IM-066 · Measuring, constructing triangles and nets

IGCSE Mathematics (0580) · HomiLabs: Maths · Ep 066

You need a ruler, a pair of compasses, a protractor and a sharp pencil.

Set A · Fluency

1. (C) (a) Write 5.3 cm in millimetres. (b) Write 47 mm in centimetres.

2. (C) The arm of an obtuse angle crosses a protractor at the marks 40 and 140. Write down the size of the angle.

3. (C) (a) An angle measures 48°. Work out the reflex angle on the other side of its arms. (b) To draw a reflex angle of 230°, what angle do you draw first?

4. (C) Using a ruler and compasses only, construct triangle XYZ with XY = 9 cm, XZ = 6 cm and YZ = 5 cm. Leave in your construction arcs. Measure angle YXZ.

5. (C) Explain why you cannot construct a triangle with sides 4 cm, 5 cm and 10 cm.

6. (C) Each shape is made of six squares. Say whether it is a net of a cube.
(a) A row of four squares, with one square above the first square of the row and one square below the last square.
(b) A row of four squares, with one square above the second square and one square above the third square.
(c) A row of five squares, with one square above the middle square.

7. (C) A cuboid measures 6 cm by 5 cm by 2 cm. Sketch its net, then work out its surface area and its volume.

8. (C) The net of a square-based pyramid is a square of side 8 cm with four identical triangles, each with base 8 cm and height 7 cm. Work out the surface area of the pyramid.

Set B · Exam style

1. (Paper 1/2 · no calculator) (C) (a) Using a ruler and compasses only, construct a rhombus ABCD with sides 6 cm and diagonal AC = 10 cm. Leave in your construction arcs. [3]
(b) Measure the length of the diagonal BD. [1]

2. (Paper 1/2 · no calculator) (C) The net of a prism is made of two right-angled triangles, with the two shorter sides 6 cm and 8 cm and the longest side 10 cm, and three rectangles 6 cm by 12 cm, 8 cm by 12 cm and 10 cm by 12 cm.
(a) Work out the surface area of the prism. [3]
(b) Work out the volume of the prism. [2]

3. (Paper 1/2 · no calculator) (C) An open box (a cuboid with no lid) is 10 cm long, 8 cm wide and 5 cm high. It is made from one piece of card with no overlaps.
(a) How many rectangles does its net have? [1]
(b) Work out the area of card used. [3]

4. (Paper 3/4 · calculator) (C) (a) Using a ruler and compasses only, construct triangle PQR with PQ = 7.5 cm, PR = 6.2 cm and QR = 4.8 cm. [2]

(b) Measure the largest angle of the triangle. [1]

(c) Explain why no triangle has sides 7.5 cm, 3.1 cm and 4.2 cm. [1]

Challenge

(E) A cube has a volume of 343 cm^3.

(a) Work out the total area of its net.

(b) Every edge of the cube is doubled. By what number is the area of the net multiplied? Explain your answer. (Squares and cubes: Ep 6.)

Answers

Set A

1. (a) 53 mm (b) 4.7 cm

2. 140° (obtuse, so not 40°)

3. (a) 360° − 48° = 312° (b) 360° − 230° = 130°, then mark the outside angle.

4. Accurate triangle with both arcs shown; angle YXZ ≈ 32° (accept 30° to 34°).

5. 4 + 5 = 9, which is less than 10, so the arcs never meet.

6. (a) Yes (b) No: the two squares on top and squares 2 and 3 of the row form a 2 by 2 block. (c) No: five squares in a row.

7. Surface area $2(6 \times 5) + 2(6 \times 2) + 2(5 \times 2) = 60 + 24 + 20 = 104$ cm²; volume $6 \times 5 \times 2 = 60$ cm³.

8. $8 \times 8 + 4 \times \frac{1}{2} \times 8 \times 7 = 64 + 112 = 176$ cm².

Set B

1. (a) AC = 10 cm drawn B1; arcs of 6 cm from A and from C, above and below AC M1; rhombus joined with arcs showing A1.
   (b) BD = 6.6 cm (accept 6.4 cm to 6.8 cm) B1. (Exact value $2\sqrt{11} = 6.633\ldots$ cm.)

2. (a) Triangles $2 \times \frac{1}{2} \times 6 \times 8 = 48$ M1; rectangles $72 + 96 + 120 = 288$ M1; surface area 336 cm² A1.
   (b) Cross-section 24 cm², V = 24 × 12 M1; V = 288 cm³ A1.

3. (a) 5 B1.
   (b) Base $10 \times 8 = 80$; two sides $2 \times 10 \times 5 = 100$; two ends $2 \times 8 \times 5 = 80$ M1 M1 (any two correct pairs); total 260 cm² A1.

4. (a) Accurate triangle with both arcs B2 (B1 for one correct arc).
   (b) Angle QRP (opposite PQ) ≈ 85° (accept 83° to 87°) B1.
   (c) 3.1 + 4.2 = 7.3, which is less than 7.5, so the two shorter sides cannot meet B1.

Challenge

(a) Edge = $\sqrt[3]{343} = 7$ cm; one face 49 cm²; net $6 \times 49 = 294$ cm².
(b) New edge 14 cm: net $6 \times 196 = 1176$ cm² $= 4 \times 294$. Each face has its length and its width doubled, so its area is multiplied by $2 \times 2 = 4$ (more in Ep 69).