Mathematics (041)

CBSE Class 12 Board Examination 2027 – Practice Paper No. 1

Practice Question Paper

Time: 3 hours **Max. Marks: 80**

(1) This question paper contains 38 questions. All questions are compulsory.
(2) This question paper is divided into five Sections – A, B, C, D and E.
(3) In Section A, Questions 1 to 18 are multiple choice questions (MCQs) and Questions 19 and 20 are Assertion–Reason based questions of 1 mark each.
(4) In Section B, Questions 21 to 25 are Very Short Answer (VSA) type questions, carrying 2 marks each.
(5) In Section C, Questions 26 to 31 are Short Answer (SA) type questions, carrying 3 marks each.
(6) In Section D, Questions 32 to 35 are Long Answer (LA) type questions, carrying 5 marks each.
(7) In Section E, Questions 36 to 38 are case study based questions, carrying 4 marks each.
(8) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one sub-part each in 2 questions of Section E.
(9) Draw neat and clean figures wherever required. Take π = 22/7 wherever required, if not stated.
(10) Use of calculators is not allowed.

SECTION A This section comprises 18 multiple choice questions (Q1–Q18) of 1 mark each. Choose the correct option. **[18]**

1. Let A = {2, 4, 6} and let R = {(2, 2), (4, 4), (6, 6), (2, 4), (4, 6)} be a relation on A. The minimum number of ordered pairs that must be added to R so that R becomes an equivalence relation is

(A) 1 (B) 2
(C) 3 (D) 4

2. The function $f : N \to N$ defined by $f(n) = n^2 + n$ is

(A) one-one but not onto (B) onto but not one-one
(C) both one-one and onto (D) neither one-one nor onto

3. The value of $\cot^{-1}(-1) + \operatorname{cosec}^{-1}(-\sqrt{2}) + \sec^{-1}(\sqrt{2})$ is

(A) $\pi/4$ (B) $3\pi/4$
(C) $-\pi/4$ (D) $5\pi/4$

4. If A is a matrix of order 3 × 4 and B is a matrix such that both A′B and BA′ are defined, then the order of B is

(A) 3 × 3 (B) 4 × 4
(C) 3 × 4 (D) 4 × 3

5. For the matrix $A = \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}$, it is given that $A^2 - 5A + 6I = O$, where I is the identity matrix of order 2. Using this, A^{-1} is equal to

(A) (1/6)(5I − A) (B) (1/6)(A − 5I)
(C) (1/6)(5I + A) (D) 6(5I − A)

6. If A is a square matrix of order 3 and $|A| = -4$, then $|\text{adj}(2A)|$ is equal to

(A) 256 (B) −1024
(C) 64 (D) 1024

7. If the area of the triangle with vertices (1, 2), (k, −1) and (4, 3) is 6 square units, then the value(s) of k is/are

(A) 4 only (B) −20 only

(C) 4 or −20 (D) −4 or 20

8. If the function f defined by $f(x) = (1 - \cos 6x)/(3x^2)$ for $x \neq 0$ and $f(0) = k$ is continuous at $x = 0$, then k is equal to

(A) 6 (B) 3

(C) 9 (D) 12

9. The derivative of log (sec x + tan x) with respect to x is

(A) tan x (B) sec x

(C) $\sec^2 x$ (D) sec x tan x

10. The rate of change of the area of a circle with respect to its circumference, when the radius is 7 cm, is

(A) 14 cm^2/cm (B) 14π cm^2/cm

(C) 7/2 cm^2/cm (D) 7 cm^2/cm

11. The minimum value of $f(x) = x^2 + 16/x^2$, $x \neq 0$, is

(A) 8 (B) 4

(C) 16 (D) 0

12. $\int 2^x \cdot 3^x \, dx$ is equal to

(A) $6^x \log 6 + C$ (B) $6^{x+1}/(x + 1) + C$

(C) $6^x/\log 6 + C$ (D) $(2^x \cdot 3^x)/(\log 2 \cdot \log 3) + C$

13. The value of $\int_{-2}^{2} (x^5 + x^3 \cos x + 3x^2) \, dx$ is

(A) 0 (B) 16

(C) 8 (D) 32

14. The sum of the order and the degree of the differential equation $(d^3y/dx^3)^2 - 4(dy/dx)^5 + y = 0$ is

(A) 6 (B) 8

(C) 7 (D) 5

15. The integrating factor of the differential equation $x (dy/dx) + 3y = e^x$, $x > 0$, is

(A) $1/x^3$ (B) x^3

(C) 3 log x (D) e^{3x}

16. The projection of the vector $2\hat{i} + 3\hat{j} - \hat{k}$ on the vector $\hat{i} - 2\hat{j} + 2\hat{k}$ is

(A) 2 (B) −6

(C) $-6/\sqrt{14}$ (D) −2

17. The direction cosines of the line directed from P(1, −2, 3) to Q(3, 4, 6) are

(A) 2/7, 6/7, 3/7 (B) 2, 6, 3

(C) −2/7, −6/7, −3/7 (D) 2/11, 6/11, 3/11

18. If P(A) = 0.5, P(B) = 0.4 and $P(A \cup B) = 0.7$, then $P(A \mid A \cup B)$ is equal to

(A) 2/7 (B) 1/2

(C) 5/7 (D) 4/7

SECTION A (contd.) Assertion–Reason based questions (Q19–Q20), 1 mark each. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the options (A), (B), (C) and (D) given below each question. **[2]**

19. **Assertion (A):** The matrix $M = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$ is not invertible.

Reason (R): A square matrix is invertible if and only if it is non-singular.

(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. **Assertion (A):** The angle between the vectors $\hat{i} + \hat{j}$ and $\hat{j} + \hat{k}$ is $\pi/2$.

Reason (R): Two non-zero vectors are perpendicular if and only if their scalar product is zero.

(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 This section comprises 5 very short answer (VSA) type questions of 2 marks each. **[10]**

21. (A) Find the value of k for which the function f defined by $f(x) = 3x - 2$ for $x \le 2$ and $f(x) = x^2 - k$ for $x > 2$ is continuous at $x = 2$. For this value of k, check whether f is differentiable at $x = 2$.

OR

(B) If $y = x \sin^{-1} x + \sqrt{(1 - x^2)}$, $-1 < x < 1$, find dy/dx and hence find its value at $x = 1/2$.

22. Find the intervals in which the function $f(x) = x^4 - 4x^3 - 2x^2 + 12x + 7$ is (i) strictly increasing, (ii) strictly decreasing.

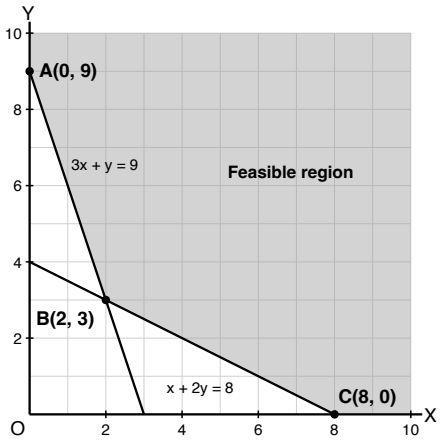
23. (A) The diagonals of a parallelogram are given by the vectors $\vec{d}_1 = 3\hat{i} + \hat{j} - 2\hat{k}$ and $\vec{d}_2 = \hat{i} - 3\hat{j} + 4\hat{k}$. Find the area of the parallelogram.

OR

(B) The cartesian equation of a line is $(2x - 1)/4 = (y + 3)/(-2) = 3 - z$. Find the direction cosines of the line and write its vector equation.

24. Find: $\int \sec^2 x / (\tan^2 x + 4 \tan x + 8)\, dx$

25. The shaded region in the figure is the feasible region of a linear programming problem with constraints $x + 2y \ge 8$, $3x + y \ge 9$, $x \ge 0$, $y \ge 0$. Its corner points are A(0, 9), B(2, 3) and C(8, 0). Find the minimum value of $Z = 4x + 7y$, if it exists. Give a reason for your answer.



SECTION C This section comprises 6 short answer (SA) type questions of 3 marks each. **[18]**

26. (A) Find: $\int (x + 7)/((x - 1)(x + 2)(x + 3))\, dx$

OR

(B) Find: $\int e^{3x} \cos 4x\, dx$

27. Evaluate: $\int_0^2 x^2 \sqrt{(4 - x^2)}\, dx$

28. (A) Find the particular solution of the differential equation $(x + 1)(dy/dx) - 2y = (x + 1)^4$, $x > -1$, given that $y = 1$ when $x = 0$.

OR

(B) Find the particular solution of the differential equation $x\,(dy/dx) = y + 2x\, e^{-y/x}$, $x > 0$, given that $y = 0$ when $x = 1$.

29. A shopkeeper in Kolhapur has a box of 8 LED bulbs, of which 3 are defective. A customer takes out three bulbs one after another without replacement. Find the probability that

(i) the first two bulbs are good and the third is defective;

(ii) exactly one of the three bulbs is defective.

30. Solve the following linear programming problem graphically:

Maximise $Z = 4x + 5y$

subject to the constraints $x + 3y \le 15$, $2x + y \le 10$, $x \ge 0$, $y \ge 0$.

31. (A) If $y = (\tan x)^x + (x^2 + 1)^{\log x}$, $0 < x < \pi/2$, find dy/dx.

OR

(B) If $x = t + 1/t$ and $y = t - 1/t$, find d^2y/dx^2 at $t = 2$.

SECTION D This section comprises 4 long answer (LA) type questions of 5 marks each. **[20]**

32. If $A = \begin{bmatrix} 1 & 2 & 2 \\ 3 & 1 & -2 \\ -1 & 2 & 3 \end{bmatrix}$, find A^{-1}. Hence, solve the following system of equations:

$x + 2y + 2z = 1$, $3x + y - 2z = 5$, $-x + 2y + 3z = -4$.

33. (A) Show that the relation R on the set Z of integers, given by $R = \{(a, b) : a^2 - b^2$ is divisible by 3$\}$, is an equivalence relation. Write the equivalence classes [0] and [1], and show that there are exactly two distinct equivalence classes.

OR

(B) Show that the function $f : R - \{2\} \to R - \{3\}$ defined by $f(x) = (3x + 1)/(x - 2)$ is one-one and onto. Also examine whether the function $g : R \to R$ defined by $g(x) = 3x^2 + 1$ is one-one or onto.

34. (A) Using integration, find the area of the region bounded by the parabola $y = x^2$, the line $x + y = 6$ and the x-axis.

OR

(B) Using integration, find the area of the smaller region into which the ellipse $x^2/36 + y^2/16 = 1$ is divided by the line $x = 3$.

35. A line l_1 passes through the points A(−1, 2, 0) and B(1, 5, 2). Another line l_2 is given by $(x - 4)/2 = (y + 1)/2 = (z - 2)/1$.

(i) Write the vector equations of l_1 and l_2.

(ii) Find the shortest distance between l_1 and l_2.

(iii) Do the lines intersect? Justify your answer.

SECTION E This section comprises 3 case study based questions of 4 marks each. Questions 36 and 37 have three sub-parts of 1, 1 and 2 marks; Question 38 has two sub-parts of 2 marks each. **[12]**

36. **Case study:** A district milk co-operative in western Maharashtra collects milk from three villages P, Q and R. Village P supplies 40%, village Q supplies 35% and village R supplies 25% of the milk cans. Laboratory records show that 3% of the cans from P, 2% of the cans from Q and 4% of the cans from R fail the quality test. A can is selected at random from the day's collection.

Based on the given information, answer the following questions:

(i) Find the probability that the selected can is from village Q and fails the quality test. [1]

(ii) Find the probability that the selected can fails the quality test. [1]

(iii) (a) If the selected can fails the quality test, find the probability that it came from village R. [2]

OR

(iii) (b) If the selected can passes the quality test, find the probability that it came from village P. [2]

37. **Case study:** During a crop survey near Baramati, the height of a drone above the ground (in metres), t minutes after the start of the recording, is given by $h(t) = t^3 - 9t^2 + 24t + 2$, $0 \le t \le 5$.

Based on the given information, answer the following questions:

(i) Find the values of t at which $h'(t) = 0$. [1]

(ii) Find the intervals in which the drone is rising (h strictly increasing) and in which it is coming down (h strictly decreasing). [1]

(iii) (a) Using the second derivative test, find the local maximum and local minimum heights of the drone. [2]

OR

(iii) (b) Find the greatest and the least heights of the drone during $0 \le t \le 5$. [2]

38. **Case study:** A triangular shade sail is fixed over a school courtyard. Taking one corner of the courtyard as the origin and distances in metres, the three corners of the sail are at A(1, 0, 2), B(3, 2, 3) and C(3, −1, 0).

Based on the given information, answer the following questions:

(i) Taking $\vec{a}$ as the vector from A to B and $\vec{b}$ as the vector from A to C, find $\vec{a} \times \vec{b}$ and hence the area of the sail. [2]

(ii) Show that $\angle BAC = 90°$ and find a unit vector perpendicular to the plane of the sail. [2]

All the best for your exam!