# Factorisation

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## ▷ What is Factorisation?

Writing an expression as a **product of its factors** — the **reverse of expanding**.

$5(x+3)$ (Factorised) $\xrightarrow{\text{Expand}}$ $5x+15$ (Expanded)

$5x+15$ (Expanded) $\xrightarrow{\text{Factorise}}$ $5(x+3)$ (Factorised)

**Always check:** expand your answer to verify!

## ◇ Common Factor (HCF)

Find the **largest factor** in every term; write it outside the bracket. **Always do this first!**

- $10x+35=5(2x+7)$
- $4y^3-12y^2=4y^2(y-3)$
- $8m^2n+12mn^2=4mn(2m+3n)$

*Check both numbers **and** variables for HCF.*

## ★ Factorising Quadratics (The Core Methods)

| Form | Method |
|---|---|
| $x^2+bx+c$ | Find $p,q$: $p\times q=c$, $p+q=b$<br>Write $(x+p)(x+q)$ |
| $ax^2+bx+c$ | Find $p,q$: $p\times q=ac$, $p+q=b$<br>Split middle term, group |
| **4 terms** | Group in pairs, factor each,<br>take out the common bracket |

**Sign rules for $x^2+bx+c$:**

| $c$ | $b$ | **Signs of $p,q$** |
|---|---|---|
| + | + | Both + |
| + | − | Both − |
| − | + | + (larger), − |
| − | − | +, − (larger) |

*"Product is c, sum is b."*

## □ Special Factorisation Patterns

**Difference of Two Squares (DOTS):**

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

- $x^2-81=(x+9)(x-9)$
- $25a^2-4b^2=(5a+2b)(5a-2b)$

$a^2+b^2$ **does NOT factorise!**

**Perfect Square Trinomials:**

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

- $x^2+16x+64=(x+8)^2$
- $9x^2+30x+25=(3x+5)^2$

*Check:* first & last are squares, middle $=2ab$

## △ Common Traps & Pitfalls

1. **Not fully factorised:**
   $18x^2+12x=6(3x^2+2x)$ × $6x(3x+2)$ ✓
2. **Sign errors with negatives:**
   $-4(b+3)=-4b-12$ ✓
3. **Dividing by $x$ loses $x=0$:**
   Factorise: $x(x+7)=0$ ✓
4. $a^2+b^2$ **cannot** be factorised!

## ✓ Quick Exam Strategy

- **Step 1:** Common factor out first
- **Step 2:** Count terms —
  2 → DOTS  3 → Quadratic  4 → Group
- **Step 3:** Can factors split further?
- **"Solve by factorising"** → set $=0$, then $AB=0\Rightarrow A=0$ or $B=0$
- **State reasons. Expand to check!**

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