SET - 1

Roll No. | | | | | | |

Candidates must write the Set No on the title page of the answer book.

SAHODAYA PRE BOARD EXAMINATION – 2024-25

- Please check that this question paper contains 07 printed pages.
- Set number given on the right-hand side of the question paper should be written on the title page of the answer book by the candidate.
- Check that this question paper contains 38 questions.
- Write down the Serial Number of the question in the left side of the margin before attempting it.
- 15 minutes time has been allotted to read this question paper. The question paper will be distributed 15 minutes prior to the commencement of the examination. The students will read the question paper only and will not write any answer on the answer script during the period. Students should not write anything in the question paper.

CLASS- XII

SUBJECT: MATHEMATICS (041)

Time Allowed: 3 Hours **Maximum Marks: 80**

General Instructions:

Read the following instructions very carefully and strictly follow them:

(i) This Question paper contains **38** questions. **All** questions are **compulsory.**

(ii) This Question paper is divided into **five** Sections - **A, B, C, D** and **E.**

(iii) In **Section A**, Questions no. **1** to **18** are **multiple choice questions (MCQs)** and Questions no. **19** and **20** are **Assertion-Reason based** questions of **1 mark each**.

(iv) In **Section B,** Questions no. **21** to **25** are **Very Short Answer (VSA)-type** questions, carrying **2 marks each**.

(v) In **Section C,** Questions no. **26** to **31** are **Short Answer (SA)-type** questions, carrying **3 marks each**.

(vi) In **Section D,** Questions no. **32** to **35** are **Long Answer (LA)-type** questions, carrying **5 marks each**.

(vii) In **Section E,** Questions no. **36** to **38** are **Case study-based questions,** carrying **4 marks each.**

(viii) 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 subpart each in 2 questions of Section E.

(ix) Use of calculators is **not** allowed.

SECTION-A [$1\times 20 = 20$]

(***This section comprises of multiple-choice questions (MCQs) of 1 mark each***)

Select the correct option (Question 1 - Question 18):

1. If $A = [a_{ij}]$ is a symmetric matrix of order n, then

(A) $a_{ij} = \frac{1}{a_{ij}} \forall i, j$ (B) $a_{ij} \neq 0, \forall i, j$ (C) $a_{ij} = 0$, for $i \neq j$ (D) $a_{ij} = a_{ji}, \forall i, j$

2. If A= $\begin{bmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{bmatrix}$ and A^{-1} exist then the value of λ is equal to

(A) λ =2 (B) $\lambda \neq$2 (C) $\lambda \neq$-2 (D) none of these

3. The function $f(x) = x(x-3)^2$ is strictly decreasing for the values of x given by

(A) $x > 0$ (B) $x < 0$ (C) $1 < x < 3$ (D) $0 < x < \frac{3}{2}$

4. If A = $\begin{bmatrix} \propto & 2 \\ 2 & \propto \end{bmatrix}$ and $|A^3|$= 125, the value of $\propto$ is

(A) 5 (B) 0 (C) ± 1 (D) ± 3

5. The value of n, such that the differential equation $x^{n-1}\frac{dy}{dx} = y(logy - logx + 1);\ x, y \in R^+$ is homogeneous is

(A) 2 (B) 1 (C) 0 (D) 3

6. Let A be a skew-symmetric matrix of order 3. If $|A| = x$, then $(241)^x$ is equal to:

(A) 241 (B) $\frac{1}{241}$ (C) $(241)^2$ (D) 1

7. If A is an invertible matrix of order 3 such that $A^2 = 3A$ then the value of $|-2A'|$ is

(A) -72 (B) 144 (C) -144 (D) -216

8. If A and B are independent events such that P($A' \cup B'$)=2/3 and P(A∪B)=5/9 then P$(A') + P(B')$ is equal to

(A) $\frac{10}{9}$ (B) $\frac{1}{9}$ (C) $\frac{1}{3}$ (D) $\frac{2}{3}$

9. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three mutually perpendicular vectors of same magnitude and equally inclined at an angle θ with the vector $\vec{a} + \vec{b} + \vec{c}$. Then $cos\theta$ is equal to

(A) $\frac{1}{\sqrt{3}}$ (B) $\frac{1}{3}$ (C) 0 (D) 1

10. If a line makes an angle of $\frac{\pi}{4}$ with positive directions of both x-axis and z-axis, then the angle which it makes with positive direction of y-axis is

(A) 0 (B) $\frac{\pi}{4}$ (C) $\frac{\pi}{2}$ (D) π

11. If $f'(x) = x^2 + \frac{1}{x^2}$, then $f(x)$ is

(A) $\frac{x^2}{2} + \log|x^2| + c$ (B) $\frac{x^2}{3} + \frac{1}{x} + c$

(C) $\frac{x^3}{3} - \frac{1}{x} + c$ (D) $\frac{x^2}{3} - \log|x^2| + c$

12. The solution set of the inequation x + 2y > 3 is

(A) half plane containing the origin

(B) open half plane not containing the origin

(C) the whole of xy-plane except points lying on the line x + 2y - 3 = 0

(D) none of these

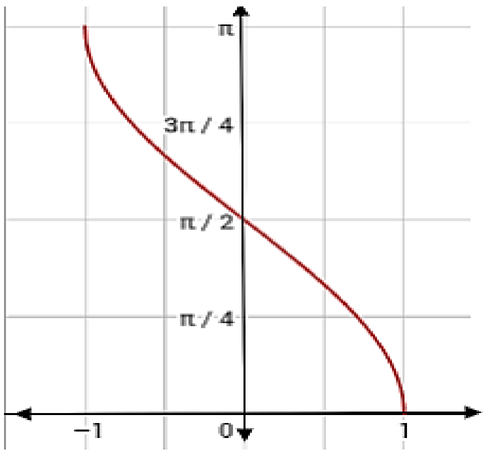
13. If $\int_0^a \frac{1}{1+4x^2}\, dx = \frac{\pi}{8}$ then "a" is

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

14. The integrating factor of $\frac{dy}{dx} + y = \frac{1+y}{x}$ is

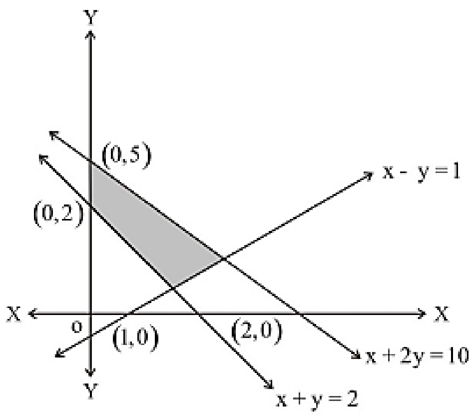
(A) $\frac{e^x}{x}$ (B) $\frac{e^{-x}}{x}$ (C) xe^x (D) x^2e^x

15. The graph drawn below depicts



(A) $y = sin^{-1}x$ (B) $y = cos^{-1}x$ (C) $y = cosec^{-1}x$ (D) $y = cot^{-1}x$

16. The feasible region corresponds to the linear constraints of a linear programming problem is given below.



Which of the following is not a constraint to the given linear programming problem?

(A) $x + y \geq 2$ (B) $x + 2y \leq 10$ (C) $x - y \geq 1$ (D) $x - y \leq 1$

17. The number of points, where f(x) = [x] , 0 < x < 4 ([.] denotes greatest integer function) is not differentiable is

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

18. The area (in sq units) of the region bounded by parabola $y^2 = 4x$ and the line $x = 1$ is

(A) $\frac{4}{3}$ (B) $\frac{8}{3}$ (C) $\frac{16}{3}$ (D) $\frac{18}{3}$

ASSERTION-REASON BASED QUESTIONS

(Question numbers 19 and 20 are Assertion-Reason based questions carrying 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) as given below.)

(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.

19. **Assertion (A):** If $f(x) = |x+1| + |x-2|$, then $f'(1) = 0$.

Reason (R): The graph of the function $f(x)$ is constant in (-1, 2).

20. **Assertion (A):** The function $f: R^+ \to R \ defined \ by \ f(x) = x^2 + 1$ is onto.

Reason (R): A function f is onto if range of the function is equal to Co-domain.

SECTION-B [$2 \times \mathbf{5} = \mathbf{10}$]

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

21. Find the value of $cos^{-1}\left(cos\frac{5\pi}{3}\right) + sin^{-1}\left(cos\frac{5\pi}{3}\right)$.

22. Check whether the function $f: R \to R$ defined by $f(x) = x^3 + x$ has any critical point(s) or not. If yes, then find the points.

OR

A car starts from a point P at time $t = 0$ second and stops at point Q. The distance x in metres covered by it in t seconds, is given by $x = t^2\left(2 - \frac{t}{3}\right)$. Find the time taken by it to reach Q and also find the distance between P and Q.

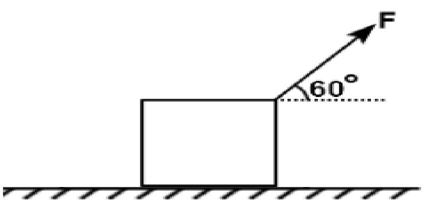
23. Show that the function f defined by $f(x) = (x-1)e^x + 1$ is an increasing function for all $x > 0$.

24. If $\vec{a}$ and $\vec{b}$ are two vectors such that $|\vec{a} + \vec{b}| = |\vec{a}|$, then find the angle between the vectors $2\vec{a} + \vec{b}$ and $\vec{b}$.

25. If $|\vec{a}| = 2, |\vec{b}| = 3$ and angle between the vectors $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{4}$, then find the value of $\left|(\vec{a} + 2\vec{b}) \times (2\vec{a} - 3\vec{b})\right|^2$.

OR

A child pulls a box with a force F of 200 N at an angle of 60^0 above the horizontal, then



find the horizontal and vertical components of the force.

SECTION-C [$3\times 6 = 18$]

(This section comprises of 6 short answer (SA) type questions of 3 marks each.)

26. Solve the differential equation: $(x^2-1)\frac{dy}{dx}+2xy=\frac{1}{x^2-1}$.

27. According to a psychologist, the ability of a person to understand spatial concepts is given by $A=\frac{1}{3}\sqrt{t}$, where t is the age in years, $t\in[5,18]$. Show that the rate of increase of the ability to understand spatial concepts decreases with age in between 5 and 18.

28. Find the shortest distance between the lines

$\vec{r}=(1+2\lambda)\hat{\imath}+(1-\lambda)\hat{\jmath}+\lambda\hat{k}$ and $\vec{r}=\left(2\hat{\imath}-\hat{\jmath}-\hat{k}\right)+\mu\left(2\hat{\imath}+\hat{\jmath}+2\hat{k}\right)$

OR

An enemy country fired a missile along the straight line $\vec{r}=\left(-2\hat{\imath}+3\hat{\jmath}+5\hat{k}\right)+\lambda\left(9\hat{\imath}-3\hat{\jmath}-6\hat{k}\right)$. At what point an iron dome missile moving along $\vec{r}=\left(-3\hat{\imath}-2\hat{\jmath}-5\hat{k}\right)+\mu\left(6\hat{\imath}+6\hat{\jmath}+12\hat{k}\right)$ destroy the enemy missile.

29. Evaluate: $\int\frac{x^2+9}{x^4-2x^2+81}dx$

OR

Evaluate: $\int_0^{\frac{\pi}{4}}\frac{dx}{cos^3x\sqrt{2sin2x}}$

30. Solve the following linear programming problem (LPP) graphically:

Minimize Z = x + 2y

subject to the constraints

x + 2y ≥ 50, 2x - y ≤ 0, 2x + y ≤ 100, x ≥ 0, y ≥ 0

31. A letter is known to have come either from TATANAGAR or from CALCUTTA. On the envelop, just two consecutive letter TA are visible. Find the probability that the letter come from TATANAGAR.

OR

In a game, a man wins Rs.5 for getting a number greater than 4 and losses Rs.1 otherwise, when a fair die is thrown. The man decided to throw a die thrice but to quit as and when he gets a number greater than 4. Find the expected value of the amount he wins/losses.

SECTION-D [$5\times 4 = 20$]

(This section comprises of 4 long answer (LA) type questions of 5 marks each)

32. Find the area of the region $\left\{(x,y):0\le y\le x^2+1, 0\le y\le x+1, 0\le x\le 2\right\}$ using integration.

33. If $x = sin\theta,\ y = cosp\theta$, prove that $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + p^2y = 0.$

OR

If y = x^x , then show that $\frac{d^2y}{dx^2} - \frac{1}{y}\left(\frac{dy}{dx}\right)^2 - \frac{y}{x} = 0.$

34. Use product $\begin{pmatrix}1 & -1 & 2\\ 0 & 2 & -3\\ 3 & -2 & 4\end{pmatrix}\begin{pmatrix}-2 & 0 & 1\\ 9 & 2 & -3\\ 6 & 1 & -2\end{pmatrix}$ to solve the system of equations

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

35. Find the image of the point P(1,6,3) with respect to the line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$.

OR

Show that the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{4}$ and $\frac{x-4}{5} = \frac{y-1}{2} = z$ *in*tersect.

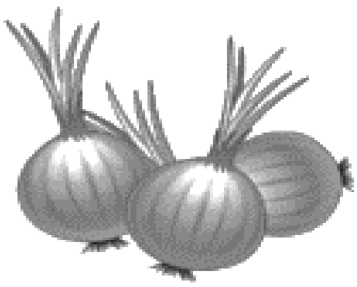
Also find the equation of a line passing through the point of intersection of the above lines and parallel to z – axis..

SECTION- E **[4× 3=12]**

(This section comprises of 3 case-study/passage-based questions of 4 marks each with subparts. The first two case study questions have three subparts (i), (ii), (iii) of marks 1, 1, 2 respectively. The third case study question has two subparts of 2 marks each)

Case Study-1

36. The government declares that farmers can get Rs.300 per quintal for their onions on 1st July and after that the price will be dropped by Rs.3 per quintal per extra day. Disha's father has 80 quintals of onions in the field on 1st July and estimates that crop is increasing at the rate of 1 quintal per day.



Based on the above information, answer the following questions.

(i) If x is the number of days after 1st July, then find price and quantity of onions in terms of x.

(ii) Find revenue in terms of x.

(iii) Find the number of days after 1st July, when Disha's father attains maximum revenue.

OR

Find maximum revenue.

Case Study-2

37. The reliability of a DENGUE fever test is specified as follows:

Of people having DENGUE, 90% test detects the disease but 10% goes undetected. Of people free of DENGUE, 99% of the test is judged DENGUE negative but 1% are diagnosed as showing DENGUE positive. From a large population of which only 0.1% have DENGUE, one person is selected at random, given the DENGUE fever test and the pathologist reports him/her as DENGUE positive.

(i) Find the probability of the person to be tested as DENGUE positive given that the person is actually having DENGUE.

(ii) Find the probability of the person to be tested as DENGUE positive given that the person is actually not having DENGUE.

(iii) Find the probability that the person selected from large population is actually not having DENGUE given that the person is tested as DENGUE positive.

OR

Find the probability that the person is actually having DENGUE given that the person is tested as DENGUE positive.

Case Study-3

38. An organization conducted bike race under two different categories – Boys and Girls.

There were 28 participants in all. Among all of them, finally three from category 1 and two from category 2 were selected for the final race. Ravi forms two sets B and G with these participants for his college project. Let B = $\{b_1, b_2, b_3\}$ and G = $\{g_1, g_2\}$, where B represents the set of Boys selected and G the set of Girls selected for the final race.

Based on the above information, answer the following questions.

(i) Find total number of relations and functions that are possible from B to G.

(ii) Let R: B→B be defined by R = {(x, y): x and y are students of the same sex}.
Check if R is an equivalence relation.