a + 1 & -2 \\ 4 & b & c - 3 \\ 2 & 6 & 0 \end{bmatrix}$ *is skew symmetric.*

Section C (6 × 3 marks)

26. Kabir has at most 3 hours a day for exercise. He walks for x hours and cycles for y hours, and on his doctor's advice cycles for no longer than he walks. Walking burns 300 kcal an hour and cycling 500 kcal an hour. Formulate a linear programming problem to maximise the energy he burns, and solve it graphically. [3]

27. Show that $f : R \to R$, $f(x) = 2x + |x|$, is one-one and onto. [3]

Or *Show that $f : R \to R$, $f(x) = x + |x|$, is neither one-one nor onto. Find a subset D of R, containing 0, such that f, with domain D and co-domain $[0, \infty)$, is one-one and onto.*

28. Three NCC cadets fire one shot each at a target, independently. They hit with probabilities $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$. Find the probability that exactly two of them hit the target. [3]

Or *A water pump works if its motor works and at least one of its two valves works. The motor works with probability 0.9 and the valves with probabilities 0.8 and 0.5, all independently. Find the probability that the pump works.*

29. Show that the lines $\frac{x-1}{2} = \frac{y+1}{3} = \frac{z-2}{-1}$ and $\frac{x-2}{1} = \frac{y-4}{-2} = \frac{z+2}{3}$ intersect, and find their point of intersection. [3]

30. A farmer has to fence a rectangular plot of area 800 m^2 that lies along a straight canal; the side along the canal needs no fence. Find the dimensions that use the least fencing, and that length. [3]

Or *An open tank with a square base is to hold 32 m^3. Find the dimensions for which the area of sheet metal needed (base and four sides) is least.*

31. Show that the system $x + 2y - z = 3$, $2x - y + z = 1$, $3x + y = 6$ has no solution, by computing $|A|$ and $(\text{adj } A)B$. [3]

Section D (4 × 5 marks)

32. (a) Sketch the curve $y = x^2 - 2x - 3$ for $-2 \le x \le 4$ and mark the points where it meets the x-axis. (b) Find the area of the region bounded by the curve, the x-axis and the ordinates $x = -2$ and $x = 4$. (c) Evaluate $\int_{-2}^{4} (x^2 - 2x - 3)\,dx$ and explain why it differs from your answer to (b). [5]

Or *(a) Sketch the curve $y = x^2 - x - 2$ for $-2 \le x \le 3$ and mark the points where it meets the x-axis. (b) Find the area of the region bounded by the curve, the x-axis and the ordinates $x = -2$ and $x = 3$. (c) Evaluate $\int_{-2}^{3} (x^2 - x - 2)\,dx$ and explain why it differs from your answer to (b).*

33. (a) Find $\int \log(x^2 + 1)\,dx$. (b) Find $\int e^x (\cot x - \operatorname{cosec}^2 x)\,dx$. [5]

Or *(a) Find $\int x^2 \cos x\,dx$. (b) Find $\int e^x (\operatorname{cosec} x - \operatorname{cosec} x \cot x)\,dx$.*

34. Show that the differential equation $(x^2 + 3xy + y^2)\,dx - x^2\,dy = 0$ is homogeneous, and find its particular solution given that $y = 0$ when $x = 1$ (take $x > 0$, $x < e$). [5]

35. The points A(1, 0, 2), B(3, 2, 3), C(4, 4, 1) and D(2, 2, 0) are given. (a) Show that ABCD is a rhombus. (b) Show that its diagonals are perpendicular. (c) Find its area in two ways: from $\to AB \times \to AD$, and from the diagonals. (d) Find $\cos \angle DAB$. [5]

Section E (3 × 4 marks)

36. Read the passage and answer the questions that follow. [4]

A farmer near Nashik marks a triangular plot on a grid map, one unit standing for 10 m. The corner posts are at P(2, 1), Q(8, 3) and R(4, 7). A water tap is to be fixed at T(5, k) on the straight fence PQ, and a straight pipe is to run along the side QR. He uses determinants for every calculation.

(a) The area of the plot PQR, in square units, is [1]

(a) 16 (b) 32
(c) 20 (d) 8

(b) The value of k for which T(5, k) lies on PQ is [1]

(a) $\frac{5}{2}$ (b) 3
(c) 2 (d) −2

(c) Find the equation of the line QR using determinants. [2]

Or *A point S(k, 1) is chosen so that the area of triangle PQS is 9 square units. Find the possible values of k.*

37. Read the passage and answer the questions that follow. [4]

A design student in Pune is drawing a curve for a logo on a coordinate grid. She wants the slope of the tangent at every point (x, y) of the curve to equal 2x − y, so the curve satisfies $\frac{dy}{dx} = 2x - y$. Rewritten as $\frac{dy}{dx} + y = 2x$, this is a first order linear differential equation, and every curve with this property belongs to one family of solution curves, one for each value of an arbitrary constant C. She first wants the member of the family that passes through the point (0, 1).

(a) The integrating factor of $\frac{dy}{dx} + y = 2x$ is [1]

(a) e^{x} (b) e^{-x}
(c) e^{2x} (d) x

(b) The general solution is $y = 2x - 2 + Ce^{-x}$. For the curve through (0, 1), the value of C is [1]

(a) 3 (b) 1
(c) −1 (d) 2

(c) Show how the general solution $y = 2x - 2 + Ce^{-x}$ is obtained from the integrating factor. [2]

Or *Find the member of the family that passes through (0, −2), and show that it is a straight line whose slope agrees with 2x − y at every point.*

38. Read the passage and answer the questions that follow. [4]

In a physics laboratory in Kolkata, a small block is attached to a light spring on a smooth table. Students pull the block 3 cm from its rest position and push it, so that it starts with a speed of 8 cm per second. If x cm is the displacement of the block from rest after t seconds, its motion is described by the differential equation $\frac{d^2x}{dt^2} + 16x = 0$. The class wants to find the solution of this equation that fits the starting position and the starting speed.

(a) The order and the degree of the differential equation are [1]

(a) order 2, degree 1
(b) order 1, degree 2
(c) order 2, degree 2
(d) order 2, degree not defined

(b) Which of the following is the general solution of the equation (A, B arbitrary constants)? [1]

(a) $x = A \cos 4t + B \sin 4t$
(b) $x = A \cos 16t + B \sin 16t$
(c) $x = A\, e^{4t} + B\, e^{-4t}$
(d) $x = A \cos 4t$

(c) Find the particular solution with $x = 3$ and $\frac{dx}{dt} = 8$ at $t = 0$. [2]