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UP BOARD • PREVIOUS 10 YEARS' QUESTION PAPERS

# Class 12 (Intermediate) Mathematics

All ten years in one book — every paper in full, questions only, as printed in the original papers.

Class 12 (Intermediate)
Subject: Mathematics
Years covered: 2017–2026 | Papers inside: 4 of 10 years
Maximum marks: 100

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Rebuilt in KAMALDNP design for practice. Content identical to the source papers; see Rebuild Notes at the end of each paper. Years not yet found are listed plainly in the Contents — no paper is ever faked.

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## Contents

One paper per year, newest first. A year marked “Not found yet” means no complete, verified copy of that year’s paper has been found so far — it will be added when one is verified. 2021 had no board exams.


| Year | Set / Code | Exam held | Marks | Page |
|---|---|---|---|---|
| **2026** | 324 DA | 23 February 2026 | 100 | 3 |
| **2025** | 324 IZ | 3 March 2025 | 100 | 7 |
| **2024** | 324 EX | 29 February 2024 | 100 | 11 |
| **2023** | 324 AX | 27 February 2023 | 100 | 15 |
| **2022** | — | Not found yet | — | — |
| **2021** | — | No board exams were held (COVID-19) | — | — |
| **2020** | — | Not found yet | — | — |
| **2019** | — | Not found yet | — | — |
| **2018** | — | Not found yet | — | — |
| **2017** | — | Not found yet | — | — |


Source: third-party transcriptions of the original UP Board papers (no official UP Board previous-year archive exists). English text only; the originals are bilingual (Hindi + English).



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# Class 12 Mathematics 2026

Set 324 DA — 3 hours 15 minutes (including 15 minutes reading time) — Maximum Marks: 100

Exam: 23 February 2026, 2:00 PM – 5:15 PM | Time allowed: 3 hours 15 minutes (including 15 minutes reading time) | Maximum marks: 100 | Total questions: 34

## General Instructions

1. All questions are compulsory.
2. This question paper has 9 questions.
3. Question 1 has five multiple choice questions of 1 mark each.
4. Question 2 has five very short answer questions of 1 mark each.
5. Questions 3 and 4 have four short answer questions of 2 marks each in each question.
6. Questions 5 and 6 have five long answer questions of 5 marks each in each question.
7. Questions 7, 8 and 9 are very long answer questions of 8 marks each, with a choice between parts (a) and (b). Attempt any one part in each question.
8. 31 of the 34 printed questions are to be attempted.
9. The symbols used in the question paper have usual meaning.

> **Note:** General instructions follow the standard UP Board format as given in the source article's pattern table; the 2026 transcription source did not carry the printed instructions.

## Question 1

Multiple Choice Questions — 1 mark each

**Q. 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 **[1 mark]**

(A) $(2, 4) \in R$ (B) $(3, 8) \in R$ (C) $(6, 8) \in R$ (D) $(8, 7) \in R$

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

(A) $\pi$ (B) $-\pi/2$ (C) 0 (D) $2\sqrt{3}$

**Q. 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 **[1 mark]**

(A) $\pi/6$ (B) $\pi/4$ (C) $\pi/3$ (D) $5\pi/12$

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

(A) $(1/2)(x + \sin x \cos x) + C$ (B) $(1/2)(x - \sin x \cos x) + C$
(C) $x/2 + \cos 2x/4 + C$ (D) $x/2 - \cos 2x/4 + C$

**Q. 1(e)** The degree of the differential equation $x(d^2y/dx^2) = (dy/dx + y)^{2/3}$ is **[1 mark]**

(A) 2 (B) 3 (C) 5 (D) 6



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## Question 2

Very Short Answer Questions — 1 mark each

**Q. 2(a)** Write $\tan^{-1}(x/\sqrt{(a^2 - x^2)})$, $|x| < a$ in simplest form. **[1 mark]**

**Q. 2(b)** If $e^y(x + 1) = 1$, show that $d^2y/dx^2 = (dy/dx)^2$. **[1 mark]**

**Q. 2(c)** Find the general solution of $dy/dx = \sqrt{(4 - y^2)}$, $(-2 < y < 2)$. **[1 mark]**

**Q. 2(d)** Show that $\int dx/(a^2 + x^2) = (1/a)\tan^{-1}(x/a) + C$. **[1 mark]**

**Q. 2(e)** If $P(A) = 6/11$, $P(B) = 5/11$ and $P(A \cup B) = 7/11$, find $P(A|B)$. **[1 mark]**

## Question 3

Short Answer Questions — 2 marks each

**Q. 3(a)** Is the function f(x) defined by $f(x) = x$, if $x \leq 1$; 5, if $x > 1$, continuous at $x = 1$? **[2 marks]**

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

**Q. 3(c)** Find the value of $\int x\,dx/((x + 1)(x + 2))$. **[2 marks]**

**Q. 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. **[2 marks]**

## Question 4

Short Answer Questions — 2 marks each

**Q. 4(a)** Find matrix AB if $A = [3\ -1\ 3; -1\ 0\ 2]$ and $B = [2\ -3; 1\ 0; 3\ 1]$. **[2 marks]**

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

**Q. 4(c)** Find the general solution of the differential equation $(y\,dx - x\,dy)/y = 0$. **[2 marks]**

**Q. 4(d)** If a leap year is selected at random, then what is the probability that it will contain 53 Tuesdays? **[2 marks]**

## Question 5

Long Answer Questions — 5 marks each

**Q. 5(a)** Find the value of the determinant $|7\ -9\ 11; 13\ 15\ -8; -6\ 9\ 7|$. **[5 marks]**

**Q. 5(b)** Prove that $\tan^{-1}x + \tan^{-1}(2x/(1 - x^2)) = \tan^{-1}((3x - x^3)/(1 - 3x^2))$, $|x| < 1/\sqrt{3}$. **[5 marks]**

**Q. 5(c)** Find dy/dx of $(\cos x)^{\wedge}(\tan x) + x^y = 0$. **[5 marks]**



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**Q. 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 marks]**

**Q. 5(e)** Find the particular solution of $2xy + y^2 - 2x^2 \, dy/dx = 0$, given that $y = 2$, when $x = 1$. **[5 marks]**

## Question 6

Long Answer Questions — 5 marks each

**Q. 6(a)** Find the shortest distance between the lines $(x + 1)/7 = (y + 1)/(-6) = (z + 1)/1$ and $(x - 3)/1 = (y - 5)/(-2) = (z - 7)/1$. **[5 marks]**

**Q. 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. **[5 marks]**

**Q. 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? **[5 marks]**

**Q. 6(d)** The order of the differential equation $x(d^3y/dx^3)^2 + \sin x \, (d^2y/dx^2)^3 + (dy/dx)^4 + y^5 = 0$ is **[5 marks]**

(A) 2 (B) 3 (C) 5 (D) 6

**Q. 6(e)** For the vectors $\vec{a}$ and $\vec{b}$, prove that $|\vec{a} + \vec{b}| \leq |\vec{a}| + |\vec{b}|$. **[5 marks]**

## Question 7

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 7(a)** Solve the following system of equations by matrix method: $2/x + 3/y + 10/z = 4$, $4/x - 6/y + 5/z = 1$, $6/x + 9/y - 20/z = 2$. **[8 marks]**

**— OR —**

7(b): Find the inverse of the following matrix: A = [0 1 2; 1 2 3; 3 1 1].

## Question 8

Very Long Answer Question — 8 marks (attempt any one part)

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

**— OR —**

8(b): Evaluate: $\int_0^{\pi} x \, dx/(a^2\cos^2 x + b^2\sin^2 x)$.

## Question 9

Very Long Answer Question — 8 marks (attempt any one part)



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**Q. 9(a)** Find the area bounded by the ellipse $x^2/a^2 + y^2/b^2 = 1$. **[8 marks]**

**— OR —**

9(b): Find the value of $\int x/((x^2 + 1)(x - 1))\, dx$.

## Rebuild Notes

This paper was rebuilt in KAMALDNP design from a third-party transcription of the original UP Board paper. Questions, order and marks are as printed in the source; answers and solutions are not included. Where the transcription was unclear or contradicted the Hindi original, the point is flagged below.

1. Q6(d) is a multiple-choice question printed inside Question 6 — reproduced as printed.
2. The article tail (after the pattern table) lists extra questions from other sets; those were ignored — only the 34 printed questions of set 324 DA are reproduced.

**Source (third-party transcription):** https://collegedunia.com/articles/e-737-up-board-class-12-mathematics-question-paper-2026-set-324-da-with-solutions

English text only. The original paper is bilingual (Hindi + English); a Hindi side is a follow-up round, not this one. No official UP Board previous-year archive exists, so every paper in this volume is third-party-source.



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# Class 12 Mathematics 2025

Set 324 IZ — 3 hours 15 minutes (including 15 minutes reading time) — Maximum Marks: 100

Exam: 3 March 2025, 8:30 AM – 11:45 AM | Time allowed: 3 hours 15 minutes (including 15 minutes reading time) | Maximum marks: 100 | Total questions: 34

## General Instructions

1. All questions are compulsory.
2. This question paper has 9 questions.
3. Question 1 has five multiple choice questions of 1 mark each.
4. Question 2 has five very short answer questions of 1 mark each.
5. Questions 3 and 4 have four short answer questions of 2 marks each in each question.
6. Questions 5 and 6 have five long answer questions of 5 marks each in each question.
7. Questions 7, 8 and 9 are very long answer questions of 8 marks each, with a choice between parts (a) and (b). Attempt any one part in each question.
8. 31 of the 34 printed questions are to be attempted.
9. The symbols used in the question paper have usual meaning.

> **Note:** General instructions follow the standard UP Board format as given in the source article's pattern table; the 2025 transcription source did not carry the printed instructions.

## Question 1

Multiple Choice Questions — 1 mark each

**Q. 1(a)** At which point is the slope of the curve $y^2 = 4x$ equal to the slope of the line $y = x + 3$? **[1 mark]**

(A) (1, 2) (B) (2, 1) (C) (−1, 2) (D) (1, −2)

**Q. 1(b)** If the vector $2\hat{i} + 3\hat{j} + 4\hat{k}$ is perpendicular to the vector $5\hat{i} - \lambda\hat{j} + 2\hat{k}$, the value of $\lambda$ is: **[1 mark]**

(A) 3 (B) 0 (C) 4 (D) 6

**Q. 1(c)** If A is a square matrix and $A^2 = A$, then $(A + I)^3 - 7A$ will be: **[1 mark]**

(A) A (B) 3A (C) I − A (D) I

**Q. 1(d)** The value of $\int \cos^2 x \, dx$ will be: **[1 mark]**

(A) $-(1/4)\sin 2x + x/4 + C$ (B) $-(1/2)\sin 2x + x/4 + C$
(C) $\cos^2 x - \sin^2 x + C$ (D) $(1/4)\sin 2x + x/2 + C$



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**Q. 1(e)** A function f : R → R is defined by f(x) = 3x for all x ∈ R. Then function f will be: **[1 mark]**

(A) Not one-one (B) Not onto (C) Onto (D) Many-one

## Question 2

Very Short Answer Questions — 1 mark each

**Q. 2(a)** If $y = A + Be^x$, then prove that $d^2y/dx^2 - dy/dx = 0$, where A and B are constants. **[1 mark]**

**Q. 2(b)** Solve the differential equation $dy/dx = (x^2 - 1)/(y^2 + 1)$. **[1 mark]**

**Q. 2(c)** Show that f(x) = |x| is continuous for all values of x. **[1 mark]**

**Q. 2(d)** Given any two events A and B are such that P(A) = 1/2, P(B) = 1/4 and P(A ∩ B) = 1/8, then find P(not A and not B). **[1 mark]**

**Q. 2(e)** If A = {1, 2} and B = {3, 4, 5}, then find all number of relations from A to B. **[1 mark]**

## Question 3

Short Answer Questions — 2 marks each

**Q. 3(a)** If $y = A \cos\theta + B \sin\theta$, then prove that $d^2y/d\theta^2 = -y$. **[2 marks]**

**Q. 3(b)** Find the Cartesian equation of a line which passes through point (3, −2, −5) and is parallel to the vector $(3\hat{i} + 2\hat{j} - 2\hat{k})$. **[2 marks]**

**Q. 3(c)** Solve the differential equation $dy/dx = e^x \cos x$. **[2 marks]**

**Q. 3(d)** If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are vectors and $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, then find the value of $(\vec{a}\cdot\vec{b} + \vec{b}\cdot\vec{c} + \vec{c}\cdot\vec{a})$. **[2 marks]**

## Question 4

Short Answer Questions — 2 marks each

**Q. 4(a)** If $R_1$ and $R_2$ be two equivalence relations on a set A, then prove that $(R_1 \cap R_2)$ also be an equivalence relation on A. **[2 marks]**

**Q. 4(b)** Find the value of $\int_{-\pi/2}^{\pi/2} \sin^2 x\, dx$. **[2 marks]**

**Q. 4(c)** There are two children in a family. It is known that there is at least one child is a boy. Then find the probability that both children are boys. **[2 marks]**

**Q. 4(d)** Find the interval in which the given function $f(x) = x^2 - 4x + 6$ is (i) Increasing (ii) Decreasing. **[2 marks]**

## Question 5

Long Answer Questions — 5 marks each

**Q. 5(a)** If the matrix A = [0 2y z; x y −z; x −y z] satisfies the equation $AA' = I$, then find the values of x, y and z. **[5 marks]**



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**Q. 5(b)** Find the differential coefficient of $y = x^{(\cos x)} + (\sin x)^x$ with respect to x. **[5 marks]**

**Q. 5(c)** Find the shortest distance between the lines $\vec{r} = (2\hat{i} + \hat{j} - \hat{k}) + \mu(3\hat{i} - 5\hat{j} + 2\hat{k})$ and $\vec{r} = (\hat{i} + \hat{j}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$. **[5 marks]**

**Q. 5(d)** Find the minimum value of $Z = 3x + 7y$ by the graphical method under the following constraints: $x + y \leq 8$, $3x + 5y \geq 0$, $x \geq 0$, $y \geq 0$. **[5 marks]**

**Q. 5(e)** If a function $f : R \to \{x \in R : x \in (-1, 1)\}$ is defined as $f(x) = x/(1 + |x|)$, $x \in R$, then prove that f is one-one and onto. **[5 marks]**

## Question 6

Long Answer Questions — 5 marks each

**Q. 6(a)** Show that $(3\hat{i} - 4\hat{j} - 4\hat{k})$, $(2\hat{i} - \hat{j} + \hat{k})$ and $(\hat{i} - 3\hat{j} - 5\hat{k})$ are the position vectors of vertices of a right angle triangle. **[5 marks]**

**Q. 6(b)** If $x\sqrt{(1 + y)} + y\sqrt{(1 + x)} = 0$, $-1 < x < 1$, then prove that $dy/dx = -1/(1 + x)^2$. **[5 marks]**

**Q. 6(c)** There are 10 white and 5 black balls in a bag. Two balls are drawn one by one. First ball is not placed back before the second is taken out. Assume that the taking out of each ball from the bag is equally likely. What is the probability that both balls taken out are white? **[5 marks]**

**Q. 6(d)** Prove that $|\vec{a} \cdot \vec{b}| \leq |\vec{a}||\vec{b}|$ is always true for any two vectors $\vec{a}$ and $\vec{b}$. **[5 marks]**

**Q. 6(e)** Solve: $\int (3x - 5)/(x^3 - x^2 - x + 1)\, dx$. **[5 marks]**

## Question 7

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 7(a)** If $A = [3\ 3\ 1;\ 3\ 4\ 1;\ 4\ 3\ 1]$, then verify that $A\ (\text{adj}\ A) = |A|\ I$ and find $A^{-1}$. **[8 marks]**

**— OR —**

7(b): Solve the system of equations $x + y + z = 2$, $2x + y - 3z = 0$, $x - y + z - 4 = 0$ by matrix method.

## Question 8

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 8(a)** Prove that: $\int_0^{\pi/4} \log_e(1 + \tan\theta)\, d\theta = (\pi/8) \log_e 2$. **[8 marks]**

**— OR —**

8(b): Prove that the radius of the right circular cylinder of maximum curved surface inscribed in a cone is half of the radius of the cone.

## Question 9

Very Long Answer Question — 8 marks (attempt any one part)



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**Q. 9(a)** If $y = 600e^{-7x} + 500e^{7x}$, then show that $d^2y/dx^2 = 49y$. **[8 marks]**

Find the area bounded by the ellipse $x^2/16 + y^2/25 = 1$.

**— OR —**

9(b): Solve the integral $\int \sec^2 2\theta/(\cot\theta - \tan\theta)^2 \, d\theta$.

## Rebuild Notes

This paper was rebuilt in KAMALDNP design from a third-party transcription of the original UP Board paper. Questions, order and marks are as printed in the source; answers and solutions are not included. Where the transcription was unclear or contradicted the Hindi original, the point is flagged below.

1. Q9(a) is printed in the source with two items (the differential-equation proof and the ellipse area) — reproduced as printed.
2. The article's "UP Board Official PDF" link was not used (it could not be verified).

**Source (third-party transcription):** https://collegedunia.com/articles/e-737-up-board-class-12-mathematics-question-paper-2025-code-324-iz

English text only. The original paper is bilingual (Hindi + English); a Hindi side is a follow-up round, not this one. No official UP Board previous-year archive exists, so every paper in this volume is third-party-source.



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# Class 12 Mathematics 2024

Set 324 EX — 3 hours 15 minutes (including 15 minutes reading time) — Maximum Marks: 100

Exam: 29 February 2024, 2:00 PM – 5:15 PM | Time allowed: 3 hours 15 minutes (including 15 minutes reading time) | Maximum marks: 100 | Total questions: 34

## General Instructions

1. All questions are compulsory.
2. This question paper has 9 questions.
3. Question 1 has five multiple choice questions of 1 mark each.
4. Question 2 has five very short answer questions of 1 mark each.
5. Questions 3 and 4 have four short answer questions of 2 marks each in each question.
6. Questions 5 and 6 have five long answer questions of 5 marks each in each question.
7. Questions 7, 8 and 9 are very long answer questions of 8 marks each, with a choice between parts (a) and (b). Attempt any one part in each question.
8. 31 of the 34 printed questions are to be attempted.
9. The symbols used in the question paper have usual meaning.

> **Note:** General instructions follow the standard UP Board format as given in the source article's pattern table; the 2024 transcription source did not carry the printed instructions.

## Question 1

Multiple Choice Questions — 1 mark each

**Q. 1(a)** If orders of matrices A and B are $p \times q$ and $q \times r$ respectively, then order of AB is: **[1 mark]**

(A) $p \times r$ (B) $r \times p$
(C) $q \times p$ (D) None of these

**Q. 1(b)** At which point is the slope of the line $y = x + 1$ equal to the slope of the curve $y^2 = 4x$? **[1 mark]**

(A) (1, 2) (B) (2, 1) (C) (1, −2) (D) (−1, 2)

**Q. 1(c)** The value of the integral $\int \sqrt{(1 + \sin 2x)}\, dx$ is: **[1 mark]**

(A) $\sin x + \cos x + c$ (B) $\sin x - \cos x + c$
(C) $\cos x - \sin x + c$ (D) $-\cos x - \sin x + c$

**Q. 1(d)** If vectors $5\hat{i} - \lambda\hat{j} + 2\hat{k}$ and $2\hat{i} + 3\hat{j} + 4\hat{k}$ are perpendicular, find $\lambda$: **[1 mark]**

(A) 3 (B) 4 (C) 6 (D) 0



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**Q. 1(e)** The degree of the differential equation $d^2y/dx^2 = \sqrt[4]{(x + (dy/dx)^2)}$ is: **[1 mark]**

(A) 4 (B) 3 (C) 1 (D) 2

## Question 2

Very Short Answer Questions — 1 mark each

**Q. 2(a)** Show that the function $f(x) = \{x + 2, \text{if } x \neq 0; 1, \text{if } x = 0\}$ is not continuous at $x = 0$. **[1 mark]**

**Q. 2(b)** Find the principal value of $\sin^{-1}(\sin 7\pi/4)$. **[1 mark]**

**Q. 2(c)** If $y = Ae^x + B$ where A, B are constants, then show that $d^2y/dx^2 - dy/dx = 0$. **[1 mark]**

**Q. 2(d)** Solve the differential equation $dy/dx = (1 + x^2)/(1 + y^2)$. **[1 mark]**

**Q. 2(e)** The probability of A winning the race is 1/3 and that of B is 1/4. In this race, find the probability that neither A nor B can win the race. **[1 mark]**

## Question 3

Short Answer Questions — 2 marks each

**Q. 3(a)** R is a relation on a set of natural numbers N defined by $R = \{(a, b): a, b \in N \text{ and } a = b^2\}$. Is $(a, b) \in R, (b, c) \in R \Rightarrow (a, c) \in R$ true? Justify it by one example. **[2 marks]**

**Q. 3(b)** If $y = (x^2 + 3x + 4)/(e^x \cos x)$, find $dy/dx$. **[2 marks]**

**Q. 3(c)** Solve the differential equation $dy/dx = e^x \sin x$. **[2 marks]**

**Q. 3(d)** A die is thrown once. The number on the die is a multiple of 3 is denoted by E, and the number on the die is even is denoted by F. Are E and F independent events? **[2 marks]**

## Question 4

Short Answer Questions — 2 marks each

**Q. 4(a)** Differentiate y = (cos x)^(sin x). **[2 marks]**

**Q. 4(b)** Find the probability of 53 Sundays in a leap year. **[2 marks]**

**Q. 4(c)** Find the vector equation of the line which passes through the point (5, 2, −4) and is parallel to the vector $3\hat{i} + 2\hat{j} - 8\hat{k}$. **[2 marks]**

**Q. 4(d)** Find the value of: $\vec{a} \times (\vec{b} + \vec{c}) + \vec{b} \times (\vec{c} + \vec{a}) + \vec{c} \times (\vec{a} + \vec{b})$ **[2 marks]**

## Question 5

Long Answer Questions — 5 marks each

**Q. 5(a)** If R is the relation “less than” from A = {1, 2, 3, 4, 5} to B = {1, 4, 5}, find the set of ordered pairs corresponding to R. Also, define this relation from B to A. **[5 marks]**

**Q. 5(b)** Find the values of x, y, z if the matrix A satisfies the equation $A^TA = I$, where A = [0 2y z; x y −z; x −y z]. **[5 marks]**

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**Q. 5(c)** Differentiate $y = x^x + (\cos x)^{\tan x}$ with respect to x. **[5 marks]**

**Q. 5(d)** Find the minimum value of $Z = x + 3y$ under the following constraints: $x + y \leq 8$, $3x + 5y \geq 15$, $x \geq 0$, $y \geq 0$. **[5 marks]**

**Q. 5(e)** Find the shortest distance between the lines $\vec{r} = \hat{i} + \hat{j} + \lambda(2\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = 2\hat{i} + \hat{j} - \hat{k} + \mu(3\hat{i} - 5\hat{j} + 2\hat{k})$. **[5 marks]**

## Question 6

Long Answer Questions — 5 marks each

**Q. 6(a)** Find two positive numbers whose sum is 15 and the sum of their squares is minimum. **[5 marks]**

**Q. 6(b)** Find the area of the circle $x^2 + y^2 = a^2$. **[5 marks]**

**Q. 6(c)** Find the perpendicular unit vectors on the vectors $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$ and $\vec{b} = 3\hat{i} + 4\hat{j} - \hat{k}$ and find the sine of the angle between them. **[5 marks]**

**Q. 6(d)** If $A = [\cos\theta \sin\theta; -\sin\theta \cos\theta]$ prove that $A^n = [\cos n\theta \sin n\theta; -\sin n\theta \cos n\theta]$, where $n \in N$. **[5 marks]**

**Q. 6(e)** The probabilities of solving a question by A and B independently are 1/2 and 1/3 respectively. If both of them try to solve it independently, find the probability that: (i) neither of them is able to solve the question, (ii) at least one of them solves the question. **[5 marks]**

## Question 7

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 7(a)** If matrix $A = [1\ 1\ 3; 1\ 3\ -3; -2\ -4\ -4]$, then find $A^{-1}$. **[8 marks]**

**— OR —**

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

## Question 8

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 8(a)** Solve the differential equation: $(\tan^{-1} y - x)\, dy = (1 + y^2)\, dx$. **[8 marks]**

**— OR —**

Solve the differential equation: $dy/dx + y/x = x^2$, $y = 1$ when $x = 1$.

## Question 9

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 9(a)** Evaluate: $I = \int_0^{\pi} (x\, dx)/(a^2 \cos^2 x + b^2 \sin^2 x)$. **[8 marks]**

**— OR —**

Prove that: $\int_0^{(\pi/2)} \sin 2x \tan^{-1}(\sin x)\, dx = \pi/2 - 1$.



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## Rebuild Notes

This paper was rebuilt in KAMALDNP design from a third-party transcription of the original UP Board paper. Questions, order and marks are as printed in the source; answers and solutions are not included. Where the transcription was unclear or contradicted the Hindi original, the point is flagged below.

1. Q1(c): the source article gives option (D) as “cos x + sin x + c” (identical to option (A)); corrected to “−cos x − sin x + c” per the Hindi original in the scanned paper.
2. Q1(e): the source article garbles the equation as “$d^2y/dx^2 = \sqrt{(x)} + dy/dx^2$”; corrected to “$d^2y/dx^2 = \sqrt[4]{(x + (dy/dx)^2)}$” per the Hindi original in the scanned paper. Options (4, 3, 1, 2) are as printed.
3. Q2(a): the source article gives the function as $f(x) = x^2 + 2$ for $x \neq 0$; corrected to $f(x) = x + 2$ for $x \neq 0$ per the Hindi original in the scanned paper.
4. Q5(d): the source article prints “( z = x + 3y )”; rendered as Z = x + 3y per the Hindi original.
5. Q5(e): the two lines are run together in the source article; separated here per the Hindi original.
6. Q6(b): the source article reads “Find the area of the circle $x^2 + y^2 = a^2$ surrounded by it.”; corrected to “Find the area of the circle $x^2 + y^2 = a^2$.” per the Hindi original.
7. Q6(e): the source article ends at “find the probability that:”; the two parts (i) and (ii) are completed from the Hindi original in the scanned paper.

**Source (third-party transcription):** https://collegedunia.com/articles/e-737-up-board-class-12-mathematics-question-paper-2024-code-324-ex

**Cross-checked against:** https://images.collegedunia.com/public/image/UP_Board_Class_12_Mathematics_Question_Paper_2024_Code_324_EX__4d53f096438d7a5fcdc32ccaf5a56fae.pdf

English text only. The original paper is bilingual (Hindi + English); a Hindi side is a follow-up round, not this one. No official UP Board previous-year archive exists, so every paper in this volume is third-party-source.



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UP BOARD • CLASS 12 (INTERMEDIATE)

# Class 12 Mathematics 2023

Set 324 AX — 3 hours 15 minutes (including 15 minutes reading time) — Maximum Marks: 100

Exam: 27 February 2023, 2:00 PM – 5:15 PM | Time allowed: 3 hours 15 minutes (including 15 minutes reading time) | Maximum marks: 100 | Total questions: 34

## General Instructions

1. All questions are compulsory.
2. This question paper has 9 questions.
3. Question 1 has five multiple choice questions of 1 mark each.
4. Question 2 has five very short answer questions of 1 mark each.
5. Questions 3 and 4 have four short answer questions of 2 marks each in each question.
6. Questions 5 and 6 have five long answer questions of 5 marks each in each question.
7. Questions 7, 8 and 9 are very long answer questions of 8 marks each, with a choice between parts (a) and (b). Attempt any one part in each question.
8. 31 of the 34 printed questions are to be attempted.
9. The symbols used in the question paper have usual meaning.

> **Note:** General instructions follow the standard UP Board format as given in the source article's pattern table; the 2023 transcription source did not carry the printed instructions.

## Question 1

Multiple Choice Questions — 1 mark each

**Q. 1(a)** The degree of differential equation $d^2y/dx^2 = (y + dy/dx)^{(1/5)}$ will be **[1 mark]**

(A) 2 (B) 5 (C) 1 (D) 1/5

**Q. 1(b)** The value of $\int \cos^2 x \, dx$ will be **[1 mark]**

(A) $x/2 + 1/4 \sin(2x) + c$ (B) $x/4 - 1/2 \sin(2x) + c$

(C) $\cos^2 x - \sin^2 x + c$ (D) $2 \cos x \sin x + x/2 + c$

**Q. 1(c)** The angle between the vectors $\vec{A} = 2\hat{i} + \hat{j} + 3\hat{k}$ and $\vec{B} = 3\hat{i} - 2\hat{j} + \hat{k}$ will be **[1 mark]**

(A) 90° (B) 60° (C) 30° (D) $\cos^{-1} 1/14$

**Q. 1(d)** If the numbers of elements of two finite sets A and B are m and n respectively, then the total number of relations from A to B will be **[1 mark]**

(A) $2^{m+n}$ (B) $2^{mn}$ (C) $m \times n$ (D) $m + n$

**Q. 1(e)** If A = {1, 2, 3}, B = {2, 3, 4}, then the function from A to B will be **[1 mark]**

(A) {(1, 2), (1, 3), (2, 3), (3, 3)} (B) {(1, 3), (2, 4)}

(C) {(1, 3), (2, 2), (3, 3)} (D) {(1, 2), (2, 3), (3, 2), (3, 4)}



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## Question 2

Very Short Answer Questions — 1 mark each

**Q. 2(a)** Prove that the function f(x) = {$x^3 - 3$, if $x \le 2$; $x^2 + 1$, if $x > 2$} is continuous at x = 2. **[1 mark]**

**Q. 2(b)** Find the differential equation of the family of curves y = a sin(x + b), where a and b are arbitrary constants. **[1 mark]**

**Q. 2(c)** Prove that the function f: N → N defined by f(x) = x − 1, when x > 2, and f(1) = f(2) = 1, is onto but not one-to-one. **[1 mark]**

**Q. 2(d)** If P(A) = P(B) = 5/13 and P(A ∩ B) = 2/5, then find P(A ∪ B). **[1 mark]**

**Q. 2(e)** Solve the inequality 8x + 4 < 7x + 8. **[1 mark]**

## Question 3

Short Answer Questions — 2 marks each

**Q. 3(a)** Find the coordinates of the point which divides the line joining the points (2, −5, 1) and (1, 4, −6) internally in the ratio 2 : 3. **[2 marks]**

**Q. 3(b)** Find the area of the triangle whose two sides are represented by the vectors $\vec{a} = 3\hat{i} - \hat{j} + 5\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$. **[2 marks]**

**Q. 3(c)** If A = [cos θ sin θ; −sin θ cos θ], prove that $A^3$ = [cos 3θ sin 3θ; −sin 3θ cos 3θ]. **[2 marks]**

**Q. 3(d)** Two integers among 1 to 11 are selected at random. If their sum is even, then find the probability that both integers are odd. **[2 marks]**

## Question 4

Short Answer Questions — 2 marks each

**Q. 4(a)** If f : R → R, where f(x) = sin x and g : R → R, where $g(x) = x^2$, then find the range of f(x) and g(x). **[2 marks]**

**Q. 4(b)** If P(A) = 1/2, P(B) = 1/3, and P(A ∪ B) = 2/3, prove that the events A and B are independent. **[2 marks]**

**Q. 4(c)** If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$, and $\vec{c} = 3\hat{i} + \hat{j}$ are such that $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{c}$, then find the value of λ. **[2 marks]**

**Q. 4(d)** Solve the differential equation (x − y) dy − (x + y) dx = 0. **[2 marks]**

## Question 5

Long Answer Questions — 5 marks each

**Q. 5(a)** Prove that |1+α 1 1; 1 1+β 1; 1 1 1+γ| = abc(1/a + 1/b + 1/c + 1). **[5 marks]**

**Q. 5(b)** If $f(x) = x + 1/x$, prove that $f(x)^3 = f(x^3) + 3f(1/x)$. **[5 marks]**



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**Q. 5(c)** Find the differential coefficient of $\tan^{-1}(2x/(1 - x^2))$ with respect to x. **[5 marks]**

**Q. 5(d)** Find the equation of the plane passing through the points $(-2\hat{i} + 6\hat{j} - 6\hat{k})$, $(-3\hat{i} + 10\hat{j} - 9\hat{k})$, $(-5\hat{i} - 6\hat{j} - 6\hat{k})$. **[5 marks]**

**Q. 5(e)** Find the equation of normal at the point (1, 1) of the curve x^(2/3) + y^(2/3) = 2. **[5 marks]**

## Question 6

Long Answer Questions — 5 marks each

**Q. 6(a)** If two dice are thrown together, then find the probability of getting at least one 6. **[5 marks]**

**Q. 6(b)** Evaluate: $\int \sec^2(2x)/(\cot x - \tan x)^2 \, dx$. **[5 marks]**

**Q. 6(c)** If the coordinates of mid-points of the sides of a triangle are (1, 5, −1), (0, 4, −2) and (2, 3, 4), then find the coordinates of its vertices. **[5 marks]**

**Q. 6(d)** Find the value of $\int_a^b x^2 \, dx$ with the help of definite integral as the limit of a sum. **[5 marks]**

**Q. 6(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 $\vec{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$. **[5 marks]**

## Question 7

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 7(a)** Solve the following system of equations by matrix method: $3x - 2y + 3z = 8$, $2x + y - z = 1$, $4x - 3y + 2z = 4$. **[8 marks]**

**— OR —**

Solve the differential equation: $\tan^{-1}(y - x) \, dy = (1 + y^2) \, dx$.

## Question 8

Very Long Answer Question — 8 marks (attempt any one part)

**Q. 8(a)** Evaluate: $\int_0^{\pi} (x \sin x)/(1 + \cos^2 x) \, dx$. **[8 marks]**

**— OR —**

(i) Evaluate: $\int_0^{(\pi/2)} \sqrt{(\sin x)}/(\sqrt{(\sin x)} + \sqrt{(\cos x)}) \, dx$. (ii) If the normal of the curve x^(2/3)/a^(2/3) + y^(2/3)/a^(2/3) = 1 makes an angle θ with the x-axis, prove that the equation of the normal is $y \cos\theta - x \sin\theta = a \cos 2\theta$.

## Question 9

Very Long Answer Question — 8 marks (attempt any one part)



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**Q. 9(a)** Solve the following linear programming problem by the graphical method, under the following constraints: $x + 3y \leq 60$, $x + y \geq 10$, $x \leq y$, $x \geq 0$, $y \geq 0$. Find the minimum and maximum values of $Z = 3x + 9y$. **[8 marks]**

**— OR —**

Find the inverse of the matrix $A = [2\ 0\ -1;\ 5\ 1\ 0;\ 0\ 1\ 3]$ by elementary transformations.

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1. Q1(a): the source article renders the equation as "$d^2y/dx^2 = y + dy/dx\ \hat{}(1/5)$"; written here as $d^2y/dx^2 = (y + dy/dx)\hat{}(1/5)$ per the text solutions PDF, which shows the power 1/5 over the whole right-hand side.
2. Q2(a) and Q2(c): the source article drops the piecewise braces and the → arrows; restored as printed.
3. Q5(a): the determinant is printed with α, β, γ on the left and a, b, c on the right in both the article and the text solutions PDF; reproduced as printed.
4. Q5(c): the source article drops the brackets; restored as $\tan^{-1}(2x/(1 - x^2))$.
5. Q8(b): the source article splits this into two separate items; the text solutions PDF shows it is one part with (i) and (ii) — combined here.
6. Q8(b)(i): the source article renders the denominator as √(sin x + cos x); written here as √(sin x) + √(cos x) per the text solutions PDF layout — flagged as ambiguous in the source.

**Source (third-party transcription):** https://collegedunia.com/news/e-737-up-board-class-12-mathematics-question-paper-with-answer-key-february-27-code-324-ax

**Cross-checked against:** https://image-static.collegedunia.com/public/image/UP_Board_Class_12_Mathematics_324_AX_2023_Question_Paper_with_Solutions_77fcc643a8dac7479bd6d9cb42edb780

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