1 Percentages with Multipliers

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WHAT A MULTIPLIER IS

- A **single number** you multiply by to do the whole change in one step.
- **Increase:** multiplier = $1 + \frac{\%}{100}$
- **Decrease:** multiplier = $1 - \frac{\%}{100}$
- Much quicker than finding the amount then adding it on.

COMMON MULTIPLIERS

Change	Multiplier
Increase 10%	1.1
Increase 25%	1.25
Increase 5%	1.05
Decrease 10%	0.9
Decrease 25%	0.75
Decrease 3%	0.97

USING A MULTIPLIER

Increase £240 by 15%:

$240 \times 1.15 =$ **£276**

Decrease £80 by 20%:

$80 \times 0.8 =$ **£64**

FINDING A PERCENTAGE CHANGE

$$\textbf{\% change} = \frac{\textbf{change}}{\textbf{original}} \times \textbf{100}$$

£40 rises to £46:

change = 6

$\frac{6}{40} \times 100 =$ **15% increase**

REVERSE PERCENTAGES

- Given the amount **after** the change, **divide** by the multiplier.
- Multiplying instead of dividing is the classic error.

A price is £72 after a **20% rise**. Find the original.

$72 \div 1.2 =$ **£60**

⚠ SPOTTING A REVERSE QUESTION

- Look for words like **"after"**, **"now"**, **"in a sale"**, **"including VAT"**.
- **Check:** put your answer back through the multiplier.
- $60 \times 1.2 = 72$ ✓

MORE PRACTICE

150 increased by 8% = **162**

90 decreased by 30% = **63**

£255 after 15% rise → **£221.74**

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

- ✕ Reverse percentages: **multiplying** by the multiplier instead of **dividing**.
- ✕ Taking the percentage **off the new amount** rather than the original.
- ✕ Using 0.15 as the increase multiplier instead of 1.15.
- ✕ Percentage change divided by the **new** value, not the **original**.
- ✕ Decrease of 5% written as 0.5 instead of 0.95.

Revise it: write the multiplier for six changes, then check.

2 Simple & Compound Interest

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SIMPLE INTEREST

- The interest is worked out on the **starting amount every time**.
- So you get the **same** interest each year.
- Interest for one year, then **× number of years**.

£500 at **4%** simple for **3** years:

One year: 500 × 0.04 = £20

Interest: 20 × 3 = **£60**

Total: **£560**

COMPOUND INTEREST

- Interest is worked out on the **new amount each year**.
- So you earn **interest on the interest**.
- Use the multiplier to the **power** of the years.

Total = P × (multiplier)^n

COMPOUND WORKED EXAMPLE

£500 at **4%** compound for **3** years:

500×1.04^3

= **£562.43** (2 d.p.)

Interest earned = **£62.43**

SIMPLE OR COMPOUND?

	Simple	Compound
Based on	Start amount	New amount
Each year	Same	Grows
After 3 yrs	£560	£562.43

Compound always gives **more** (for a gain).

DEPRECIATION

- Value **falls** each year — same method, **decrease** multiplier.
- A £12 000 car loses **15%** a year for 3 years:
- 12000×0.85^3 = **£7369.50**

MONEY ANSWERS

- Round to **2 decimal places** and include the **£**.
- £562.4 should be written **£562.40**.
- Read carefully: **total** amount or **interest earned**?

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

- ✕ Using the **simple** method when the question says **compound**.
- ✕ Multiplying by the rate **× years** for compound instead of using a power.
- ✕ Giving the **total** when the **interest** was asked for (or the reverse).
- ✕ Money not written to **2 d.p.**
- ✕ Depreciation done with an **increase** multiplier.

Revise it: work out both interest types on £500 at 4% for 3 years.

3 Similarity with Length

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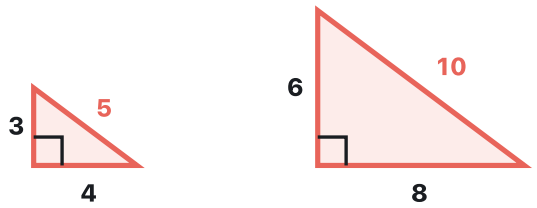
SIMILAR VS CONGRUENT

- **Similar** — same shape, **different size**. Angles equal, sides in the same ratio.
- **Congruent** — same shape **and** same size.
- Congruent shapes are similar with scale factor **1**.

TWO SIMILAR TRIANGLES



Every side is **×2** — the scale factor is **2**.

FINDING THE SCALE FACTOR

$$\text{SF} = \frac{\text{new length}}{\text{old length}}$$

- Use a pair of **corresponding** sides where you know **both**.
- **SF > 1** → bigger. **SF < 1** → smaller.

WORKED EXAMPLE

Similar shapes: a side of 4 matches a side of 10.

SF = 10 ÷ 4 = 2.5

Another side is 6. Its match:

6 × 2.5 = **15**

GOING BACKWARDS

- To go from the **big** shape to the **small** one, **divide** by the scale factor.
- Or use the scale factor the other way round.

MATCHING THE SIDES UP

- Corresponding sides are **between the same two angles**.
- The **longest** side matches the **longest**; shortest matches shortest.
- The shapes may be **rotated or flipped** — redraw them the same way round.

PROVING TRIANGLES ARE SIMILAR

- Show **two pairs of equal angles** (the third must then match).
- Look for **parallel lines** giving equal angles.
- A shared angle counts as a **common** angle.

SETTING OUT THE WORKING

- State the **scale factor** with its working.
- Show the multiplication for **each** missing length.
- Keep the **units** the same throughout.

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

- ✕ Pairing up **non-corresponding** sides, especially when a shape is rotated.
- ✕ Scale factor **upside down** — old ÷ new instead of new ÷ old.
- ✕ **Adding** the difference in lengths instead of multiplying.
- ✕ Dividing when you should multiply (going the wrong way).
- ✕ Assuming shapes are similar when the **angles** are not equal.

4 Right-Angled Trigonometry

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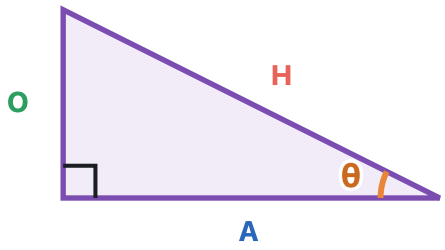
LABELLING THE SIDES



H opposite the right angle · **O** opposite θ · **A** next to θ

LABEL FROM THE ANGLE

- **H** never moves — always opposite the **right angle**.
- **O** and **A** depend on **which angle** you are using.
- Label the triangle **before** choosing a ratio.

THE THREE RATIOS

$$\sin\theta = \frac{O}{H} \quad \cos\theta = \frac{A}{H} \quad \tan\theta = \frac{O}{A}$$

SOH · CAH · TOA

- Choose the ratio with the **two sides in the question**.
- **SOHCAHTOA** — each triple gives one ratio, e.g. **S**in = **O** over **H**.

THE METHOD

1. **Label** H, O and A from the angle.
2. **Choose** the ratio (sin, cos or tan).
3. **Substitute** the numbers in.
4. **Rearrange** to get the unknown.
5. **Answer** to 1 d.p. unless told otherwise.

FINDING A SIDE

Angle 35°, H = 12, find O.

$\sin 35 = \frac{O}{12}$

$O = 12 \sin 35 = \mathbf{6.9}$

FINDING AN ANGLE

A = 7, H = 12, find the angle.

$\cos x = \frac{7}{12}$

$x = \cos^{-1}(\frac{7}{12}) = \mathbf{54.3°}$

Use **inverse** trig to get an angle.

ELEVATION & DEPRESSION

- **Elevation:** angle looking **up** from the horizontal.
- **Depression:** angle looking **down** from the horizontal.
- They are **equal** (alternate angles).
- Both are measured from the **horizontal**, never the vertical.

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

- ✕ Labelling **O** and **A** from the **wrong angle**.
- ✕ Choosing the wrong ratio — check which two sides you have.
- ✕ Forgetting **inverse** trig when finding an angle.
- ✕ Calculator in the wrong mode — it must be in **degrees**.
- ✕ Measuring elevation from the **vertical** instead of the horizontal.
- ✕ **Rounding too early** in a two-stage question.

Revise it: label a triangle, then find one side and one angle.