IGCSE MATHEMATICS 0580 · CHAPTER 3 NOTES · ~18 MIN READ

# Algebraic manipulation

Collect, expand, factorise, simplify and rearrange with confidence. Area models, FOIL arrows and step-by-step flow charts show why every algebra rule works, not just what to do.

Expanding | Factorising | Algebraic fractions | Rearranging formulae | Substitution

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No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again

Test yourself at the end

## IN 30 SECONDS

- Algebra is **arithmetic with letters**. Collect **like terms**, multiply **every term** when you expand, and **always take out the common factor first** when you factorise.
- Expanding and factorising are **opposites**: $(x + 2)(x + 3) \longleftrightarrow x^2 + 5x + 6$. **Rearranging** a formula means **undoing the operations in reverse order**.
- **Extended:** factorise quadratics, difference of two squares and grouping; simplify algebraic fractions; rearrange when the subject appears twice.

## BY THE END YOU CAN

- Simplify expressions by collecting like terms, and use the index laws with letters.
- Write expressions and formulae from words, and substitute numbers (including negatives) into them.
- Expand single and double brackets, and take out common factors.
- Rearrange simple formulae to change the subject.
- Factorise quadratics, the difference of two squares and by grouping. EXT
- Simplify, add and subtract algebraic fractions. EXT
- Rearrange formulae when the subject appears twice or inside a root. EXT
- Use algebra to show that a statement is always true. EXT

## 1 Algebra language

### Terms and like terms

expression = terms joined by + and −

| $3x^2$ | $-5xy$ | $+ 7$ |
|---|---|---|
| term<br>coefficient 3<br>variable x | term<br>coefficient −5<br>variables x and y | constant term<br>(no letter) |

the sign belongs to the term after it

**Collect like terms (same letters, same powers):**

$$4a + 3b - a + 2b$$

$$= 3a + 5b$$

a and b are different letters, so 3a + 5b cannot be simplified further

Every term has a sign in front of it. Only terms with exactly the same letters and powers are like terms.

**Expression** — letters and numbers joined by + and −, with **no equals sign**: 3x + 5.

**Equation** — two expressions **joined by an equals sign** that is true for **certain** values: 3x + 5 = 20.

**Formula** — a rule linking quantities, for example $A = \pi r^2$.

- **Like terms** have **identical letters and powers**: $3x^2$ and $5x^2$ are like, but $3x^2$ and 3x are **not**.
- **Multiply:** numbers first, then letters, adding powers: $3x^2 \times 4x^3 = \mathbf{12x^5}$. **Divide:** subtract powers: $12x^5 \div 4x^2 = \mathbf{3x^3}$.
- **Power of a power:** $(2x^3)^2 = 2^2 \times (x^3)^2 = \mathbf{4x^6}$. Square the **number** as well as the letter. (More on the laws in Number toolkit.)

WORKED EXAMPLE

**Simplify 5a + 3b − 2a + 4b.**

1. collect the **a** terms: 5a − 2a = **3a**
2. collect the **b** terms: 3b + 4b = **7b**
3. **answer: 3a + 7b**

WORKED EXAMPLE

**Simplify $3x^2y \times 4xy^3$.**

1. numbers: 3 × 4 = **12**
2. x: $x^2 \times x = \mathbf{x^3}$
3. y: $y \times y^3 = \mathbf{y^4}$
4. **answer: $12x^3y^4$**

## From words to algebra

| | | |
|---|---|---|
| 5 more than x | → | **x + 5** |
| 3 less than x | → | **x – 3** |
| twice x | → | **2x** |
| x squared, then doubled | → | **$2x^2$** |
| x doubled, then squared | → | **$(2x)^2$** |
| x shared between 4 | → | **x ÷ 4** |

not 3 – x

Read each word carefully. "Less than" reverses the order, and the order of "squared" and "doubled" matters.

**WORKED EXAMPLE**

**A pen costs £p and a book costs £b. Write an expression for the cost of 3 pens and 2 books.**

1. 3 pens = **3p**
2. 2 books = **2b**
3. **total cost = 3p + 2b pounds**

**WORKED EXAMPLE**

**A rectangle has sides (x + 3) and 2x. Write a simplified expression for its perimeter.**

1. perimeter = 2 × (x + 3) + 2 × 2x
2. = 2x + 6 + 4x
3. **= 6x + 6**

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## 2 Expanding brackets

### Single brackets and FOIL

#### Single bracket




$3 \times 2x + 3 \times (-5)$

$= 6x - 15$

Multiply the number outside by EVERY term inside the bracket.

#### Double bracket: FOIL




**First**: $x \times x = x^2$
**Outer**: $x \times (-2) = -2x$
**Inner**: $3 \times x = +3x$
**Last**: $3 \times (-2) = -6$
→ $x^2 + x - 6$

Every term inside the first bracket multiplies every term inside the second. Watch the signs.

- **Single bracket:** multiply the outside by **each** term inside. $3(2x - 5) = \mathbf{6x - 15}$.
- **Negative outside:** the sign changes **both** terms. $-2(x - 4) = -2x + \mathbf{8}$.
- **Double brackets (FOIL):** First, Outer, Inner, Last, then collect like terms. $(x + 3)(x - 2) = x^2 - 2x + 3x - 6 = \mathbf{x^2 + x - 6}$.
- **Squared bracket:** write it twice. $(x + 5)^2 = (x + 5)(x + 5) = \mathbf{x^2 + 10x + 25}$.

**COMMON MISTAKE**

$(x + 5)^2 = x^2 + 25$. **No!** You **must** write the bracket twice and expand. The middle term 10x is missing.

**WORKED EXAMPLE**

**Expand and simplify $3(x + 2) + 2(x - 1)$.**

1. $3(x + 2) = \mathbf{3x + 6}$
2. $2(x - 1) = \mathbf{2x - 2}$
3. add: $3x + 6 + 2x - 2$
4. $\mathbf{= 5x + 4}$

**WORKED EXAMPLE**

**Expand and simplify $(2x - 1)(x + 4)$.**

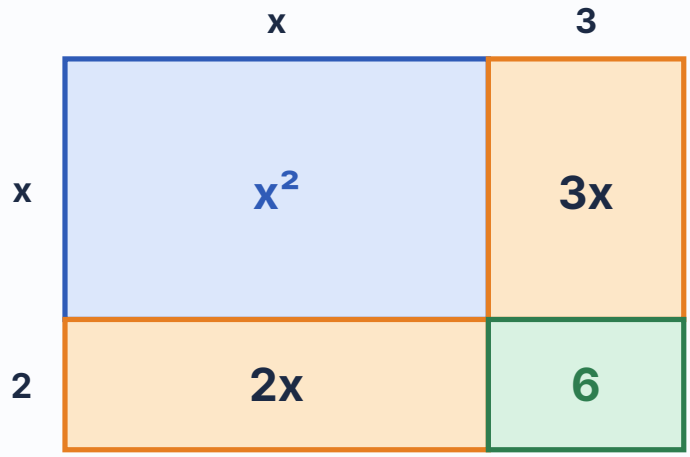
1. First: $2x \times x = \mathbf{2x^2}$
2. Outer: $2x \times 4 = \mathbf{+8x}$
3. Inner: $-1 \times x = \mathbf{-x}$
4. Last: $-1 \times 4 = \mathbf{-4}$
5. **collect: $2x^2 + 8x - x - 4 = 2x^2 + 7x - 4$**

WORKED EXAMPLE

**Expand $(3x - 2)^2$.**

1. write twice: $(3x - 2)(3x - 2)$
2. $9x^2 - 6x - 6x + 4$
3. **$= 9x^2 - 12x + 4$**

## The area model




**$(x + 3)(x + 2)$**

$= x^2 + 3x + 2x + 6$

**$= x^2 + 5x + 6$**

the four areas are the four products

Check with $x = 1$: $4 \times 3 = 12$ and $1 + 5 + 6 = 12$ ✓

The four areas inside the rectangle are exactly the four products in FOIL.

- Draw a rectangle with the first bracket across the top and the second down the side. **Multiply the label on the row by the label on the column** in each cell, then add the cells.
- **Check:** substitute a simple number (like $x = 1$) into the **question and the answer**. They must match.

WORKED EXAMPLE

EXT **Expand and simplify $(x + 1)(x + 2)(x + 3)$.**

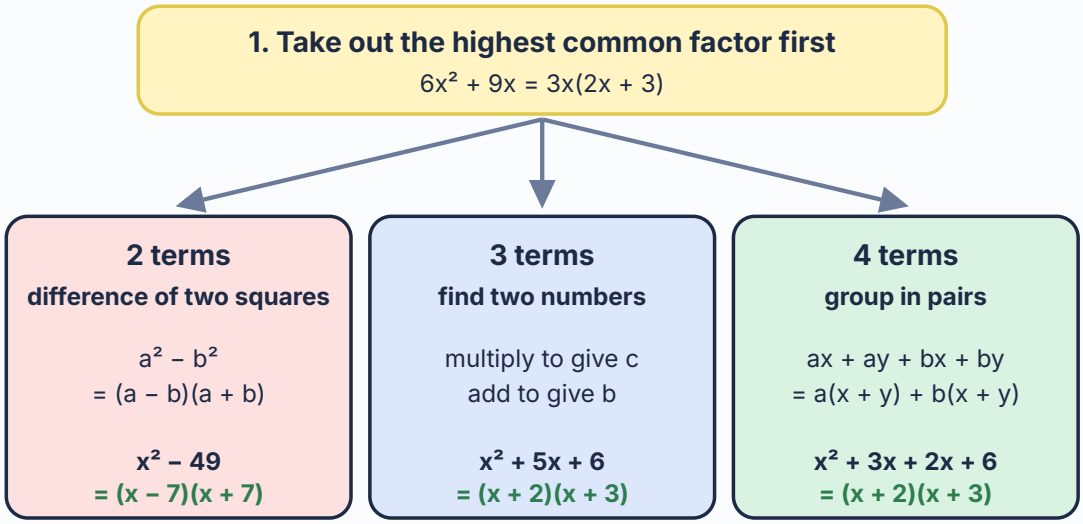
1. expand two brackets first: $(x + 1)(x + 2) =$ **$x^2 + 3x + 2$**
2. multiply by the third: $(x^2 + 3x + 2)(x + 3)$
3. $= x^3 + 3x^2 + 3x^2 + 9x + 2x + 6$
4. **collect: $x^3 + 6x^2 + 11x + 6$**

MEMORY TRICK

"**Smiley face**": draw arcs from the first bracket's terms to the second bracket's terms. You should have **4 arcs** for two terms each.

## 3 Factorising

### Factorising: the plan




Always start by taking out the highest common factor, then count the terms.

- **Factorising** puts the brackets **back**. It is the reverse of expanding. **Always check** by expanding your answer.
- **Highest common factor (HCF):** the **biggest number and the highest power of each letter** that divides **every** term. $12x^2 - 18x$: the HCF is **6x**.

**WORKED EXAMPLE**

**Factorise $12x^2 - 18x$.**

1. HCF of 12 and 18 is **6**, and of $x^2$ and x is **x**
2. HCF = **6x**
3. $12x^2 \div 6x$ = **2x** and $18x \div 6x$ = **3**
4. **answer: 6x(2x – 3)**

**WORKED EXAMPLE**

**Factorise $4a^2b + 6ab^2$.**

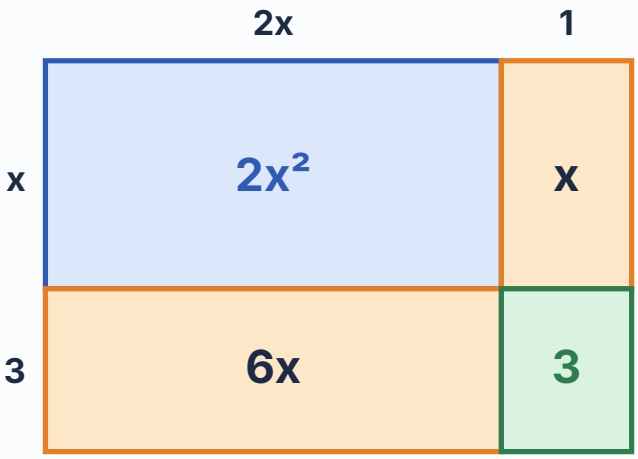
1. HCF of 4 and 6 is 2
2. a: lowest power is a, b: lowest power is b
3. HCF = **2ab**
4. $4a^2b \div 2ab$ = **2a**, $6ab^2 \div 2ab$ = **3b**
5. **answer: 2ab(2a + 3b)**

**COMMON MISTAKE**

Factorising $12x^2 - 18x$ as **$2(6x^2 - 9x)$**. This is not fully factorised. The bracket still has a common factor, so take out the **highest** one (6x).

## Factorising quadratics

EXTENDED




the four cells add to $2x^2 + 7x + 3$

1. $a \times c = 2 \times 3 = 6$
2. two numbers: product 6, sum 7 → they are 1 and 6
3. $2x^2 + x + 6x + 3$
4. $= x(2x + 1) + 3(2x + 1)$
5. **$= (2x + 1)(x + 3)$**

When the number in front of $x^2$ is not 1, split the middle term using two numbers that multiply to a × c.

- EXT **$x^2 + bx + c$:** find **two numbers** that **multiply to c** and **add to b**. These go in the brackets.
- EXT **$ax^2 + bx + c$:** find two numbers that **multiply to a × c** and **add to b**, split the middle term, then **factorise in pairs**.
- EXT **Signs:** if c is **positive**, both numbers have the **same** sign. If c is **negative**, the signs are **different**.

**WORKED EXAMPLE**

EXT **Factorise $x^2 + 5x + 6$.**

1. two numbers: **multiply to 6, add to 5**
2. $2 \times 3 = 6$ and $2 + 3 = 5$
3. **answer: $(x + 2)(x + 3)$**

**WORKED EXAMPLE**

EXT **Factorise $x^2 - 2x - 15$.**

1. multiply to **−15**, add to **−2**
2. different signs: **−5 and +3**
3. **answer: $(x - 5)(x + 3)$**

**WORKED EXAMPLE**

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

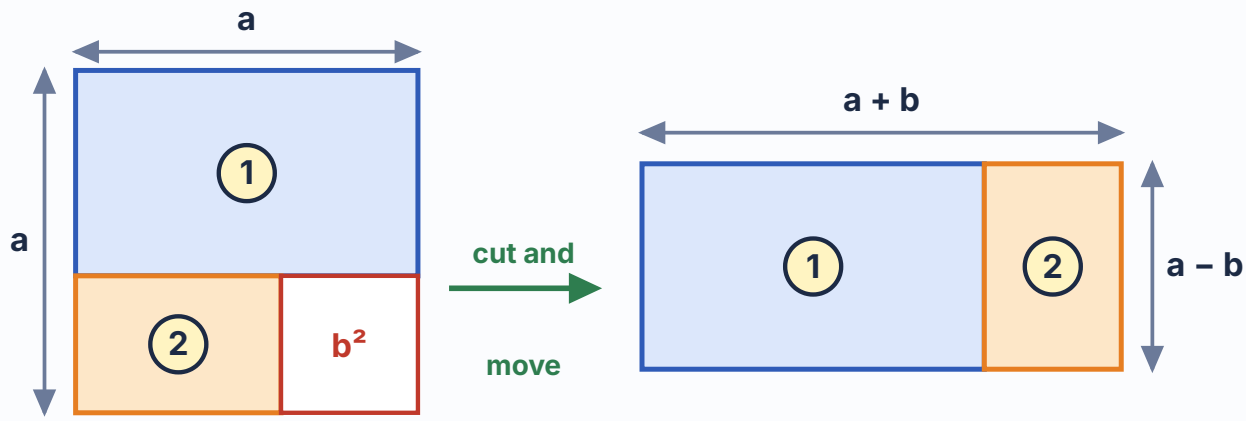
1. $a \times c = 6 \times (-2) =$ **−12**
2. two numbers that multiply to −12 and add to +1: **+4 and −3**
3. split: $6x^2 + 4x - 3x - 2$
4. pairs: $2x(3x + 2) - 1(3x + 2)$
5. **answer: $(3x + 2)(2x - 1)$**

**EXAM TIP**

Always **expand your answer** to check it. $(3x + 2)(2x - 1) = 6x^2 - 3x + 4x - 2 = 6x^2 + x - 2$ ✓

## Difference of two squares

EXTENDED




**L-shape area: $a^2 - b^2 = (a + b)(a - b)$**

Piece 2 turns and moves beside piece 1: the area stays the same.

A square with a smaller square removed can be cut and rearranged into a rectangle with sides (a + b) and (a − b).

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

two squares with a MINUS between them. No middle term

- EXT **Spot it:** two terms, both **perfect squares**, joined by a **minus**. $x^2 - 49 = x^2 - 7^2$.
- EXT **Always take out a common factor first.** $2x^2 - 50 = 2(x^2 - 25)$.

WORKED EXAMPLE

EXT **Factorise $25x^2 - 9$.**

1. $25x^2 = (5x)^2$ and $9 = 3^2$
2. $a = 5x$, $b = 3$
3. **answer: $(5x - 3)(5x + 3)$**

WORKED EXAMPLE

EXT **Factorise $2x^2 - 50$.**

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

WORKED EXAMPLE

EXT **Use algebra to work out $99^2 - 1$ without a calculator.**

1. $99^2 - 1^2 = (99 - 1)(99 + 1)$
2. $= 98 \times 100$
3. **$= 9800$**

### Factorising by grouping

EXTENDED

- EXT **Four terms:** group them in **pairs**, factorise each pair, and look for a **common bracket**.

WORKED EXAMPLE

EXT **Factorise $xy + 3x + 2y + 6$.**

1. group: $(xy + 3x) + (2y + 6)$
2. factorise each pair: $x(y + 3) + 2(y + 3)$
3. **common bracket $(y + 3)$: $(x + 2)(y + 3)$**

## 4 Algebraic fractions EXT

### Simplifying

#### Cancel common FACTORS, never terms

$$\frac{x^2 - 9}{x^2 + 3x} \xrightarrow{\text{factorise}} \frac{(x - 3)(x + 3)}{x(x + 3)} \xrightarrow{\text{cancel}} \frac{x - 3}{x}$$

#### Why? A factor multiplies the whole top. A term is added.

$\frac{x + 3}{3}$ — the 3 is a term, so it cannot cancel: x + 3 over 3 ≠ x + 1

$\frac{3x + 6}{3}$ — factorise first: 3(x + 2) ÷ 3 = x + 2

Factorise the top and the bottom, then cancel the factors they have in common.

- EXT You may only **cancel factors** (things that **multiply** the whole top or bottom). **Never cancel terms** (things that are **added** or **subtracted**).
- EXT **Multiply:** multiply the tops and the bottoms, then cancel. **Divide:** keep, change, flip, then multiply.

**WORKED EXAMPLE**

EXT Simplify $\frac{x^2 - 9}{x^2 + 3x}$.

1. factorise the top: $x^2 - 9 = (x - 3)(x + 3)$
2. factorise the bottom: $x^2 + 3x = x(x + 3)$
3. cancel the common factor $(x + 3)$
4. **answer:** $\frac{x - 3}{x}$

**WORKED EXAMPLE**

EXT Simplify $\frac{x}{3} \times \frac{6}{x^2}$.

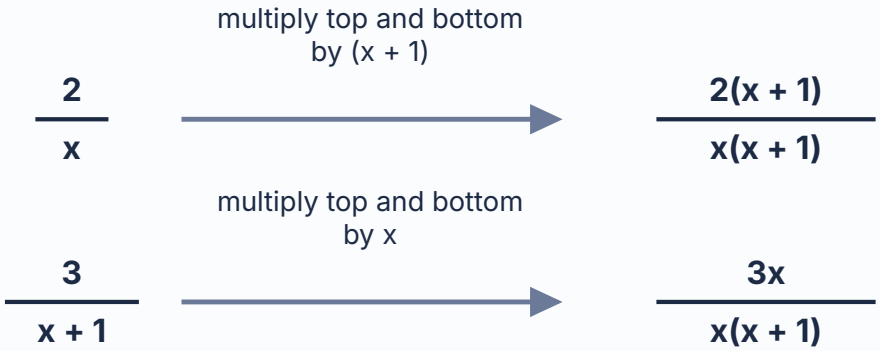
1. multiply tops and bottoms: $\frac{6x}{3x^2}$
2. cancel 3 and one x
3. **answer:** $\frac{2}{x}$

WORKED EXAMPLE

EXT **Simplify $\frac{x+1}{2} \div \frac{x+1}{6}$.**

1. flip and multiply: $\frac{x+1}{2} \times \frac{6}{x+1}$
2. cancel $(x + 1)$ and divide 6 by 2
3. **answer: 3**

## Adding and subtracting




**Same denominator now: add the tops, keep the bottom**

$$\frac{2(x+1)+3x}{x(x+1)} = \frac{5x+2}{x(x+1)}$$

Make the denominators the same by multiplying top and bottom, then add the numerators.

- EXT **Adding / subtracting:** find a **common denominator** (the product if there is nothing in common), rewrite each fraction, then combine the numerators. **Brackets** around any subtracted numerator!

WORKED EXAMPLE

EXT **Write $\frac{2}{x} + \frac{3}{x+1}$ as a single fraction.**

1. common denominator: $x(x + 1)$
2. $\frac{2(x+1)}{x(x+1)} + \frac{3x}{x(x+1)}$
3. add the tops: $2x + 2 + 3x$
4. **answer: $\frac{5x+2}{x(x+1)}$**

WORKED EXAMPLE

EXT **Write $\frac{3}{x-1} - \frac{2}{x+2}$ as a single fraction.**

1. common denominator: $(x - 1)(x + 2)$
2. top: $3(x + 2) - 2(x - 1)$
3. $= 3x + 6 - 2x + 2$
4. **answer: $\frac{x+8}{(x-1)(x+2)}$**

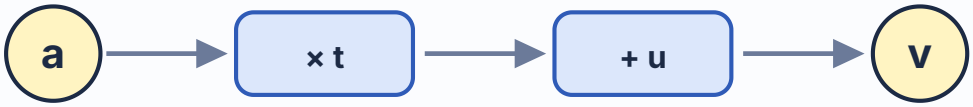
**COMMON MISTAKE**

Writing $3(x + 2) - 2(x - 1)$ as $3x + 6 - 2x$ **$- 1$**. The minus multiplies **both** terms in the bracket: $-2(x - 1) = -2x$ **$+ 2$**.

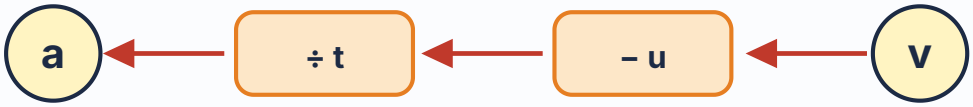
## 5 Rearranging formulae

### Changing the subject

**v = u + at: build v from a**




**Undo each step in reverse order:**




**$a = (v - u) \div t$**

Build the formula as a chain of operations, then undo them in the reverse order with the opposite operation.

**Subject** — the letter on its own on one side of a formula. In $v = u + at$ the subject is v.

- **Opposites:** + ↔ −, × ↔ ÷, square ↔ square root. **Do the same thing to both sides.**
- **Method:** (1) get the term with the new subject **on its own** (use + and −); (2) **undo** any multiplying or dividing; (3) undo powers last.

**WORKED EXAMPLE**

**Make t the subject of $v = u + at$.**

1. subtract u from both sides: $v - u = at$
2. **divide both sides by a: $t = \frac{v - u}{a}$**

**WORKED EXAMPLE**

**Make F the subject of $C = \frac{5}{9}(F - 32)$.**

1. multiply both sides by $\frac{9}{5}$: $\frac{9C}{5} = F - 32$
2. **add 32 to both sides: $F = \frac{9C}{5} + 32$**

WORKED EXAMPLE

**Make r the subject of $A = \pi r^2$.**

1. divide by π: $\frac{A}{\pi} = r^2$
2. **square root both sides: $r = \sqrt{\left(\frac{A}{\pi}\right)}$**

## When the subject appears twice

EXTENDED

**Make x the subject of $y = (x + 1) \div (x - 2)$**

| | | |
|---|---|---|
| 1 | $y(x - 2) = x + 1$ | multiply both sides by $(x - 2)$ |
| 2 | $xy - 2y = x + 1$ | expand the bracket |
| 3 | $xy - x = 2y + 1$ | x-terms one side, the rest the other |
| 4 | $x(y - 1) = 2y + 1$ | factorise: x now appears just once |
| 5 | $x = (2y + 1) \div (y - 1)$ | divide by $(y - 1)$ |

Get every x-term on one side, factorise so x appears once, then divide.

- EXT **Subject in a fraction:** multiply out first. **Subject twice:** collect **all** terms with the subject on one side, **factorise**, then divide.

WORKED EXAMPLE

EXT **Make x the subject of $ax + b = cx + d$.**

1. collect x terms on the left: $ax - cx = d - b$
2. factorise: $x(a - c) = d - b$
3. **divide: $x = \frac{d - b}{a - c}$**

WORKED EXAMPLE

EXT **Make x the subject of $x + 3y = 2xy$.**

1. bring x terms together: $x - 2xy = -3y$
2. factorise: $x(1 - 2y) = -3y$
3. divide: $x = \frac{-3y}{1 - 2y}$
4. **multiply top and bottom by −1: $x = \frac{3y}{2y - 1}$**

WORKED EXAMPLE

EXT **Make x the subject of $y = \sqrt{(x + 3)}$.**

1. square both sides: $y^2 = x + 3$
2. **subtract 3: $x = y^2 - 3$**

EXAM TIP

**Check** by choosing numbers. For $y = (x + 1) \div (x - 2)$: $x = 5$ gives $y = 2$. Put $y = 2$ in the answer $(2y + 1) \div (y - 1) = 5 \div 1 = 5$ ✓

## 6 Substitution and proof

### Substituting numbers

**Evaluate $2x^2 - 5x + 1$ when $x = -3$**

1. replace x with (−3), in brackets
   **$2(-3)^2 - 5(-3) + 1$**
2. indices first: $(-3)^2 = 9$
   **$2 \times 9 - 5(-3) + 1$**
3. multiply: $-5 \times -3 = +15$
   **$18 + 15 + 1$**
4. add
   **$= 34$**

**Calculator trap**

with the bracket:
$(-3)^2 = 9$
without it:
$-3^2 = -9$
Always bracket
a negative.

Replace each letter by its value inside brackets, follow BIDMAS, and take extra care with negatives.

- **Substitute** means replace the letters by numbers. **Brackets round every negative number** stops sign errors.

WORKED EXAMPLE

**Evaluate $s = ut + \frac{1}{2}at^2$ when $u = 4$, $a = -2$ and $t = 3$.**

1. $ut = 4 \times 3 = \mathbf{12}$
2. $\frac{1}{2} \times (-2) \times 3^2 = \frac{1}{2} \times (-2) \times 9 = \mathbf{-9}$
3. $s = 12 + (-9)$
4. **$= 3$**

WORKED EXAMPLE

**The volume of a cone is $V = \frac{1}{3}\pi r^2 h$. Find V when r = 3 and h = 5. Give your answer to 3 significant figures.**

1. $V = \frac{1}{3} \times \pi \times 3^2 \times 5$
2. $= \frac{1}{3} \times \pi \times 45 = 15\pi$
3. **$= 47.12... = 47.1$ (3 s.f.)**

### Algebraic proof

EXTENDED

- EXT To **show** a statement is **always true**, use **n** for any whole number and **expand or simplify**. **Even number:** 2n. **Odd number:** 2n + 1. **Consecutive integers:** n, n + 1, n + 2.

WORKED EXAMPLE

EXT **Show that the sum of two consecutive integers is always odd.**

1. let the integers be **n** and **n + 1**
2. sum = n + (n + 1)
3. = **2n + 1**
4. **2n is even, so 2n + 1 is odd ✓**

WORKED EXAMPLE

EXT **Show that $(n + 3)^2 - (n - 3)^2 = 12n$.**

1. expand: $(n^2 + 6n + 9) - (n^2 - 6n + 9)$
2. $= n^2 + 6n + 9 - n^2 + 6n - 9$
3. **$= 12n$ ✓**

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## 7 Test yourself

### Test yourself — cover the answers first

**QUICK CHECK**

1. Simplify $7a + 2b - 3a + b$.
2. Simplify $5x \times 3x^2$.
3. Simplify $20x^6 \div 5x^2$.
4. Expand $4(3x - 2)$.
5. Expand and simplify $(x + 4)(x + 5)$.
6. Expand $(x - 3)^2$.
7. Factorise $15x - 25$.
8. Factorise $6a^2b + 9ab^2$.
9. Make t the subject of $v = u + at$.
10. Make r the subject of $A = \pi r^2$.
11. Evaluate $3x^2 - x$ when $x = -2$.
12. Evaluate $(a + b)^2$ when $a = 3$ and $b = -5$.
13. EXT Factorise $x^2 + 7x + 12$.
14. EXT Factorise $x^2 - 36$.
15. EXT Factorise $3x^2 + 10x + 8$.
16. EXT Simplify $\frac{x^2 - 25}{x + 5}$.
17. EXT Write $\frac{x}{2} + \frac{x}{3}$ as one fraction.
18. EXT Expand $(2x - 1)(x + 4)$.

**EXAM-STYLE**

19. Expand and simplify $(3x - 2)(x + 5)$. [3]
20. Make m the subject of $E = \frac{1}{2}mv^2$. [2]
21. The formula $v^2 = u^2 + 2as$ is used with $v = 15$, $u = 5$ and $s = 10$. Find the value of a. [3]
22. Simplify $(2x^3y)^2 \div 4xy$. [2]
23. EXT Factorise completely $2x^2 - 18$. [2]
24. EXT Factorise $x^2 - 5x - 14$. [2]
25. EXT Simplify $\frac{2x^2 + 6x}{x^2 - 9}$. [3]
26. EXT Write $\frac{3}{x - 2} + \frac{2}{x + 1}$ as a single fraction. [3]
27. EXT Make x the subject of $y = \frac{x + 2}{x - 1}$. [4]

**Show answers**

1. $4a + 3b$
2. $15x^3$
3. $4x^4$
4. $12x - 8$
5. $x^2 + 9x + 20$
6. $x^2 - 6x + 9$
7. $5(3x - 5)$
8. $3ab(2a + 3b)$
9. $t = (v - u) \div a$
10. $r = \sqrt{(A \div \pi)}$
11. 14
12. 4
13. $(x + 3)(x + 4)$
14. $(x - 6)(x + 6)$
15. $(3x + 4)(x + 2)$
16. $x - 5$
17. $\frac{5x}{6}$
18. $2x^2 + 7x - 4$
19. $3x^2 + 15x - 2x - 10$
    $= 3x^2 + 13x - 10$
20. multiply both sides by 2: $2E = mv^2$
    $m = 2E \div v^2$
21. $15^2 = 5^2 + 2 \times a \times 10$
    $225 = 25 + 20a$
    $20a = 200$, so $a = 10$
22. $(2x^3y)^2 = 4x^6y^2$
    $4x^6y^2 \div 4xy = x^5y$
23. take out the 2: $2(x^2 - 9)$
    difference of two squares: $2(x - 3)(x + 3)$
24. numbers that multiply to $-14$ and add to $-5$: $-7$ and $+2$
    $(x - 7)(x + 2)$
25. top: $2x(x + 3)$
    bottom: $(x - 3)(x + 3)$
    cancel $(x + 3)$: $\frac{2x}{x - 3}$
26. common denominator $(x - 2)(x + 1)$
    top: $3(x + 1) + 2(x - 2) = 3x + 3 + 2x - 4$
    $\frac{5x - 1}{(x - 2)(x + 1)}$

27. $y(x - 1) = x + 2$

$xy - y = x + 2$

$xy - x = y + 2$

$x(y - 1) = y + 2$, so $x = \frac{y + 2}{y - 1}$


**Stuck on a question?**

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