UP Board Class 12 Mathematics 2026 (Set 324 DB) 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 $A = \{1, 2, 3\}$, then the number of equivalence relations on A containing $(1, 2)$ is:

(A) 1

(B) 2

(C) 3

(D) 4

1(b). The function $f : Z \to Z$ defined by $f(x) = x^3 \; \forall x \in Z$ is:

(A) Onto

(B) Neither one-one nor onto

(C) One-one but not onto

(D) Many-one

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

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

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

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

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

1(d). $A = [a_{ij}]_{m\times n}$ is a square matrix if:

(A) m < n

(B) m > n

(C) m = n

(D) None of these

1(e). The value of $\int x \cos x \, dx$ is:

(A) $\cos x + x \sin x + c$

(B) $x \sin x + c$

(C) $x \cos x + c$

(D) $\sin x + x \cos x + c$

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

2(b). Find the integrating factor of the differential equation $x\dfrac{dy}{dx} + 2y = x^2 \; (x \neq 0)$.

2(c). Find the projection of vector $(\hat{i} - \hat{j})$ on vector $(\hat{i} + \hat{j})$.

2(d). If $P(A) = \frac{1}{2}$, $P(B) = \frac{1}{3}$ and A, B are independent events, find the value of $P(A/B)$.

2(e). If $X = \{1, 2, 3\}$ and $Y = \{a, b\}$, then find the number of functions from X to Y.

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

3(b). If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & -1 & 3 \\ -1 & 0 & 2 \end{bmatrix}$, then find the value of $(2A - B)$.

3(c). Prove that $3\cos^{-1} x = \cos^{-1}(4x^3 - 3x),\ x \in \left[\frac{1}{2}, 1\right]$.

3(d). Differentiate the function $\sin^2 x$ with respect to the function $e^{\cos x}$.

4(a). Prove that the given function $f(x) = 3x + 17$ is increasing on $\mathbb{R}$.

4(b). If $f : \mathbb{R} \to \mathbb{R}$ and $g : \mathbb{R} \to \mathbb{R}$ be functions such that $f(x) = \cos x$ and $g(x) = 3x^3$, then find $f \circ g$.

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

4(d). Find the magnitude of the vectors $\vec{a}$ and $\vec{b}$, if having equal magnitudes and angle $60°$ between them and their scalar product is $\dfrac{1}{2}$.

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

5(b). Find the general solution of the differential equation $\log\left(\dfrac{dy}{dx}\right) = 3x + 4y$.

5(c). Show that the line passing through the points $(1, -1, 2)$ and $(3, 4, -2)$ is perpendicular to the line passing through the points $(0, 3, 2)$ and $(3, 5, 6)$.

5(d). If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ and $A^2 = KA - 2I$, then find the value of K.

5(e). Prove that the function defined by $f(x) = \begin{cases} x^2 \sin \dfrac{1}{x}, & x \neq 0 \\ 0, & x = 0 \end{cases}$ is continuous.

6(a). A circular disc having radius 3 cm is warmed and due to expansion its radius is increasing at the rate 0.05 cm/s. Find the increasing rate of its area when its radius is 3.2 cm.

6(b). Find the minimum value of the linear programming problem $Z = 200x + 500y$ under the following constraints: $x + 2y \geq 10$, $3x + 4y \leq 24$, $x \geq 0, y \geq 0$ by graphical method.

6(c). A die is thrown twice and found that the sum of the numbers is 6. Find the conditional probability of getting number 4 at least once.

6(d). If vectors $\vec{a}, \vec{b}, \vec{c}$ are mutually perpendicular and having equal magnitude, then show that the vector $\vec{a} + \vec{b} + \vec{c}$ is equally inclined to the vectors $\vec{a}, \vec{b}, \vec{c}$.

6(e). Find the area of the circle $x^2 + y^2 = r^2$.

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

OR

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

8. Prove that the radius of the largest (maximum surface area) right circular cylinder that can be inscribed in a cone is half of the radius of the cone.

OR

Evaluate: $\int_0^{\pi/2} \log \sin x \, dx$.

9. Find the value of $\int_0^{\pi} \frac{x\,dx}{a^2 \cos^2 x + b^2 \sin^2 x}$.

OR

If $y = \sin^{-1} x$, then show that $(1 - x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = 0$.