

MATHEMATICS

Time allowed : 3 hours

Maximum Marks: 100

General Instructions:

1. All questions are compulsory.
2. This question paper contains 29 questions.
3. Questions 1 – 4 in Section A are very short-answer type questions carrying 1 mark each.
4. Questions 5 – 12 in Section B are short-answer type questions carrying 2 marks each.
5. Questions 13 – 23 in Section C are long-answer I type questions carrying 4 marks each.
6. Questions 24 – 29 in Section D are long-answer II type questions carrying 6 marks each.

Section A

1. If A and B are invertible matrices of order 3, $|A| = 2$ and $|(AB)^{-1}| = -\frac{1}{6}$. Find $|B|$.
2. Differentiate $\sin^2(x^2)$ w.r.t x^2 .
3. Write the order of the differential equation:

$$\log\left(\frac{d^2y}{dx^2}\right) = \left(\frac{dy}{dx}\right)^3 + x$$

4. Find the acute angle which the line with direction cosines $\frac{1}{\sqrt{3}}, \frac{1}{\sqrt{6}}, n$ makes with positive direction of z-axis.

OR

Find the direction cosines of the line: $\frac{x-1}{2} = -y = \frac{z+1}{2}$

Section B

5. Let $A = Z \times Z$ and $*$ be a binary operation on A defined by $(a, b)*(c, d) = (ad + bc, bd)$.

Find the identity element for $*$ in the set A.

6. If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, find k so that $A^2 = 5A + kI$.

7. Find : $\int \frac{(x^2 + \sin^2 x) \sec^2 x}{1 + x^2} dx$

8. Find: $\int \frac{e^x (x-3)}{(x-1)^3} dx$

OR

Find: $\int \frac{(x^4 - x)^{\frac{1}{4}}}{x^5} dx$

9. Form the differential equation of all circles which touch the x-axis at the origin.

10. Find the area of the parallelogram whose diagonals are represented by the vectors

$$\vec{a} = 2\hat{i} - 3\hat{j} + 4\hat{k} \text{ and } \vec{b} = 2\hat{i} - \hat{j} + 2\hat{k}$$

OR

Find the angle between the vectors

$$\vec{a} = \hat{i} + \hat{j} - \hat{k} \text{ and } \vec{b} = \hat{i} - \hat{j} + \hat{k}$$

11. If A and B are two independent events, prove that A' and B are also independent.

12. One bag contains 3 red and 5 black balls. Another bag contains 6 red and 4 black balls. A ball is transferred from first bag to the second bag and then a ball is drawn from the second bag. Find the probability that the ball drawn is red.

OR

If $P(A) = 0.6$, $P(B) = 0.5$ and $P(A|B) = 0.3$, then find $P(A \cup B)$.

Section C

13. Prove that the function $f: [0, \infty) \rightarrow \mathbf{R}$ given by $f(x) = 9x^2 + 6x - 5$ is not invertible. Modify the codomain of the function f to make it invertible, and hence find f^{-1} .

OR

Check whether the relation R in the set \mathbf{R} of real numbers, defined by

$R = \{(a, b) : 1 + ab > 0\}$, is reflexive, symmetric or transitive.

14. Find the value of : $\sin\left(2 \tan^{-1} \frac{1}{4}\right) + \cos(\tan^{-1} 2\sqrt{2})$

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15. Using properties of determinants, prove that:

$$\begin{vmatrix} a & b-c & c+b \\ a+c & b & c-a \\ a-b & b+a & c \end{vmatrix} = (a+b+c)(a^2+b^2+c^2)$$

16. If $y = x^{\sin x} + \sin(x^x)$, find $\frac{dy}{dx}$

OR

If $y = \log(1+2t^2+t^4)$, $x = \tan^{-1}t$, find $\frac{d^2y}{dx^2}$

17. If $y = \cos(m \cos^{-1} x)$

Show that: $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} + m^2y = 0$

18. Find the equations of the normal to the curve $y = 4x^3 - 3x + 5$ which are perpendicular to the line $9x - y + 5 = 0$.

19. Find: $\int \frac{x^4+1}{x(x^2+1)^2} dx$

20. Evaluate: $\int_{-1}^1 \frac{x+|x|+1}{x^2+2|x|+1} dx$

21. Find the particular solution of the following differential equation.

$$\cos y dx + (1 + 2e^{-x}) \sin y dy = 0; y(0) = \frac{\pi}{4}$$

OR

Find the general solution of the differential equation:

$$\frac{dx}{dy} = \frac{y \tan y - x \tan y - xy}{y \tan y}$$

22. If $\vec{p} = \hat{i} + \hat{j} + \hat{k}$ and $\vec{q} = \hat{i} - 2\hat{j} + \hat{k}$, find a vector of magnitude $5\sqrt{3}$ units perpendicular to the vector \vec{q} and coplanar with vectors \vec{p} and \vec{q} .

23. Find the vector equation of the line joining $(1, 2, 3)$ and $(-3, 4, 3)$ and show that it is perpendicular to the z-axis.

Section D

24. If $A = \begin{bmatrix} 3 & 1 & 2 \\ 3 & 2 & -3 \\ 2 & 0 & -1 \end{bmatrix}$, find A^{-1} .

Hence, solve the system of equations:

$$3x + 3y + 2z = 1$$

$$x + 2y = 4$$

$$2x - 3y - z = 5$$

OR

Find the inverse of the following matrix using elementary transformations.

$$\begin{bmatrix} 2 & -1 & 3 \\ -5 & 3 & 1 \\ -3 & 2 & 3 \end{bmatrix}$$

25. A cuboidal shaped godown with square base is to be constructed. Three times as much cost per square meter is incurred for constructing the roof as compared to the walls. Find the dimensions of the godown if it is to enclose a given volume and minimize the cost of constructing the roof and the walls.

26. Find the area bounded by the curves $y = \sqrt{x}$, $2y + 3 = x$ and x -axis.

OR

Find the area of the region.

$$\{(x, y) : x^2 + y^2 \leq 8, x^2 \leq 2y\}$$

27. Find the equation of the plane through the line $\frac{x-1}{3} = \frac{y-4}{2} = \frac{z-4}{-2}$ and parallel to the

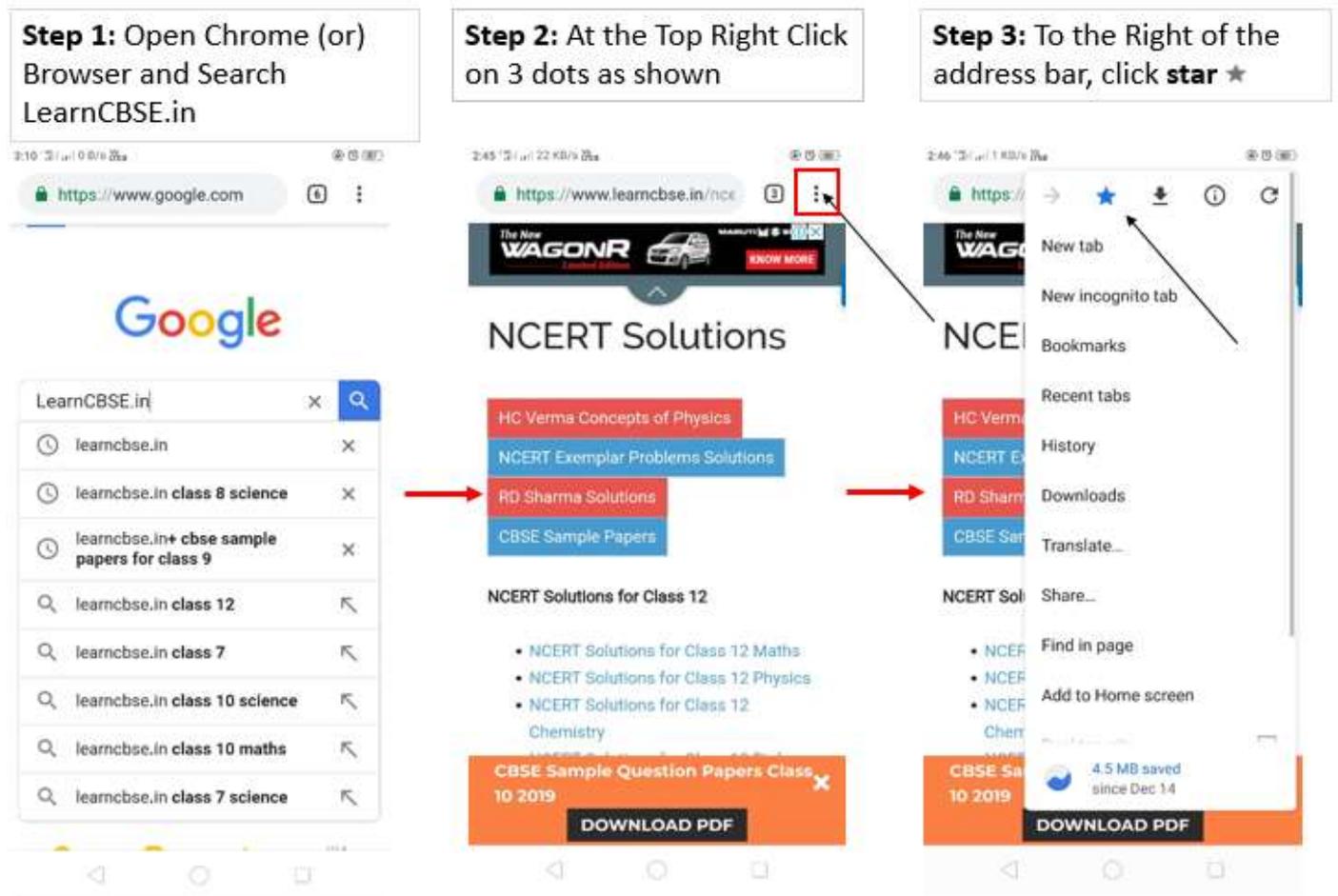
line $\frac{x+1}{2} = \frac{1-y}{4} = \frac{z+2}{1}$. Hence, find the shortest distance between the lines.

OR

Show that the line of intersection of the planes $x + 2y + 3z = 8$ and $2x + 3y + 4z = 11$ is coplanar with the line $\frac{x+1}{1} = \frac{y+1}{2} = \frac{z+1}{3}$. Also find the equation of the plane containing

them.

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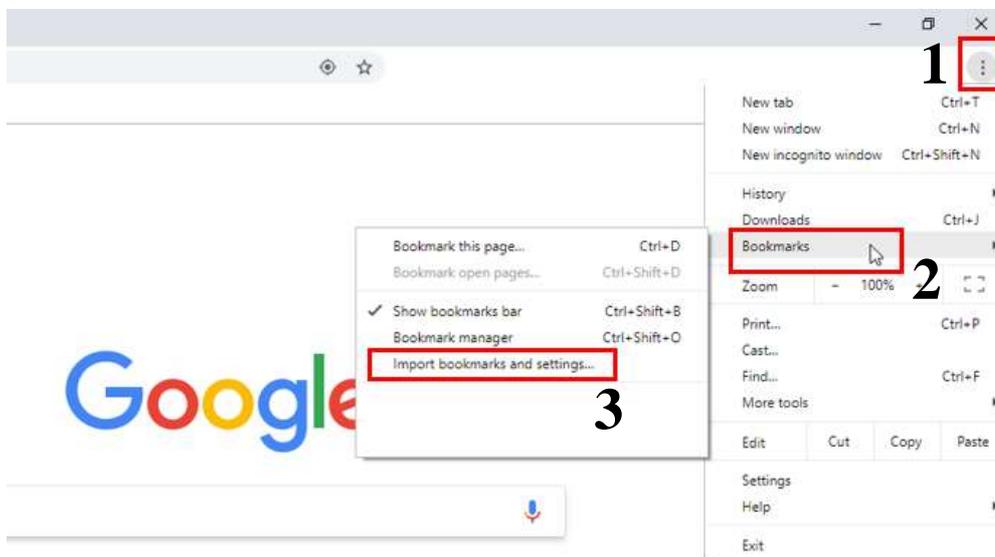
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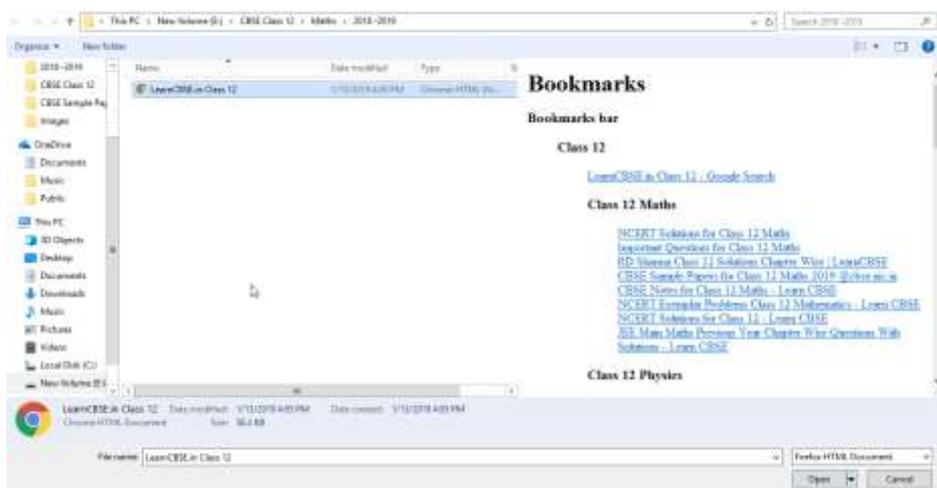
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28. A manufacturer makes two types of toys A and B. Three machine are needed for this purpose and the time (in minutes) required for each toy on the machines is given below:

Types of Toys	Machines		
	I	II	III
A	20	10	10
B	10	20	30

The machines I, II and III are available for a maximum of 3 hours, 2 hours and 2 hours 30 minutes respectively. The profit on each toy of type A is ₹ 50 and that of type B is ₹ 60. Formulate the above problem as a L.P.P and solve it graphically to maximize profit.

29. The members of a consulting firm rent cars from three rental agencies: 50% from agency X, 30% from agency Y and 20% from agency Z. From past experience it is known that 9% of the cars from agency X need a service and tuning before renting, 12% of the cars from agency Y need a service and tuning before renting and 10% of the cars from agency Z need a service and tuning before renting. If the rental car delivered to the firm needs service and tuning, find the probability that agency Z is not to be blamed.

Class 12 Maths NCERT Solutions

NCERT Solutions	Important Questions	NCERT Exemplar
Chapter 1 Relations and Functions	Relations and Functions	Chapter 1 Relations and Functions
Chapter 2 Inverse Trigonometric Functions	Concept of Relations and Functions	Chapter 2 Inverse Trigonometric Functions
Chapter 3 Matrices	Binary Operations	Chapter 3 Matrices
Chapter 4 Determinants	Inverse Trigonometric Functions	Chapter 4 Determinants
Chapter 5 Continuity and Differentiability	Matrices	Chapter 5 Continuity and Differentiability
Chapter 6 Application of Derivatives	Matrix and Operations of Matrices	Chapter 6 Application of Derivatives
Chapter 7 Integrals Ex 7.1	Transpose of a Matrix and Symmetric Matrix	Chapter 7 Integrals
Integrals Class 12 Ex 7.2	Inverse of a Matrix by Elementary Operations	Chapter 8 Applications of Integrals
Integrals Class 12 Ex 7.3	Determinants	Chapter 9 Differential Equations
Integrals Class 12 Ex 7.4	Expansion of Determinants	Chapter 10 Vector Algebra
Integrals Class 12 Ex 7.5	Properties of Determinants	Chapter 11 Three Dimensional Geometry
Integrals Class 12 Ex 7.6	Inverse of a Matrix and Application of Determinants and Matrix	Chapter 12 Linear Programming
Integrals Class 12 Ex 7.7	Continuity and Differentiability	Chapter 13 Probability
Integrals Class 12 Ex 7.8	Continuity	
Integrals Class 12 Ex 7.9	Differentiability	
Integrals Class 12 Ex 7.10	Application of Derivatives	
Integrals Class 12 Ex 7.11	Rate Measure Approximations and Increasing-Decreasing Functions	
Integrals Class 12 Miscellaneous Exercise	Tangents and Normals	
Chapter 8 Application of Integrals	Maxima and Minima	
Chapter 9 Differential Equations	Integrals	
Chapter 10 Vector Algebra	Types of Integrals	
Chapter 11 Three Dimensional Geometry	Differential Equation	
Chapter 12 Linear Programming	Formation of Differential Equations	
Chapter 13 Probability Ex	Solution of Different Types of Differential	

13.1	Equations	
Probability Solutions Ex 13.2	Vector Algebra	
Probability Solutions Ex 13.3	Algebra of Vectors	
Probability Solutions Ex 13.4	Dot and Cross Products of Two Vectors	
Probability Solutions Ex 13.5	Three Dimensional Geometry	
	Direction Cosines and Lines	
	Plane	
	Linear Programming	
	Probability	
	Conditional Probability and Independent Events	
	Baye's Theorem and Probability Distribution	

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Chapter 1: Relations	Chapter 12: Higher Order Derivatives	Chapter 23 Algebra of Vectors
Chapter 2: Functions	Chapter 13: Derivative as a Rate Measurer	Chapter 24: Scalar Or Dot Product
Chapter 3: Binary Operations	Chapter 14: Differentials, Errors and Approximations	Chapter 25: Vector or Cross Product
Chapter 4: Inverse Trigonometric Functions	Chapter 15: Mean Value Theorems	Chapter 26: Scalar Triple Product
Chapter 5: Algebra of Matrices	Chapter 16: Tangents and Normals	Chapter 27: Direction Cosines and Direction Ratios
Chapter 6: Determinants	Chapter 17: Increasing and Decreasing Functions	Chapter 28 Straight line in space
Chapter 7: Adjoint and Inverse of a Matrix	Chapter 18: Maxima and Minima	Chapter 29: The plane
Chapter 8: Solution of Simultaneous Linear Equations	Chapter 19: Indefinite Integrals	Chapter 30: Linear programming
Chapter 9: Continuity	Chapter 20: Definite Integrals	Chapter 31: Probability
Chapter 10: Differentiability	Chapter 21: Areas of Bounded Regions	Chapter 32: Mean and variance of a random variable
Chapter 11: Differentiation	Chapter 22: Differential Equations	Chapter 33: Binomial Distribution

JEE Main Maths Chapter wise Previous Year Questions

1. [Relations, Functions and Reasoning](#)
2. [Complex Numbers](#)
3. [Quadratic Equations And Expressions](#)
4. [Matrices, Determinants and Solutions of Linear Equations](#)
5. [Permutations and Combinations](#)
6. [Binomial Theorem and Mathematical Induction](#)
7. [Sequences and Series](#)
8. [Limits, Continuity, Differentiability and Differentiation](#)
9. [Applications of Derivatives](#)
10. [Indefinite and Definite Integrals](#)
11. [Differential Equations and Areas](#)
12. [Cartesian System and Straight Lines](#)
13. [Circles and System of Circles](#)
14. [Conic Sections](#)
15. [Three Dimensional Geometry](#)
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18. [Trigonometry](#)
19. [Miscellaneous](#)

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