UP Board Class 12 Mathematics 2026 (Set 324 DC) 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). The function $f : R \to R$ defined by $f(x) = 3x + 5,\ \forall x \in R$ is:

(A) f is one-one onto

(B) f is many-one onto

(C) f is one-one but not onto

(D) f is neither one-one nor onto

1(b). The value of $\tan^{-1}(\sqrt{3}) - \cot^{-1}(-\sqrt{3})$ is:

(A) π

(B) $\dfrac{-\pi}{2}$

(C) 0

(D) $2\sqrt{3}$

1(c). If A is any matrix and K is any constant, then $(KA)'$ is:

(A) $K'A'$

(B) $A'K'$

(C) KA'

(D) KA

1(d). If the radius of a circle is $r = 6$ cm, then the rate of change of Area with respect to radius is:

(A) 10π

(B) 12π

(C) 8π

(D) 11π

1(e). The value of $\int_0^{2/3} \frac{dx}{4+9x^2}$ is:

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

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

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

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

2(a). Evaluate: $\int_{-\pi/2}^{\pi/2} (x^3 + x\cos x)\,dx$

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

2(c). Find the order and degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^3 + \left(\frac{dy}{dx}\right)^2 + \sin\left(\frac{dy}{dx}\right) + 1 = 0$.

2(d). Find the area of the parallelogram whose adjacent sides are given by $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$.

2(e). If $A^2 = A$, then simplify $(I + A)^2 - 7A$, where A is a square matrix.

3(a). If the ordered pairs $(2x - 3, -5)$ and $(x, y - 1)$ are equal, then find the value of x and y.

3(b). Examine the continuity of the function $f(x) = 2x^2 - 1$ at $x = 3$.

3(c). Differentiate $\log(\log x)$, $x > 1$ with respect to x.

3(d). Prove that on R, the function $f(x) = e^{2x}$ is increasing.

4(a). Prove that $(\vec{a} + \vec{b}) \cdot (\vec{a} + \vec{b}) = |\vec{a}|^2 + |\vec{b}|^2$ if and only if $\vec{a}$ and $\vec{b}$ are perpendicular. It is given that $\vec{a} \neq 0$, $\vec{b} \neq 0$.

4(b). Find the direction cosines of the x, y and z axes.

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

4(d). Solve: $\int \cos^2 x \, dx$

5(a). Evaluate: $\int_0^1 \frac{\tan^{-1} x}{1+x^2} \, dx$

5(b). Three vectors $\vec{a}, \vec{b}$ and $\vec{c}$ satisfy the condition $\vec{a} + \vec{b} + \vec{c} = 0$. If $|\vec{a}| = 3, |\vec{b}| = 4$ and $|\vec{c}| = 5$, then find the value of $\vec{a} \cdot \vec{b} + \vec{b} \cdot \vec{c} + \vec{c} \cdot \vec{a}$.

5(c). Find the angle between the lines $\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ and $\vec{r} = 5\hat{i} - 2\hat{j} + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$.

5(d). Minimize $z = 3x + 2y$ under the following constraints by graphical method: $x + y \geq 8,\ x \geq 0,\ 3x + 5y \leq 15,\ y \geq 0$.

5(e). If $A = \begin{bmatrix} 2 & 3 \\ 1 & -4 \end{bmatrix}$, $B = \begin{bmatrix} 1 & -2 \\ -1 & 3 \end{bmatrix}$, then find $(AB)^{-1}$.

6(a). Write $\tan^{-1}\left(\frac{\cos x - \sin x}{\cos x + \sin x}\right)$, $\frac{-\pi}{4} < x < \frac{3\pi}{4}$ in the simplest form.

6(b). If the function $f : \left[0, \frac{\pi}{2}\right] \to R$ is given by $f(x) = \cos x$ and the function $g : \left[0, \frac{\pi}{2}\right] \to R$ is given by $g(x) = \sin x$, then prove that f and g are one-one, but $f + g$ is not one-one.

6(c). Is the function $f(x) = \begin{cases} x + 5, & x \leq 1 \\ x - 5, & x > 1 \end{cases}$ continuous at $x = 1$?

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

6(e). A family has two children. If it is known that at least one child is a boy, then find the probability of both children being boys.

7. Find the general solution of the differential equation $x \cos\left(\frac{y}{x}\right) \frac{dy}{dx} = y \cos\left(\frac{y}{x}\right) + x$.

OR

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

8. Find the area bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

OR

Prove that the volume of the largest right circular cone that can be inscribed in a sphere of radius R is $\frac{8}{27}$ of the volume of the sphere.

9. Solve the system of linear equations by Matrix Method: $2x - 3y + 5z = 11$, $3x + 2y - 4z = -5$, $x + y - 2z = -3$.

OR

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