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

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 $f : R \to R$ is given by $f(x) = (5 - x^5)^{1/5}$, then $f \circ f(x)$ is equal to:

(A) $x^{1/5}$

(B) x

(C) x^5

(D) $5 - x^5$

1(b). The value of $\int_2^{2\sqrt{3}} \frac{dx}{4 + x^2}$ is:

(A) $\frac{\pi}{12}$

(B) $\frac{\pi}{18}$

(C) $\frac{\pi}{24}$

(D) $\frac{\pi}{6}$

1(c). A relation R is defined in the set N as $R = \{(x, y) : y = x + 5,\ y > 5\}$. Then which of the following is correct?

(A) $(6, 10) \in R$

(B) $(3, 6) \in R$

(C) $(4, 9) \in R$

(D) $(2, 6) \in R$

1(d). The value of $\int_0^{\pi/4} \sin^3 2x \cos 2x \, dx$ is:

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

(B) $\frac{1}{4}$

(C) $\frac{1}{8}$

(D) $\frac{1}{16}$

1(e). The probability of impossible events is:

(A) 0

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

(C) $\frac{1}{3}$

(D) $\frac{1}{4}$

2(a). Find the value of $\cos^{-1}\left(\frac{1}{2}\right) + 2\sin^{-1}\left(\frac{1}{2}\right)$.

2(b). Write $\cot^{-1}\left(\frac{1}{\sqrt{x^2 - 1}}\right)$, $x > 1$ in the simplest form.

2(c). If the direction ratios of a line are $3, -2, -6$, then find its direction cosines.

2(d). Find the angle between the vectors $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$.

2(e). Show that the function $f(x) = x^3 - 6x^2 + 12x,\ x \in R$, is an increasing function on R.

3(a). If two vectors $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - 5\hat{k}$, then show that $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$ are perpendicular.

3(b). If A and B are independent events and $P(A) = 0.3$, $P(B) = 0.4$, then find (i) $P(A \cap B)$, (ii) $P(A \cup B)$.

3(c). Prove that the relation given by $R = \{(1,1), (2,2), (3,3), (1,2), (2,3)\}$ in the set $\{1, 2, 3\}$ is reflexive but neither symmetric nor transitive.

3(d). If $\sin^{-1}(1 - x) - 2\sin^{-1} x = \frac{\pi}{2}$, then find the value of x.

4(a). If $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b}) = 8$ and $|\vec{a}| = 8|\vec{b}|$, then find $|\vec{a}|$ and $|\vec{b}|$.

4(b). Simplify: $\cos\theta \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} + \sin\theta \begin{bmatrix} \sin\theta & -\cos\theta \\ \cos\theta & \sin\theta \end{bmatrix}$.

4(c). Simplify: $\tan^{-1}\left(\frac{3a^2x - x^3}{a^3 - 3ax^2}\right)$.

4(d). Show that the points $A(2, 3, -4)$, $B(1, -2, 3)$ and $C(3, 8, -11)$ are collinear.

5(a). Find the minimum value of the objective function $Z = 3x + 5y$ under the following constraints by the graphical method: $x + 3y \geq 3,\ x + y \geq 2,\ x \geq 0,\ y \geq 0$.

5(b). Find the minimum distance between the lines $\vec{r} = \hat{i} + \hat{j} + \lambda(2\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = 2\hat{i} + \hat{j} - \hat{k} + \mu(3\hat{i} - 5\hat{j} + 2\hat{k})$.

5(c). If $y = Ae^{mx} + Be^{nx}$, then show that $\frac{d^2y}{dx^2} - (m + n)\frac{dy}{dx} + mny = 0$.

5(d). Find the values of a and b for which the function defined by $f(x) = \begin{cases} ax + 1, & x \leq 3 \\ bx + 3, & x > 3 \end{cases}$ is continuous at $x = 3$.

5(e). Find the value of the determinant $\begin{vmatrix} 18 & 22 & -13 \\ 7 & -9 & 11 \\ -11 & 7 & 17 \end{vmatrix}$.

6(a). Three vectors $\vec{a}, \vec{b}, \vec{c}$ satisfy the condition $\vec{a} + \vec{b} + \vec{c} = 0$. If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{c}| = 2$, then find the value of $\mu = \vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$.

6(b). Prove that the height of a cylinder of maximum volume, inscribed in a sphere of radius R, is $\frac{2R}{\sqrt{3}}$.

6(c). Differentiate: $y = x^{\sin x} + (\cos x)^{\tan x}$.

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

6(e). Find the area surrounded by the line $y = 3x + 2$, the x-axis, and the ordinates $x = -1$ and $x = 1$.

7. Solve the following system of equations by matrix method: $3x - 2y + 3z = 8,\ 2x + y - z = 1,\ 4x - 3y + 2z = 4$.

OR

Express the matrix $B = \begin{bmatrix} 2 & -2 & -4 \\ -1 & 3 & 4 \\ 1 & -2 & -3 \end{bmatrix}$ in the form of the sum of a symmetric matrix and a skew-symmetric matrix.

8. Solve the differential equation $(x\,dy - y\,dx)\,y\sin\left(\frac{y}{x}\right) = (y\,dx + x\,dy)\,x\cos\left(\frac{y}{x}\right)$.

OR

Find the value of $\int_{-1}^{2} |x^3 - x|\,dx$.

Find the value of $\int_{1}^{4} \left(|x-1| + |x-2| + |x-3|\right) dx$.

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9. Find the value of the integral $\int \frac{x^4}{(x-1)(x^2+1)}\,dx$.

OR

Show that the general solution of the differential equation $\frac{dy}{dx} + \frac{y^2+y+1}{x^2+x+1} = 0$ is $x + y + 1 = A(1 - x - y - 2xy)$, in which A is a parameter.