

Exercise walk-through

E4.2

Geometrical constructions

IGCSE Mathematics

You must be able to

- construct triangles and quadrilaterals accurately from given measurements
- recognise and draw nets of prisms and pyramids
- use a scale to convert between drawing and real lengths
- work out a bearing and a back bearing

1

The method

Method — Constructions, scale and bearings

- **Construct a triangle (3 sides):** draw the base, then mark each other side as a compass **arc**; the arcs cross at the third vertex.
- **Scale drawing** : e.g. 1 cm represents 5 m $\rightarrow$ a 6 cm line is 30 m.
- **Bearing** : three figures, clockwise from north. **Back bearing** differs by 180° .

Worked construction and net: For an isosceles triangle of sides 6 cm, 5 cm, 5 cm, draw the 6 cm base; draw 5 cm arcs from each endpoint and join their intersection to both endpoints. The height is $\sqrt{5^2 - 3^2} = 4$ cm. A 9 cm long prism with this cross-section needs two congruent triangles and three rectangles: 6×9 , 5×9 and 5×9 cm. Attach each triangular edge to the matching rectangle edge. Its volume is $(6 \times 4/2) \times 9 = 108 \text{ cm}^3$. A pyramid net instead has one polygon base and a triangle attached to each base edge.

Exercises 2.1·2.3

2.1 A map uses a scale of 1 cm to 4 km. A road is 7 cm long on the map. Find its real length. [2]

2.2 The bearing of Q from P is 060° . Find the bearing of P from Q . [2]

2.3 Write down the three-figure bearing of due west. [1]

Exercises 2.1·2.3

2.1 A map uses a scale of 1 cm to 4 km. A road is 7 cm long on the map. Find its real length. [2]

2.1

- $7 \times 4 = \mathbf{28}$ km

2.2 The bearing of Q from P is 060° . Find the bearing of P from Q . [2]

2.2

- reverse bearing: add 180°
- $060 + 180 = \mathbf{240^\circ}$

2.3 Write down the three-figure bearing of due west. [1]

2.3

- due west is $\mathbf{270^\circ}$

Exercises 3.1·3.3

3.1 A scale drawing uses 1 cm to represent 20 m. A field is 250 m long. Find the length on the drawing. [2]

3.2 The bearing of B from A is 145° . Find the bearing of A from B . [2]

3.3 Describe how to construct a triangle with sides 6 cm, 5 cm and 4 cm. [2]

Exercises 3.1·3.3

3.1 A scale drawing uses 1 cm to represent 20 m. A field is 250 m long. Find the length on the drawing. [2]

3.1

$$\text{length on the drawing} = \frac{\text{real distance}}{\text{scale}} = \frac{250 \text{ m}}{20 \text{ m/cm}} = \mathbf{12.5 \text{ cm}}$$

3.2 The bearing of B from A is 145° . Find the bearing of A from B . [2]

3.2

- $145 + 180 = \mathbf{325^\circ}$

3.3 Describe how to construct a triangle with sides 6 cm, 5 cm and 4 cm. [2]

3.3

- draw the 6 cm base with a ruler
- from one end set compasses to 5 cm and from the other to 4 cm; the arcs cross at the third vertex; join it to both ends

Exercise 3.4 (a)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(a) Construct triangle ABC using a ruler and compasses only. Leave all construction arcs visible. [3]

Exercise 3.4 (a)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(a) Construct triangle ABC using a ruler and compasses only. Leave all construction arcs visible. [3]

(a)

- Draw $AB = 8$ cm accurately.
- Draw equal 5 cm arcs from A and B, meeting at C.
- Join AC and BC and leave the arcs visible.

Exercise 3.4 (b)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(b) Measure angle ABC with a protractor.

[2]

Exercise 3.4 (b)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(b) Measure angle ABC with a protractor.

[2]

(b)

- Place the protractor centre at B and align its baseline with BA.
- Angle ABC is about **37°**; accept 35° to 39° for a drawing.

Exercise 3.4 (c)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(c) Describe the five faces of a net of this prism, giving the dimensions of each. [4]

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3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

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(c)

- Two congruent triangles with sides 8, 5, 5 cm.
- One 8×10 cm rectangle.
- Two 5×10 cm rectangles.
- Match each triangle side to the rectangle of the same width; join into a connected net that folds without overlap.

Exercise 3.4 (d)

3.4 A triangular prism has cross-section ABC with $AB = 8$ cm and $AC = BC = 5$ cm. Its length is 10 cm.

(d) The perpendicular height of triangle ABC is 3 cm. Find the volume of the prism. [3]

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(d)

- Cross-section area uses perpendicular height: $A = bh/2$.
- $A = 8(3)/2 = 12 \text{ cm}^2$.
- $V = Al = 12(10) = \mathbf{120 \text{ cm}^3}$.