

Algebraic identities are **formulas that are always true** and are used to **simplify expressions, expand brackets, and factorize polynomials** quickly.

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## 1 Square of a Binomial

◆  $(a + b)^2$

$$(a+b)^2 = a^2 + 2ab + b^2$$

**Use:** Expanding squares

**Example:**

$$(x+3)^2 = x^2 + 6x + 9$$

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◆  $(a - b)^2$

$$(a-b)^2 = a^2 - 2ab + b^2$$

**Example:**

$$(2x-5)^2 = 4x^2 - 20x + 25$$

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## 2 Difference of Squares

◆  $(a + b)(a - b)$

$$(a+b)(a-b)=a^2-b^2 \quad (a+b)(a-b)=a^2-b^2$$

**Use:** Fast multiplication & factorization

**Example:**

$$(7x+y)(7x-y)=49x^2-y^2 \quad (7x+y)(7x-y)=49x^2-y^2$$

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### **3** Cube of a Binomial

◆  $(a + b)^3$

$$(a+b)^3=a^3+b^3+3ab(a+b) \quad (a+b)^3 = a^3 + b^3 + 3ab(a+b)$$

OR

$$=a^3+3a^2b+3ab^2+b^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

**Example:**

$$(x+2)^3=x^3+6x^2+12x+8 \quad (x+2)^3 = x^3 + 6x^2 + 12x + 8$$

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◆  $(a - b)^3$

$$(a-b)^3=a^3-b^3-3ab(a-b) \quad (a-b)^3 = a^3 - b^3 - 3ab(a-b)$$

OR

$$= a^3 - 3a^2b + 3ab^2 - b^3$$

**Example:**

$$(2x-1)^3 = 8x^3 - 12x^2 + 6x - 1$$

## 4 Sum and Difference of Cubes

◆  $a^3 + b^3$

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

**Example:**

$$x^3 + 8 = (x+2)(x^2 - 2x + 4)$$

◆  $a^3 - b^3$

$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

**Example:**

$$x^3 - 27 = (x-3)(x^2 + 3x + 9)$$

## 5 Special Identity

◆  $a^3 + b^3 + c^3 - 3abc$

$$= (a+b+c)(a^2+b^2+c^2-ab-bc-ca) = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ca)$$

**Important Case:**

If  $a + b + c = 0$ , then

$$a^3+b^3+c^3=3abca^3 + b^3 + c^3 = 3abca^3+b^3+c^3=3abc$$


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## 6 Very Important Exam Identities (Summary Table)

Identity	Formula
$(a + b)^2$	$a^2 + 2ab + b^2$
$(a - b)^2$	$a^2 - 2ab + b^2$
$(a + b)(a - b)$	$a^2 - b^2$
$(a + b)^3$	$a^3 + 3a^2b + 3ab^2 + b^3$
$(a - b)^3$	$a^3 - 3a^2b + 3ab^2 - b^3$
$a^3 + b^3$	$(a + b)(a^2 - ab + b^2)$
$a^3 - b^3$	$(a - b)(a^2 + ab + b^2)$

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## 7 Common Mistakes to Avoid

- Forgetting the **middle term** ( $\pm 2ab$ ) in squares
- Wrong signs in  $(a - b)^3$
- Mixing  $a^3 + b^3$  and  $a^3 - b^3$  formulas
- Not checking brackets during factorization

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