

Total No. of Questions—24

Total No. of Printed Pages—4

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Part III
MATHEMATICS
Paper I-B
(English Version)

Time : 3 Hours

Max. Marks : 75

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

SECTION A

10×2=20

- (I) Very short answer type questions :
- (i) Attempt ALL questions.
- (ii) Each question carries TWO marks.
1. Find the ratio in which the straight line $3x + 4y = 6$ divides the line joining the points $(2, -1)$ and $(1, 1)$. State whether the points lie on the same side or on either side of the straight line.
 2. Find the value of p , if the straight lines $3x + 7y - 1 = 0$ and $7x - py + 3 = 0$ are mutually perpendicular.
 3. Show that the points $A(3, 2, -4)$, $B(5, 4, -6)$ and $C(9, 8, -10)$ are collinear and find the ratio in which B divides \overline{AC} .
 4. Find the equation to the plane parallel to the ZX-plane and passing through $(0, 4, 4)$.
 5. Show that :

$$\lim_{x \rightarrow 2} -\frac{|x-2|}{x-2} = -1.$$

6. Compute :

$$\lim_{x \rightarrow -\infty} \frac{5x^3 + 4}{\sqrt{2x^4 + 1}}$$

7. If $f(x) = \cos [\log (\cot x)]$, then find $f'(x)$.
8. If $f(x) = 2x^2 + 3x - 5$, then prove that $f'(0) + 3f'(-1) = 0$.
9. The time t , of a complete oscillation of a simple pendulum of length l is given by $t = 2\pi\sqrt{\frac{l}{g}}$ where g is gravitational constant. Find the approximate percentage of error in t when the percentage of error in l is 1%.
10. Define stationary point with example.

SECTION B

5×4=20

(II) Short answer type questions :

- (i) Attempt ANY FIVE questions.
- (ii) Each question carries FOUR marks.

11. Find the equation of locus of P, if the line segment joining (2, 3) and (-1, 5) subtends a right angle at P.
12. When the origin is shifted to the point (2, 3), the transformed equation of a curve is :

$$x^2 + 3xy - 2y^2 + 17x - 7y - 11 = 0.$$

Find the original equation of the curve.

13. A straight line passing through A(1, -2) makes an angle $\tan^{-1}\left(\frac{4}{3}\right)$ with the positive direction of the X-axis in the anticlockwise sense. Find the points on the straight line whose distance from A is 5.

14. Check the continuity of the following function at 2 :

$$f(x) = \begin{cases} \frac{1}{2}(x^2 - 4) & \text{if } 0 < x < 2 \\ 0 & \text{if } x = 2 \\ 2 - 8x^{-3} & \text{if } x > 2 \end{cases}$$

15. Find the derivative of $f(x) = \cot x$ using the first principle.
16. A stone is dropped into a quiet lake and ripples move in circles at the speed of 5 cm/sec. At the instant when the radius of circular ripple is 8 cm, how fast is the enclosed area increases ?
17. Find the angle between the curves $y^2 = 8x$; $4x^2 + y^2 = 32$.

SECTION C

5×7=35

(III) Long answer type questions :

- (i) Attempt ANY FIVE questions.
- (ii) Each question carries SEVEN marks.
18. Find the equations of the straight lines passing through the point (1, 2) and making an angle of 60° with the line $\sqrt{3}x + y + 2 = 0$.
19. Find the centroid and the area of the triangle formed by the lines $3x^2 - 4xy + y^2 = 0$, $2x - y = 6$.
20. Show that the product of the perpendicular distances from the origin to the pair of straight lines represented by $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ is :

$$\frac{|c|}{\sqrt{(a-b)^2 + 4h^2}}$$

21. Find the angle between the lines whose direction cosines are given by the equations $3l + m + 5n = 0$ and $6mn - 2nl + 5lm = 0$.

22. Find the derivative of the function :

$$x^x + (\cot x)^x.$$

23. Find the equations of the tangents to the curve $y = 3x^2 - x^3$, where it meets the X-axis.

24. From a rectangular sheet of dimensions 30 cm \times 80 cm, four equal squares of side x cm are removed at the corners, and the sides are then turned up so as to form an open rectangular box. Find the value of x , so that the volume of the box is the greatest.