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STD: XII **HALF YEARLY-2020** **MARKS: 90**

SUBJECT: MATHEMATICS **TIME: 3.00 hrs**

PART- A

Note : (i) All questions are compulsory. **20x1=20**

(ii) Choose the most suitable answer from the given four alternatives and write the option code and the corresponding answer.

1. If $A^T A^{-1}$ is symmetric, then A^2 =

(1) A^{-1} (2) $(A^T)^2$ (3) A^T (4) $(A^{-1})^2$

2. If $A = \begin{bmatrix} \frac{3}{5} & \frac{4}{5} \\ x & \frac{3}{5} \end{bmatrix}$ and $A^T = A^{-1}$, then the value of x is

(1) $\frac{-4}{5}$ (2) $\frac{-3}{5}$ (3) $\frac{3}{5}$ (4) $\frac{4}{5}$

3. If $|z| = 1$, then the value of $\frac{1+z}{1+\bar{z}}$ is

(1) z (2) $\bar{z}$ (3) $\frac{1}{z}$ (4) 1

4. If z is a complex number such that $z \in C \backslash R$ and $z + \frac{1}{z} \in R$, then $|z|$ is

(1) 0 (2) 1 (3) 2 (4) 3

5. The polynomial $x^3 - kx^2 + 9x$ has three real roots if and only if, k satisfies

(1) $|k| \leq 6$ (2) $k = 0$ (3) $|k| > 6$ (4) $|k| \geq 6$

6. If z and ω be two complex numbers such that $\bar{z} + i\bar{\omega} = 0$ and $\arg z\omega = \pi$.Then $\arg z$ equals

(1) $\frac{\pi}{4}$ (2) $\frac{5\pi}{4}$ (3) $\frac{3\pi}{4}$ (4) $\frac{\pi}{2}$

7. $\sin(\tan^{-1} x), |x| < 1$ is equal to

(1) $\frac{x}{\sqrt{1-x^2}}$ (2) $\frac{1}{\sqrt{1-x^2}}$ (3) $\frac{1}{\sqrt{1+x^2}}$ (4) $\frac{x}{\sqrt{1+x^2}}$

8. Area of the greatest rectangle inscribed in the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$is

(1) 2ab (2) ab (3) $\sqrt{ab}$ (4) $\frac{a}{b}$

9. The focus of the parabola $y^2 - 8x - 2y + 17 = 0$ is

(1) (1, 4) (2) (3, 1) (3) (4, 1) (4) (1, 3)

10. Which of the complex number is nearer to origin?

(1) 1+ 4i (2) -3+ 2i (3) 4 - 3i (4) 1+ 2i

11. The tangent to the curve $y^2-xy+9 = 0$ is vertical when

(1) y = 0 (2) $y = \pm\sqrt{3}$ (3) $y = \frac{1}{2}$ (4) $y = \pm 3$

12. The maximum value of the product of two positive numbers, when their sum of the squares is 200, is

(1) 100 (2) $25\sqrt{7}$ (3) 28 (4) $24\sqrt{14}$

13. If $u = x^y y^x$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

(1) (x+y) u (2) (x+y+log u) u (3) x+y+log u (4) u (x+y+log u) u

14. If we measure the side of a cube to be 4 cm with an error of 0.1 cm, then the error in our calculation of the volume is

(1) 0.4 cu.cm (2) 0.45 cu.cm (3) 2 cu.cm (4) 4.8 cu.cm

15. The value of $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin^2 x \cos x dx$ is

(1) $\frac{3}{2}$ (2) $\frac{1}{2}$ (3) 0 (4) $\frac{2}{3}$

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

(1) 4 (2) 1 (3) 3 (4) 2

17. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ then A∧ B

(1) $\begin{bmatrix} 0 & 1 \\ 1 & 1 \end{bmatrix}$ (2) $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ (3) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ (4) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$

18. The solution of the differential equation $y\,dx + (x + x^2y)dy = 0$ is

(1) $\frac{1}{xy} = c$ (2) $\frac{-1}{xy} + \log y = c$ (3) $\frac{1}{xy} + \log y = c$ (4) $\log y = cx$

19. Which of the following is a discrete random variable?

I. The number of cars crossing a particular signal in a day.
II. The number of customers in a queue to buy train tickets at a moment.
III. The time taken to complete a telephone call.

(1) I and II (2) II only (3) III only (4) II and III

20. The operation $*$ defined by $a * b = \frac{ab}{7}$ is not a binary operation on

(1) Q^+ (2) Z (3) R (4) C

PART – B

Note: (i) Answer any 7 questions. **7X2 = 14**

(ii) Questions No. 30 is compulsory and choose any six questions from the remaining.

21. Solve 6x-7y = 16, 9x-5y = 35, By using Cramer's Rule.

22. Simplify $\left(\frac{1+i}{1-i}\right)^3 - \left(\frac{1-i}{1+i}\right)^3$.

23. If $x^2+2(k+2)x+9k = 0$ has equal roots, find k .

24. For what value of x, the inequality $\frac{\pi}{2} < \cos^{-1}(3x-1) < \pi$ holds?

25. The line $3x+4y-12 = 0$ meets the coordinate axes at A and B. Find the equation of the circle drawn on AB as diameter.

26. Find the length of the perpendicular from the point $(1,-2,3)$ to the plane $x- y+z = 5$.

27. The sides of the equilateral triangle are increasing at the rate of 2 cm/ sec. Find the rate at which its area increases , when side is 10 cm long.

28. Solve $\frac{dy}{dx} + \frac{y}{x} = \sin x$

29. Prove that, In an algebraic structure the identity element (if exists) must be unique.

30. Evaluate : $\int_1^2 \frac{x^3-1}{x^2}\, dx$

PART – C

Note: (i) Answer any 7 questions. **7 X 3 = 21**

(ii) Questions No. 40 is compulsory and choose any six questions from the remaining...

31. If $A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, show that $A^{-1} = \frac{1}{2}(A^2 - 3I)$.

32. Find the fourth roots of unity.

33. Solve: $(2x-1)(x+3)(x-2)(2x+3) + 20 = 0$.

34. Prove that $[\vec{a} - \vec{b}, \vec{b} - \vec{c}, \vec{c} - \vec{a}] = 0$

35. Evaluate : $\lim_{x \to 0^+} x \log x$

36. Solve $sin\ \frac{dy}{dx} = a, y(0) = 1$

37. Construct the truth table for $(p \bar{\vee} q) \wedge (p \bar{\vee} \neg q)$.

38. If $y = 2\sqrt{2}x + c$ is a tangent to the circle $x^2 + y^2 = 16$, find the value of c.

39. Prove that $\int_0^{\frac{\pi}{4}} \log(1 + \tan x)\, dx = \frac{\pi}{8} \log 2$.

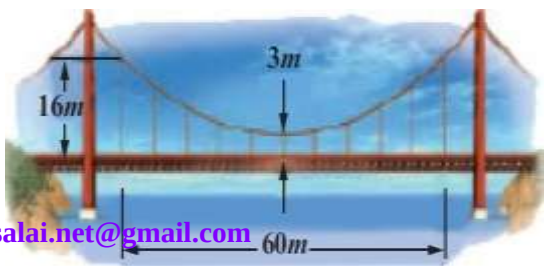
40. Find the value, if it exists. If not, give the reason for non-existence. $\tan^{-1}\left(\sin\left(\frac{-5\pi}{2}\right)\right)$

PART – D

Note: Answer all questions. **7 X 5 = 35**

41. (a) If $A = \begin{bmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{bmatrix}$ are square matrices, find A.B and hence solve the system of equations x-y = 3, 2x+3y+4z = 17, y+2z = 7. **(OR)**

(b) Parabolic cable of a 60m portion of the road



bed of a suspension bridge are positioned as shown below. Vertical Cables are to be spaced every 6m along this portion of the roadbed. Calculate the lengths of first two of these vertical cables from the vertex.

42. (a) Suppose a person deposits 10,000 Indian rupees in a bank account at the rate of 5% per annum compounded continuously. How much money will be in his bank account 18 months later? **(OR)**

(b) Find all cube roots of $\sqrt{3}+ i$.

43.(a) Solve the equation: $x^4-14x^2+45 = 0$ **(OR)**

(b) Using vector method, prove that $\cos(\alpha-\beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$

44.(a) Sketch the curve $y = f(x) = x^3 - 6x - 9$ **(OR)**

(b) If $f(x,y) = \sin(xy^2) + e^{x^3+5y}$ for all $(x, y)\in \mathbb{R}^2$ verify $\frac{\partial^2 f}{\partial y \partial x} = \frac{\partial^2 f}{\partial x \partial y}$

45.(a) A hollow cone with base radius a cm and height b cm is placed on a table. Show that the volume of the largest cylinder that can be hidden underneath is $\frac{4}{9}$ times volume of the cone. **(OR)**

(b) Verify (i) closure property, (ii) commutative property, (iii) associative property, (iv) existence of identity, and (v) existence of inverse for the operation $\times_{11}$ on a subset A = {1,3,4,5,9}of the set of remainders {0,1,2,3,4,5,6,7,8,9,10}.

46.(a) A watermelon has an ellipsoid shape which can be obtained by revolving an ellipse with major-axis 20 cm and minor-axis 10 cm about its major-axis. Find its volume using integration **(OR)**

(b) If X is the random variable with probability density function f (x) given by,

$$f(x) = \begin{cases} x-1, & 1 \le x < 2 \\ -x+3, & 2 \le x < 3 \\ 0 & \text{Otherwise} \end{cases}$$

find (i) the distribution function F(x) (ii) P(1.5≤X≤2.5)

47.(a) Prove that $2\tan^{-1}\left(\frac{1}{5}\right) + \sec^{-1}\left(\frac{5\sqrt{2}}{7}\right) + 2\tan^{-1}\left(\frac{1}{8}\right) = \frac{\pi}{4}$ **(OR)**

(b) Find the area of the region bounded by $y = \sin^{-1}x$, $y = \cos^{-1}x$ and x-axis.

&&&&& HARD WORK NEVER FAILS &&&&&