



eClassroom

GCSE MATHEMATICS • ALGEBRA

Factorising

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Factorising worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: take out common factors, including “factorise fully” • factorise $x^2 + bx + c$ • factorise the difference of two squares • use factorising in area and number problems • *Higher:* $ax^2 + bx + c$, factorising in two stages, and hidden quadratics.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: factorising $ax^2 + bx + c$, plus factorising fully in two stages, harder differences of two squares, and hidden quadratics. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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A**Worked examples & Your turn**

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION*Everyone starts here***Worked example A1**

Factorise fully $12x^2y + 18xy^2$

Highest common factor: 6 from the numbers, x and y from the letters.

$$12x^2y \div 6xy = 2x \quad 18xy^2 \div 6xy = 3y$$

$$6xy(2x + 3y)$$

Your turn A1

Factorise fully $15ab^2 - 10a^2b$

Worked example A2

Factorise $x^2 - 2x - 24$

Two numbers that multiply to -24 and add to -2 : -6 and 4

$$(x - 6)(x + 4)$$

Your turn A2

Factorise $x^2 + 11x + 28$

Worked example A3

Factorise $x^2 - 81$

A difference of two squares: $x^2 - 9^2$

$$(x + 9)(x - 9)$$

Your turn A3

Factorise $25 - y^2$



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HIGHER*Higher only: $ax^2 + bx + c$, two stages and hidden forms***Worked example A4:** $ax^2 + bx + c$ Factorise $2x^2 + 7x + 3$ *$2 \times 3 = 6$. Two numbers that multiply to 6 and add to 7: 6 and 1. Split the middle term.*

$$2x^2 + 6x + x + 3 = 2x(x + 3) + 1(x + 3)$$

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

Your turn A4Factorise $3x^2 - 11x + 6$ **Worked example A5: factorising fully in two stages**Factorise fully $3x^2 - 12x - 36$ *Take out the common factor first, then factorise what is left.*

$$3(x^2 - 4x - 12)$$

$$3(x - 6)(x + 2)$$

Your turn A5Factorise fully $2x^3 - 8x$ **Worked example A6: harder differences of two squares**Factorise $9x^2 - 16y^2$

$$(3x)^2 - (4y)^2$$

$$(3x + 4y)(3x - 4y)$$

Your turn A6Factorise $(x - 2)^2 - 25$ **Worked example A7: from an area to the sides**A rectangle has area $(x^2 + 8x + 15) \text{ cm}^2$. Its sides are linear expressions. Find its perimeter.*Factorise the area to find the sides.*

$$(x + 3)(x + 5) \quad 2(x + 3) + 2(x + 5)$$

$$(4x + 16) \text{ cm}$$

Your turn A7A rectangle has area $(2x^2 + 11x + 12) \text{ cm}^2$. Its sides are linear expressions. Find its perimeter.

B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here***B1** Factorise

(a) $4x + 12$

(b) $4x + 6$

(c) $x^2 + 5x$

(d) $6x^2 + 9x$

[4 marks]**B2** Factorise fully

(a) $10ab - 15b$

(b) $8p^2q + 12pq^2$

(c) $3x^3 - 6x^2$

(d) $7a - 14a^2 + 21a^3$

[4 marks]**B3** Factorise

(a) $x^2 + 8x + 12$

(b) $x^2 - 8x + 12$

(c) $x^2 + 4x - 12$

(d) $x^2 - 4x - 12$

[4 marks]**B4** Factorise

(a) $x^2 + 10x + 25$

(b) $x^2 - 12x + 36$

(c) $x^2 - x - 20$

(d) $x^2 + 13x + 36$

[4 marks]**B5** Factorise

(a) $x^2 - 36$

(b) $x^2 - 1$

(c) $49 - y^2$

[3 marks]**B6** Factorise, if possible. If it cannot be factorised, say so.

(a) $x^2 - 9x$

(b) $x^2 - 9$

(c) $x^2 - 9x + 18$

(d) $x^2 + 9$

[4 marks]

HIGHER*Higher tier only***B7** Factorise

(a) $2x^2 + 5x + 3$

(b) $2x^2 - 5x + 3$

(c) $2x^2 + x - 3$

(d) $6x^2 + 5x - 6$

[4 marks]**B8** Factorise fully

(a) $2x^2 - 50$

(b) $3x^2 + 15x + 18$

(c) $x^3 - 4x^2 - 5x$

(d) $12x^2 - 27$

[4 marks]**B9** Factorise fully

(a) $4x^2 - 1$

(b) $25a^2 - 9b^2$

(c) $x^4 - 16$

(d) $(x+1)^2 - 9$

[4 marks]**B10** Factorise

(a) $(x+3)^2 + 5(x+3)$

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

(c) $x^4 + 5x^2 + 6$

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

[4 marks]

C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Kim is asked to factorise $8x^2 - 12x$ fully. She writes $2x(4x - 6)$
Explain why Kim's answer is not fully factorised, and write the correct answer. [2 marks]
- C2** Tom writes $x^2 - 16 = (x - 4)(x - 4)$
Expand Tom's brackets to show he is wrong, and write the correct factorisation. [2 marks]
- C3** Here are three expressions. $x^2 + 5x + 6$ $x^2 + 5x - 6$ $x^2 + 6$
Factorise the two that can be factorised, and explain why the third cannot. [3 marks]
- C4** Show that $x^2 + 6x + 9$ is a perfect square, and hence explain why it is never negative. [3 marks]



HIGHER*Higher tier only*

- C5** Jo factorises $2x^2 + 7x + 6$ and writes $(2x + 2)(x + 3)$
Show that Jo is wrong, and factorise $2x^2 + 7x + 6$ correctly. [3 marks]
- C6** Explain why $x^2 - 4$ can be factorised but $x^2 + 4$ cannot. Then factorise $x^4 - 81$ fully. [3 marks]
- C7** n is a whole number. Show that $n^2 + 3n + 2$ is always even. [3 marks]
- C8** a and b are positive whole numbers and $a^2 - b^2 = 60$
Use factorising to find all the possible pairs of values of a and b . Explain why there are no others. [5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** Pens cost p pence and pencils cost q pence. Sam buys 12 pens and 18 pencils.
Show that the total cost, in pence, is always a multiple of 6 [3 marks]
- D2** $x^2 + bx + 12$ can be factorised into two brackets $(x + m)(x + n)$, where m and n are whole numbers.
Find all the possible values of b . [4 marks]
- D3** Without a calculator, use factorising to work out $17 \times 23 + 17 \times 77$ [3 marks]
- D4** (a) Factorise $n^2 + 5n + 6$
(b) Hence, without a calculator, work out the value of $n^2 + 5n + 6$ when $n = 10$ [3 marks]



HIGHER*Higher tier only*

D5 A cuboid has volume $(2x^3 + 10x^2 + 12x) \text{ cm}^3$. One of its edges is $2x \text{ cm}$, and the other two edges are linear expressions.

(a) Find expressions for the other two edges. (b) Check your answer when $x = 3$ [4 marks]

D6 A square has side $(x + 5) \text{ cm}$. A small square of side 3 cm is cut from one corner.

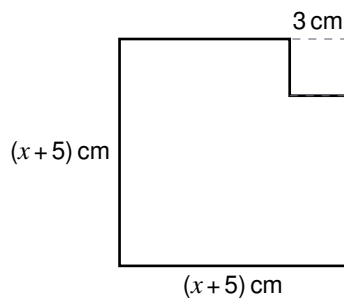


Diagram NOT accurately drawn

(a) Show that the area left is $(x+2)(x+8) \text{ cm}^2$

(b) The area left is 91 cm^2 . Find x . [4 marks]

D7 $x^2 - y^2 = 40$ and $x + y = 10$

Find the values of x and y . [4 marks]

D8 (a) Show that $n^4 + 4 \equiv (n^2 + 2n + 2)(n^2 - 2n + 2)$

(b) Hence explain why $n^4 + 4$ is never prime when n is a whole number greater than 1

(c) Write $5^4 + 4$ as the product of two whole numbers greater than 1 [5 marks]



**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover***E1** (a) Factorise $6x + 15$

.....
(1)

(b) Factorise fully $8y^2 - 12y$

.....
(2)

(Total for Question E1 is 3 marks)

E2 Factorise $x^2 + 7x + 12$

.....
(Total for Question E2 is 2 marks)

E3 Factorise $x^2 - 3x - 10$

.....
(Total for Question E3 is 2 marks)

E4 Factorise $x^2 - 49$

.....
(Total for Question E4 is 2 marks)



E5 A rectangle has area $(x^2 + 9x + 20) \text{ cm}^2$. One side is $(x + 4) \text{ cm}$.

(a) Find an expression for the length of the other side.

.....
(2)

(b) Find an expression for the perimeter of the rectangle.

.....
(1)

(Total for Question E5 is 3 marks)

E6 (a) Without a calculator, use factorising to work out $57^2 - 43^2$

.....
(2)

(b) Explain how your method shows that $57^2 - 43^2$ is a multiple of 100

.....
(1)
(Total for Question E6 is 3 marks)

HIGHER*Higher tier only*

E7 Factorise

(a) $(x + 3)^2 - 16$

.....
(2)

(b) $4x^2 - 9y^2$

.....
(1)

(Total for Question E7 is 3 marks)



E8 (a) Factorise fully $5x^2 - 45$

.....
(2)

(b) Factorise $6x^2 - x - 2$

.....
(2)

(Total for Question E8 is 4 marks)

E9 A rectangle has area $(6x^2 + 7x - 3) \text{ cm}^2$. Its length and width are linear expressions in x with whole-number coefficients.

Find an expression, in its simplest form, for the perimeter of the rectangle.

.....
(Total for Question E9 is 3 marks)

E10 n is a whole number greater than 1

(a) Factorise fully $n^3 - n$

.....
(2)

(b) Hence explain why $n^3 - n$ is always a multiple of 6

(2)

(c) Hence show that $101^3 - 101$ is a multiple of 6

(1)

(Total for Question E10 is 5 marks)

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