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

General Instructions

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

(ii) It has multiple-choice questions as well as questions that need a written answer.

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

1(a). Let relation R be defined in the set N as follows:

$R = \{(a, b) : a = b - 2,\ b > 6\}$

For this relation R

(A) $(2, 4) \in R$

(B) $(3, 8) \in R$

(C) $(6, 8) \in R$

(D) $(8, 7) \in R$

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

(A) π

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

(C) 0

(D) $2\sqrt{3}$

1(c). If $|\vec{a}| = 2$, $|\vec{b}| = \sqrt{3}$ and $\vec{a} \cdot \vec{b} = \sqrt{6}$, then the angle between the vectors $\vec{a}$ and $\vec{b}$ is

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

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

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

(D) $\frac{5\pi}{12}$

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

(A) $\frac{1}{2}(x + \sin x \cos x) + C$

(B) $\frac{1}{2}(x - \sin x \cos x) + C$

(C) $\frac{x}{2} + \frac{\cos 2x}{4} + C$

(D) $\frac{x}{2} - \frac{\cos 2x}{4} + C$

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

(A) 2

(B) 3

(C) 5

(D) 6

2(a). Write $\tan^{-1}\left(\frac{x}{\sqrt{a^2 - x^2}}\right)$, $|x| < a$ in simplest form.

2(b). If $e^y(x+1)=1$, show that $\frac{d^2y}{dx^2}=\left(\frac{dy}{dx}\right)^2$.

2(c). Find the general solution of $\frac{dy}{dx}=\sqrt{4-y^2}$, $(-2<y<2)$.

2(d). Show that $\int \frac{dx}{a^2+x^2}=\frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right)+C$.

2(e). If $P(A)=\frac{6}{11}$, $P(B)=\frac{5}{11}$ and $P(A\cup B)=\frac{7}{11}$, find $P(A\mid B)$.

3(a). Is the function $f(x)$ defined by

$$f(x)=\begin{cases}x, & \text{if } x\le 1\\ 5, & \text{if } x>1\end{cases}$$

continuous at $x=1$?

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

3(c). Find the value of $\int \frac{x\,dx}{(x+1)(x+2)}$.

3(d). Find the position vectors of the points R_1 and R_2, which divide the line joining the points $P(\hat{i} + 2\hat{j} - \hat{k})$ and $Q(-\hat{i} + \hat{j} + \hat{k})$,
(i) internally, (ii) externally in the ratio 2 : 1 respectively.

4(a). Find matrix AB if $A = \begin{bmatrix} 3 & -1 & 3 \\ -1 & 0 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & -3 \\ 1 & 0 \\ 3 & 1 \end{bmatrix}$.

4(b). Find the intervals in which the function f given by $f(x) = x^2 - 4x + 6$ is
(i) increasing, (ii) decreasing.

4(c). Find the general solution of the differential equation $\frac{y\,dx - x\,dy}{y} = 0$.

4(d). If a leap year is selected at random, then what is the probability that it will contain 53 Tuesdays?

5(a). Find the value of the determinant $\begin{vmatrix} 7 & -9 & 11 \\ 13 & 15 & -8 \\ -6 & 9 & 7 \end{vmatrix}$.

5(b). Prove that $\tan^{-1} x + \tan^{-1} \frac{2x}{1 - x^2} = \tan^{-1} \left(\frac{3x - x^3}{1 - 3x^2} \right)$, $|x| < \frac{1}{\sqrt{3}}$.

5(c). Find $\frac{dy}{dx}$ of $(\cos x)^{\tan x} + x^y = 0$.

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 particular solution of $2xy + y^2 - 2x^2\frac{dy}{dx} = 0$, given that $y = 2$, when $x = 1$.

6(a). Find the shortest distance between the lines $\frac{x+1}{7} = \frac{y+1}{-6} = \frac{z+1}{1}$ and $\frac{x-3}{1} = \frac{y-5}{-2} = \frac{z-7}{1}$.

6(b). Minimize $Z = 10(x - 7y + 190)$ subject to the constraints
$x + y \leq 8,\ x + y \geq 4,\ x \leq 5,\ y \leq 5,\ x \geq 0,\ y \geq 0,$
by graphical method.

6(c). Two bags I and II are given. Bag I contains 3 red and 4 black balls whereas bag II contains 5 red and 6 black balls. One ball has been drawn out at random from any one bag, which is of red colour. What is the probability that this ball has been drawn out from bag II ?

6(d). 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

6(e). For the vectors $\vec{a}$ and $\vec{b}$, prove that $|\vec{a} + \vec{b}| \leq |\vec{a}| + |\vec{b}|$.

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

OR

Find the inverse of the following matrix :

$$A = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{pmatrix}$$

8(a). Prove that the height of the cylinder of given surface and maximum volume is equal to the diameter of its base.

OR

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

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

OR

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