

## 12 MATHEMATICS

## PREVIOUS YEAR PUBLIC QUESTIONS 3-MARKS

S.NO.	3 MARK QUESTIONS	YEAR
C1.1	If matrix $A = \begin{bmatrix} 2 & 9 \\ 1 & 7 \end{bmatrix}$ , then verify that $(A^T)^{-1} = (A^{-1})^T$	Mar-2020
1.2	verify that $(AB)^{-1} = B^{-1}A^{-1}$ with $A = \begin{pmatrix} 0 & -5 \\ 1 & 4 \end{pmatrix}$ and $B = \begin{pmatrix} -2 & -5 \\ 0 & -1 \end{pmatrix}$	Sep-2020 Jul-2022
1.3	If $A = \begin{pmatrix} 8 & -4 \\ -5 & 3 \end{pmatrix}$ , verify that $A(adjA) = (adjA)A = AI_2$	Sep-2020 Mar-2021
1.4	Show that the rank of the matrix $\begin{bmatrix} 0 & 1 & 2 & 1 \\ 0 & 2 & 4 & 3 \\ 8 & 1 & 0 & 2 \end{bmatrix}$ is 3	Mar-2021
1.5	Show that the rank of the matrix $\begin{bmatrix} 1 & 2 & -1 \\ -1 & 2 & 3 \\ 1 & -2 & 3 \\ 1 & -1 & 1 \end{bmatrix}$ is 3	Mar-2022
1.6	Solve the following system of linear equations, using matrix inversion method: $5x + 2y = 3, 3x + 2y = 5.$	Mar-2022
1.7	Find the rank of the matrix $\begin{bmatrix} 1 & -2 & 3 \\ 2 & 4 & -6 \\ 5 & 1 & -1 \end{bmatrix}$	Jul-2022
1.8	If $F(\alpha) = \begin{pmatrix} \cos\alpha & 0 & \sin\alpha \\ 0 & 1 & 0 \\ -\sin\alpha & 0 & \cos\alpha \end{pmatrix}$ , Show that $[F(\alpha)]^{-1} = [F(-\alpha)]$	Mar-2023
1.9	Solve the system of linear equations $2x + 5y = -2, x + 2y = -3$ using matrix inversion method.	Jun-2023
C2.1	Show that the points $1, -\frac{1}{2} + i\sqrt{\frac{3}{2}}$ and $-\frac{1}{2} - i\sqrt{\frac{3}{2}}$ are the vertices of an equilateral triangle of side length $\sqrt{3}$	Mar-2021
2.2	Which one of the points $10 - 8i, 11 + 6i$ is closest to $1 + i$	Mar-2022
2.3	Show that the square roots of $6 - 8i$ are $\pm(2\sqrt{2} - i\sqrt{2})$	Jul_2022
2.4	If $z = (2 + 3i)(1 - i)$ , then find $z^{-1}$ .	Mar-2023
2.5	State and prove triangle inequality.	Jun-2023

<b>C3.1</b>	If $p$ is real, discuss the nature of the roots of the equation. $4x^2 + 4px + p + 2 = 0$ , in terms of $p$ .	<b>Mar-2020</b>
<b>3.2</b>	Obtain the condition that the roots of $x^3 + px^2 + qx + r = 0$ are in A.P.	<b>Sep-2020</b>
<b>3.3</b>	If the sides of a cubic box are increased by 1, 2, 3 units respectively to form a cuboid, then the volume is increased by 52 cubic units. Show that the volume of the cuboid is 60 cubic units.	<b>Mar-2021</b>
<b>3.4</b>	Solve the equation $2x^3 - 9x^2 + 10x = 3$ , if 1 is a root, find the other roots.	<b>Mar-2022</b>
<b>3.5</b>	Prove that the roots of the equation $x^4 - 3x^2 - 4 = 0$ are $\pm 2, \pm i$	<b>Jul-2022</b>
<b>3.6</b>	If $a + b + c = 0$ and $a, b, c$ are rational numbers then, prove that the roots of the equation $(b + c - a)x^2 + (c + a - b)x + (a + b - c) = 0$ are rational numbers.	<b>Mar-2023</b>
<b>3.7</b>	Show that the polynomial equation $9x^9 + 2x^5 - x^4 - 7x^2 + 2 = 0$ has at least six imaginary roots.	<b>Jun-2023</b>
<b>C4.1</b>	For what value of $x$ , the inequality $\frac{\pi}{2} < \cos^{-1}(3x - 1) < \pi$ holds?	<b>Mar-2023</b>
<b>4.2</b>	Find the value of $\sin^{-1}\left(\sin \frac{5\pi}{9} \cos \frac{\pi}{9} + \cos \frac{5\pi}{9} \sin \frac{\pi}{9}\right)$	<b>Jun-2023</b>
<b>C5.1</b>	A concrete bridge is designed as a parabolic arch. The road over bridge is 40m long and the maximum height of the arch is 15m. Write the equation of the parabolic arch. Take $(0,0)$ as the vertex.	<b>Mar-2020</b>
<b>5.2</b>	A circle of area $9\pi$ square units has two of its diameters along the lines $x + y = 5$ and $x - y = 1$ . Find the equation of the circle.	<b>Sep-2020</b>
<b>5.3</b>	Prove that the equation of the parabola with focus $(4,0)$ and directrix $x = -4$ is $y^2 = 16x$	<b>Mar-2021</b>
<b>5.4</b>	Prove that the general equation of the circle whose diameter is the line segment joining the points $(-4, -2)$ and $(-1, -1)$ is $x^2 + y^2 + 5x + 3y + 6 = 0$ .	<b>Mar-2022</b>
<b>5.5</b>	Find the center and radius of the circle $x^2 + y^2 + 6x - 4y + 4 = 0$ .	<b>Jul-2022</b>
<b>5.6</b>	Find the equation of the parabola with vertex $(-1, -2)$ axis parallel to $y$ -axis and passing through $(3,6)$	<b>Mar-2023</b>

5.7	The maximum and minimum distances of the Earth from the sun respectively are $152 \times 10^6$ km and $94.5 \times 10^6$ km. The Sun is at one focus of the elliptical orbit. Find the distance from the Sun to the other focus.	Mar-2023
5.8	Prove that the point of intersection of the tangents at $t_1$ and $t_2$ on the parabola $y^2 = 4ax$ is $\left[ a(t_1 + t_2), a(t_1 t_2) \right]$ .	Jun-2023
C6.1	Find the Vector and Cartesian equations of straight line passing through the points $(-5, 7, -4)$ and $(13, -5, 2)$ . Find the point where the straight line crosses the xy-plane.	Mar-2020
6.2	If the lines $\frac{x-x_1}{l_1} = \frac{y-y_1}{m_1} = \frac{z-z_1}{n_1}$ and $\frac{x-x_2}{l_2} = \frac{y-y_2}{m_2} = \frac{z-z_2}{n_2}$ lie on the same plane, then write the number of ways to find the Cartesian equation of the above plane and explain in detail.	Mar-2020
6.3	Prove that with usual notations $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ by using the area of the triangle property.	Sep-2020 Jun-2023
6.4	A force $13\hat{i} + 10\hat{j} - 3\hat{k}$ act on a particle which is displaced from the point with position vector $4\hat{i} - 3\hat{j} - 2\hat{k}$ to the point with position vector $6\hat{i} + \hat{j} - 3\hat{k}$ . Show that the work done by the force is 69 units.	Mar-2021
6.5	Find the magnitude and the direction cosines of the torque about the point $(2, 0, -1)$ of a force $2\hat{i} + \hat{j} - \hat{k}$ whose line of action passes through the origin.	Mar-2022
6.6	A particle acted on by constant forces $8\hat{i} + 2\hat{j} - 6\hat{k}$ and $6\hat{i} + 2\hat{j} - 2\hat{k}$ is displaced from the point $(1, 2, 3)$ to the point $(5, 4, 1)$ . Find the total work done by the forces.	Jul-2022
6.7	Find the angle made by the straight line $\frac{x+3}{2} = \frac{y-1}{2} = -z$ with coordinate axes.	Mar-2023
C7.1	Find the critical numbers (only x value) of the function $f(x) = x^{4/3}(x-4)^2$	Mar-2020
7.2	Find the absolute extrema of the function $f(x) = x^2 - 12x + 10$ on $[1, 2]$	Sep-2020
7.3	Show that the point on the curve $y = x^2 - 5x + 4$ at which the tangent is parallel to the line $3x + y = 7$ , is $(1, 0)$	Mar-2021
7.4	Evaluate: $\lim_{x \rightarrow \infty} \frac{2x-3}{x^2-5x+3}$	Mar-2022
7.5	Show that $\lim_{x \rightarrow 0^+} x \log x$ is 0.	Jul-2022

7.6	Find two positive numbers whose sum is 12 and their product is maximum.	June-2023
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<b>C8.1</b>	If $U = \log(x^3 + y^3 + z^3)$ then find $\frac{\partial U}{\partial x} + \frac{\partial U}{\partial y} + \frac{\partial U}{\partial z}$	<b>Mar-2020 Jun-2023</b>														
<b>8.2</b>	Suppose that $z = ye^{x^2}$ , where $x = 2t$ and $y = 1 - t$ then find $\frac{dz}{dt}$	<b>Sep-2020</b>														
<b>8.3</b>	An egg of a particular bird is spherical in shape. If the radius to the inside of the shell is 4mm and radius to the outside of the shell is 4.2mm, prove that the approximate volume of the shell is $12.8\pi \text{ mm}^3$ .	<b>Mar-2021</b>														
<b>8.4</b>	Assume that the cross section of the artery of human is circular. A drug is given to a patient to dilate his arteries. If the radius of an artery is increased from 2mm to 2.1mm how much is cross sectional area increased approximately.	<b>Mar-2022</b>														
<b>8.5</b>	A circular plate expands uniformly under the influence of heat. If its radius increases from 10.5 cm to 10.75 cm, then find an approximate change in the area.	<b>Jul-2022</b>														
<b>8.6</b>	Use the linear approximation to find an approximate value of $(123)^{\frac{2}{3}}$	<b>Mar-2023</b>														
<b>C9.1</b>	Show that $\int_0^1 \frac{\sqrt{x}}{\sqrt{1-x} + \sqrt{x}} dx = \frac{1}{2}$	<b>Mar-2021</b>														
<b>9.2</b>	Show that $\int_0^{\frac{\pi}{2}} \frac{\sec x \tan x}{1 + \sec^2 x} dx = \tan(2) - 1 - \frac{\pi}{4}$	<b>Mar-2022</b>														
<b>9.3</b>	Prove that $\int_0^1 xe^x dx = 1$	<b>Jul-2022</b>														
<b>C10.1</b>	Solve: $x \cos y dy = e^x (x \log x + 1) dx$	<b>Mar-2023</b>														
<b>10.2</b>	Find the population of a city at any time $t$ , given that the rate of increase of population is proportional to the population at that instant and that in a period of 40 years the population increased from 3,00,000 to 4,00,000.	<b>Jun-2023</b>														
<b>C11.1</b>	An random variable $X$ has the following probability mass function. <table border="1" style="margin-left: 20px;"> <tbody> <tr> <td><math>X</math></td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> </tr> <tr> <td><math>f(x)</math></td> <td><math>k</math></td> <td><math>2k</math></td> <td><math>6k</math></td> <td><math>5k</math></td> <td><math>6k</math></td> <td><math>10k</math></td> </tr> </tbody> </table> Find $P(2 < X < 6)$	$X$	1	2	3	4	5	6	$f(x)$	$k$	$2k$	$6k$	$5k$	$6k$	$10k$	<b>Mar-2020</b>
$X$	1	2	3	4	5	6										
$f(x)$	$k$	$2k$	$6k$	$5k$	$6k$	$10k$										
<b>11.2</b>	Let $X$ be a continuous random variable and $f(x)$ is defined as $f(x) = \begin{cases} kx(1-x)^{10}, & 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$ Find the value of $K$ .	<b>Mar-2020</b>														
<b>11.3</b>	Two fair coins are tossed simultaneously. Find the probability mass function for number of heads occurred.	<b>Sep-2020</b>														

11.4	The mean and variance of a binomial variate $X$ are respectively 2 and 1.5. Find $P(X = 0)$	Sep-2020
C12.1	Prove that $p \rightarrow q \equiv \neg p \vee q$	Mar-2020
12.2	Show that $((\neg q) \wedge p) \wedge q$ is a contradiction.	Sep-2020
12.3	Define an operation $*$ on $Q$ as follows: $a * b = \frac{a+b}{2}$ , $a, b \in Q$ . Examine the closure and commutative properties satisfied by $*$ on $Q$ .	Mar-2021
12.4	Let $*$ be defined on $R$ by $a * b = a + b + ab - 7$ . Is $*$ binary on $R$ ? If so find $3 * \left(\frac{-7}{15}\right)$	Mar-2022
12.5	Verify (i) Closure property (ii) Commutative property of the following operation on the given set $a * b = a^b$ ; $\forall a, b \in N$ (exponentiation property)	Jul-2022
12.6	Show that $p \rightarrow q$ and $q \rightarrow p$ are not equivalent.	Mar-2023
12.7	Establish the equivalence property connecting the bi-conditional with conditional: $p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$	Jun-2023

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