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

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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). If $\dfrac{dy}{dx} = e^{x+y}$, then its solution is:

(A) $e^{-y} = e^x + c$

(B) $e^x + e^{-y} = c$

(C) $e^{-x} - e^{-y} = c$

(D) $e^{-x} + e^{-y} = c$

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

(A) $\dfrac{x}{\sqrt{1+x^2}}$

(B) $\dfrac{x}{\sqrt{1-x^2}}$

(C) $\dfrac{1}{\sqrt{1+x^2}}$

(D) $\dfrac{1}{\sqrt{1-x^2}}$

1(c). The interval in which the function $f(x) = x^2 - 4x + 6$ is increasing, is:

(A) $(2, 10)$

(B) $(2, \infty)$

(C) $(-2, \infty)$

(D) $(0, \infty)$

1(d). The function $f(x) = 2x$, $x \in R$ is:

(A) one-one but not onto

(B) one-one and onto

(C) many-one and onto

(D) many-one but not onto

1(e). If $3P(A) = P(B) = \frac{5}{13}$ and $P(A/B) = \frac{2}{5}$, then $P(A \cup B)$ will be:

(A) $\frac{20}{39}$

(B) $\frac{16}{39}$

(C) $\frac{11}{39}$

(D) $\frac{14}{39}$

2(a). If $f : R \to R$ and $g : R \to R$ are defined by $f(x) = \cos x$ and $g(x) = 3x^2$ respectively, find gof.

2(b). If a line makes $90°$, $60°$ and $30°$ with the x, y and z-axes respectively in the positive direction, then find its direction cosines.

2(c). Find the value of $\tan^{-1}\sqrt{3} - \sec^{-1}(-2)$.

2(d). Find the value of the integral $\int x^2 \tan(x^3 + 2)\, dx$.

2(e). If for a unit vector $\vec{a}$, $(\vec{x} - \vec{a}) \cdot (\vec{x} + \vec{a}) = 12$, then find $|\vec{x}|$.

3(a). If $\vec{a} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{b} = 3\hat{i} + 5\hat{j} - 2\hat{k}$, find $|\vec{a} \times \vec{b}|$.

3(b). Prove that the function $f : R \to \{x \in R : -1 < x < 1\}$, where $f(x) = \dfrac{2x}{1 + |x|}$, $x \in R$, is one-one.

3(c). If $f(x) = \sin x$, $x \in [0, \pi/2]$ and $g(x) = \cos x$, $x \in [0, \pi/2]$, prove that $(f + g)$ is not one-one.

3(d). If the lines $\dfrac{x-1}{-3} = \dfrac{y-2}{2k} = \dfrac{z-3}{2}$ and $\dfrac{x-1}{3k} = \dfrac{y-1}{1} = \dfrac{z-6}{-5}$ are mutually perpendicular, find the value of k.

4(a). Find the Cartesian equation of the line parallel to the vector $3\hat{i} + 2\hat{j} - 8\hat{k}$ and passing through the point $(5, 2, -4)$.

4(b). If $x \in \left(0, \frac{\pi}{4}\right)$, then prove that $\cot^{-1}\left(\frac{\sqrt{1+\sin x}+\sqrt{1-\sin x}}{\sqrt{1+\sin x}-\sqrt{1-\sin x}}\right) = \frac{x}{2}$.

4(c). Find the value of the determinant $\begin{vmatrix} a & b & c \\ b & c & a \\ c & a & b \end{vmatrix}$.

4(d). If $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$, then find $P(A \cup B)$ and $P(A/B)$.

5(a). Suppose that $\vec{a}$, $\vec{b}$ and $\vec{c}$ are three vectors 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. Find $|\vec{a} + \vec{b} + \vec{c}|$.

5(b). Find the maximum value of the objective function $Z = 5x + 10y$ by graphical method under the following constraints: $x + 2y \leq 120$, $x + y \geq 60$, $x - 2y \geq 0$, $x \geq 0$, $y \geq 0$.

5(c). For what value of λ, is the function

$$f(x) = \begin{cases} \lambda(x^2 - 2x), & x \leq 0 \\ 4x + 1, & x > 0 \end{cases}$$

continuous at $x = 0$?

5(d). If the position vectors of points A, B, C and D are respectively $\hat{i} + \hat{j} + \hat{k}$, $2\hat{i} + 5\hat{j}$, $3\hat{i} + 2\hat{j} - 3\hat{k}$ and $\hat{i} - 6\hat{j} - \hat{k}$, then find the angle between the lines AB and CD. Prove that AB and CD are collinear.

5(e). Find the interval in which the function $f(x) = \dfrac{4\sin x - 2x - x\cos x}{2 + \cos x}$ is strictly increasing and strictly decreasing.

6(a). If $A = \begin{bmatrix} 1 & 2 & 3 \\ 3 & -2 & 1 \\ 4 & 2 & 1 \end{bmatrix}$, then show that $A^3 - 23A - 40I = 0$.

6(b). Prove that if A and B are independent events, then the probability of happening of at least one of A or B is $[1 - P(A')P(B')]$.

6(c). Prove that the height of the right circular cone of maximum volume inscribed in a sphere of radius r is $\dfrac{4r}{3}$.

6(d). Find the area of the region bounded by $x = 0$, $x = 2\pi$ and the curve $y = \sin x$.

6(e). Find the value of $\int_{-1}^{3/2} |x \sin \pi x| \, dx$.

7. Suppose that $A = \begin{bmatrix} 2 & -1 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 5 & 2 \\ 7 & 4 \end{bmatrix}$, $C = \begin{bmatrix} 2 & 5 \\ 3 & 8 \end{bmatrix}$. Find the matrix D such that $CD - AB = 0$.

OR

Solve the following system of equations by matrix method: $\frac{2}{x} + \frac{3}{y} + \frac{10}{z} = 4$, $\frac{4}{x} - \frac{6}{y} + \frac{5}{z} = 1$, $\frac{6}{x} + \frac{9}{y} - \frac{20}{z} = 2$.

8. Prove that the function $y = Ae^{3x} \cos 4x + Be^{3x} \sin 4x$, where A, B are arbitrary constants, is the solution of the differential equation $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 25y = 0$.

OR

Find $\int \left[\sqrt{\tan x} + \sqrt{\cot x}\right] dx$.

9. Find the particular solution of the differential equation $\frac{dy}{dx} + y \cot x = 4x \csc x$, $(x \neq 0)$, given that $y = 0$ when $x = \frac{\pi}{2}$.

OR

Find $\int \frac{x \sin^{-1} x}{\sqrt{1 - x^2}} dx$.

Find $\int e^x \left(\frac{1 + \sin x}{1 + \cos x}\right) dx$.