🟩 Class 9 Maths – Chapter 2: Polynomials (🌟 Easy Notes with Emojis)

1️⃣ What is a Polynomial? 🧮

A polynomial is an expression made up of:

- ✅ Constants (numbers like 2, –5)
- ✅ Variables (like x, y)
- ✅ Exponents (whole numbers only)
- ✅ Operations: +, –, ×

📌 Example:
✔️ $2x^2 + 3x + 5$ → Yes, it's a polynomial
❌ $1/x$ or $\sqrt{x}$ → No! Exponents must be whole numbers (no negative or fractions)

2️⃣ Types of Polynomials ✍️

Type	Example	Description
🔹 Monomial	$4x$	One term
🔸 Binomial	$x^2 + 3$	Two terms
🔺 Trinomial	$x^2 + 2x + 1$	Three terms
🟢 Multinomial	$x^3 - x + 2x^2 - 7$	More than 3 terms

3️⃣ Degree of a Polynomial 🎯

📌 The highest exponent of the variable = degree

✔️ Example:
$2x^3 + 5x - 4$ → Degree = 3
$x^5 - 7x^2 + 6$ → Degree = 5

4️⃣ Kinds Based on Degree 🎓

Degree	Type	Example
0	Constant	4
1	Linear	3x + 2
2	Quadratic	$x^2 + 5x + 6$
3	Cubic	$x^3 - x^2 + x - 1$

5️⃣ Value of a Polynomial 📈

Just substitute the value of the variable and simplify.

🧮 Example:
$p(x) = x^2 - 3x + 2$
Find $p(2)$:
$= 2^2 - 3\times2 + 2 = 4 - 6 + 2 = 0$

6️⃣ Zero of a Polynomial 🕳️

📌 If $p(a) = 0$, then a is called a zero (or root) of the polynomial.

🧮 Example:
$p(x) = x - 4$
Put $x = 4 \rightarrow p(4) = 0 \rightarrow$ So, 4 is a zero of the polynomial

7️⃣ Remainder Theorem 🧠

If a polynomial p(x) is divided by $x - a$, then:

👉 Remainder = p(a)

✍️ Example:
$p(x) = x^2 - 4x + 3$
Divide by $x - 1 \rightarrow$ remainder $= p(1) = 1 - 4 + 3 = 0$

8️⃣ Factor Theorem 🔍

If $p(a) = 0$, then $x - a$ is a factor of the polynomial p(x)

✔️ Used to check or find factors quickly.

9️⃣ Factorisation Techniques ✂️

A. Middle Term Splitting (Quadratic):

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

→ $x^2 + 2x + 3x + 6$

→ $x(x + 2) + 3(x + 2)$

→ $(x + 2)(x + 3)$

B. Using Identities (see next section 👇)

🔟 Algebraic Identities (Super Useful!) 🧙‍♂️

📚 Learn these by heart, they're your power tools! ⚡

✅ 1. Square of a Binomial

$(x + y)^2 = x^2 + 2xy + y^2$
📌 *Used when you square a sum*
👉 Example: $(3 + 2)^2 = 9 + 12 + 4 =$ **25**

$(x - y)^2 = x^2 - 2xy + y^2$
📌 *Used when you square a difference*
👉 Example: $(5 - 2)^2 = 25 - 20 + 4 =$ **9**

✅ 2. Difference of Squares

$x^2 - y^2 = (x + y)(x - y)$
📌 *Used when you see a square minus another square*
👉 Example: $49 - 36 = (7 + 6)(7 - 6) =$ **$13 \times 1 = 13$**

✅ 3. Factoring Quadratic Expressions

$(x + a)(x + b) = x^2 + (a + b)x + ab$
📌 *Used when multiplying two binomials*
👉 Example: $(x + 2)(x + 3) = x^2 + 5x + 6$

✅ 4. Cube Identities

$(x + y)^3 = x^3 + y^3 + 3xy(x + y)$
📌 *Used for the cube of a sum*
👉 Example: $(2 + 1)^3 = 8 + 1 + 18 =$ **27**

$(x - y)^3 = x^3 - y^3 - 3xy(x - y)$
📌 *Used for the cube of a difference*
👉 Example: $(4 - 1)^3 = 64 - 1 - 36 =$ **27**

✅ 5. Sum and Difference of Cubes

$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$
$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$
📌 *Used to factor expressions like $a^3 \pm b^3$*

✅ 6. Special Identity for 3 Variables

$x^3 + y^3 + z^3 - 3xyz = (x + y + z)(x^2 + y^2 + z^2 - xy - yz - zx)$
📌 *Used when the sum of the variables = 0*

👉 If **$x + y + z = 0$**, then: x3+y3+z3=3xyzx3 + y3 + z3 = 3xyzx3+y3+z3=3xyz

🎁 Bonus Tip:

These identities also help in quick calculations, like:

- 9992=(1000−1)2=10002−2×1000×1+12=998001999^2 = (1000 - 1)^2 = 1000^2 - 2×1000×1 + 1^2 = 9980019992=(1000−1)2=10002−2×1000×1+12=998001