

Question – Paper

Preboard Exam 2021 -22

Higher Secondary School Certificate Exam 2021 -22

Sub : Higher Mathematics

Class : 12

Time : 3 Hours

Max.Marks : 80

Instructions :

- 1. All the questions are compulsory.**
- 2. Marks allotted for the questions are mentioned against them.**
- 3. Questions from 1 to 5 are objective type questions.**
- 4. Internal choices have been provided for the questions from 6 to 23.**
- 5. Questions from 6 to 15 each carries 2 marks.**
- 6. Questions from 16 to 19 each carries 3 marks.**
- 7. Questions from 20 to 23 each carries 4 marks.**

Q.1 Choose the correct option:

1 × 6 = 6

(i). let $f: R \rightarrow R$, be defined by $f(x) = 3x - 4$ then $f^{-1}(x) =$

- (a) $\frac{x+4}{3}$ (b) $\frac{x}{3} - 4$ (c) $3x + 4$ (d) None of the above

(ii). let R be the relation in the set N given by $R = \{(a, b): a = b - 2, b > 6\}$. Choose the correct answer:

- (a) $(2, 4) \in R$ (b) $(3, 8) \in R$ (c) $(6, 8) \in R$ (d) $(8, 7) \in R$

(iii). $\tan^{-1}\sqrt{3} - \sec^{-1}(-2) =$

- (a) π (b) $-\frac{\pi}{3}$ (c) $\frac{\pi}{3}$ (d) $\frac{2\pi}{3}$

(iv). $A = [a_{ij}]_{m \times n}$ is a square matrix, if

- (a) $m < n$ (b) $m > n$ (c) $m = n$ (d) None of the above

(v). let A be a nonsingular squar matrix of order 3×3 . Then $|\text{adj}A|$ is equal to :

- (a) $|A|$ (b) $|A|^2$ (c) $|A|^3$ (d) $3|A|$

(vi). Derivative of 5^x with respect to x is :

- (a) $5^x \log_e 5$ (b) $5^x \log_5 e$ (c) 5^x (d) $\frac{5^x}{\log_e a}$

Q. 2. Fill in the blanks:

1 × 7 = 7

- (i). If $f(x) = 1 - \cos x$ Then value of $f' \left(\frac{\pi}{4} \right)$ is
- (ii). $\int_0^{2/3} \frac{dx}{4+9x^2}$ is equal to
- (iii). Order of a differential equation $2x^2 \frac{d^2y}{dx^2} - 3 \frac{dy}{dx} + y = 0$ is.....
- (iv). If angle between two vectors \vec{a} and \vec{b} is θ then $|\vec{a} \cdot \vec{b}| = |\vec{a} \times \vec{b}|$ when θ is equal to
- (v). Any point in feasible region that gives optimal value of the objective functions is called.....
- (vi). If two events such that the probability of occurrence of one of them is not affected by occurrence of the other; are called.....
- (vii). Any point outside the feasible region is an.....

Q. 3. Match the columns :

1 × 6 = 6

- | | |
|---------------------------------------|--|
| (i) $\int \frac{dx}{\sqrt{x^2-a^2}}$ | (a) $\frac{1}{a} \tan^{-1} \frac{x}{a} + c$ |
| (ii) $\int \frac{dx}{\sqrt{a^2-x^2}}$ | (b) $\frac{1}{2a} \log \left[\frac{a+x}{a-x} \right] + c$ |
| (iii) $\int \frac{dx}{x^2+a^2}$ | (c) $\sin^{-1} \frac{x}{a} + c$ |
| (iv) $\int \frac{dx}{x^2-a^2}$ | (d) $\log x + \sqrt{x^2-a^2} + c$ |
| (v) $\int \sqrt{x^2+a^2}$ | (e) $\frac{1}{2} x \sqrt{a^2-x^2} + \frac{a^2}{2} \sin^{-1} \frac{x}{a} + c$ |
| (vi) $\int \sqrt{a^2-x^2}$ | (f) $\frac{1}{2} x \sqrt{x^2+a^2} + \frac{a^2}{2} \log x + \sqrt{x^2+a^2} + c$ |

Q. 4. Answer in one word / sentence:

1 × 7 = 7

- (i). For what value of x , will the matrix $\begin{bmatrix} 6-x & 4 \\ 3-x & 1 \end{bmatrix}$ be Singular.
- (ii). Find the value of m , if the line $y = mx + c$ is a tangent to curve $y^2 = 4x$.
- (iii). Find the value of $\int x^2 e^{x^3} dx$
- (iv). Find the value of $i \times (j \times k) + j \cdot (i \times k) + k \cdot (i \times j)$
- (v). Write equation of a yz -plane
- (vi). When a pair of dice is rolled, what is the probability of obtaining an even prime number on each die.
- (vii) find $P(A/B)$, if $P(A) = \frac{1}{2}$ and $P(B) = 0$

Q. 5. Write True / False for the following sentences:

1 × 6 = 6

- (i). If $f: R \rightarrow R$ be given by $f(x) = (3 - x^3)^{1/3}$ then $(f \circ f) = x$
- (ii). Domain of $\cos^{-1}x$ is $R - (-1, 1)$
- (iii). If $\cos \alpha, \cos \beta, \cos \gamma$ are direction cosines of a line then $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = \frac{4}{3}$
- (iv). Area of region bounded by the curve $y^2 = 4x$, y -axis and the line $y = 3$ is $\frac{9}{4}$ square units.
- (v). The vector sum of the three sides of a triangle taken in order is 0.
- (vi). The planes: $2x - y + 4z = 5$ and $5x - 2.5y + 10z = 0$ are parallel

Q6. If $A = \{1, 2, 3\}$, $B = \{4, 5, 6, 7\}$ and let $f = \{(1,4) (2,5) (3,6)\}$ be a function from A to B . Show that f is one-one. **2**

(or)

Show that the relation in the set $\{1, 2, 3\}$ given by $R = \{(1,2) (2,1)\}$ is symmetric.

Q 7. Simplify $\cos \theta \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix} + \sin \theta \begin{bmatrix} \sin \theta & -\cos \theta \\ \cos \theta & \sin \theta \end{bmatrix}$ **2**

(or)

Find the value of X if $Y = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$ and $2X + Y = \begin{bmatrix} 1 & 0 \\ -3 & 2 \end{bmatrix}$

Q.8. Find the value of k , if function

2

$$f(x) = \begin{cases} x \sin\left(\frac{1}{x}\right) & ; x \neq 0 \\ k & ; x = 0 \end{cases} \text{ is continuous at } x = 0$$

(or)

Is function $f(x) = x^2 - \sin x + 5$, continuous at $x = \pi$

Q.9 Find the rate of change of area of a circle with respect to r when $r = 5\text{cm}$ 2

(or)

Find points on the curve $\frac{x^2}{9} + \frac{y^2}{16} = 1$ at which the tangents are parallel to

x - axis

Q.10. Find the value of $\int \frac{\sec^2(\log x)}{x} dx$

2

(or)

Find the value of $\int \frac{\sin \sqrt{x}}{\sqrt{x}} dx$

Q.11 Find the value of $\int_{-1}^1 \sin^5 x \cdot \cos^4 x dx$

2

(or)

Find the value of $\int_0^{\frac{\pi}{2}} \cos^2 x dx$

Q.12. Find unit vector in the direction of the vector $\vec{a} = \vec{i} + \vec{j} + 2\vec{k}$

2

(or)

Find angle between vectors $\vec{i} + 2\vec{j} + 3\vec{k}$ and $3\vec{i} - 2\vec{j} + \vec{k}$

Q.13. Find the distance of a plane $2x - 3y + 4z - 6 = 0$ from the origin.

2

(or)

Find the equation of line $\frac{x+3}{2} = \frac{y-5}{4} = \frac{z+6}{2}$ in vector form.

Q14. Find the vector equation of the plane which is at a distance of 7 from the origin and its normal vector from the origin is $3\hat{i} + 5\hat{j} - 6\hat{k}$. 2

(or)

Find the equation of the plane with intercepts 2, 3 and 4 on the x, y and z - axis respectively

Q. 15. Find value of $P(A/B)$ if $P(B)=0.5$ and $P(A \cap B) = 0.32$ 2

(or)

Find value of $P(A \cap B)$, if $P(A) = 0.3$, $P(B) = 0.6$ and if A and B are independent events.

Q.16 Solve $\tan^{-1}2x + \tan^{-1}3x = \frac{\pi}{4}$ 3

(or)

Prove that $2\tan^{-1}\frac{1}{2} + \tan^{-1}\frac{1}{7} = \tan^{-1}\frac{31}{17}$

Q.17. If $A = \begin{bmatrix} 1 & -2 & 3 \\ -4 & 2 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 3 \\ 4 & 5 \\ 2 & 1 \end{bmatrix}$ then show that $(AB)' = B'A'$ 3

(or)

Express the matrix $\begin{bmatrix} 5 & 2 \\ 3 & -6 \end{bmatrix}$ as the sum of a symmetric and a skew symmetric matrix.

Q.18. Find the maximum value of the function : $\sin x + \cos x$ 3

(or)

Find the equation of normal of the curve $x = 1 - \cos\theta$ and $y = \theta - \sin\theta$ at $\theta = \frac{\pi}{4}$

Q.19. Minimise $Z = 3x + 2y$, subject to the constraints : 3

$$x + y \geq 8, \quad 3x + 5y \leq 15, \quad x \geq 0, \quad y \geq 0,$$

(or)

Maximise $Z = 3x + 4y$, subject to the constraints :

$$x + y \leq 4, \quad x \geq 0, \quad y \geq 0,$$

Q.20. Applying the properties of determinants: 4

and prove that :
$$\begin{vmatrix} 1+a & 1 & 1 \\ 1 & 1+b & 1 \\ 1 & 1 & 1+c \end{vmatrix} = abc \left(1 + \frac{1}{a} + \frac{1}{b} + \frac{1}{c} \right)$$

(or)

If $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$ then prove that : $A \cdot (\text{adj}A) = |A| \cdot I$

Q.21. Differentiate the function: $x^{\sin x} + (\sin x)^{\cos x}$ with respect to x 4

(or)

Find $\frac{dy}{dx}$ if $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$

Q.22. Find the area enclosed by the ellipse $\frac{x^2}{16} + \frac{y^2}{9} = 1$ 4

(or)

Find the area of the smaller part of the circle $x^2 + y^2 = a^2$ cut off by line $x = \frac{a}{\sqrt{2}}$

Q.23 Find the general solution of the differential equation: 4

$$(x^2 - y^2)dx + 2xydy = 0$$

(or)

Solve the differential equation : $(\tan^{-1}y - x)dy + (1 + y^2)dx = 0$

.....

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