Ratio

R3–R8 · Ratio, proportion and rates of change · revision notes

A ratio compares the sizes of two or more quantities, e.g. 3 : 5. Ratio questions are common on both tiers: simplifying and sharing on both and, at Higher tier, multi-step problems where you combine ratios or form an equation when a ratio changes.

Key facts

- Total parts = the numbers in the ratio added together
- In a : b, the first share is $\frac{a}{a+b}$ of the total
- a : b = c : d means $\frac{a}{b} = \frac{c}{d}$ (equal ratios are in proportion)
- Grade 7+ only Changing ratio: write the amounts as 3x and 5x (say), apply the change, set the new amounts equal to the new ratio as fractions, cross-multiply
- One part = amount ÷ total parts
- Form 1 : n: divide both parts by the first part
- Combine a : b and b : c by making the b parts equal (use the LCM)

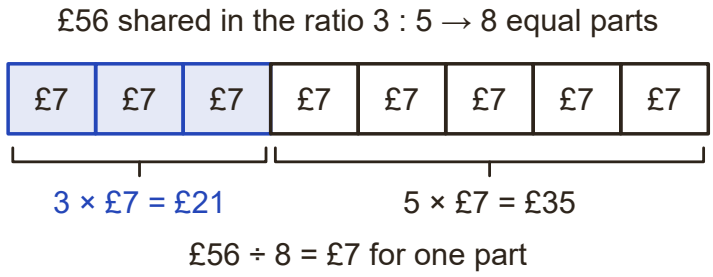
Notes

Simplifying ratios

- A ratio compares quantities in order: if boys : girls = 3 : 4, then girls : boys = 4 : 3.
- Simplify by dividing every part by the HCF: 18 : 24 : 30 = 3 : 4 : 5 (divide by 6).
- Change to the same units first, then leave the units out: 40 cm : 2 m = 40 : 200 = 1 : 5.
- Clear decimals or fractions by multiplying every part: 1.5 : 2 = 3 : 4, and $\frac{1}{2} : \frac{1}{3}$ = 3 : 2 (multiply by 6).
- For the form 1 : n, divide both parts by the first part: 8 : 20 = 1 : 2.5 (n can be a decimal).

Sharing and finding one part

- Add the numbers in the ratio to get the total parts, divide the amount by this to find one part, then multiply.
- £56 in the ratio 3 : 5 is 8 parts, so one part = £7 and the shares are £21 and £35.



Draw a bar of equal parts: find one part, then multiply.

- Given one share, divide it by its number of parts. In 2 : 7, if the smaller share is 16, one part is 8 and the larger share is 56.
- Given a difference, divide by the difference in parts. In 5 : 2, a difference of 45 is 3 parts, so one part is 15.
- A part : whole ratio compares one share with the total: boys : whole class = 3 : 8 means boys : girls = 3 : 5.

Ratios, fractions and proportion

- In a : b the first quantity is $\frac{a}{a+b}$ of the total: red : blue = 3 : 5 means $\frac{3}{8}$ are red.
- 'A is $\frac{2}{3}$ of B' means A : B = 2 : 3.
- One quantity as a fraction of another: same units, then first over second. 45 minutes out of 2 hours is $\frac{45}{120} = \frac{3}{8}$
- The fraction can be greater than 1: 3 hours as a fraction of 2 hours is $\frac{3}{2}$
- Equal ratios are in proportion: 4 : 6 = 10 : 15, as both simplify to 2 : 3.
- A ratio gives a straight-line rule: if y : x = 3 : 2, then $y = \frac{3}{2}x$

Combining ratios

- If a : b = 2 : 3 and b : c = 4 : 5, make the b parts equal. The LCM of 3 and 4 is 12.
- a : b = 8 : 12 and b : c = 12 : 15, so a : b : c = 8 : 12 : 15.

Changing ratios Grade 7+ only

- Write the starting amounts with a letter, e.g. red = 3x and blue = 5x.
- Apply the change, e.g. 6 red counters are added, so red = 3x + 6.
- Write the new ratio as a fraction equation and cross-multiply: $\frac{3x+6}{5x} = \frac{3}{4}$ gives 12x + 24 = 15x, so x = 8.
- So there were 24 red and 40 blue at the start. Check: 30 : 40 = 3 : 4.

How to answer each type of question

M = method mark, A = answer mark, B = a mark on its own, P = a process mark.

Share an amount in a given ratio

2 marks | Grade 3

1. Add the numbers in the ratio to get the total number of parts.
2. Divide the amount by the total number of parts to find one part.
3. Multiply one part by each number in the ratio.
4. Check that the shares add up to the amount you started with.

Example. Priya and Tom share £84 in the ratio 3 : 4.
Work out how much money each of them gets.

Model answer.

3 + 4 = 7 parts, so one part = 84 ÷ 7 = £12 (M1)

Priya gets 3 × 12 = £36 and Tom gets 4 × 12 = £48 (A1)

Write a fraction as a ratio in the form 1 : n

2 marks | Grade 4

1. Turn the fraction into a ratio: if one share is $\frac{2}{5}$ of the total, the other share is $\frac{3}{5}$, so the ratio is 2 : 3.
2. Divide both parts by the first part.
3. Leave n as a decimal if it does not divide exactly.

Example. Ben and Ali share some money. Ben gets $\frac{2}{5}$ of the money and Ali gets the rest.
Write the ratio of Ben's share to Ali's share in the form 1 : n.

Model answer.

Ali gets $\frac{3}{5}$, so Ben : Ali = 2 : 3 (M1)

2 ÷ 2 : 3 ÷ 2 = 1 : 1.5 (A1)

Use one share or a difference to find an amount

3 marks | Grade 4

1. Work out how many parts the known amount stands for (one share, or the difference between two shares).
2. Divide to find the value of one part.
3. Multiply to find what the question asks for (a share or the total).

Example. A bag contains only red sweets and green sweets.
The ratio of red sweets to green sweets is 7 : 3.
There are 28 more red sweets than green sweets.
How many sweets are in the bag altogether?

Model answer.

The difference is 7 − 3 = 4 parts, so one part = 28 ÷ 4 = 7	(P1)
Total = (7 + 3) × 7	(P1)
= 70 sweets	(A1)

Combine two ratios

3 to 4 marks | Grade 5

1. Find the quantity that appears in both ratios.
2. Multiply each ratio so that this quantity has the same number of parts in both (use the LCM).
3. Write one three-part ratio and add the parts.
4. Find one part, then the amount the question asks for.

Example. An orchestra has only string, wind and brass players.
The ratio of string players to wind players is 5 : 2.
The ratio of wind players to brass players is 4 : 3.
There are 68 players in the orchestra.
How many brass players are there?

Model answer.

string : wind = 10 : 4 and wind : brass = 4 : 3	(P1)
string : wind : brass = 10 : 4 : 3, which is 17 parts	(P1)
One part = 68 ÷ 17 = 4	(P1)
Brass = 3 × 4 = 12 players	(A1)

Form and solve an equation when a ratio changes 3 marks **Grade 7**

1. Write the starting amounts with a letter, e.g. 5x and 3x.
2. Apply the change to the right amount.
3. Set the new amounts equal to the new ratio as fractions, then cross-multiply.
4. Solve for x, then answer the actual question (not just x).

Example. A box contains only milk chocolates and dark chocolates.
The ratio of milk chocolates to dark chocolates is 5 : 3.
Sam eats 8 of the milk chocolates.
The ratio of milk chocolates to dark chocolates is now 4 : 3.
How many dark chocolates are in the box?

Model answer.

Milk = 5x and dark = 3x, so $\frac{5x - 8}{3x} = \frac{4}{3}$ (P1)

3(5x − 8) = 12x, so 15x − 24 = 12x and x = 8 (P1)

Dark chocolates = 3 × 8 = 24 (A1)

Don’t lose marks

- Dividing the amount by one number in the ratio instead of by the total number of parts.
- Writing the ratio in the wrong order: keep the order the question uses.
- Simplifying before changing to the same units, e.g. writing 40 cm : 2 m as 20 : 1.
- In difference questions, dividing by the total number of parts instead of the difference in parts.
- Reading a ratio as a fraction: in 2 : 3 the first share is $\frac{2}{5}$ of the total, not $\frac{2}{3}$
- Stopping at x in a changing-ratio question instead of working out the amount asked for.

More tips

Memory tricks

- Think 'one part first': almost every ratio question is easy once you know what one part is worth.
- Draw a bar model: one box per part, write the known amount across its boxes, then share it out.
- Check that your shares add up to the total and simplify back to the ratio you were given.
- On the calculator paper, entering 18 ÷ 24 as a fraction simplifies it to $\frac{3}{4}$, so 18 : 24 = 3 : 4.

Exam technique

- Write 'one part = ...' clearly: it is usually the first method or process mark.
- Label each share with its name and units, e.g. 'Tom: £48'.
- 'Simplest form' means no whole number other than 1 divides into every part.
- In multi-step problems, write a few words next to each calculation (e.g. 'rest of the money') so the examiner can follow your process.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 2

Simplify a ratio using the HCF

Divide every part by the highest common factor, e.g. 12 : 18 = 2 : 3.

Grade 3

Share an amount in a given ratio

Find the value of one part first, e.g. £40 shared in the ratio 3 : 5 gives £15 and £25.

Grade 3

Write one quantity as a fraction of another

Use the same units, then write the first over the second and simplify, e.g. 40 minutes out of an hour is $\frac{2}{3}$

Grade 4

Convert between ratios and fractions

In the ratio 2 : 5 the first share is $\frac{2}{7}$ of the total, not $\frac{2}{5}$

Grade 4

Use one share or a difference

Divide the known amount by the number of parts it stands for to find one part.

Grade 4

Write ratios in the form 1 : n

Divide both parts by the first part, e.g. 4 : 10 = 1 : 2.5.

Grade 5

Combine two ratios with a shared quantity

Make the shared quantity's parts equal, e.g. a : b = 1 : 2 and b : c = 3 : 4 give a : b : c = 3 : 6 : 8.

Grade 7

Form an equation when a ratio changes

Write the amounts as multiples of x, apply the change and solve the equation given by the new ratio.

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