CBSE CLASS 12 Maths SET 2 Question Paper

Time Allowed :3 hours	Maximum Marks :70	Total Questions :33

General Instructions

Read the following instructions very carefully and strictly follow them:

This question paper is divided into five sections:

1. The total duration of the examination is 3 hours. The question paper contains five sections -
   Section A: Questions 1 to 20 — MCQs and Assertion-Reason (1 mark each)
   Section B: Questions 21 to 25 — Very Short Answer (VSA), 2 marks each
   Section C: Questions 26 to 31 — Short Answer (SA), 3 marks each
   Section D: Questions 32 to 35 — Long Answer (LA), 5 marks each
   Section E: Questions 36 to 38 — Case Study, 4 marks each
2. The total number of questions is 38.
3. The marking scheme is as follows:
   (i) Each question in Section A carries 1 mark.
   (ii) Each question in Section B carries 2 marks.
   (iii) Each question in Section C carries 3 marks.
   (iv) Each question in Section D carries 5 marks.
   (v) Each question in Section E carries 4 marks.
4. There is no overall choice. However, internal choices are provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D, and 2 questions in Section E.
5. Use of calculator is **NOT** allowed.

Section - A

1. The values of x for which the angle between the vectors $\vec{a} = 2x^2\hat{i} + 4x\hat{j} + \hat{k}$ and $\vec{b} = 7\hat{i} - 2\hat{j} + x\hat{k}$ is obtuse, is:

(A) 0 or $\frac{1}{2}$

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

(C) $\left(0, \frac{1}{2}\right)$

(D) $\left[0, \frac{1}{2}\right]$

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2. If a line makes angles of $\frac{3\pi}{4}, \frac{\pi}{3}$ and θ with the positive directions of x, y and z-axis respectively, then θ is

(A) $-\frac{\pi}{3}$ only

(B) $\frac{\pi}{3}$ only

(C) $\frac{\pi}{6}$

(D) $\pm\frac{\pi}{3}$

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3. The integral $\int \frac{dx}{\sin^2 x \cos^2 x}$ is equal to

(A) $\tan x + \cot x + C$

(B) $(\tan x + \cot x)^2 + C$

(C) $\tan x - \cot x + C$

(D) $(\tan x - \cot x)^2 + C$

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4. Let P be a skew-symmetric matrix of order 3. If $\det(P) = \alpha$, then $(2025)^\alpha$ is

(A) 0

(B) 1

(C) 2025

(D) $(2025)^3$

5. **The principal value of** $\sin^{-1}\left(\cos\frac{43\pi}{5}\right)$ **is**

(A) $-\frac{7\pi}{5}$

(B) $-\frac{\pi}{10}$

(C) $\frac{\pi}{10}$

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

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6. If A denotes the set of continuous functions and B denotes the set of differentiable functions, then which of the following depicts the correct relation between set A and B?

(A) Figure 1

(B) Figure 2

(C) Figure 3

(D) Figure 4

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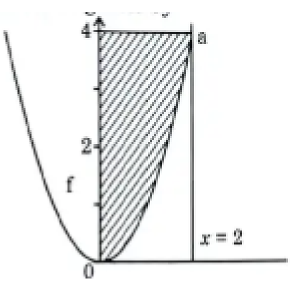
7. The area of the shaded region (figure) represented by the curves $y = x^2$, $0 \le x \le 2$ **and y-axis is given by**



(A) $\int_0^2 x^2 dx$

(B) $\int_0^4 \sqrt{y} dy$

(C) $\int_0^4 x^2 dx$

(D) $\int_0^2 \sqrt{y} dy$

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8. Four friends Abhay, Bina, Chhaya and Devesh were asked to simplify $4AB + 3(AB + BA) - 4BA$, where A and B are both matrices of order 2×2. It is known that $A \neq B \neq I$ and $A^{-1} \neq B$. Their answers are given as: Abhay : $6AB$ Bina : $7AB - BA$ Chhaya : $8AB$ Devesh : $7BA - AB$ Who answered it correctly?

(A) Abhay

(B) Bina

(C) Chhaya

(D) Devesh

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9. If p and q are respectively the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 = 0$, then $(p - q)$ is

(A) 0

(B) 1

(C) 2

(D) 3

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10. The function $f(x) = x^2 - 4x + 6$ is increasing in the interval

(A) $(0, 2)$

(B) $(-\infty, 2)$

(C) $[1, 2]$

(D) $(2, \infty)$

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11. In the following probability distribution, the value of p is:

X	0	1	2	3
P(X)	p	p	0.3	2p

(A) $\frac{7}{40}$

(B) $\frac{1}{10}$

(C) $\frac{9}{35}$

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

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12. If $\vec{PQ} \times \vec{PR} = 4\hat{i} + 8\hat{j} - 8\hat{k}$, then the area $(\triangle PQR)$ is

(A) 2 sq units

(B) 4 sq units

(C) 6 sq units

(D) 12 sq units

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13. If E and F are two events such that $P(E) > 0$ and $P(F) \neq 1$, then $P(\overline{E}/F)$ is

(A) $\frac{P(\overline{E} \cap F)}{P(F)}$

(B) $1 - P(E/F)$

(C) $1 - P(E/F)$

(D) $\frac{1 - P(E \cup F)}{P(F)}$

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14. Which of the following can be both a symmetric and skew-symmetric matrix?

(A) Unit Matrix

(B) Diagonal Matrix

(C) Null Matrix

(D) Row Matrix

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15. The equation of a line parallel to the vector $3\hat{i} - \hat{j} + 2\hat{k}$ and passing through the point $(4, -3, 7)$ is:

(A) $x = 4t + 3, y = -3t + 1, z = 7t + 2$

(B) $x = 3t + 4, y = -t + 3, z = 2t + 7$

(C) $x = 3t + 4, y = t - 3, z = 2t + 7$

(D) $x = 3t + 4, y = -t + 3, z = 2t + 7$

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16. If A and B are square matrices of order m such that $A^2 - B^2 = (A - B)(A + B)$, then which of the following is always correct?

(A) $A = B$ or 0

(B) $AB = BA$

(C) $A = 0$ or $B = 0$

(D) $A = I$ or $B = I$

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17. The line $x = 1 + 5\mu, y = -5 + \mu, z = 6 - 3\mu$ passes through which of the following point?

(A) $(1, -5, 6)$

(B) $(1, 5, 6)$

(C) $(1, -5, -6)$

(D) $(-1, 5, 6)$

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18. A factory produces two products X and Y. The profit earned by selling X and Y is represented by the objective function $Z = 5x + 7y$, where x and y are the number of units of X and Y respectively sold. Which of the following statement is correct?

(A) The objective function maximizes the difference of the profit earned from products X and Y.

(B) The objective function measures the total production of products X and Y.

(C) The objective function maximizes the combined profit earned from selling X and Y.

(D) The objective function ensures the company produces more of product X than product Y.

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19. Assertion (A) : $A =$ **diag**$[3\ 5\ 2]$ **is a scalar matrix of order** 3×3**. Reason (R) : If a diagonal matrix has all non-zero elements equal, it is known as a scalar matrix.**

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

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

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

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

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20. Assertion (A) : Every point of the feasible region of a Linear Programming Problem is an optimal solution. Reason (R) : The optimal solution for a Linear Programming Problem exists only at one or more corner point(s) of the feasible region.

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

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

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

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

Section - B

21. Find the values of 'a' for which $f(x) = \sin x - ax + b$ **is increasing on R.**

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22. Evaluate: $\int_0^{\pi} \frac{\sin 2px}{\sin x} dx$**,** $p \in N$**.**

23. (a) If $x = e^{x/y}$, then prove that $\frac{dy}{dx} = \frac{x-y}{x \log x}$.

23. OR (b)If $f(x) = \begin{cases} 2x-3, & -3 \le x \le -2 \\ x+1, & -2 < x \le 0 \end{cases}$, check the differentiability of $f(x)$ at $x = -2$.

24. Let $\vec{p} = 2\hat{i} - 3\hat{j} - \hat{k}$, $\vec{q} = -3\hat{i} + 4\hat{j} + \hat{k}$ and $\vec{r} = \hat{i} + \hat{j} + 2\hat{k}$. Express $\vec{r}$ in the form of $\vec{r} = \lambda\vec{p} + \mu\vec{q}$ and hence find the values of λ and μ.

25. (a)A vector $\vec{a}$ makes equal angles with all the three axes. If the magnitude of the vector is $5\sqrt{3}$ units, then find $\vec{a}$.

25. OR (b)If $\vec{\alpha}$ and $\vec{\beta}$ are position vectors of two points P and Q respectively, then find the position vector of a point R in QP produced such that $QR = \frac{3}{2}QP$.

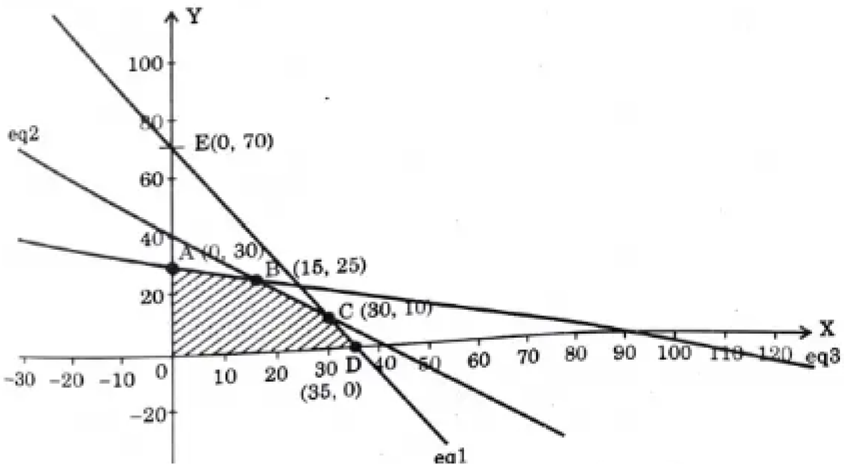
Section - C

26. (a)If $y = \log\left(\sqrt{x} + \frac{1}{\sqrt{x}}\right)^2$, then show that $x(x+1)^2 y_2 + (x+1)^2 y_1 = 2$.

26. OR (b) If $x\sqrt{1+y} + y\sqrt{1+x} = 0$, $-1 < x < 1$, $x \neq y$, then prove that $\frac{dy}{dx} = \frac{-1}{(1+x)^2}$.

27. Prove that $f : N \to N$ defined as $f(x) = ax + b$ $(a, b \in N)$ is one-one but not onto.

28. The feasible region along with corner points for a linear programming problem are shown in the graph. Write all the constraints for the given linear programming problem.



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29. (a)Solve the differential equation $2(y+3) - xy\frac{dy}{dx} = 0$; given $y(1) = -2$.

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29. OR (b) Solve the following differential equation: $(1+x^2)\frac{dy}{dx} + 2xy = 4x^2$.

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30. (a) A die with numbers 1 to 6 is biased such that $P(2) = \frac{3}{10}$ and the probability of other numbers is equal. Find the mean of the number of times number 2 appears on the die, if the die is thrown twice.

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30. OR (b) Two dice are thrown. Defined are the following two events A and B: $A = \{(x,y) : x+y = 9\}$, $B = \{(x,y) : x \neq 3\}$, where (x,y) denote a point in the sample space. Check if events A and B are independent or mutually exclusive.

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31. f and g are continuous functions on interval $[0,a]$. Given that $f(a-x) = f(x)$ and $g(x) + g(a-x) = a$, show that $\int_0^a f(x)g(x)dx = \frac{a}{2}\int_0^a f(x)dx$.

Section - D

32. (a)Find the shortest distance between the lines: $\frac{x+1}{2} = \frac{y-1}{1} = \frac{z-9}{-3}$ and $\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5}$.

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32. OR (b) Find the image A' of the point $A(2,1,2)$ in the line $l : \vec{r} = 4\hat{i} + 2\hat{j} + 2\hat{k} + \lambda(\hat{i} - \hat{j} - \hat{k})$. Also, find the equation of line joining AA'. Find the foot

of perpendicular from point A on the line l.

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33. Find: $\int \frac{5x}{(x+1)(x^2+9)} dx$.

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34. (a) Given $A = \begin{bmatrix} -4 & 4 & 1 \\ -7 & 1 & 3 \\ 5 & -3 & -1 \end{bmatrix}$ **and** $B = \begin{bmatrix} 1 & -1 & 1 \\ 1 & -2 & -2 \\ 2 & 1 & 3 \end{bmatrix}$**, find AB. Hence, solve the system of linear equations:** $x - y + z = 4$ $x - 2y - 2z = 9$ $2x + y + 3z = 1$

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34. OR (b) If $A = \begin{bmatrix} 1 & 2 & 0 \\ -2 & -1 & -2 \\ 0 & -1 & 1 \end{bmatrix}$**, then find** A^{-1}**. Hence, solve the system of linear equations:** $x + 2y = 10$ $-2x - y - z = 8$ $-2y + z = 7$

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35. Using integration, find the area of the region bounded by the line $y = 5x + 2$**, the x-axis and the ordinates** $x = -2$ **and** $x = 2$**.**

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36. Three persons viz. Amber, Bonzi and Comet are manufacturing cars which are run on petrol and on battery as well. Their production share in the market is 60%, 30% and 10% respectively. Of their respective production capacities, 20%, 10% and 5% cars respectively are electric (or battery operated). Based on the above, answer the following:

[(i)]**(a)** What is the probability that a randomly selected car is an electric car? **(b)** What is the probability that a randomly selected car is a petrol car? **[OR]** A car is selected at random and is found to be electric. What is the probability that it was manufactured by Comet? A car is selected at random and is found to be electric. What is the probability that it was manufactured by Amber or Bonzi?

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37. A small town is analyzing the pattern of a new street light installation. The lights are set up in such a way that the intensity of light at any point x metres from the start of

the street can be modelled by $f(x) = e^x \sin x$, where x is in metres. Based on the above, answer the following:

[(i)]Find the intervals on which the $f(x)$ is increasing or decreasing, $x \in [0, \pi]$. Verify, whether each critical point when $x \in [0, \pi]$ is a point of local maximum or local minimum or a point of inflexion.

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38. A school is organizing a debate competition with participants as speakers $S = \{S_1, S_2, S_3, S_4\}$ and these are judged by judges $J = \{J_1, J_2, J_3\}$. Each speaker can be assigned one judge. Let R be a relation from set S to set J defined as $R = \{(x, y) :$ speaker x is judged by judge $y, x \in S, y \in J\}$. Based on the above, answer the following:

[(i)]How many relations can there be from set S to set J ? A student identifies a function from S to J as $f = \{(S_1, J_1), (S_2, J_2), (S_3, J_2), (S_4, J_3)\}$. Check if it is bijective. **(a)** How many one-one functions can there be from set S to set J ? **OR (b)** Another student considers a relation $R_1 = \{(S_1, S_2), (S_2, S_4)\}$ in set S. Write minimum ordered pairs to be included in R_1 so that R_1 is reflexive but not symmetric.
