SAMPLE QUESTION PAPER (2024 - 25)

CLASS- XII

SUBJECT: Mathematics (041) (FOR VISUALLY IMPAIRED)

Time: 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):

Q.1. If for a square matrix A, $A.(adj\,A)=\begin{bmatrix} 2025 & 0 & 0 \\ 0 & 2025 & 0 \\ 0 & 0 & 2025 \end{bmatrix}$, then the value of $|A|+|adj\,A|$ is equal to:

(A) 1 (B) $2025+1$ (C) $(2025)^2+45$ (D) $2025+(2025)^2$

Q.2. Assume X, Y, Z, W and P are matrices of order $2\times n$, $3\times k$, $2\times p$, $n\times 3$ and $p\times k$, respectively. Then the restriction on n, k and p so that $PY+WY$ will be defined are:

(A) $k=3, p=n$ (B) k **is arbitrary,** $p=2$

(C) p **is arbitrary,** $k=3$ (D) $k=2, p=3$

Q.3. The interval in which the function f defined by $f(x)=e^x$ is strictly increasing, is

(A) $[1,\infty)$ (B) $(-\infty,0)$ (C) $(-\infty,\infty)$ (D) $(0,\infty)$

Q.4. If A **and** B are non-singular matrices of same order with $\det(A) = 5$, then $\det(B^{-1}AB)^2$ is equal to

(A) 5 (B) 5^2 (C) 5^4 (D) 5^5

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

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

Q.6. If the points $(x_1, y_1), (x_2, y_2)$ and $(x_1 + x_2, y_1 + y_2)$ are collinear, then $x_1 y_2$ is equal to

(A) $x_2 y_1$ (B) $x_1 y_1$ (C) $x_2 y_2$ (D) $x_1 x_2$

Q.7. If $A = \begin{bmatrix} 0 & 1 & c \\ -1 & a & -b \\ 2 & 3 & 0 \end{bmatrix}$ is a skew-symmetric matrix then the value of $a + b + c =$

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

Q.8. For any two events A and B, if $P(\overline{A}) = \frac{1}{2}, P(\overline{B}) = \frac{2}{3}$ and $P(A \cap B) = \frac{1}{4}$, then $P\left(\bar{A}/\bar{B}\right)$ equals:

(A) $\frac{3}{8}$ (B) $\frac{8}{9}$ (C) $\frac{5}{8}$ (D) $\frac{1}{4}$

Q.9. The value of α if the angle between $\vec{p} = 2\alpha^2\hat{\imath} - 3\alpha\hat{\jmath} + \hat{k}$ and $\vec{q} = \hat{\imath} + \hat{\jmath} + \alpha\hat{k}$ is obtuse, is

(A) $R - [0, 1]$ (B) (0,1) (C) $[0, \infty)$ (D) $[1, \infty)$

Q.10. If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{a} + \vec{b}| = 5$, then $|\vec{a} - \vec{b}| =$

(A) **3** (B) **4** (C) **5** (D) **8**

Q.11. If the feasible region of a linear programming problem is bounded then the objective function Z = ax + by with a, b > 0 has

(A) Maximum value only
(B) Minimum value only
(C) Both maximum and minimum values
(D) Neither maximum nor minimum value

Q.12. $\int \frac{dx}{x^3(1+x^4)^{\frac{1}{2}}}$ equals

(A) $-\frac{1}{2x^2}\sqrt{1+x^4} + c$ (B) $\frac{1}{2x}\sqrt{1+x^4} + c$

(C) $-\frac{1}{4x}\sqrt{1+x^4} + c$ (D) $\frac{1}{4x^2}\sqrt{1+x^4} + c$

Q.13. $\int_0^{2\pi} cosec^7 x\, dx =$

(A) **0** (B) **1** (C) **4** (D) **2π**

Q.14. What is the general solution of the differential equation $e^{y'} = x$?

(A) $y = xlogx + c$ (B) $y = xlogx - x + c$ (C) $y = xlogx + x + c$ (D) $y = x + c$

Q.15. The domain of the function $f(x) = \cos^{-1}\sqrt{x+1}$ is

(A) $(-1,1)$ (B) $(0,1)$ (C) $[-1,0]$ (D) $[-1,1]$

Q.16. The solution set for the inequality $-2x + 3y > -7$ is

(A) Open half plane containing $(-3, 2)$
(B) Closed half plane containing $(-3, 2)$
(C) Open half plane not containing $(-3, 2)$
(D) Closed half plane not containing $(-3, 2)$

Q.17. The function $f: R \to Z$ defined by $f(x) = [x]$; where $[.]$ denotes the greatest integer function, is

(A) Continuous at $x = 2.5$ but not differentiable at $x = 2.5$
(B) Not Continuous at $x = 2.5$ but differentiable at $x = 2.5$
(C) Not Continuous at $x = 2.5$ and not differentiable at $x = 2.5$
(D) Continuous as well as differentiable at $x = 2.5$

Q.18. A student observes an open-air Honeybee nest on the branch of a tree, whose plane figure is parabolic shape given by $x^2 = 4y$. Then the area (in sq units) of the region bounded by parabola $x^2 = 4y$ and the line $y = 4$ is

(A) $\frac{32}{3}$ (B) $\frac{64}{3}$ (C) $\frac{128}{3}$ (D) $\frac{256}{3}$

ASSERTION-REASON BASED QUESTIONS

(Questions number 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.

Q.19. Assertion (A): Consider the function defined as $f(x) = |x| + |x-1|$ $x \in R$. Then $f(x)$ is not differentiable **at** $x = 0$ **and** $x = 1$.

Reason (R): Suppose f be defined and continuous on (a,b) and $c \in (a,b)$, then $f(x)$ is not differentiable at $x = c$ if $\lim_{h \to 0^-} \frac{f(c+h)-f(c)}{h} \neq \lim_{h \to 0^+} \frac{f(c+h)-f(c)}{h}$.

Q.20. Assertion (A): The function $f: R - \left\{(2n+1)\frac{\pi}{2} : n \in Z\right\} \to (-\infty, -1] \cup [1, \infty)$ defined by $f(x) = \sec x$ is not one-one function in its domain.

Reason (R): The line $y = 2$ meets the graph of the function at more than one point.

SECTION B $[2 \times 5 = 10]$

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

Q.21. If $\cot^{-1}(3x+5) > \frac{\pi}{4}$, then find the range of the values of x.

Q.22. The cost (in rupees) of producing x items in factory, each day is given by

$$C(x) = 0.00013x^3 + 0.002\,x^2 + 5x + 2200$$

Find the marginal cost when 150 items are produced.

Q.23. (a) Find the derivative of $\tan^{-1} x$ with respect to $\log x$; (where $x \in (1, \infty)$).

OR

Q.23. (b) Differentiate the following function with respect to x : $(\cos x)^x$; $\left(\text{where } x \in \left(0, \frac{\pi}{2}\right)\right)$.

Q.24. (a) If vectors $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{b} + \lambda\vec{c}$ is perpendicular to $\vec{a}$, then find the value of λ.

OR

Q.24. (b) A person standing at $O(0,0,0)$ is watching an aeroplane which is at the coordinate point $A(4,0,3)$. At the same time he saw a bird at the coordinate point $B(0,0,1)$. Find the angles which $\overrightarrow{BA}$ makes with the x, y and z axes.

Q.25. The two co-initial adjacent sides of a parallelogram are $2\hat{i} - 4\hat{j} - 5\hat{k}$ and $2\hat{i} + 2\hat{j} + 3\hat{k}$. Find its diagonals and use them to find the area of the parallelogram.

SECTION C $\left[3\times 6=18\right]$

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

Q.26. A kite is flying at a height of 3 metres and 5 metres of string is out. If the kite is moving away horizontally at the rate of 200 cm/s, find the rate at which the string is being released.

Q.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.

Q.28. (a) An ant is moving along the vector $\vec{l_1} = \hat{\imath} - 2\hat{\jmath} + 3\hat{k}$. Few sugar crystals are kept along the vector $\vec{l_2} = 3\hat{\imath} - 2\hat{\jmath} + \hat{k}$ which is inclined at an angle θ with the vector $\vec{l_1}$. Then find the angle θ. Also find the scalar projection of $\vec{l_1}\ on\ \vec{l_2}$.

OR

Q.28. (b) Find the vector and the cartesian equation of the line that passes through $(-1, 2, 7)$ and is perpendicular to the lines $\vec{r} = 2\hat{\imath} + \hat{\jmath} - 3\hat{k} + \lambda(\hat{\imath} + 2\hat{\jmath} + 5\hat{k})$ and $\vec{r} = 3\hat{\imath} + 3\hat{\jmath} - 7\hat{k} + \mu(3\hat{\imath} - 2\hat{\jmath} + 5\hat{k})$.

Q.29. (a) Evaluate: $\int\left\{\frac{1}{\log x}-\frac{1}{(\log x)^2}\right\}dx;\ (\text{where } x>1).$

OR

Q.29. (b) Evaluate : $\int_0^1 x(1-x)^n dx;\ \ (where\ n\ \in N)$.

Q.30. The feasible region of a linear programming problem lies in the first quadrant with corner points A(0, 0), B(20,0), C(10, 50) and D(0, 60). It has its maximum value on the line segment CD for the objective function Z = mx + 30 y. Find m and hence find the difference between the maximum value of the objective function from its value at B.

Q.31. (a) The probability that it rains today is **0.4**. If it rains today, the probability that it will rain tomorrow is **0.8**. If it does not rain today, the probability that it will rain tomorrow is **0.7**. If

P_1: denotes the probability that it does not rain today.

P_2: denotes the probability that it will not rain tomorrow, if it rains today.

P_3: denotes the probability that it will rain tomorrow, if it does not rain today.

P_4: denotes the probability that it will not rain tomorrow, if it does not rain today.

(i) Find the value of $P_1\times P_4 - P_2\times P_3$. $[2\,Marks]$

(ii) Calculate the probability of raining tomorrow. $[1\,Mark]$

OR

Q.31. (b) A random variable X can take all non – negative integral values and the probability that X takes the value r is proportional to 5^{-r}. Find $P(X < 3)$.

SECTION D

$[5 \times 4 = 20]$

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

Q.32. U**sing integration,** find the area of the region bounded by $\frac{x^2}{4} + \frac{y^2}{1} = 1$.

Q.33. The equation of the path traversed by the ball headed by the footballer is $y = ax^2 + bx + c$; $(where\ 0 \le x \le 14\ and\ a, b, c\ \in R\ and\ a\ \neq 0)$ with respect to a XY-coordinate system in the vertical plane. The ball passes through the points $(2,15)$, $(4,25)$ **and** $(14,15)$. Determine the values of a, b and c by solving the system of linear equations in a, b and c, using matrix method.

Q.34. (a) If $f: R \to R$ is defined by $f(x) = |x|^3$, show that $f''(x)$ exists for all real x and find it.

OR

Q.34. (b) If $(x-a)^2 + (y-b)^2 = c^2$, for some $c > 0$, prove that $\dfrac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}}$ is a constant independent of a and b.

Q.35. (a) Find the shortest distance between the lines l_1 and l_2 whose vector equations are respectively

$$\vec{r} = (-\hat{\imath} - \hat{\jmath} - \hat{k}) + \lambda(7\hat{\imath} - 6\hat{\jmath} + \hat{k}) \text{ and } \vec{r} = (3\hat{\imath} + 5\hat{\jmath} + 7\hat{k}) + \mu(\hat{\imath} - 2\hat{\jmath} + \hat{k})$$

where λ and μ are parameters.

OR

Q.35. (b) Find the image of the point $(1,2,1)$ with respect to the line $\frac{x-3}{1} = \frac{y+1}{2} = \frac{z-1}{3}$. Also find the equation of the line joining the given point and its image.

SECTION- E

$[4 \times 3 = 12]$

(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

Q.36. Ramesh, the owner of a sweet selling shop purchased some rectangular card board sheets of $25\,cm$ **by** $40\ cm$ to make container packets without top. Let $x\,cm$ be the length of the side of the square to be cut out from each corner to give that sheet the shape of the container by folding up the flaps.

Based on the above information answer the following questions.

(i) Express the volume (V) of each container as function of x only. [1 *Mark*]

(ii) Find $\frac{dV}{dx}$ [1 *Mark*]

(iii) (a) For what value of x, the volume of each container is maximum? [2 *Marks*]

OR

(iii) (b) Check whether V has a point of inflection at x = $\frac{65}{6}$ or not? [2 *Marks*]

Case Study-2

Q.37. An organization conducted bike race under 2 different categories-boys and girls. In all, there were **250** participants. Among all of them finally three from Category **1** and two from Category **2** were selected for the final race. Ravi forms two sets $\boldsymbol{B}$ and $\boldsymbol{G}$ with these participants for his college project.

Let $B = \{b_1, b_2, b_3\}, G = \{g_1, g_2\}$ where $\boldsymbol{B}$ represents the set of boys selected and $\boldsymbol{G}$ the set of girls who were selected for the final race.

Ravi decides to explore these sets for various types of relations and functions.

On the basis of the above information, answer the following questions:

(i) Ravi wishes to form all the relations possible from $\boldsymbol{B}$ to $\boldsymbol{G}$. How many such relations are possible? [1 *Mark*]

(ii) Write the smallest equivalence relation on **G**. [1 *Mark*]

(iii) (a) Ravi defines a relation from **B to B** as $\boldsymbol{R_1} = \{(\boldsymbol{b_1}, \boldsymbol{b_2}), (\boldsymbol{b_2}, \boldsymbol{b_1})\}$. Write the minimum ordered pairs to be added in $\boldsymbol{R_1}$ so that it becomes (A) reflexive but not symmetric, (B) reflexive and symmetric but not transitive. [2 *Marks*]

OR

(iii) (b) If the track of the final race (for the biker b_1) follows the curve

$x^2 = 4y$; (**where** $0 \le x \le 20\sqrt{2}$ **&** $0 \le y \le 200$), then state whether the track represents a one-one and onto function or not. (Justify). [2 *Marks*]

Case Study- 3

Q.38. Arka bought two cages of birds: Cage-I contains 5 parrots and 1 owl and Cage –II contains 6 parrots. One day Arka forgot to lock both cages and two birds flew from Cage-I to Cage-II (simultaneously). Then two birds flew back from cage-II to cage-I(simultaneously).

Assume that all the birds have equal chances of flying.

On the basis of the above information, answer the following questions:-

(i) When two birds flew from Cage-I to Cage-II and two birds flew back from Cage-II to Cage-I then find the probability that the owl is still in Cage-I. **[2 *Marks*]**

(ii) When two birds flew from Cage-I to Cage-II and two birds flew back from Cage-II to Cage-I, the owl is still seen in Cage-I, what is the probability that one parrot and the owl flew from Cage-I to Cage-II? **[2 *Marks*]**

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