UP Board Class 12 Mathematics 2026 (Set 324 CZ) Question Paper

collegedunia

General Instructions

(i) This question paper contains 9 questions. All questions are compulsory.

(ii) It comprises 5 single-correct multiple-choice questions.

(iii) Attempt every question; detailed solutions are provided in the companion solutions booklet.

1(a). $f : X \to Y$ will be an onto function if and only if its range is

(A) X

(B) $X \cap Y$

(C) Y

(D) $X \cup Y$

1(b). The value of $\cos(\sec^{-1} x + \text{cosec}^{-1} x)$, $|x| \geq 1$ is

(A) 1

(B) 0

(C) -1

(D) $\frac{1}{2}$

1(c). For which value of λ is the vector $2\hat{i} + \hat{j} - \lambda\hat{k}$ perpendicular to the vector $\hat{i} + 4\hat{j} + \hat{k}$?

(A) 4

(B) 5

(C) 6

(D) -6

1(d). The value of the integral $\int \frac{\sin^2 x - \cos^2 x}{\sin^2 x \cos^2 x} \, dx$ is

(A) $-\tan x + \cot x + C$

(B) $\tan x + \sec x + C$

(C) $\tan x - \cot x + C$

(D) $\tan x + \cot x + C$

1(e). The order of the differential equation $x\left(\frac{d^3y}{dx^3}\right)^2 + \sin x\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^4 + y^5 = 0$ is

(A) 2

(B) 3

(C) 5

(D) 6

2(a). Show that $\tan^{-1}\frac{2}{11} + \tan^{-1}\frac{7}{24} = \tan^{-1}\frac{1}{2}$.

2(b). If $x = at^2,\ y = 2at$, find the value of $\frac{dy}{dx}$.

2(c). Find the general solution of $\dfrac{dy}{dx} = (1 + x^2)(1 + y^2)$.

2(d). Integrate $x \log x$ with respect to x.

2(e). If $P(A) = 0.8,\ P(B) = 0.5$ and $P(B \mid A) = 0.4$, find $P(A \cup B)$.

3(a). Prove that $f(x) = \tan x$ is a continuous function.

3(b). A relation R is defined in $N \times N$ as follows: $(a, b)\, R\, (c, d)$ if and only if $ad = bc$. Prove that R is an equivalence relation.

3(c). Evaluate: $\displaystyle\int \frac{1}{\sqrt{2x - x^2}}\, dx$.

3(d). Show that the points A, B, C, whose position vectors are respectively $\vec{a} = 3\hat{i} - 4\hat{j} - 4\hat{k}$, $\vec{b} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = \hat{i} - 3\hat{j} - 5\hat{k}$, form the vertices of a right-angled triangle.

4(a). If $2\begin{bmatrix} x & 5 \\ 7 & y-3 \end{bmatrix} + \begin{bmatrix} 3 & -4 \\ 1 & 2 \end{bmatrix} = \begin{bmatrix} 7 & 6 \\ 15 & 10 \end{bmatrix}$, find the values of x and y.

4(b). The length x of a rectangle is decreasing at the rate of 3 cm/min and the breadth y is increasing at the rate of 2 cm/min. When $x = 5$ cm and $y = 3$ cm, find the rate of change of the area of the rectangle.

4(c). Verify that the function $y = a\cos x + b\sin x$, in which $a, b \in R$, is a solution of the differential equation $\frac{d^2y}{dx^2} + y = 0$.

4(d). Prove that if E and F are independent events, then E and F' will also be independent.

5(a). Find the value of the determinant $\begin{vmatrix} 17 & 15 & 13 \\ 9 & -8 & 7 \\ -3 & 2 & 5 \end{vmatrix}$.

5(b). Show that $\sin^{-1}\frac{12}{13} + \cos^{-1}\frac{4}{5} + \tan^{-1}\frac{63}{16} = \pi$.

5(c). If $x = a\sin^3 t,\ y = b\cos^3 t$, then find $\frac{dy}{dx}$ at the point $t = \frac{\pi}{2}$.

5(d). Let three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ be such that $|\vec{a}| = 3, |\vec{b}| = 4, |\vec{c}| = 5$ and each of them is perpendicular to the sum of the other two vectors, then find the value of $|\vec{a} + \vec{b} + \vec{c}|$.

5(e). $x^2\,dy + \frac{1}{2}(xy + y^2)\,dx = 0$; find the particular solution, given that $y = 1$ when $x = 1$.

6(a). Find the Cartesian equation of the line which passes through the point $(-1, 4, -5)$ and is parallel to $\frac{x+3}{3} = \frac{y-4}{5} = \frac{z-8}{6}$.

6(b). Maximize $Z = 105x + 90y$ under the constraints $2x + y \leq 80,\ x + y \leq 50,\ x \geq 0,\ y \geq 0$ by graphical method.

6(c). It is given that the numbers obtained on throwing two dice are different. Find the probability that the sum of both numbers is 4.

6(d). Solve the differential equation $y\,dx + (x - y^2)\,dy = 0$.

6(e). If the position vectors of the vertices A, B, C of a $\triangle ABC$ are respectively $\vec{a}, \vec{b}$ and $\vec{c}$, then prove that the area of $\triangle ABC$ will be $\frac{1}{2}\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|$.

7. Solve by matrix method the system of equations: $x - y + 2z = 7,\ 3x + 4y - 5z = -5,\ 2x - y + 3z = 12$.

OR

Prove that the matrix $A = \begin{bmatrix} 2 & -1 \\ 3 & 4 \end{bmatrix}$ satisfies the equation $A^2 - 6A + 11I = O$, where I is the identity matrix of order 2×2 and O is the zero matrix of order 2×2. With the help of it, find A^{-1}.

8. Prove that the height of the cylinder of maximum volume inscribed in a right circular cone of semi-vertical angle α and height h is one-third of the height of the cone, and the maximum volume of the cylinder is $\frac{4}{27}\pi h^3 \tan^2 \alpha$.

OR

Prove that $\int_0^{\pi/2} \log \sin x \, dx = -\frac{\pi}{2} \log 2$.

9. Find the area of the circle $(x-2)^2 + y^2 = 4$.

OR

Find the value of $\int \left(\sqrt{\cot x} + \sqrt{\tan x}\right) dx$.