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COMMON HALF YEARLY EXAMINATION – 2022

Standard XII

Reg.No. : | | | | | | |

MATHEMATICS

Time: 3.00 hrs. **Marks: 90**

Part - I

I. Choose the correct answer: **20 x 1 = 20**

1. If $A = \begin{pmatrix} 7 & 3 \\ 4 & 2 \end{pmatrix}$, then $9I_2 - A =$

a) A^{-1} b) $\frac{A^{-1}}{2}$ c) $3A^{-1}$ d) $2A^{-1}$

2. If A and B are any two matrices such that AB = 0 and A is non-singular, then

a) B is non-singular b) B is singular

c) B = 0 d) B = A

3. If $|Z_1| = 1$, $|Z_2| = 2$, $|Z_3| = 3$ and $|9Z_1 Z_2 + 4Z_1 Z_3 + Z_2 Z_3| = 12$ then the value of $|Z_1 + Z_2 + Z_3|$ is

a) 1 b) 2 c) 3 d) 4

4. A polynomial equation in x of degree n always has

a) n distinct roots b) n real roots

c) n complex roots d) atmost one root

5. If $\sin^{-1} x/5 + \text{cosec}^{-1} 5/4 = \pi/2$, then the value of x is

a) 4 b) 5 c) 2 d) 3

6. The radius of the circle $3x^2 + by^2 + 4bx - 6by + b^2 = 0$ is

a) 1 b) 3 c) $\sqrt{10}$ d) $\sqrt{11}$

7. $16x^2 - 3y^2 - 32x - 12y - 44 = 0$ represents

a) an ellipse b) a circle c) a parabola d) a hyperbola

8. Distance from the origin to the plane $3x - 6y + 2z + 7 = 0$ is

a) 0 b) 1 c) 2 d) 3

9. If the projection of $\vec{a}$ on $\vec{b}$ and projection of $\vec{b}$ on $\vec{a}$ are equal then the angle between $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ is

a) $\pi/2$ b) $\pi/3$ c) $\pi/4$ d) $2\pi/3$

10. The slope of the line normal to the curve $f(x) = 2\cos 4x$ at $x = \frac{\pi}{12}$ is

a) $-4\sqrt{3}$ b) -4 c) $\sqrt{3}/12$ d) $4\sqrt{3}$

11. The minimum value of the function $|3 - x| + 9$ is

a) 0 b) 3 c) 6 d) 9

12. If $w(x,y,z) = x^2(y - z) + y^2(z - x) + z^2(x - y)$, then $\frac{\partial w}{\partial x} + \frac{\partial w}{\partial y} + \frac{\partial w}{\partial z}$ is

a) xy + yz + zx b) x(y + z) c) y(z + x) d) 0

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13. The value of $\int_0^{\frac{\pi}{2}} \sin^6 x\,dx$ is

a) $\pi/2$ b) $5\pi/32$ c) $\pi/32$ d) $5\pi/16$

14. The value of $\int_0^{\infty} e^{-3x} x^2\,dx$ is

a) $7/27$ b) $5/27$ c) $4/27$ d) $2/27$

15. The order of the differential equation of all circles with centre at (h,k) and radius a is

a) 2 b) 3 c) 4 d) 1

16. The number of arbitary constants in the particular solution of a differential equation of third order is

a) 3 b) 2 c) 1 d) 0

17. 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

a) I and II b) II only c) III only d) II and III

18. Let X have a Bernoulli distribution with mean 0.4, then the variance (2X - 3) is

a) 0.24 b) 0.48 c) 0.6 d) 0.96

19. Subtraction is not a binary operation in

a) R b) Z c) N d) Q

20. In the last column of the truth table for $\sim(p \vee \sim q)$ the number of final outcomes of the truth value F are

a) 1 b) 2 c) 3 d) 4

Part - II

II. Answer any 7 questions. (Q.No.30 is compulsory) **7 x 2 = 14**

21. Find the rank of the matrix $\begin{pmatrix} 1 & -2 & 3 \\ -2 & 4 & -6 \\ 5 & 1 & -1 \end{pmatrix}$

22. Simplify : $\sum_{n=1}^{10} i^{n+50}$

23. Find the value of $\cos^{-1}\left(\cos\frac{\pi}{7}\cos\frac{\pi}{17} - \sin\frac{\pi}{7}\sin\frac{\pi}{17}\right)$

24. Find the equation of the tangent at t = 2 to the parabola $y^2 = 8x$ (use parametric form)

25. Find the acute angle between the planes $\vec{r}.(2\vec{i} + 2\vec{j} + 2\vec{k}) = 11$ and $4x - 2y + 2z = 15$.

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26. Evaluate : $\lim_{x \to 0} + (x \log x)$

27. If $w(x,y) = x^3 - 3xy + 2y^2$, $x,y \in R$, find the linear approximation for w at $(1, -1)$

28. Evaluate: $\int_2^3 \frac{\sqrt{x}}{\sqrt{5-x} + \sqrt{x}} dx$

29. Form the differential equation by eliminating the arbitrary constants A and B from $y = A \cos x + B \sin x$

30. Suppose that f(x) given below represents a probability mass function.

x	1	2	3	4	5	6
f(x)	k^2	$2k^2$	$3k^2$	$4k^2$	k	$2k$

Find the value of K.

Part - III

III. Answer any 7 questions: (Q.No.40 is compulsory) **7 x 3 = 21**

31. Verify the property $(A^T)^{-1} = (A^{-1})^T$ with $A = \begin{pmatrix} 2 & 9 \\ 1 & 7 \end{pmatrix}$

32. Find the square root of 6– 8i

33. Show that the equation $x^9 - 5x^5 + 4x^4 + 2x^2 + 1 = 0$ has atleast 6 imaginary soluations.

34. If the equatin $3x^3 + (3 - p)xy + qy^2 - 2px = 8pq$ represents a circle, find p and q. Also determine and radius of the circle.

35. Show that the four points (6, –7, 0), (16, –19, –4), (0, 3, –6), (2, –5,10) lie on a same plane.

36. Find two positive numbers whose sum is 100 and their product is maximum.

37. If the radius of a sphere, with radius 10 cm, has to decrease by 0.1 cm, approximately how much will its volume decrease?

38. Find the volume of a sphere of radius a.

39. Solve: $x \frac{dy}{dx} + y = x \log x$

40/ Establish the equivalence property connecting the bi-conditional with conditional:
$p \leftrightarrow q \equiv (p \rightarrow q) \wedge (q \rightarrow p)$

Part - IV

IV. Answer all the questions: **7 x 5 = 35**

41. a) By using Gaussian elimination method, balance the chemical reaction equation
$C_2H_6 + O_2 \rightarrow H_2O + CO_2$

(OR)

b) $z = x + iy$ and $\arg\left(\frac{z-1}{z+1}\right) = \frac{\pi}{3}$, show that $\sqrt{3}x^2 + \sqrt{3}y^2 - 2y - \sqrt{3} = 0$

42. a) Solve the equation :- $(2x - 3)(6x - 1)(3x - 2)(x - 2) - 5 = 0$

(OR)

b) If $\tan^{-1}x + \tan^{-1}y + \tan^{-1}z = \pi$, show that $x + y + z = xyz$.

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43. a) Show that the line $x - y + 4 = 0$ is a tangent to the ellipse $x^2 + 3y^2 - 12$. Also find the coordinates of the point of contact.

(OR)

b) Find the parametric form of vector equation, and Cartesian equation of the plane containing the line $\vec{r} = (\vec{i} - \vec{j} + 3\vec{k}) + (2\vec{i} - \vec{j} + 4\vec{k})$ and perpendicular to plane $\vec{r}.(\vec{i} + 2\vec{j} + \vec{k}) = 8$

44. a) By vector method, prove that $\cos(\alpha + \beta) = \cos\alpha \cos\beta - \sin\alpha \sin\beta$

(OR)

b) A conical water tank with vertex down of 12 metres height has a radius of 5 metres at the top. If water flows into the tank at a rate 10 cubic m/min, how fast is the depth of the water increases when the water is 8 metres deep?

45. a) If $U - \sin^{-1}\left[\frac{x+y}{\sqrt{x}+\sqrt{y}}\right]$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \frac{1}{2}\tan u$

(OR)

b) Find the area of the region bounded by $y = \cos x$, $y = \sin x$, the lines $x = \pi/4$ and $x = 5\pi/4$.

46. a) Solve : $\frac{dy}{dx} = \frac{x-y+5}{2(x-y)+7}$

(OR)

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.

47. a) Suppose a discrete random variable can only take the values 0,1 and 2. The probability mass function is defined by

$$f(x) = \begin{cases} \frac{x^2+1}{k}, & \text{for } x = 0,1,2 \\ 0, & \text{otherwise} \end{cases}$$

Find

1) the value of k
2) Cumulative distribution function
3) $p(X \geq 1)$

(OR)

Verify

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

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