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III

Total No. of Questions - 24

Total No. of Printed Pages - 3

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Part -III
MATHEMATICS, Paper - I (A)
(English Version)

Time : 3 Hours

Max. Marks : 75

Note: This question paper consists of THREE Sections - A, B and C.

SECTION - A

I. Very short answer type questions -

10×2=20

(i) Answer **ALL** the questions.

(ii) Each question carries **TWO** marks.

1. Find the domain of $f(x) = \frac{1}{\sqrt{|x|-x}}$.

2. If $A = \{1, 2, 3, 4\}$ and $f : A \rightarrow R$ is a function defined by $f(x) = \frac{x^2-x+1}{x+1}$, then find the range of f .

3. If $A = \begin{bmatrix} 2 & 4 \\ -1 & k \end{bmatrix}$ and $A^2 = 0$, then find the value of k .

4. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 8 \\ 7 & 2 \end{bmatrix}$ and $2X + A = B$, then find X .

5. OABC is a parallelogram. If $\overrightarrow{OA} = \vec{a}$ and $\overrightarrow{OC} = \vec{c}$, find the vector equation of the side BC.

6. Find a vector in the direction of vector $\bar{a} = \bar{i} - 2\bar{j}$ that has magnitude 7 units.

7. If $4\bar{i} + \frac{2p}{3}\bar{j} + p\bar{k}$ is parallel to the vector $\bar{i} + 2\bar{j} + 3\bar{k}$, find p.

8. Prove that $\frac{\cos 9^\circ + \sin 9^\circ}{\cos 9^\circ - \sin 9^\circ} = \cot 36^\circ$.

9. Find a sine function whose period is $\frac{2}{3}$.

10. For any $x \in \mathbb{R}$, prove that $\cos h^4 x - \sin h^4 x = \cos h(2x)$.

SECTION B

II. Short answer type questions -

5×4=20

(i) Answer **ANY FIVE** questions.

(ii) Each question carries **FOUR** marks.

11. Find the adjoint and the inverse of the matrix $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$.

12. Show that the points $A(2\bar{i} - \bar{j} + \bar{k})$, $B(\bar{i} - 3\bar{j} - 5\bar{k})$, $C(3\bar{i} - 4\bar{j} - 4\bar{k})$ are the vertices of a right angled triangle.

13. Let $\bar{e}_1$ and $\bar{e}_2$ be unit vectors making angle θ . If $\frac{1}{2}|\bar{e}_1 - \bar{e}_2| = \sin(\lambda\theta)$, then find λ .

14. Show that $\cos^4 \frac{\pi}{8} + \cos^4 \frac{3\pi}{8} + \cos^4 \frac{5\pi}{8} + \cos^4 \frac{7\pi}{8} = \frac{3}{2}$.

15. Solve $1 + \sin^2 \theta = 3 \sin \theta \cos \theta$.

16. Prove that $\cos \left(2 \tan^{-1} \frac{1}{7} \right) = \sin \left(2 \tan^{-1} \frac{3}{4} \right)$.

17. If $a = (b - c) \sec \theta$, prove that $\tan \theta = \frac{2\sqrt{bc}}{b - c} \sin \frac{A}{2}$.

SECTION - C

III. Long answer type questions -

5×7=35

- (i) Answer **ANY FIVE** questions.
(ii) Each question carries **SEVEN** marks.

18. Let $f: A \rightarrow B$, $g: B \rightarrow C$ be bijections, then prove that $(g \circ f)^{-1} = f^{-1} \circ g^{-1}$.

19. Using mathematical induction, prove that $1^2 + (1^2 + 2^2) + (1^2 + 2^2 + 3^2) + \dots$ upto n terms $= \frac{n(n+1)^2(n+2)}{12}$, for all $n \in \mathbb{N}$.

20. Solve the following system of equation by using Cramer's rule.

$$x + y + z = 9$$

$$2x + 5y + 7z = 52$$

$$2x + y - z = 0$$

21. Show that -

$$\begin{vmatrix} a+b+2c & a & b \\ c & b+c+2a & b \\ c & a & c+a+2b \end{vmatrix} = 2(a+b+c)^3.$$

22. If $\vec{a} = 2\vec{i} + 3\vec{j} + 4\vec{k}$, $\vec{b} = \vec{i} + \vec{j} - \vec{k}$, and $\vec{c} = \vec{i} - \vec{j} + \vec{k}$, then compute $\vec{a} \times (\vec{b} \times \vec{c})$ and verify that it is perpendicular to $\vec{a}$.

23. If A, B, C are angles in a triangle, then prove that $\cos^2 A + \cos^2 B + \cos^2 C = 1 + 2 \sin A \sin B \sin C$.

24. In a $\triangle ABC$, if $a = 13$, $b = 14$, $c = 15$, show that $R = \frac{65}{8}$, $r = 4$, $r_1 = \frac{21}{2}$, $r_2 = 12$ and $r_3 = 14$.



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