UP Board Class 12 Mathematics 2026 (Set 324 DD) 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 the function $f : N \to N$ is defined as $f(x) = x^2$, then f is:

(A) One-one and onto

(B) One-one but not onto

(C) Neither one-one nor onto

(D) Many-one and onto

1(b). The relation $R = \{(a, b) : a \leq b^2\}$ is defined in the set of real numbers. Then R is:

(A) Reflexive and symmetric but not transitive

(B) Reflexive and transitive but not symmetric

(C) Symmetric and transitive but not reflexive

(D) Not reflexive, not symmetric and not transitive

1(c). If vectors $5\hat{i} - \lambda\hat{j} + 2\hat{k}$ and $2\hat{i} + 3\hat{j} + 4\hat{k}$ are perpendicular to each other, then the value of λ is:

(A) 3

(B) 4

(C) 6

(D) 0

1(d). If $x - y = \pi$, then the value of $\frac{dy}{dx}$ is:

(A) 0

(B) π

(C) 1

(D) x

1(e). Direction cosines of the x-axis are:

(A) (1, 0, 0)

(B) (0, 1, 0)

(C) (0, 0, 1)

(D) (0, 0, 0)

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

2(b). Find the value of $\int_2^3 \frac{1}{x}\,dx$.

2(c). Find the angle between vectors $\hat{i} - 2\hat{j} + 3\hat{k}$ and $3\hat{i} - 2\hat{j} + \hat{k}$.

2(d). Direction ratios of a line are 2, −1 and −2. Find the direction cosines of the line.

2(e). If $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$, then find $P\left(\frac{A}{B}\right)$.

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

3(b). Find the value of the determinant $\begin{vmatrix} x & a & x+a \\ y & b & y+b \\ z & c & z+c \end{vmatrix}$.

3(c). If $f(x) = \begin{cases} x+2, & x \neq 0 \\ 1, & x = 0 \end{cases}$, then prove that the function is not continuous at $x = 0$.

3(d). Find the vector and Cartesian equations of a line which passes through the point $(1, 2, 3)$ and is parallel to the vector $2\hat{i} + 3\hat{j} + 2\hat{k}$.

4(a). Find the general solution of the differential equation $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$.

4(b). If $y = 5\cos x - 3\sin x$, then prove that $\frac{d^2y}{dx^2} + y = 0$.

4(c). Find the projection of vector $\hat{i} + 3\hat{j} + 7\hat{k}$ on vector $7\hat{i} - \hat{j} + 8\hat{k}$.

4(d). If $P(A) = \frac{1}{3}$, $P(B) = \frac{1}{2}$ and $P(A \cup B) = \frac{2}{3}$, then show that A and B are independent events.

5(a). Prove that $\tan^{-1}\frac{1}{5} + \tan^{-1}\frac{1}{7} + \tan^{-1}\frac{1}{3} + \tan^{-1}\frac{1}{8} = \frac{\pi}{4}$.

5(b). If $\cos y = x\cos(a + y)$ and $\cos a \neq \pm 1$, then prove that $\frac{dy}{dx} = \frac{\cos^2(a + y)}{\sin a}$.

5(c). Solve the differential equation: $(1 + x^2)\,dy + 2xy\,dx = \cot x\,dx$.

5(d). Maximize $Z = 10x + 3y$ by the graphical method under the following constraints: $x \geq 0;\ y \geq 0;\ 5x + 3y \leq 15;\ 2x + 5y \leq 10$.

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

6(a). Find the value of the determinant $\begin{vmatrix} a & b & c \\ a^2 & b^2 & c^2 \\ a^3 & b^3 & c^3 \end{vmatrix}$.

6(b). Evaluate $\int \frac{x^2+1}{x^2-5x+6}\,dx$.

6(c). Prove that vectors $2\hat{i}-\hat{j}+\hat{k}$, $\hat{i}-3\hat{j}-5\hat{k}$ and $3\hat{i}-4\hat{j}-4\hat{k}$ are vertices of a right-angled triangle.

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

6(e). If a die is thrown three times, then find the probability of getting at least one odd number.

7. If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$, then find A^{-1}.

OR

Solve the following system of equations by using the Matrix Method:

$$x-y+2z=7$$

$$3x+4y-5z=-5$$

$$2x-y+3z=12$$

8. Prove that the height of the cylinder of maximum volume inscribed in a sphere of radius R is $\frac{2R}{\sqrt{3}}$. Also find the maximum volume of the cylinder.

OR

Solve the differential equation $(x-y)\frac{dy}{dx} = x + 2y$.

9. Find the value of: $\int_0^{\pi/2} \log \sin x \, dx$.

OR

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