KENDRIYA VIDYALAYA SANGATHAN, PATNA REGION

PRE-BOARD I (2025-26)

Class: 12 **F.M: 80** **(SET-A)**

Subject: Mathematics **Time: 3Hrs**

General Instructions:

1. All questions are compulsory.

2. The question paper consists 38 questions divided into 5 sections A, B, C, D &E.

3. Section A consist 18 MCQ and 2 ASSERTION-REASON BASED QUESTIONScarry 1 mark each, section B consist 5questions carry 2 mark each, section Cconsist 6 questions carry 3 mark each, section D consist 4 questions carry 5 mark each, section E consist 3 questions (CASE BASED STUDY) carry 4 marks each.

4. There is no overall choice. However, and internal choice has been provided in 2 questions in section B, 3 questions in section C, 2 questions in sections D & 2 questions in sections E

5. Use of calculator is not permitted.

Section A

1. The maximum number of equivalence relation on the set A= {1,2,3} are

(a) 1 **(b) 2**

(c) 3 **(d) 5**

2. Set A has 3 elements and the set B has 4 elements, then the number of injective function that can be defined from A to B is

(a) 144 **(b) 12**

(c) 24 **(d) 64**

3. If $y = sin^{-1}x, -1 \leq x \leq 0$ then the range of y is

(a) $(\frac{-\pi}{2}, 0)$ **(b)** $[\frac{-\pi}{2}, 0]$

(c) $[\frac{-\pi}{2}, 0)$ **(d)** $(\frac{-\pi}{2}, 0]$

4. If $A = \begin{bmatrix} a & c & -1 \\ b & 0 & 5 \\ 1 & -5 & 0 \end{bmatrix}$ is a skew symmetric metrix, then the value of 2a-(b+c) is

(a) 0 **(b) 1**

(c) -10 **(d) 10**

5. For a square matric $A, A^2 - 3A + I = 0$ and $A^{-1} = xA + yI$ then the value of x+y is

(a) -2 **(b) 2**

(c) 3 **(d) -3**

6. If $|A|$=2, where A is a 2×2 matrix then $|4A^{-1}|$ equals

(a) 4 **(b) 2**

(c) 8 **(d)** $\frac{1}{32}$

7. The value of k for which $f(x) = \begin{cases} 3x + 5, & x \geq 2 \\ kx^2, & x < 2 \end{cases}$ is a continuous function, is

(a) $\frac{-11}{4}$ (b) $\frac{4}{11}$
(c) 11 (d) $\frac{11}{4}$

8. The function f(x)=[x], where [x] denotes the greatest integer function, is continuous at

(a) 4 (b) -2
(c) 3 (d) 1.5

9. If $siny = x.cos(a + y)$ then $\frac{dy}{dx}$ is

(a) $\frac{cos\ a}{cos^2(a+y)}$ (b) $\frac{-cos\ a}{cos^2(a+y)}$
(c) $\frac{cos\ a}{sin^2 y}$ (d) $\frac{-cos\ a}{sin^2 y}$

10. If $x = A\ cos4t + B\ sin4t$ then $\frac{d^2x}{dt^2}$ is equal to

(a) X (b) –x
(c) 16x (d) -16x

11. The function $f(x) = x^2 - 4x + 6$ is increasing in the interval

(a) $(0, 2)$ (b) $(-\infty, 2]$
(c) $[1, 2]$ (d) $[2, \infty)$
(e)

12. $\int e^x[sec\ x(1 + tan\ x)]\ dx$ is

(a) $e^x.cos\ x + c$ (b) $e^x.sec\ x + c$
(c) $e^x.tan\ x + c$ (d) $e^x.cot\ x + c$

13. $\int_{-1}^{1} x|x|\ dx$ is

(a) $\frac{1}{6}$ (b) $\frac{1}{3}$
(c) $-\frac{1}{6}$ (d) 0

14. Area of the region bounded by the curve $y^2 = 4x$ and the x-axis between x=0 and x=1 is

(a) $\frac{2}{3}$ (b) $\frac{8}{3}$
(c) 3 (d) $\frac{4}{3}$

15. The difference of order and degree of the differential equation $\frac{d}{dx}\left(\frac{dy}{dx}\right)^3 = 0$ is

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

16. The value of P for which the vectors $2\hat{\imath} + p\hat{\jmath} + \hat{k}$ and $-4\hat{\imath} - 6\hat{\jmath} + 26\hat{k}$ are perpendicular to each other, is

(a) 3 (c) -3
(c) $\frac{-17}{3}$ (d) $\frac{17}{3}$

17. If the points $P(a, b, 0)$ lies on the line $\frac{x+1}{2} = \frac{y+2}{3} = \frac{z+3}{4}$, then$(a, b)$ is

(a) (1,2) **(b) $\left(\frac{1}{2}, \frac{2}{3}\right)$**

(c) $\left(\frac{1}{2}, \frac{1}{4}\right)$ **(d) (0,0)**

18. The objective function $Z = ax + by$ of an LPP has maximum value 42 at (4,6) and minimum value 19 at (3,2), which of the following is true?

(a) a=9, b=1 **(b) a=9, b=2**

(c) a=3, b=5 **(d) a=5, b=3**

ASSERTION-REASON BASED QUESTIONS

Question number 19 & 20 are Assertions(A) and Reason(R) based question carrying 1 mark each. The two statements are given, one labelled Assertion(A) & one labelled Reason(R). Select the correct answer from the option given below.

(a) **Both A and R are true and R is the correct explanation of A.**

(b) **Both A and R are true but R is not the correct explanation of A.**

(c) **A is true but R is false.**

(d) **A is false but R is true.**

19. Assertion(A): In a linear programming problem if the feasible region is empty, then the linear programming problem has no solution.
Reason(R): A feasible region is defined as the region that satisfies all the constraints.

20. Assertion(A): If $P(A) = \frac{1}{2}, P(A \cap B) = \frac{1}{3}$, then $P(A/B) = \frac{2}{3}$

Reason(R): $P(B/A) = \frac{P(A \cap B)}{P(A)}$

Section B

21. Find k so that $f(x) = \begin{cases} \frac{x^2-2x-3}{x+1}, & x \neq -1 \\ k, & x = -1 \end{cases}$ is continuous at $x = -1$

[OR]

Check the differentiability of the function $f(x) = x|x|$ at $x = 0$

22. If $A = \begin{bmatrix} 2 & 0 & 0 \\ -1 & 2 & 3 \\ 3 & 3 & 5 \end{bmatrix}$, then find A(adjA)

23. Simplify $sin^{-1}\left(\frac{x}{\sqrt{1+x^2}}\right)$

[OR]

Find the domain of $\sin^{-1}\sqrt{x-1}$

24. Find the values of a for which $f(x) = x^2 - 2ax + b$ is an increasing function for $x > 0$.

25. Calculate the area of the region bounded by the curve $\frac{x^2}{9} + \frac{y^2}{4} = 1$ and the x-axis using Integration.

Section C

26. Show that the relation R in the set $A = \{x \in Z: 0 \leq x \leq 12\}$ given by $R = \{(a, b): a, b \in Z, |a - b| \text{ is divisible by } 3\}$ is an equivalence relation.

[OR]

Let $A = R - \{2\}$ and $B = R - \{1\}$. If $f: A \to B$ is a function defined by $f(x) = \frac{x-1}{x-2}$, show that f is a bijective function.

27. Find $\frac{dy}{dx}$, if $(Cosx)^y = (Cosy)^x$

[OR]

If $x = a(\theta - \sin\theta), y = a(1 - \cos\theta), a > 0$, then find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{3}$.

28. Find $\int_0^{\frac{\pi}{4}} \frac{x+sin\,x}{1+cos\,x}\,dx$.

29. Let $\vec{a} = \hat{\imath} + 4\hat{\jmath} + 2\hat{k}$, $\vec{b} = 3\hat{\imath} - 2\hat{\jmath} + 7\hat{k}$ and $\vec{c} = 2\hat{\imath} - \hat{\jmath} + 4\hat{k}$. Find a vector $\vec{d}$ which is perpendicular to both $\vec{a}$ and $\vec{b}$ and $\vec{c}.\vec{d} = 18$.

30. Solve the following linear programming problem graphically:

Maximise $Z = 3x + 9y$

Subject to constraints:

$$x + y \geq 10, x + 3y \leq 60, x \leq y, x \geq 0, y \geq 0.$$

31. The probability of two students A and B coming to school in time are $\frac{2}{7}$ and $\frac{4}{7}$ respectively. Assuming that the events 'A coming on time' and 'B coming on time' are independent. Find the probability of only one of them coming to school on time

[OR]

A committee of 4 students is selected at random from a group consisting of 7 boys and 4 girls. Find the probability that there are exactly 2 boys in the committee, given that at least one girl must be there in the committee.

Section D

32. If $A = \begin{bmatrix} 1 & 2 & 0 \\ -2 & -1 & -2 \\ 0 & -1 & 1 \end{bmatrix}$ then find A^{-1}. Hence solve the system of linear equations:

$x - 2y = 10;\ 2x - y - z = 8\ and - 2y + z = 7$

33. Evaluate: $\int \frac{5x+3}{\sqrt{x^2+4x+10}}\,dx$

[OR]

Evaluate: $\int_0^{\pi} \frac{x}{a^2cos^2x+b^2sin^2x}\,dx$

34. Find the particular solution of the differential equation $x\frac{dy}{dx} + xcos^2\frac{y}{x} = y$; given that when $x = 1, y = \frac{\pi}{4}$.

[OR]

Find the general solution of the differential equation:

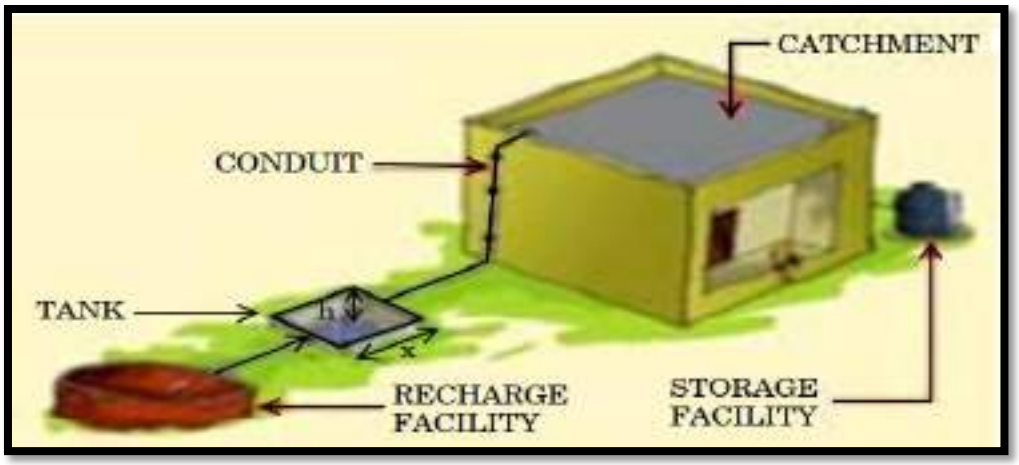
$$(x^2 + 1)\frac{dy}{dx} + 2xy = \sqrt{x^2 + 4}$$

35. Find the shortest distance between the lines: $\frac{x+1}{2} = \frac{y-1}{1} = \frac{z-9}{-3}$ and $\frac{x-3}{2} = \frac{y+15}{-7} = \frac{z-9}{5}$.

Section E (CASE STUDY)

36. In order to set up a rain water harvesting system, a tank to collect rain water is to be dug. The tank should have a square base and a capacity of 250 m^3. The cost of land is ₹ 5,000 per square metre and cost of digging increases with depth and for the whole tank, it is ₹40,000 h^2, where h is the depth of the tank in metres. x is the side of the square base of the tank in metres.

ELEMENTS OF A TYPICAL RAIN WATER HARVESTING SYSTEM



Based on the above information, answer the following questions:

(i) Find the total cost C of digging the tank in terms of x.

(ii) Find $\frac{dc}{dx}$.

(iii) Find the value of x for which cost C is minimum.

[OR]

Check whether the cost function C(x) expressed in terms of x is increasing or not, Where x>0.

37. The equation of motion of a missile are x = 3t, y = − 4t, z = t, where the time 't' is given in seconds, and the distance is measured in kilometres.

(i) Write the path of the missile.

(ii) Find the distance of the missile from the starting point (0, 0, 0) in 5 seconds.

(iii) If the position of the missile at a certain instant of the time is (5, -8, 10). Find the height of the missile from the ground? (Ground considered as xy – plane)

[OR]

Find the value of k for which the lines $\frac{x-1}{2}=\frac{y-1}{3}=\frac{z-1}{k}$ and $\frac{x-2}{-2}=\frac{y-3}{-1}=\frac{z-5}{7}$ are perpendicular?

38. A bank offers loans to its customers on different types of interest namely, fixed rate, floating rate, and variable rate. From the past data with the bank, it is known that a customer avails loan on fixed rate, floating rate, or variable rate with probabilities 10%, 20%, and 70% respectively. A customer after availing loan can pay the loan or default on loan repayment. The bank data suggests that the probability that a person defaults on loan after availing it at fixed rate, floating rate, and variable rate is 5%, 3%, and 1% respectively.

Based on the above information, answer the following:

(i) What is the probability that a customer after availing the loan will default on the loan repayment?

(ii) A customer after availing the loan, defaults on loan repayment. What is the probability that he availed the loan at a variable rate of interest?

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