CBSE Class 12 Mathematics · Sample Paper 5 (2026-27 pattern)

Time: 3 hours · Maximum marks: 80 · CBSE Math Revision (not an official CBSE paper)

General instructions

1. This question paper contains 38 questions. All questions are compulsory.
2. The paper is divided into five sections: A, B, C, D and E.
3. Section A: questions 1–18 are MCQs and questions 19–20 are Assertion–Reason based, 1 mark each.
4. Section B: questions 21–25 are very short answer (VSA) questions of 2 marks each.
5. Section C: questions 26–31 are short answer (SA) questions of 3 marks each.
6. Section D: questions 32–35 are long answer (LA) questions of 5 marks each.
7. Section E: questions 36–38 are case study based questions of 4 marks each, with sub-parts of 1, 1 and 2 marks.
8. There is no overall choice. Internal choice is provided in 2 questions of Section B, 2 of Section C, 2 of Section D and in the 2-mark sub-part of each case study in Section E.
9. Use of calculators is not allowed.

Section A

20 marks

Questions 1 to 20 carry 1 mark each. Questions 1 to 18 are multiple choice questions (MCQs); questions 19 and 20 are Assertion–Reason based questions.

1. The number of equivalence relations on the set $\{a, b, c\}$ is **1**

(a) 3 **(b)** 4
(c) 5 **(d)** 6

2. The value of $\sin^{-1}(\sin 10)$ (angle in radians) is **1**

(a) 10 **(b)** $3\pi - 10$
(c) $10 - 3\pi$ **(d)** $\pi - 10$

3. If A is a square matrix with $A^3 = O$, then $(I - A)^{-1}$ equals **1**

(a) $I + A$ **(b)** $I - A$
(c) $I + A + A^2$ **(d)** $I - A + A^2$

4. If A and B are square matrices of order 3 with $|A| = 6$ and $|B| = -2$, then $\left|3A^{-1}B'\right|$ is **1**

(a) -9 **(b)** 9
(c) -1 **(d)** -3

5. The number of 2×2 skew-symmetric matrices whose entries are all from $\{-1, 0, 1\}$ is **1**

(a) 1 **(b)** 2
(c) 3 **(d)** 9

6. If A is a non-singular matrix of order 3 and $|\text{adj } A| = 64$, then $|A|$ is **1**

(a) 8 only **(b)** ± 8
(c) ± 4 **(d)** 4 only

7. The area of the triangle with vertices $(a, b+c)$, $(b, c+a)$ and $(c, a+b)$, where a, b, c are distinct, is **1**

(a) 0

(b) $\frac{1}{2}(a+b+c)$

(c) $\frac{1}{2}|(a-b)(b-c)(c-a)|$

(d) 1

8. Let $f(x) = x^3$ for $x \leq 1$ and $f(x) = 3x - 2$ for $x > 1$. Then at $x = 1$, f is **1**

(a) discontinuous

(b) continuous but not differentiable

(c) differentiable with $f'(1) = 3$

(d) differentiable with $f'(1) = 1$

9. If $y = \frac{\sin^{-1} x}{\sqrt{1-x^2}}$, $|x| < 1$, then $(1-x^2)\frac{dy}{dx} - xy$ equals **1**

(a) 0

(b) 1

(c) -1

(d) y

10. The number of critical points of $f(x) = |x|e^{-|x|}$ on $\mathbb{R}$ (points where $f' = 0$ or f' does not exist) is **1**

(a) 1

(b) 2

(c) 3

(d) 4

11. For every $n > 0$, $\int_0^{\pi/2} \frac{\sin^n x}{\sin^n x + \cos^n x}\, dx$ equals **1**

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

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

(c) $\frac{n\pi}{4}$

(d) 1

12. The solution of $\frac{dy}{dx} - y = e^x$ with $y(0) = 1$ is **1**

(a) $y = e^x$

(b) $y = xe^x$

(c) $y = (x+1)e^x$

(d) $y = (x-1)e^x$

13. If $|\vec{a}| = 3$, $|\vec{b}| = 4$ and $\vec{a} \cdot \vec{b} = 6$, then $|\vec{a} \times \vec{b}|$ is **1**

(a) 6

(b) $6\sqrt{3}$

(c) 12

(d) $6\sqrt{2}$

14. The direction cosines of a line equally inclined to the three coordinate axes are **1**

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

(b) $(1, 1, 1)$

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

(d) $\pm\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0\right)$

15. The angle which the line $\frac{x-2}{3} = \frac{y+1}{-2} = \frac{z}{6}$ makes with the positive x-axis is **1**

(a) $\cos^{-1}\frac{3}{7}$

(b) $\cos^{-1}\frac{2}{7}$

(c) $\cos^{-1}\frac{6}{7}$

(d) $\cos^{-1}\frac{3}{\sqrt{41}}$

16. The system of constraints $x + y \leq 4$, $x + y \geq 6$, $x, y \geq 0$ **1**

(a) has a bounded feasible region

(b) has an unbounded feasible region

(c) has no feasible solution

(d) has exactly one feasible point

17. On a bounded feasible region, $Z = 3x + 2y$ attains its maximum value 18 at the corner points $(4, 3)$ and $(6, 0)$. Then **1**

(a) the maximum occurs only at these two points

(b) the maximum occurs at every point of the segment joining $(4, 3)$ and $(6, 0)$

(c) the problem has no maximum

(d) the minimum is also 18

18. An urn has 5 red and 5 black balls. A ball is drawn, its colour noted, and it is returned together with 2 more balls of the same colour. A second ball is then drawn. The probability that the second ball is red is **1**

(a) $\frac{5}{12}$

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

(c) $\frac{7}{12}$

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

19. In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option. **1**

Assertion (A): The vectors $\vec{a} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{b} = -2\hat{i} - 4\hat{j} - 2\hat{k}$ are collinear.

Reason (R): Two non-zero vectors are collinear if and only if one is a scalar multiple of the other.

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

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

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

20. In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option. **1**

Assertion (A): If A and B are independent events, then $P(A \cup B) = 1 - P(A')P(B')$.

Reason (R): If A and B are independent, then A' and B' are also independent.

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

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

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

Section B

10 marks

Questions 21 to 25 are very short answer (VSA) type questions carrying 2 marks each. Internal choice is provided in 2 questions.

21. Show that $f : \mathbb{R} \to \mathbb{R}$, $f(x) = 2x + |x|$, is both one-one and onto. **2**

OR

Find all real x in $[0, 2\pi]$ for which $\sin^{-1}(\sin x) = \pi - x$.

22. Let $f(x) = |x|^3$. Show that $f''(0)$ exists and find it. **2**

23. Find $\int \sqrt{e^x - 1}\, dx$. **2**

OR

Evaluate $\int_{-1}^{1} \left(x|x| + e^x + e^{-x}\right) dx$.

24. Using vectors, find the acute angle between two diagonals of a cube. **2**

25. Given $P(A) = \frac{2}{5}$, $P(B \mid A) = \frac{1}{2}$ and $P(A \mid B) = \frac{1}{3}$, find $P(B)$ and $P(A' \cap B')$. **2**

Section C

18 marks

Questions 26 to 31 are short answer (SA) type questions carrying 3 marks each. Internal choice is provided in 2 questions.

26. Show that $f(x) = e^{-|x|}$ is continuous at $x = 0$ but not differentiable there. Write $f'(x)$ for $x \neq 0$. **3**

27. If $y = (\sin x)^{\tan x}$, $0 < x < \frac{\pi}{2}$, find $\frac{dy}{dx}$, and its value at $x = \frac{\pi}{4}$. **3**

OR

If $y = x^2 \log x$, $x > 0$, show that $x^2 \frac{d^2y}{dx^2} - 3x\frac{dy}{dx} + 4y = 0$.

28. Find $\int \frac{x^2 + 1}{(x^2 + 4)(x^2 + 9)}\, dx$. **3**

29. Evaluate $\int_0^{\pi/2} \frac{\sin x \cos x}{\sin x + \cos x}\, dx$. **3**

30. Find the vector equation of the line through $P(2, 1, -1)$ that meets the line $L : \frac{x-1}{1} = \frac{y+2}{2} = \frac{z-3}{-2}$ at right angles. Also find the point where they meet. **3**

OR

Find k so that the lines $\frac{x-1}{1} = \frac{y+1}{2} = \frac{z-2}{1}$ and $\frac{x-3}{2} = \frac{y-k}{1} = \frac{z-1}{-1}$ intersect, and find their point of intersection.

31. Maximise $Z = 2x + 2y$ subject to $x + y \leq 5$, $x \leq 4$, $y \leq 3$, $x, y \geq 0$. Show that the problem has infinitely many optimal solutions and describe them. **3**

Section D

20 marks

Questions 32 to 35 are long answer (LA) type questions carrying 5 marks each. Internal choice is provided in 2 questions.

32. Find A^{-1} for $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & -1 & 3 \\ 0 & 2 & 1 \end{bmatrix}$. Hence solve the system $2x + y = 4$, $x - y + 2z = 5$, $3y + z = 9$. **5**

OR

Express $M = \begin{bmatrix} 3 & 5 & 1 \\ -1 & 2 & 4 \\ 7 & 0 & -2 \end{bmatrix}$ as the sum of a symmetric matrix P and a skew-symmetric matrix Q. Find $|P|$, and show that $|Q| = 0$.

33. A farmer in Punjab wants to fence a rectangular field along a straight canal; no fence is needed along the canal. He also puts one fence across the field, perpendicular to the canal, to split it into two plots. Fencing parallel to the canal costs ₹30 per metre and fencing perpendicular to it costs ₹20 per metre, and his budget is ₹6000. Find the dimensions that maximise the total area, and the maximum area. **5**

OR

A right circular cylinder is inscribed in a right circular cone of height 12 cm and base radius 6 cm, with their axes along the same line and the base of the cylinder on the base of the cone. Find the dimensions of the cylinder with the greatest curved surface area, and that area.

34. A cup of tea at 90°C is left in a room at 30°C. Its temperature T falls at a rate proportional to $T - 30$. After 5 minutes it is 70°C. (a) Form and solve the differential equation. (b) Find how long after the start the tea reaches 50°C. (Answer in logarithmic form and to one decimal place, using $\log 3 = 1.0986$, $\log 1.5 = 0.4055$.) **5**

35. The vertices of $\triangle ABC$ are $A(1, 2, 3)$, $B(3, 4, 1)$ and $C(-1, 6, 5)$. (a) Write the vector equation of the line BC. (b) Find the foot D of the perpendicular from A to BC, and the length AD. (c) Verify that $\frac{1}{2}|\vec{AB} \times \vec{AC}| = \frac{1}{2} \cdot BC \cdot AD$. **5**

Section E

12 marks

Questions 36 to 38 are case study based questions carrying 4 marks each (1 + 1 + 2). Internal choice is provided in the 2-mark sub-part of each case study.

36. **Motor insurance.** A motor insurer classifies its policy-holders in Chennai as careful (60%), average (30%) and risky (10%). The probabilities that a driver of each type has an accident in a year are 0.01, 0.03 and 0.15 respectively. **4**

i. Find the probability that a randomly chosen policy-holder has an accident in the year. *[1 mark]*

ii. A policy-holder had an accident. Find the probability that the driver is of the risky type. *[1 mark]*

iii. A policy-holder had an accident. Find the probability that the driver is careful, and comment on the insurer's classification. *[2 marks]*

OR

Two policy-holders are chosen at random, independently. Find the probability that exactly one of them has an accident in the year. *[2 marks]*

37. **Giant wheel.** At a mela in Lucknow, the height (in metres) of a rider on a giant wheel above the ground t minutes after the ride starts is $h(t) = 12 - 10\cos\dfrac{\pi t}{2}$, $0 \le t \le 4$. **4**

i. Find the height of the rider at $t = 1$. *[1 mark]*

ii. Find the rate of change of height at $t = 1$. *[1 mark]*

iii. Find the times in $[0, 2]$ at which the rider is rising at 2.5π m/min. *[2 marks]*

OR

Find $\dfrac{d^2h}{dt^2}$ at $t = \dfrac{1}{3}$ and state whether the rider's rate of rising is increasing or decreasing then. *[2 marks]*

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38. **Square residues.** A number-theory club studies the relation $R = \{(a, b) \in \mathbb{Z} \times \mathbb{Z} : 5 \text{ divides } a^2 - b^2\}$. **4**

i. Is $(2, 3) \in R$? Justify. *[1 mark]*

ii. Write the equivalence class of 0. *[1 mark]*

iii. Show that R is an equivalence relation, and find the number of distinct equivalence classes. *[2 marks]*

OR

Describe the equivalence class of 1. *[2 marks]*