9th Grade Mathematics Notes

1. Algebra

1.1 Polynomials

- Definition: A polynomial is an expression of the form:

$$a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$$

where a_i are constants, and n is a non-negative integer.

- Degree of a Polynomial: The highest power of x in the polynomial.
- Types of Polynomials:
  1. Monomial: 1 term (e.g., $7x^2$)
  2. Binomial: 2 terms (e.g., $x^2 + 5$)
  3. Trinomial: 3 terms (e.g., $x^2 + 3x + 2$)

Formulas:

- Sum of cubes: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
- Difference of cubes: $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

Example: Factorize $x^2 + 5x + 6$

- Find factors of 6 that sum to 5 → 2 and 3 → $(x + 2)(x + 3)$

1.2 Factorization

- Methods:
    1. Take out the greatest common factor (GCF)
    2. Use special identities:
        - $a^2 - b^2 = (a - b)(a + b)$
        - $a^2 + 2ab + b^2 = (a + b)^2$
        - $a^2 - 2ab + b^2 = (a - b)^2$

Example:
Factorize $x^2 - 16 \rightarrow (x - 4)(x + 4)$

1.3 Linear and Quadratic Equations

- Linear Equation: Ax + B = 0 → x = -B/A
- Quadratic Equation: $ax^2 + bx + c = 0$
    - Solved by: Factorization, Completing the Square, or Quadratic Formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Example: Solve $x^2 + 5x + 6 = 0 \rightarrow (x + 2)(x + 3) = 0 \rightarrow$ x = -2, -3

2. Geometry

2.1 Triangles

- Sum of Angles: ∠A + ∠B + ∠C = 180°
- Types: Equilateral, Isosceles, Scalene, Right-Angled
- Pythagoras Theorem: $a^2 + b^2 = c^2$(for right triangles)

Example: Hypotenuse of a right triangle with sides 3 cm and 4 cm → $c^2 = 3^2 + 4^2 = 25 \rightarrow c = 5$

2.2 Quadrilaterals

- Types: Square, Rectangle, Parallelogram, Rhombus, Trapezium
- Properties:
  - Opposite sides of parallelogram are equal
  - Opposite angles are equal
  - Diagonals bisect each other

Area Formulas:

- Square: a^2
- Rectangle: $l \times b$
- Parallelogram: $base \times height$

- Trapezium:
  $\frac{1}{2}(sum\ o \qquad f\ p \qquad arallel\ s$
  $height$

2.3 Circles

- Definition: A set of points equidistant from a center
- Radius (r), Diameter (d), Circumference:
  - $d = 2r$
  - Circumference = $2\pi r$
  - Area = πr^2

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3. Trigonometry

3.1 Trig Ratios

- For a right-angled triangle:
  - $\sin\ \theta = \frac{opposite}{hypotenuse}$
  - $\cos\ \theta = \frac{adjacent}{hypotenuse}$
  - $\tan\ \theta = \frac{opposite}{adjacent}$

Other Ratios:

- $\cot\ \theta = \frac{1}{\tan\theta}$

- $\sec\theta = \frac{1}{\cos\theta}$
- $\csc\theta = \frac{1}{\sin\theta}$

Example:
If opposite = 3, adjacent = 4, hypotenuse = 5 → sinθ = 3/5, cosθ = 4/5, tanθ = 3/4

3.2 Applications

- Finding height of a tower using angle of elevation
- Distance between points using triangles

4. Statistics & Probability

4.1 Mean, Median, Mode

- Mean: $\bar{x} = \frac{\text{Sum of observations}}{n}$
- Median: Middle value in an ordered dataset
- Mode: Most frequently occurring value

Example: 2, 3, 3, 5, 7 → Mean = 4, Median = 3, Mode = 3

4.2 Probability

- Probability of an event = $\frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$

- Example: Probability of getting a 4 on a dice = 1/6

5. Coordinate Geometry

5.1 Distance Formula

- Between two points $(x_1, y_1), (x_2, y_2)$:

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

5.2 Midpoint Formula

- Midpoint = $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$

6. Mensuration

6.1 Surface Area & Volume

- Cube: SA = $6a^2$, Volume = a^3
- Cuboid: SA = $2(lb+bh+hl)$, Volume = $l \times b \times h$
- Sphere: SA = $4\pi r^2$, Volume = $4/3\pi r^3$
- Cylinder: SA = $2\pi r(h+r)$, Volume = $\pi r^2 h$