

# DexNotePro: Senior Secondary Mathematics (Grades 11–12)

## Welcome to Advanced Mathematics

Welcome to **DexNotePro's Senior Secondary Mathematics**, where logic meets abstraction, and formulas shape modern computing, engineering, and AI.

You're about to master the building blocks of calculus, vectors, and probability — the tools behind physics, economics, and even machine learning.

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## 1. Sets, Relations & Functions

**Sets** form the language of modern math.

A **set** is a collection of well-defined elements.

### Examples:

- $A = \{2, 4, 6, 8\}$
- $B = \{x \mid x < 10, x \in \mathbb{N}\}$

### Relations & Functions:

A **relation** shows connection between two sets.

A **function** is a special relation where every input has exactly one output.

### Try This:

If  $f(x) = 2x + 3$ , find  $f(2)$ ,  $f(5)$ .

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## 2. Trigonometric Functions

Now we extend trigonometry to all angles and real numbers.

### Concepts:

- General Solutions
- Graphs of trigonometric functions
- Trigonometric equations

### Key Identity:

$$\sin^2\theta + \cos^2\theta = 1$$

### Try This:

$$\text{Solve for } \theta: 2\sin^2\theta = 1$$

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## 3. Principle of Mathematical Induction

This principle is the logic of infinite truths — proving statements for all natural numbers.

### Steps:

1. Verify for  $n = 1$
2. Assume true for  $n = k$
3. Prove for  $n = k + 1$

### Try This:

$$\text{Prove by induction: } 1 + 3 + 5 + \dots + (2n-1) = n^2$$

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## 4. Complex Numbers & Quadratic Equations

To handle roots of negative numbers, we extend real numbers to **complex numbers**.

### Concepts:

- $i^2 = -1$
- $z = a + ib$

- Conjugate and modulus

**Try This:**

Find modulus and argument of  $z = 3 + 4i$ .

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## 5. Linear Inequalities

Used in optimization and economics to model constraints.

**Example:**

$x + y \leq 5$ ,  $x \geq 0$ ,  $y \geq 0$  forms a feasible region.

**Try This:**

Graph  $x + 2y \leq 8$  and  $x \geq 2$ .

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## 6. Permutations & Combinations

Counting arrangements and selections forms the base of probability and data science.

**Formulas:**

- $nPr = n! / (n-r)!$
- $nCr = n! / [r!(n-r)!]$

**Try This:**

How many ways can 5 students sit in 3 chairs?

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## 7. Binomial Theorem

Used in algebraic expansions and probability.

$$(a+b)^n = \sum_{k=0}^n \binom{n}{k} a^{n-k} b^k$$

$$(a+b)^n = \sum_{k=0}^n \binom{n}{k} a^k b^{n-k}$$

**Try This:**

Find the middle term in the expansion of  $(x+1)^6(x+1)^6(x+1)^6$

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## 8. Sequences and Series

Mathematical patterns that appear everywhere — from finance to code optimization.

**Concepts:**

- Arithmetic Progression (AP)
- Geometric Progression (GP)
- Sum of  $n$  terms

**Try This:**

If  $a = 3$ ,  $r = 2$ , find the sum of first 5 terms of GP.

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## 9. Straight Lines & Conic Sections

Coordinate geometry extends to curves — circles, ellipses, and hyperbolas.

**Equations:**

- Line:  $y = mx + c$
- Circle:  $x^2 + y^2 = r^2$
- Parabola:  $y^2 = 4ax$

**Try This:**

Find the equation of the line passing through  $(2,3)$  with slope 4.

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## 10. Limits & Continuity

The foundation of calculus — studying how functions behave near points.

**Key Idea:**

$\lim_{x \rightarrow a} f(x)$  represents the value approached by  $f(x)$  as  $x$  gets close to  $a$ .

**Try This:**

Find  $\lim_{x \rightarrow 2} \frac{x^2 - 4}{x - 2}$

## 11. Differentiation

Differentiation tells us how fast things change — used in motion, economics, and AI training.

**Rules:**

- $\frac{d}{dx}(x^n) = nx^{n-1}$
- Chain rule, Product rule, Quotient rule

**Try This:**

Differentiate:  $y = x^3 + 2x^2 + 5x + 7$

## 12. Applications of Derivatives

Derivatives help in finding maxima, minima, and rate of change.

**Example:**

Find the slope of tangent to  $y = x^2$  at  $x = 3$ .

Solution:  $\frac{dy}{dx} = 2x \rightarrow \text{slope} = 6$ .

**Try This:**

Find maximum or minimum of  $y = x^2 - 4x + 5$ .

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## 13. Integrals

Integration is the reverse of differentiation — it measures accumulation.

### Formulas:

- $\int x^n dx = \frac{x^{n+1}}{n+1} + C$
- $\int e^x dx = e^x + C$

### Try This:

Evaluate  $\int (3x^2 + 4x) dx$

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## 14. Differential Equations

These link functions and their derivatives — used in physics, population growth, and AI models.

### Example:

$$\frac{dy}{dx} = ky \Rightarrow y = Ce^{kx}$$

### Try This:

$$\frac{dy}{dx} = 3y \Rightarrow y = Ce^{3x}$$

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## 15. Vectors

Vectors describe quantities with both magnitude and direction — crucial for graphics and physics.

### Concepts:

- Vector addition
- Scalar product (dot)

- Vector product (cross)

**Try This:**

Find the angle between  $a = (3,4)$  and  $b = (4,3)$ .

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## 16. Three-Dimensional Geometry

Understanding points, lines, and planes in 3D.

**Equations:**

- Line:  $r = a + \lambda b$
- Plane:  $ax + by + cz + d = 0$

**Try This:**

Find the distance from  $(1,2,3)$  to plane  $2x + y + z = 5$ .

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## 17. Probability & Statistics

You now use math to predict the unpredictable.

**Concepts:**

- Conditional probability
- Bayes' theorem
- Variance and standard deviation

**Try This:**

A bag has 5 red and 3 blue balls. Find  $P(\text{getting 2 red balls when 2 are drawn})$ .

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## 18. Linear Programming

Used to optimize production, costs, or profits.

**Steps:**

1. Form inequalities
2. Graph feasible region
3. Optimize  $Z = ax + by$

**Try This:**

Maximize  $Z = 3x + 4y$  subject to  
 $x + y \leq 10, x \geq 0, y \geq 0$

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## 19. Matrices & Determinants

The algebra of arrays — key for coding, graphics, and machine learning.

**Formulas:**

- Addition:  $A + B$
- Multiplication:  $AB$
- Determinant of  $2 \times 2$ :  $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$

**Try This:**

Find the inverse of

$$\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$$


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## 20. Mathematical Modeling

The heart of applied math — turning real-world problems into equations.

**Example:**

Modeling population growth:

$$P(t) = P_0 e^{kt}$$



**Try This:**

If population doubles in 5 years, find  $k$ .

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**✓ Congratulations!**

You've completed **DexNotePro: Senior Secondary Mathematics (Grades 11–12)** 🎉

You now have command over the most powerful tools in modern mathematics — from algebra to calculus and beyond.

Go to [ishaan7india.github.io/DexNotePro](https://ishaan7india.github.io/DexNotePro) and **mark this course as complete!**