Name	Date started	Target end date

WJEC GCSE Mathematics and Numeracy (Double Award) — Question Pack

Spotting similar and congruent shapes, finding missing lengths using scale factors, and applying the area (k^2) and volume (k^3) scale rules. Incl

REVISE
.wales

2.19 — Similarity & congruence

Spec 3.9.1, 3.9.2, 3.9.3, 3.9.5, 3.9.6 — Unit 3 (calculator allowed)

Spotting similar and congruent shapes, finding missing lengths using scale factors, and applying the area (k^2) and volume (k^3) scale rules. Includes the four congruence conditions (SSS, SAS, ASA, RHS). Sourced from legacy WJEC GCSE Mathematics / Mathematics–Numeracy Higher non-calculator papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~2 hours 32 minutes

*Derived from the GCSE Higher pace of **~1.5 min/mark** (101 marks across 29 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification.

Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

A calculator is allowed on every question in this pack (Unit 3 is the calculator-allowed paper).

Similarity & congruence — what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 3: calculator-allowed.

Similar shapes 3.4.6

- Corresponding angles equal, corresponding sides in ratio k.
- $k = \dfrac{\text{new length}}{\text{old length}}$.
- Match corresponding sides — check angle layout.

Area & volume scaling 3.4.6

- Area scales by k^2.
- Volume scales by k^3.
- Recover k from $\sqrt{\text{area ratio}}$ or $\sqrt[3]{\text{volume ratio}}$.

Congruence 3.4.6

- SSS: three sides.
- SAS: two sides plus included angle.
- ASA / AAS: two angles plus a corresponding side.
- RHS: right angle, hypotenuse, one other side.

Proving similarity 3.4.6

- Show two pairs of equal angles (third follows automatically), or
- Show all three pairs of sides are in the same ratio.
- Cite shared angles and parallel-line angle facts where they apply.

Crib sheet »

Similarity & congruence in one page

Quick-reference notes — revisit before each question. Don't use during the questions.

Similar vs congruent

Similar: same shape, corresponding sides in the same ratio (scale factor k), corresponding angles equal.

Congruent: identical — same shape *and* same size ($k = 1$).

Finding the scale factor

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

Pick a pair of corresponding sides where both lengths are known.

$k > 1$: enlargement. $0 < k < 1$: reduction.

Missing lengths

Multiply by k to go from the smaller shape to the larger; divide by k to go back.

Always match *corresponding* sides — check the angle layout, don't assume by position alone.

Area & volume scale rules

$$\text{area scales by } k^2, \text{ volume scales by } k^3$$

If lengths double ($k = 2$): area $\times 4$, volume $\times 8$.

Going the other way: $k = \sqrt{\text{area ratio}} = \sqrt[3]{\text{volume ratio}}$.

Congruence conditions

Two triangles are congruent if one of these holds:

SSS: three sides equal.

SAS: two sides and the included angle.

ASA (or AAS): two angles and a corresponding side.

RHS: right angle, hypotenuse, one other side.

Proving similarity

Either show all three pairs of angles are equal (AAA — two pairs is enough since angles sum to 180°),

or show all three side ratios are equal.

Watch for shared angles and parallel lines giving equal angles automatically.

Worked example (area)

Two similar rectangles. Small area $= 12$ cm^2, $k = 3$.

Large area $= 12 \times 3^2 = 12 \times 9 = 108$ cm^2.

Common traps

- Using k instead of k^2 or k^3 for area / volume.
- Mismatching corresponding sides on a rotated or reflected diagram — redraw to match orientations if needed.
- Confusing 'SSA' (which isn't a congruence condition) with RHS.

Examiner only

1. *(a)* The Headteacher of Ysgol Bro Gwyn investigates building a new bike shed.

Bike sheds are built on a rectangular base of width x metres and length y metres.

The Headteacher is given a formula for working out the number of bikes, b, that can be stored in a bike shed that has a base of width x metres and length y metres.

He is told the formula only works when
- x and y are whole numbers
- x is greater than 3
- y is greater than 5

The formula is as follows:

$$b = \frac{6xy}{5}$$

According to the details the Headteacher has been given, what is the formula for calculating the length, y metres, of a bike shed x metres wide that can hold b bikes?
Circle your answer. [1]

$y = \frac{b-5}{6x}$ $x = \frac{6b}{5y}$ $y = \frac{b+5}{6x}$ $y = \frac{5b}{6x}$ $y = \frac{6x}{5b}$

Examiner only

(b) The Headteacher decides to place signs around the school site to stop pupils using their bikes on grassed areas.

He introduces a new sign to pupils in the school newsletter.
The size of the sign in the newsletter is shown below.

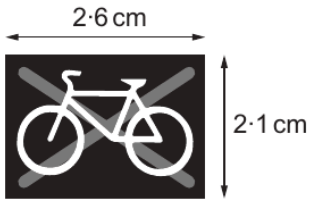

Diagram not drawn to scale

A mathematically similar new sign is placed near the side of the playing field.

Diagram not drawn to scale

It is 33·6 cm high.
How wide is this sign? [2]

Width is ..... cm

Examiner only

17. Two similar shapes have areas of $700\,cm^2$ and $140\,cm^2$.
The perimeter of the smaller shape is 83 cm.
Calculate the perimeter of the larger shape. [3]

Examiner only

13. The front views of two mathematically similar milk cartons are shown below.

Diagram not drawn to scale

(a) Circle either TRUE or FALSE for each statement given below. [1]

STATEMENT		
The ratio of the lengths of the cartons is the same as the ratio of the heights of the cartons.	TRUE	FALSE
The ratio of the volumes of the cartons is the same as the ratio of the heights of the cartons.	TRUE	FALSE

(b) It is claimed that the larger carton contains double the amount of milk contained in the smaller carton.
Show that this claim is not true.
Explain your answer. [3]

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Examiner only

(c) Another similar milk carton has a label with an area that is one quarter of the area of the label on the carton of height 24 cm.

Diagram not drawn to scale

Calculate the height of this new carton. [3]

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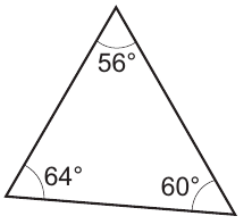
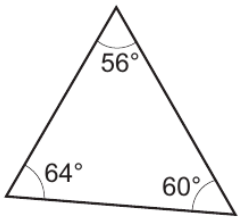
Examiner only

14. SSS, SAS, ASA and RHS are notations used to describe the conditions required to prove that two triangles are congruent.
[S ≡ Side, A ≡ Angle, R ≡ Right angle and H ≡ Hypotenuse.]

The following triangles are **not** drawn to scale.
For each pair of triangles, circle the correct statement.

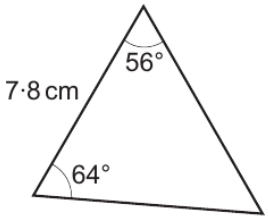
(a) [1]

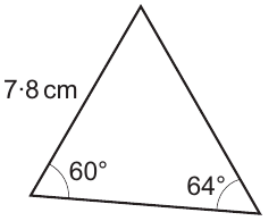




congruent: SSS | congruent: SAS | congruent: ASA | congruent: RHS | definitely not congruent | not necessarily congruent

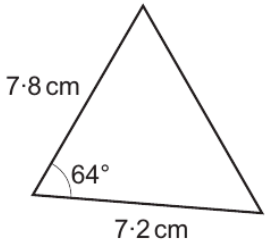
(b) [1]

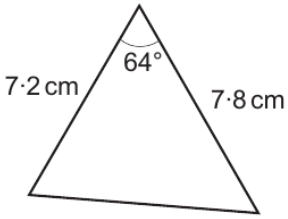




congruent: SSS | congruent: SAS | congruent: ASA | congruent: RHS | definitely not congruent | not necessarily congruent

(c) [1]

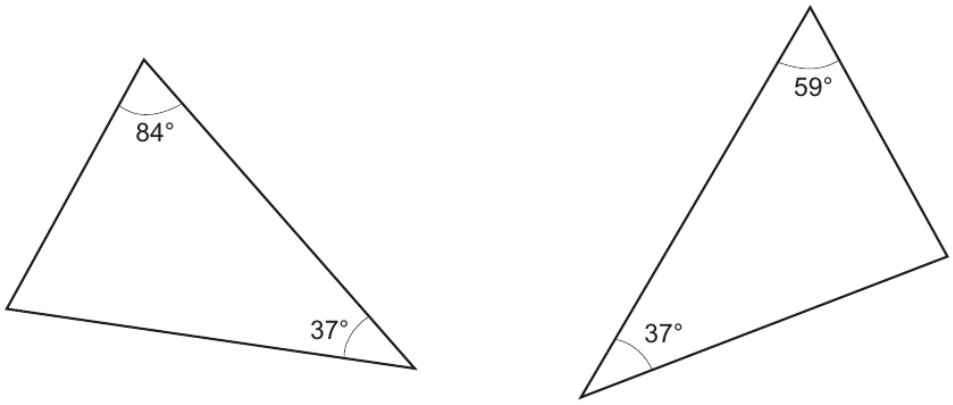




congruent: SSS | congruent: SAS | congruent: ASA | congruent: RHS | definitely not congruent | not necessarily congruent

Examiner only

14. The two triangles shown below are not drawn to scale.



Which **one** of the following statements is correct?
Give full reasons for your answer. [2]

A: the triangles **must** be congruent
B: the triangles **could** be congruent
C: the triangles **cannot** be congruent

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The correct statement is .....

This is because .....

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Examiner only

15. Two **similar** pyramids have volumes of 3970 cm^3 and 3100 cm^3 respectively.
The height of the larger pyramid is 25 cm.
Calculate the height of the smaller pyramid. [3]

Height = ... cm

Examiner only

3. Yared is going to make a door wedge.

(a) The cross-section of the wedge is shown below.
The horizontal length is 12 cm and the vertical height is 3 cm.

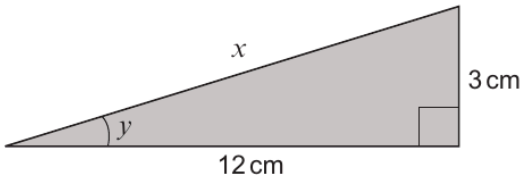


Diagram not drawn to scale

(i) Calculate the length x.

Give your answer correct to 3 significant figures. [4]

x = ... cm

(ii) The wedge must fit under Yared's door.
The angle y must be less than 15°.
Show that this wedge will fit under Yared's door.
You must show all your working. [3]

Examiner only

(b) Yared decides to make a larger wedge that is mathematically **similar** to the one shown in part *(a)*.
This wedge is to have a vertical height of 4·5 cm.

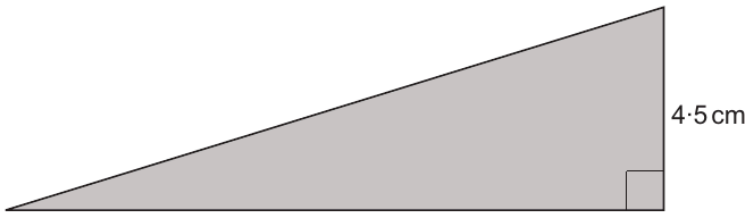


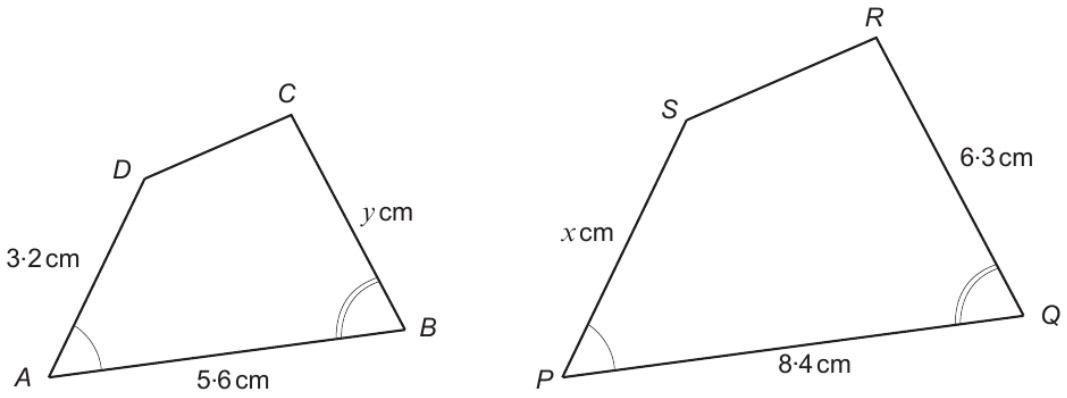
Diagram not drawn to scale

Calculate the horizontal length of this door wedge. [2]

The wedge will be ..... cm long

Examiner only

7. The diagrams below show two similar shapes, *ABCD* and *PQRS*.



Diagrams not drawn to scale

(a) Calculate the value of x. [2]

(b) Calculate the value of y. [2]

Examiner only

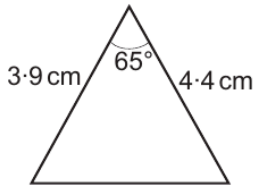
(c) Explain clearly why the following statement cannot be true. [2]

'The length of CD is 3·9 cm and the length of RS is 6·5 cm'.

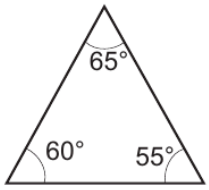
Examiner only

12. In the diagrams below, only two pairs of triangles are **definitely** congruent.
Identify the two pairs.
In each case, state the condition of congruency. [4]

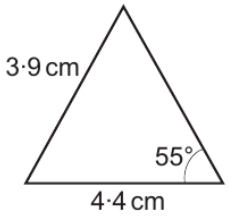
A



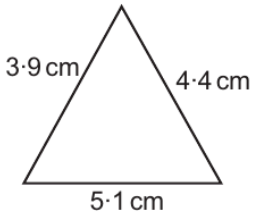
B



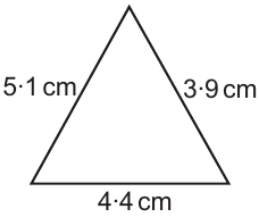
C



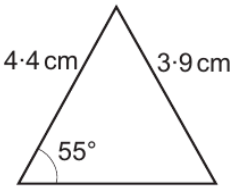
D



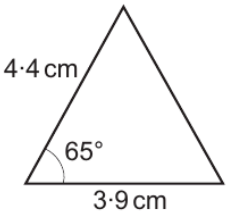
E



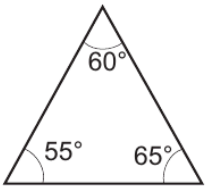
F



G



H



Diagrams not drawn to scale

Triangle ..... is congruent to triangle .....

Condition of congruency:

.....

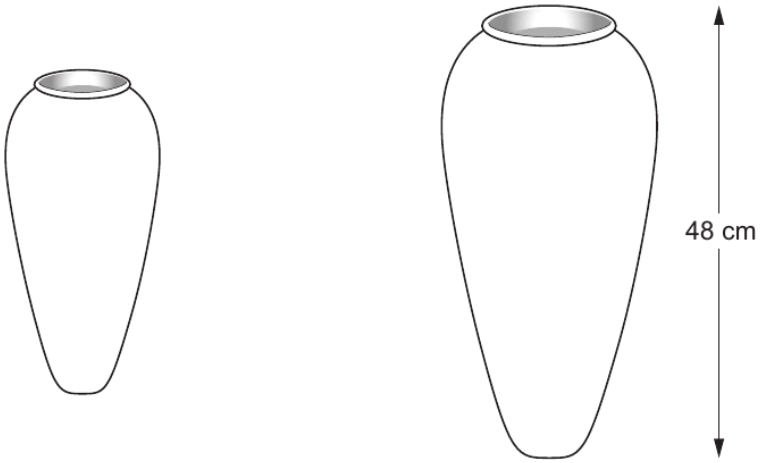
Triangle ..... is congruent to triangle .....

Condition of congruency:

.....

Examiner only

12. *Ffiol-Aur* is a company that makes vases.
They make one of their vases in two mathematically similar sizes.



Diagrams not drawn to scale

A decorative glaze covers the surfaces of each vase.
The glaze covers an area of:

- $400\,cm^2$ on the smaller vase,
- $3600\,cm^2$ on the larger vase.

The height of the larger vase is 48 cm.
Calculate the height of the smaller vase. [3]

Examiner only

4. (a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Jade is planning a weekend break to celebrate her 21st birthday.
The weekend break costs £350.
Jade's father says,

'If you save 21% of your earnings each week for the next 20 weeks, I will give you the rest of the money you need.'

Jade earns £72 per week.
How much is Jade's father offering to pay towards her weekend break?
You must show all your working. [4 + 2 OCW]

Examiner only

(b) (i) Jade's new suitcase weighs 3 kg.
When it is packed, her suitcase must not weight more than 25 kg altogether.
What percentage of the 25 kg does Jade have left for packing? [2]

(ii) Which one of the following formulae could be used to work out the volume of Jade's new suitcase?
a, b and c are measurements of the 3 dimensions of the suitcase.
Circle your answer. [1]

$a + b^2 + c$ $\quad 2a^2c - 4\pi b^2$ $\quad abc + \pi a^2 c$ $\quad a^3 - b^2 + c$ $\quad a + b^3 + c$

(c) Jade needs a new passport photograph.
A passport photograph must be 45 mm high by 35 mm wide.

Jade has a mathematically similar photograph that she could reduce in size to use as her new passport photograph.
The height of this photograph is 9 cm.
Calculate the width of this photograph. [2]

Examiner only

2. *(a)* (i) The internal measurements of a tin of baked beans are:

- radius 3·6 cm,
- height 9·3 cm.

Calculate the internal volume of the tin. [2]

(ii) Every 1 cm^3 of baked beans in a tin has a mass of 1 g.
A portion of baked beans is $\frac{1}{2}$ a tin.
What is the mass of a portion of baked beans? [1]

A portion of baked beans has a mass of ..... g

(b) A mathematically similar tin of baked beans has a radius of 4·2 cm.

Diagram not drawn to scale

Calculate the height of the larger tin of beans. [2]

Examiner only

(c) In a portion of baked beans there is:
- 1·85 g of salt,
- 11·7 g of sugar.

For women, the recommended daily allowance of:
- salt is 6 g,
- sugar is 90 g.

Consider a portion of baked beans.
Is it salt or sugar that provides the greater proportion of the recommended daily allowance for women?
You must show all your working. [3]

Examiner only

8. A company makes buckets in two sizes. Both sizes are in the shape of a frustum of a cone. Bucket A has the dimensions shown in the diagram below.

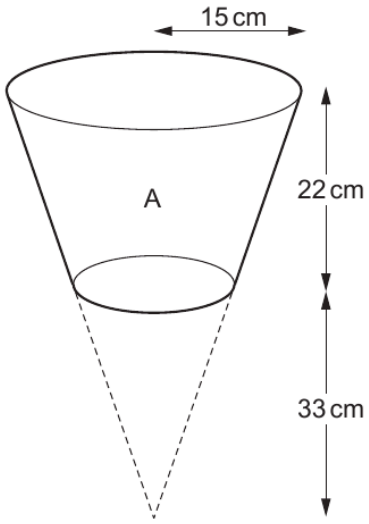


Diagram not drawn to scale

(a) Show that:

- the radius of the base of the bucket is 9 cm,
- the volume of the bucket is $3234\pi\,\text{cm}^3$. [5]

Examiner only

(b) Bucket B is shown below. It is mathematically similar to Bucket A.

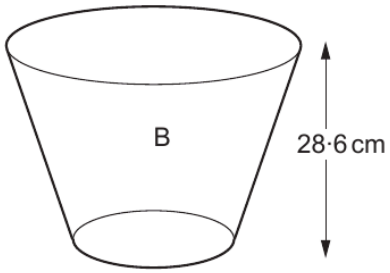


Diagram not drawn to scale

Calculate the number of **gallons** Bucket B can hold when full. [6]

Remember:
1 gallon = 8 pints

Examiner only

12. In the following diagram, *AE* and *BD* are straight lines and *BC* = *CE*.

Is it possible to conclude that triangles *ABC* and *DEC* are congruent?
You must show all your working and explain your decision. [2]

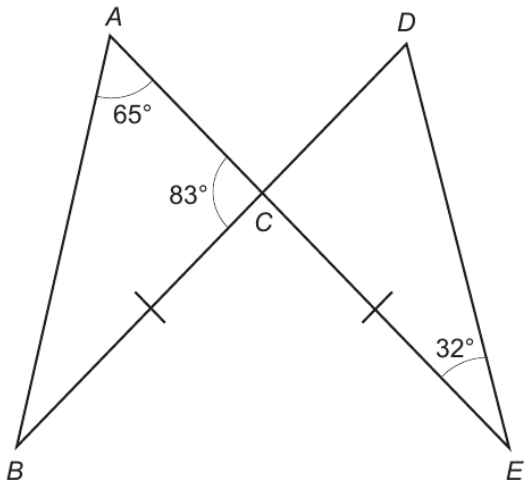


Diagram not drawn to scale

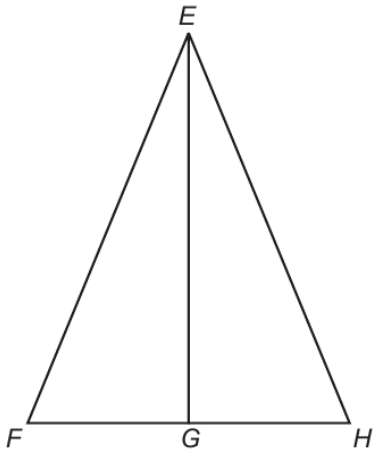
Examiner only

13. Two similar cones have volumes of $20\,cm^3$ and $1280\,cm^3$.
The radius of the base of the smaller cone is $2{\cdot}3\,cm$.
Calculate the radius of the base of the larger cone. [3]

Examiner only

15. In the triangle *EFH* below:

- *G* is the midpoint of *FH*,
- *EG* and *FH* are perpendicular.



Prove that *EFG* and *EHG* are congruent triangles.
You must state the condition of congruence. [4]

Examiner only

5. In the diagram:

- *AB* and *ED* are parallel
- triangles *ABC* and *DEC* are similar.

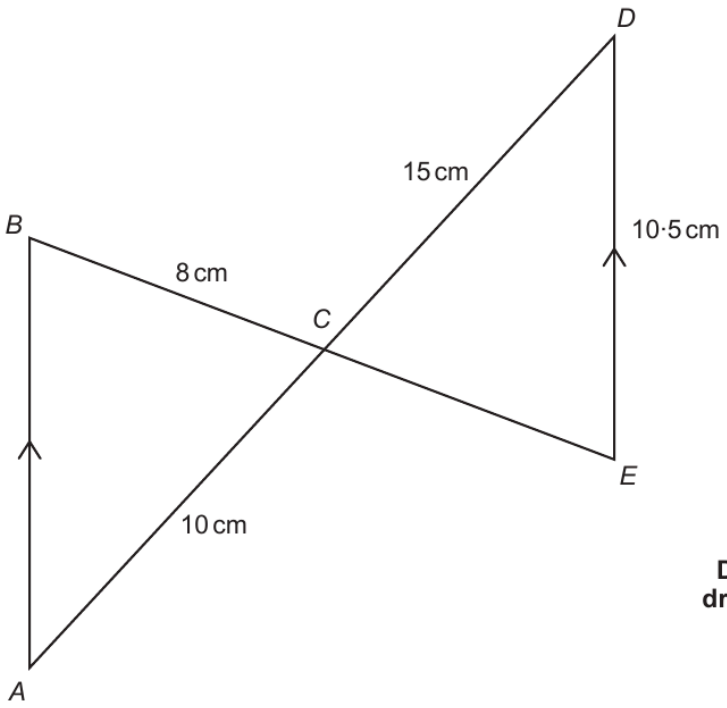


Diagram not drawn to scale

(a) Calculate the length of *CE*. [2]

(b) Calculate the length of *AB*. [2]

Examiner only

1. (a) *In this part of the question, you will be assessed on the quality of your organisation, communication and accuracy in writing.*

Malik has two orchards.
He has apple trees and pear trees in his north orchard.
He has pear trees and cherry trees in his west orchard.

In the north orchard,
- Malik has a total of 35 trees
- number of apple trees : number of pear trees = 4 : 3.

In the west orchard,
- Malik has twice as many **pear** trees as he has **pear** trees in the north orchard
- number of pear trees : number of cherry trees = 5 : 11.

How many **cherry** trees does Malik have?
You must show all your working. [5 + 2 OCW]

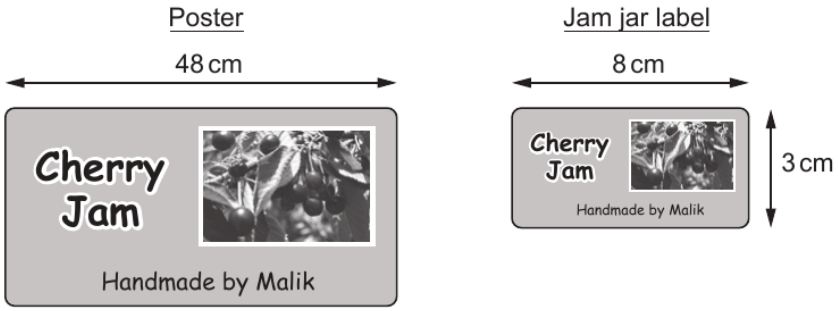
Examiner only

(b) Malik's crop of apples this year has a total mass of 5280 pounds.
He makes apple juice from $\frac{1}{6}$ of the mass of his apple crop.
Malik makes 2 litres of apple juice from every 5 kg of apples.

Calculate the number of litres of apple juice Malik makes. [6]

Examiner only

(c) Malik makes cherry jam using some of the fruit from his trees.
Malik makes a poster to advertise his jam.
He also makes labels for the jars.
The poster and the labels are mathematically similar.



Diagrams not drawn to scale

Calculate the height of the poster. [2]

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Examiner only

13. In the following diagram, the lines *AC* and *BD* **bisect** each other.

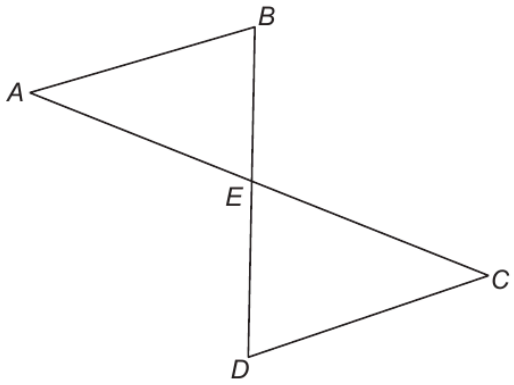


Diagram not drawn to scale

Prove that triangles *ABE* and *CDE* are congruent.
You must state the condition of congruence. [3]

Examiner only

12. Solve the equation $59x^2 - 7x - 13 = 0$.
Give your answers correct to 2 decimal places.
You must show all your working. [3]

13. Two similar shapes have perimeters of 241 cm and 719 cm.
The area of the smaller shape is 2063 cm^2.

Calculate the area of the larger shape.
Give your answer in m^2. [4]

Examiner only

6. The diagram below shows a shape made by joining two congruent rectangles together.
The length of each rectangle is $(5x+3)$cm.
The width of each rectangle is $(2x-1)$cm.

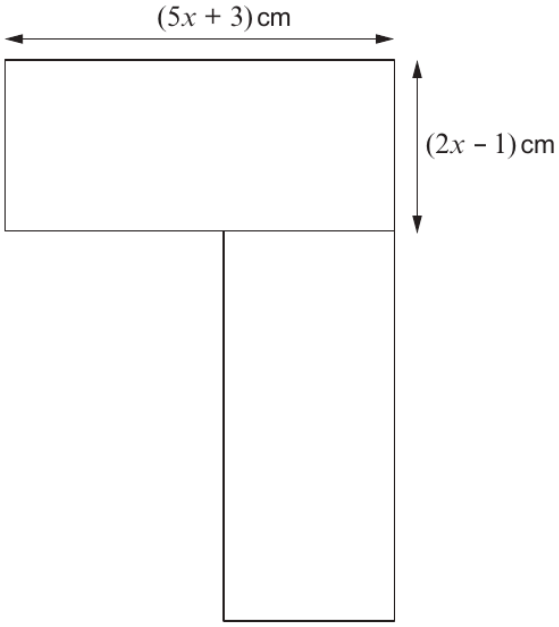


Diagram not drawn to scale

Write an expression for the total area of the shape in the form ax^2+bx+c, where a, b and c are whole numbers. [3]

Examiner only

6. A solid statue is made from an alloy of copper and tin.
It has a volume of 150 cm^3.

(a) In the statue, the volume of copper and the volume of tin are in the ratio 22 : 3.

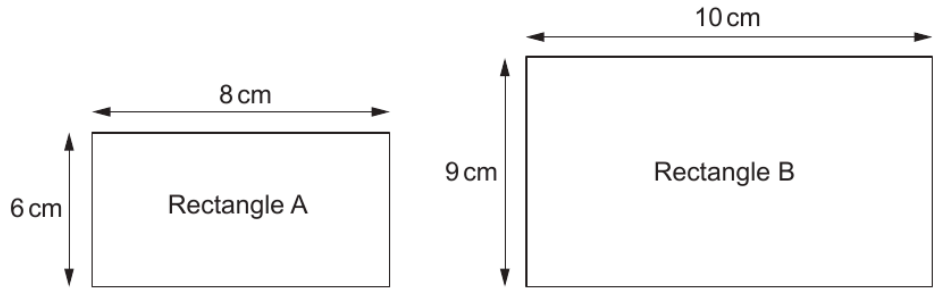
The density of copper is 8·96 g/cm^3.
The density of tin is 7·31 g/cm^3.

Calculate the mass of the statue.
You must show all your working. [4]

(b) The height of the statue is 12 cm.
A larger statue is mathematically similar to this statue.
It has a height of 21·6 cm.
Calculate the volume of this larger statue. [3]

Examiner only

7.



Diagrams not drawn to scale

(a) Explain why Rectangle A is **not** mathematically similar to Rectangle B. [2]

(b) Alun changes **only one** of the measurements of **Rectangle B** to make the two rectangles mathematically similar.

Write down a possible length and width of Alun's new rectangle.
You must show all your working. [2]

Length = ... cm

Width = ... cm

Examiner only

15. In the following diagram:

- *CB* and *DE* are parallel
- *CE* and *BD* are straight lines
- *CA* = *AE*.

Prove that triangles *ABC* and *ADE* are congruent.
You must show all your working and explain your reasoning. [2]

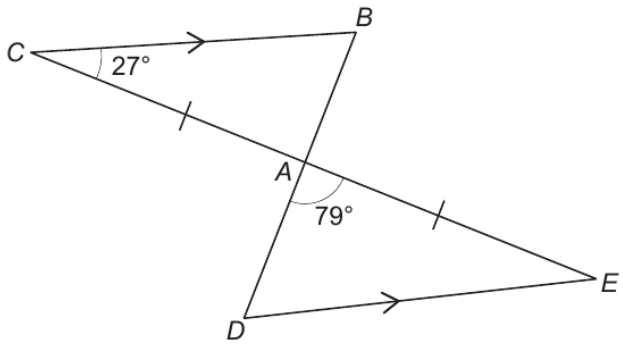


Diagram not drawn to scale

Examiner only

5. (a) The area of Wales is 20 735 km^2.

The table below gives the population of Wales in 1977, 1998 and 2015.

Year	1977	1998	2015
Population	2·8 million	2·9 million	3·1 million

(i) What was the increase in the population of Wales between 1977 and 1998? Circle your answer. [1]

1×10^3 1×10^4 1×10^5 1×10^6 1×10^7

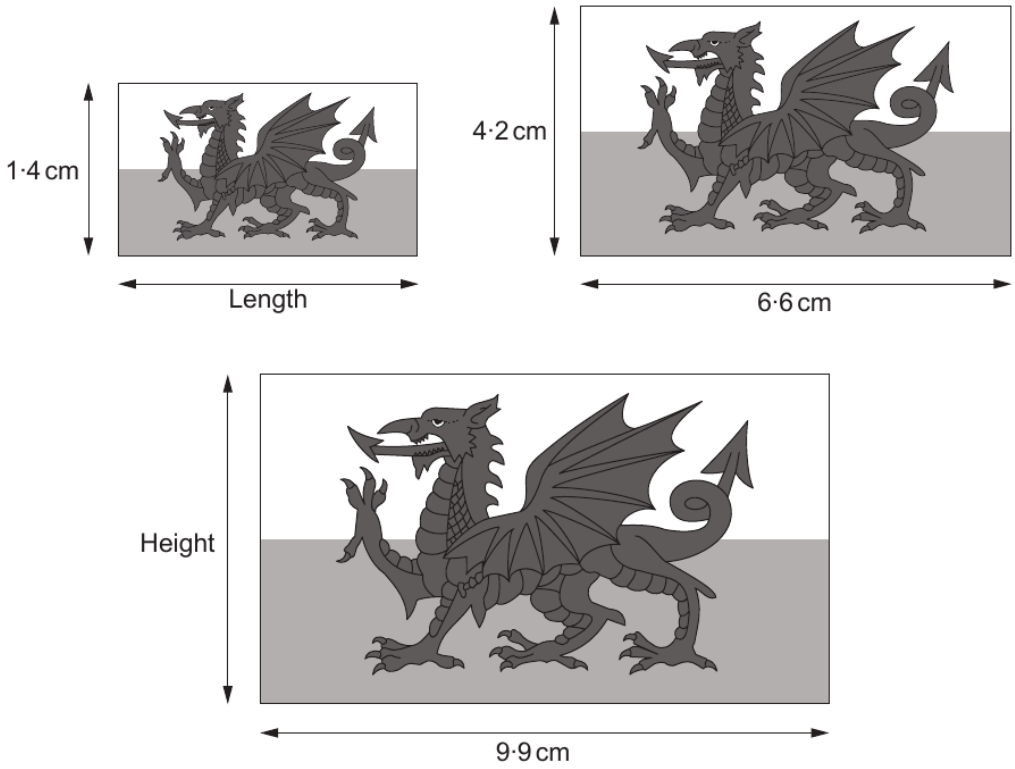
(ii) Estimate the population density of Wales in 2015. [3]

Population density of Wales in 2015 was ..... people / km^2

(b) Cardiff is the largest city in Wales.
In 2018, the population of Cardiff was approximately 360 000.
The population of Cardiff increased by 20% from 1991 to 2018.
Calculate the population of Cardiff in 1991. [3]

Examiner only

(c) DraigYma prints Welsh flags onto stickers.
Three of their mathematically similar Welsh flag stickers are shown below.



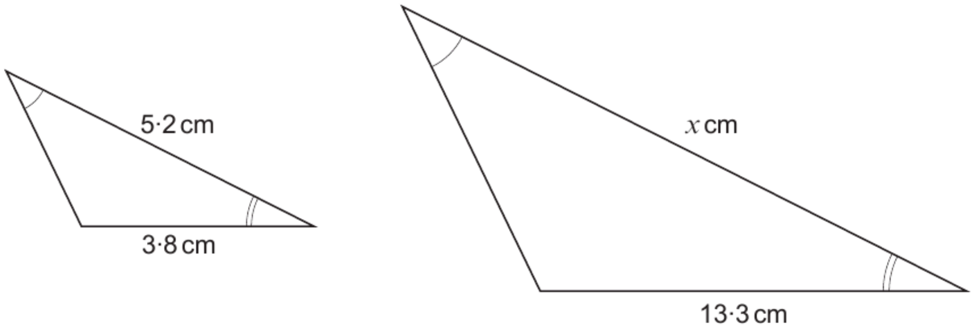
Diagrams not drawn to scale

Calculate the missing length and height in the diagrams. [4]

Length is ..... cm Height is ..... cm

Examiner only

7. (a) The triangles shown below are similar.



Diagrams not drawn to scale

Calculate the value of x. [2]

....

....

....

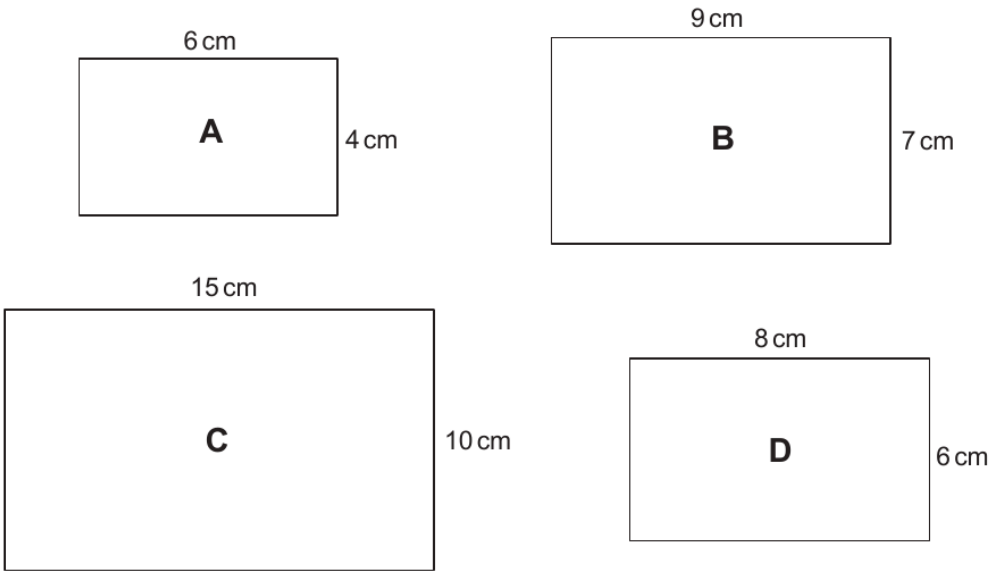
....

....

....

Examiner only

(b) Four rectangles labelled **A**, **B**, **C** and **D** are shown below.



Diagrams not drawn to scale

Which two rectangles are similar?
Give a reason for your choice. [2]

The two rectangles which are similar are rectangles ..... and .....

Reason: .....

.....

.....

.....

Examiner only

18. Two **similar** prisms have volumes of 569 cm^3 and 3821 cm^3, as shown below.
The uniform cross-sectional area of the smaller prism is 29 cm^2.

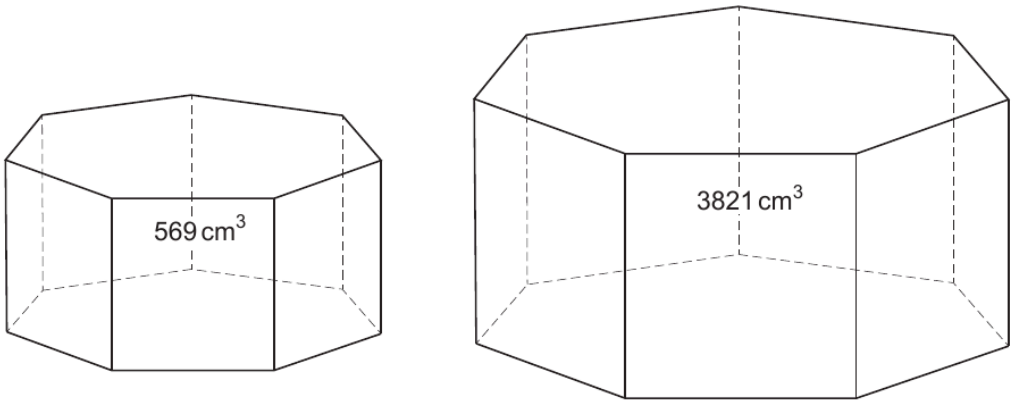


Diagram not drawn to scale

Calculate the uniform cross-sectional area of the larger prism. [4]

Examiner only

3. (a) The base of a flagpole is fixed to horizontal ground.
It is held vertically by a straight rod of length 3·8 m.
The rod is fixed to the ground and to a point 1·5 m from the top of the flagpole.
The flagpole and the rod are shown in the diagram below.

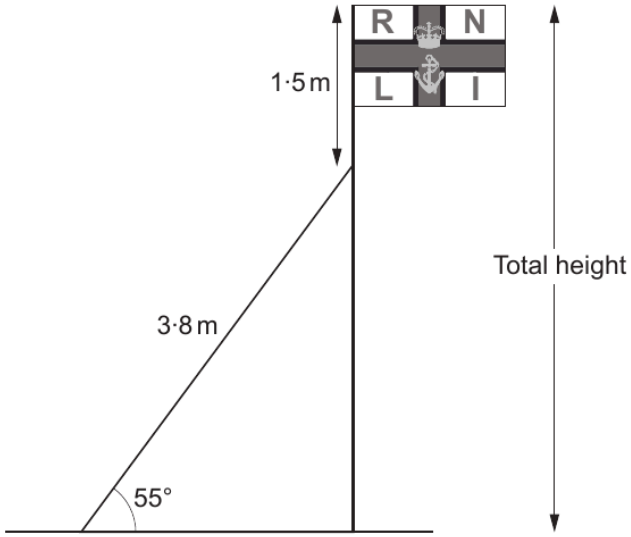


Diagram not drawn to scale

Calculate the **total** height of the flagpole.
Give your answer correct to the nearest centimetre. [4]

Examiner only

(b) Mathematically similar large, medium and small flags are made.

Diagrams not drawn to scale

(i) Calculate the length of the medium flag. [2]

.....

.....

.....

.....

Length of the medium flag is ..... cm

(ii) Calculate the height of the small flag. [2]

.....

.....

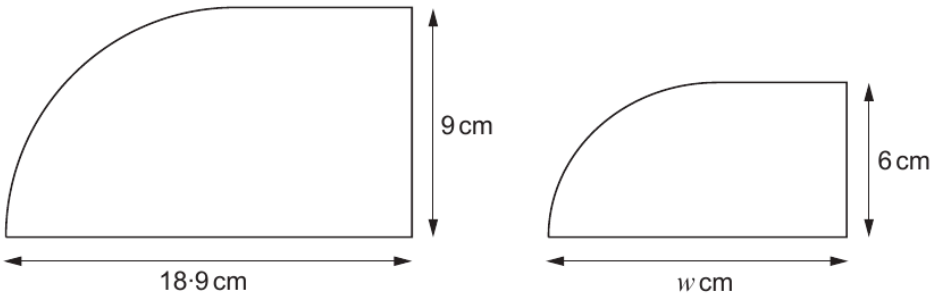
.....

.....

Height of the small flag is ..... cm

Examiner only

5. The two shapes below are mathematically similar.



Diagrams not drawn to scale

Calculate the value of w. [2]