1 Ratio

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WRITING & SIMPLIFYING

- A **ratio** compares amounts: a : b. **Order matters.**
- **Equivalent:** × or ÷ **both parts** by the same number. 2:3 = 4:6 = 6:9.
- **Simplify:** divide both parts by their **HCF**. 12:18 = 2:3.
- **1:n form:** divide both parts so one side is 1. 5:2 = 2.5:1.

RATIO → FRACTION / PERCENTAGE

Total parts = a + b. Each amount is that many parts out of the total.

3 : 2 → $\frac{3}{5}$ and $\frac{2}{5}$ = **60% and 40%**

SHARING IN A RATIO

Total given: total ÷ (sum of parts) = **one part**, then multiply.

Share £60 in 2:3: 60÷5 = 12 → **£24 : £36**

One quantity given: find one part, then the rest.

Difference given: difference ÷ (difference in parts) = one part. In 2:5, the difference is 3 parts.

SETTING OUT THE WORKING

Share £60 in the ratio 2 : 3

1. Add the parts: 2 + 3 = 5 parts

2. One part: £60 ÷ 5 = £12

3. Multiply each part:
2 × £12 = £24 and 3 × £12 = £36

4. Check they add back: 24 + 36 = 60 ✓

Answer: **£24 : £36**

COMBINING RATIOS

Make the **shared letter** match, then join.

A:B = 2:3, B:C = 4:5

B common (12): A:B = 8:12, B:C = 12:15

→ **A : B : C = 8 : 12 : 15**

SCALE DRAWINGS

- A scale like 1 : 100 means 1 cm on the drawing = 100 cm in real life.
- Multiply to get real size; divide to get drawing size.
- Scale 1:50, drawing 8 cm → real = 400 cm = 4 m.

WORKED RATIO PROBLEMS

One quantity given: A:B = 3:7, A = 12. 1 part = 4, so **B = 28**.

Difference given: 2:5, difference = 27. 3 parts = 27, 1 part = 9 → **18 : 45**.

Total given: Share 84 as 1:2:4. 7 parts, 1 part = 12 → **12 : 24 : 48**.

N : 1 AND 1 : N

- Divide **both** parts by the one you want to become **1**.
- 5 : 2 as n : 1 → divide by 2 → 2.5 : 1.
- 5 : 2 as 1 : n → divide by 5 → 1 : 0.4.

⚠ COMMON EXAM MISTAKES (recurring errors flagged in examiners' reports)

- ✕ Writing 3:2 as the fraction $\frac{3}{2}$ instead of $\frac{3}{5}$ — **divide by the total parts**.
- ✕ Forgetting to **add the parts** before sharing a total.
- ✕ Swapping the **order** of the ratio.
- ✕ Only simplifying **one** part of the ratio.
- ✕ On "difference given", dividing by the total parts instead of the **difference** in parts.

2 Algebra Recap

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COLLECTING LIKE TERMS

Like terms = same letters to the same power. Add/subtract the **coefficients**.

$6p + 9p + 4q =$ **$15p + 4q$**

$5x^2 + 3x - 2x^2 =$ **$3x^2 + 3x$**

TERMS & COEFFICIENTS

- A **term** is a number, a letter, or number × letter.
- The **coefficient** is the number in front (in 4a it is 4).

MULTIPLYING TERMS

Multiply the numbers; **add** the powers of the same letter.

$3a \times 4a =$ **$12a^2$**

$8x^4y^7 \times x^2y^4 =$ **$8x^6y^{11}$**

DIVIDING TERMS

Divide the numbers; **subtract** the powers of the same letter.

$12y^{11} \div 6y^7 =$ **$2y^4$**

$\frac{8a^5b^3}{4ab^7} =$ **$2a^4/b^4$**

SUBSTITUTION

Replace the letter with its value — **use brackets**.

$6x$ when $x = 5$: $6(5) =$ **30** (not 65!)

$x^2 - 2x$ when $x = 4$: $(4)^2 - 2(4) = 16 - 8 =$ **8**

WATCH THE NOTATION

- $3a$ means $3 \times a$; a^2 means $a \times a$.
- $3a^2 \neq (3a)^2$ — only the a is squared in $3a^2$.
- $(3a)^2 = 9a^2$ — the bracket squares **both**.

MORE PRACTICE

$7x + 3y - 2x + 5y =$ **$5x + 8y$**

$4a \times 5b =$ **$20ab$**

$6p^2 \times 3p^4 =$ **$18p^6$**

$20y^7 \div 4y^3 =$ **$5y^4$**

LIKE TERMS ONLY

- You can only add or subtract terms with the **same letter and same power**.
- $3x + 4x = 7x$ ✓ $3x + 4x^2$ — cannot be simplified.
- 5ab and 3ba **are** like terms (order does not matter).

⚠ COMMON EXAM MISTAKES (recurring errors flagged in examiners' reports)

- ✕ $3a + 2a = 5a^2$ — collecting only changes the coefficient: 5a.
- ✕ Adding/multiplying **unlike terms** ($3a + 2b = 5ab$).
- ✕ Multiplying terms: $3a \times 2a = 6a$ or $5a^2$ instead of $6a^2$.
- ✕ Substituting 6x, x=5 as 65 — **use brackets 6(5).**
- ✕ Writing $3 \times a$ as 3a but also $3 + a$ as 3a.
- ✕ Dividing terms: not **subtracting** the powers, or dropping a letter.

3 Index Laws

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THE INDEX LAWS (SAME BASE)

$a^b \times a^c = a^{b+c}$	**Multiply** → add the powers
$a^b \div a^c = a^{b-c}$	**Divide** → subtract the powers
$(a^b)^c = a^{bc}$	**Power of a power** → multiply
$a^0 = 1$	Anything (not 0) to the power 0
$a^{-b} = \frac{1}{a^b}$	**Negative** → reciprocal

WORKED EXAMPLES

$y^{11} \times y^5 = \mathbf{y^{16}}$ $6y^3 \times 2y^5 = \mathbf{12y^8}$

$y^{12} \div y^4 = \mathbf{y^8}$ $12y^{11} \div 6y^7 = \mathbf{2y^4}$

$(y^3)^7 = \mathbf{y^{21}}$ $(3^2)^4 = \mathbf{3^8}$

WITH COEFFICIENTS & BRACKETS

Everything inside the bracket gets the power:

$(3c^4)^2 = 3^2c^8 = \mathbf{9c^8}$

$(2a^6b^3)^2 = \mathbf{4a^{12}b^6}$

POWER ZERO & NEGATIVE POWERS

$7^0 = 1$, $(7x)^0 = 1$, but $0^7 = 0$.

$3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

$(-3)^{-2} = \frac{1}{9}$ but $-3^{-2} = -\frac{1}{9}$

ONLY WORKS FOR THE SAME BASE

- Add / subtract powers **only when the bases (or letters) match**.
- $a^3 \times b^2$ cannot be simplified — different letters.

WHY YOU ADD THE POWERS

$$a^3 \times a^2 = \underbrace{(a\times a\times a)}_{\text{3 of them}} \times \underbrace{(a\times a)}_{\text{2 more}}$$

$$= a^5$$

The power just **counts** how many are multiplied — so you **add** the counts.

MORE INDEX PRACTICE

$y^{11} \times y^5 = \mathbf{y^{16}}$ $y^{12} \div y^4 = \mathbf{y^8}$

$(y^3)^7 = \mathbf{y^{21}}$ $(4a^6b^3)^2 = \mathbf{16a^{12}b^6}$

$12y^{11} \div 6y^7 = \mathbf{2y^4}$

$3^{-2} = \frac{1}{9}$ $(7x)^0 = \mathbf{1}$

⚠ COMMON EXAM MISTAKES (recurring errors flagged in examiners' reports)

- ✕ **Multiplying the powers** when multiplying terms: $y^{11} \times y^5 = y^{55}$ instead of y^{16}.
- ✕ Forgetting the **coefficient** gets the power too: $(3c^4)^2 = 3c^8$ instead of $9c^8$.
- ✕ Thinking $a^0 = 0$ instead of **1**.
- ✕ Applying a law to **different bases**.
- ✕ Sign slip: $(-3)^{-2}$ vs -3^{-2}.

Revise it: write the five laws, then simplify one of each with answers covered.