

Factorization

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Name: _____

Date: _____

At a glance

Common factors, difference of two squares, quadratics, grouping, and solving by factorising.

1. Common factors
2. Difference of two squares
3. Quadratics $x^2 + bx + c$
4. Quadratics $ax^2 + bx + c$
5. Four terms: grouping
6. Solving by factorising

1. Common factors

☐ I revised this

- Take out the **highest common factor** of every term — numbers and letters.
- 'Factorise fully' means nothing more can be taken out.
- Check by expanding back.

Worked example

Factorise fully $12x^2y - 18xy^2$.

1. HCF of 12 and 18 is 6; of x^2y and xy^2 is xy .
2. $12x^2y \div 6xy = 2x$ and $18xy^2 \div 6xy = 3y$.

$6xy(2x - 3y)$

2. Difference of two squares

☐ I revised this

- $a^2 - b^2 = (a - b)(a + b)$. Both terms must be squares and there must be a minus between them.
- $16x^2 - 25y^2 = (4x - 5y)(4x + 5y)$.
- Take out a common factor first: $2x^2 - 50 = 2(x^2 - 25) = 2(x - 5)(x + 5)$.
- $a^2 + b^2$ does not factorise.

Formulas

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

Worked example

Factorise fully $3x^2 - 75$.

1. Common factor 3: $3(x^2 - 25)$.
2. $x^2 - 25 = (x - 5)(x + 5)$.

$3(x - 5)(x + 5)$

3. Quadratics $x^2 + bx + c$

☐ I revised this

- Find two numbers that **multiply to c** and **add to b**.
- If c is positive, both numbers have the sign of b. If c is negative, the signs are different.

Expression	Numbers	Factorised
$x^2 + 7x + 12$	3, 4	$(x + 3)(x + 4)$
$x^2 - 7x + 12$	-3, -4	$(x - 3)(x - 4)$
$x^2 + x - 12$	4, -3	$(x + 4)(x - 3)$
$x^2 - x - 12$	-4, 3	$(x - 4)(x + 3)$

Worked example

Factorise $x^2 + 2x - 15$.

1. Multiply to -15, add to 2: 5 and -3.

$$(x + 5)(x - 3)$$

4. Quadratics $ax^2 + bx + c$

☐ I revised this

- Use the **ac method**: find two numbers that multiply to $a \times c$ and add to b .
- Split the middle term with them, then factorise in pairs.

ac method

1. Multiply $a \times c$.
2. Find two numbers with that product and sum b .
3. Rewrite bx as the two terms.
4. Factorise the first pair and the second pair.
5. Take out the common bracket.

Worked example

Factorise $6x^2 + x - 2$.

1. $ac = -12$; numbers 4 and -3.
2. $6x^2 + 4x - 3x - 2$.
3. $2x(3x + 2) - 1(3x + 2)$.

$$(2x - 1)(3x + 2)$$

5. Four terms: grouping

☐ I revised this

- Group into two pairs, factorise each pair, then take out the common bracket.
- If the brackets don't match, try grouping the terms differently.

Worked example

Factorise $xy - 3x + 2y - 6$.

1. $x(y - 3) + 2(y - 3)$.

$$(x + 2)(y - 3)$$

6. Solving by factorising

☐ I revised this

- Rearrange to $= 0$, factorise, then set each factor equal to 0.
- $x(x - 5) = 0$ gives $x = 0$ or $x = 5$ — never divide both sides by x .
- $(2x + 3)(x - 3) = 0$ gives $x = -3/2$ or $x = 3$.

Worked example

Solve $2x^2 - 3x - 9 = 0$.

1. $ac = -18$: -6 and 3.

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

3. $(2x + 3)(x - 3) = 0$.

$x = 3$ or $x = -1.5$

Common mistakes

Don't write	Write instead
$\times$ $16x^2 - 25 = (4x - 5)^2$	$\checkmark$ That expands to $16x^2 - 40x + 25$. Use $(4x - 5)(4x + 5)$
$\times$ $6x^2 + 9x = 3(2x^2 + 3x)$	$\checkmark$ Take out 3x as well: $3x(2x + 3)$
$\times$ $(x + 5)(x - 3) = 0 \rightarrow x = 5$ or -3	$\checkmark$ Change the signs: $x = -5$ or 3
$\times$ Dividing $x^2 = 5x$ by x	$\checkmark$ Rearrange: $x(x - 5) = 0$, so $x = 0$ or 5

In the exam

- Always check a factorisation by expanding it in your head.
- If a quadratic will not factorise, the question probably wants the formula.
- 'Hence solve' means use the factorisation you have just found.

My notes

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