



IG.M8 Similarity: Length, Area and Volume Scale Factors

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer in full sentences for any question that asks to 'Show that' or to 'Explain'. Spend about 60 minutes on the paper.

- 1** Two squares on a sheet of paper represent similar shapes. The side of the smaller square is 6 cm and the side of the larger square is 9 cm. Find the linear scale factor from the smaller square to the larger square.

(Total for Question 1 is 1 mark)

- 2** Two similar rectangles A and B have corresponding lengths 5 cm (in A) and 15 cm (in B). Calculate the linear scale factor from rectangle A to rectangle B.

(Total for Question 2 is 1 mark)

- 3** Two equilateral triangles are similar. The side of the small triangle is 4 cm and the side of the large triangle is 10 cm. Calculate the area scale factor from the small triangle to the large triangle.

(Total for Question 3 is 2 marks)

- 4** Two similar regular pentagons have corresponding areas 49 cm^2 (small) and $A \text{ cm}^2$ (large). The linear scale factor from small to large is 3. Calculate A, the area of the larger pentagon.

(Total for Question 4 is 2 marks)

- 5** A cone and a similar cone have heights 8 cm and 20 cm respectively. Find the volume scale factor from the smaller cone to the larger cone.

(Total for Question 5 is 2 marks)

- 6** Two similar cylinders have radii 4 cm and 6 cm. Their heights are in the same ratio as the radii. The volume of the smaller cylinder is 201.06 cm^3 (to two decimal places). Calculate the volume of the larger cylinder. Give your answer to 2 decimal places.

(Total for Question 6 is 3 marks)

- 7** Diagram: Two similar right-angled triangles P and Q. Triangle P has legs 3 cm and 4 cm; triangle Q has a short leg corresponding to the 3 cm leg equal to 9 cm. Show that the triangles are similar, and find the length of the other leg in triangle Q.

(Total for Question 7 is 3 marks)

- 8** Two similar rectangular swimming pools are modelled. The smaller pool is 10 m by 4 m and holds 80 000 litres. The larger pool is similar with short side 6 m. Calculate the capacity of the larger pool in litres. Give your answer to the nearest litre.

(Total for Question 8 is 4 marks)

- 9** A metal model of a statue is made similar to the original statue. The linear scale factor from model to original is 8. The model has mass 0.125 kg. Find the mass of the original statue, assuming mass scales in proportion to volume.

(Total for Question 9 is 3 marks)

- 10** Two similar cones have volumes in the ratio 1:27. The smaller cone has height 5 cm. Find the height of the larger cone.

(Total for Question 10 is 3 marks)

- 11** A triangular lamina is similar to another triangular lamina. The larger has area 162 cm^2 and the smaller has area 72 cm^2 . Calculate the linear scale factor from the smaller lamina to the larger lamina. Give your answer in simplest fractional form.

(Total for Question 11 is 3 marks)

- 12** A model car is made at a linear scale of 1:18 of the real car. The real car has a fuel tank capacity of 54 litres. Estimate the capacity of the model car in millilitres. Give your answer to the nearest millilitre.

(Total for Question 12 is 2 marks)

- 13** Two similar solid wooden beams are used to make benches. The small beam has cross-sectional area 36 cm^2 and length 1.2 m ; the large beam is similar with cross-sectional area 81 cm^2 . Calculate the length of the larger beam, stating the steps in your working.

(Total for Question 13 is 4 marks)

- 14** A museum displays a pair of similar bronze models of a famous column. The smaller model has height 40 cm and volume 0.064 m^3 . The larger model has height 1.6 m . Use similarity to calculate the volume of the larger model in cubic metres. Show your method and give the answer to three significant figures.

(Total for Question 14 is 4 marks)

Mark scheme · IG.M8 Similarity: Length, Area and Volume Scale Factors

Question 1

- **B1** linear scale factor = $9/6 = 3/2$ or 1.5 cao
- **Answer: scale factor = $3/2$ or 1.5**

Question 2

- **B1** scale factor = $15/5 = 3$ cao
- **Answer: 3**

Question 3

- **M1** finds linear scale factor = $10/4 = 5/2$
- **A1** area scale factor = $(5/2)^2 = 25/4$ cao
- **Answer: area scale factor = $25/4$**

Question 4

- **M1** uses area scale factor = $3^2 = 9$
- **A1** $A = 49 * 9 = 441 \text{ cm}^2$ cao
- **Answer: 441 cm^2**

Question 5

- **M1** finds linear scale factor = $20/8 = 5/2$
- **A1** volume scale factor = $(5/2)^3 = 125/8$ cao
- **Answer: volume scale factor = $125/8$**

Question 6

- **M1** finds linear scale factor = $6/4 = 3/2$
- **M1** uses volume scale factor = $(3/2)^3 = 27/8$ and multiplies 201.06 by 27/8
- **A1** volume = $201.06 * 27/8 = 678.5775...$ so 678.58 cm^3 to 2dp cao
- **Answer: 678.58 cm^3**

Question 7

- **M1** identifies ratio of corresponding sides = $9/3 = 3$ and states corresponding sides are in same ratio, showing similarity
- **M1** sets up proportion for the other leg: other leg = $4 * 3$
- **A1** other leg = 12 cm cao
- **Answer: 12 cm**

Question 8

- **M1** finds linear scale factor = $6/4 = 3/2$ (short side ratio)
- **M1** uses volume/capacity scale factor = $(3/2)^3 = 27/8$
- **M1** multiplies capacity: $80\,000 * 27/8$
- **A1** capacity = $80\,000 * 27/8 = 270\,000$ litres cao (to nearest litre)
- **Answer: 270000 litres**

Question 9

- **M1** uses volume/mass scale factor = $8^3 = 512$
- **M1** multiplies mass: $0.125 * 512$
- **A1** mass = 64 kg cao
- **Answer: 64 kg**

Question 10

- **M1** uses volume ratio = (linear ratio)³, so linear ratio = cube root of 27/1 = 3
- **M1** sets up height scale: larger height = 5 * 3
- **A1** height = 15 cm cao
- **Answer: 15 cm**

Question 11

- **M1** uses area ratio = 162/72 = 9/4 after simplifying
- **M1** takes square root to find linear ratio = $\sqrt{9/4} = 3/2$
- **A1** linear scale factor = 3/2 cao
- **Answer: 3/2**

Question 12

- **M1** uses capacity scale factor = $(1/18)^3 = 1/5832$ and converts 54 litres to ml (54 000 ml) then multiplies
- **A1** capacity approx = 54 000 / 5832 = 9.259... so 9 ml to nearest ml cao
- **Answer: 9 ml**

Question 13

- **M1** finds area ratio = 81/36 = 9/4 and uses linear ratio = $\sqrt{9/4} = 3/2$
- **M1** states that lengths scale by 3/2
- **M1** multiplies length: 1.2 * 3/2
- **A1** length = 1.8 m cao
- **Answer: 1.8 m**

Question 14

- **M1** finds linear scale factor from small to large = 1.6 / 0.40 = 4
- **M1** uses volume scale factor = 4³ = 64
- **M1** multiplies volume: 0.064 * 64
- **A1** volume = 4.10 m³ to 3 s.f. cao
- **Answer: 4.10 m³ (to 3 s.f.)**