HIGHER

6.8 Similar Shapes (Area and Volume): 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Two similar vases have volumes 32 cm³ and 108 cm³. The first vase is 8 cm high. Work out the height of the second vase.

(Total for Question 1 is 3 marks)

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2 Two toy models are mathematically similar. Corresponding lengths of the first and second are in the ratio 1:3. The area of the first is 4 cm². Work out the area of the second.

(Total for Question 2 is 3 marks)

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3 Two similar garden lawns have areas 196 cm² and 16 cm². A length on the first is 42 cm. Work out the corresponding length on the second.

(Total for Question 3 is 3 marks)

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4 Two mathematically similar solids have surface areas 144 cm^2 and 256 cm^2. The second solid has volume 256 cm^3. Work out the volume of the first solid.

(Total for Question 4 is 4 marks)

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5 A model statue is 20 cm tall and needs 24 ml of paint for its surface. A similar statue is 30 cm tall. How much paint is needed for the taller statue?

(Total for Question 5 is 3 marks)

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6 Two similar vases have volumes 48 cm^3 and 162 cm^3. The first vase is 12 cm high. Work out the height of the second vase.

(Total for Question 6 is 3 marks)

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7 Two similar tins have heights 2 cm and 5 cm. The first has volume 64 cm^3. Work out the volume of the second.

(Total for Question 7 is 3 marks)

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8 Two similar vases have volumes 7 cm^3 and 56 cm^3. The first vase is 6 cm high. Work out the height of the second vase.

(Total for Question 8 is 3 marks)

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9 Two similar statues have heights 2 cm and 5 cm. The first has volume 16 cm^3. Work out the volume of the second.

(Total for Question 9 is 3 marks)

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10 Two similar vases have volumes 16 cm^3 and 54 cm^3. The first vase is 10 cm high. Work out the height of the second vase.

(Total for Question 10 is 3 marks)

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11 Two similar statues have heights 3 cm and 4 cm. The first has volume 162 cm^3. Work out the volume of the second.

(Total for Question 11 is 3 marks)

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12 Two similar tins have heights 2 cm and 5 cm. The first has volume 56 cm^3. Work out the volume of the second.

(Total for Question 12 is 3 marks)

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13 Two similar bottles have heights 2 cm and 3 cm. The first has volume 48 ml. Work out the volume of the second.

(Total for Question 13 is 3 marks)

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14 Shape C and shape D are mathematically similar. The area of shape C is 18 cm^2 and the area of shape D is 50 cm^2. A side of shape C is 6 cm.

(a) Work out the linear scale factor from shape C to shape D. **(2)**

.....

(b) Work out the length of the corresponding side on shape D. **(2)**

.....

(Total for Question 14 is 4 marks)

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15 Solid E and solid F are mathematically similar. The volume of solid E is 64 cm^3 and the volume of solid F is 216 cm^3. The height of solid E is 8 cm.

(a) Work out the linear scale factor from solid E to solid F. **(2)**

.....

(b) Work out the height of solid F. **(2)**

.....

(Total for Question 15 is 4 marks)

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16 A scale model of a bus is built using a linear scale factor of 1/20 from the real bus to the model. Work out the volume scale factor from the real bus to the model.

(Total for Question 16 is 2 marks)

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17 Amara is designing two mathematically similar circular garden ponds. Pond A has a diameter of 2 m and a surface area of 6 m^2. Pond B has a diameter of 5 m. Work out the surface area of pond B.

(Total for Question 17 is 3 marks)

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18 Jar A and jar B are mathematically similar storage jars. Jar A has a height of 12 cm and a volume of 480 cm^3. Jar B has a height of 18 cm. Work out the volume of jar B.

(Total for Question 18 is 3 marks)

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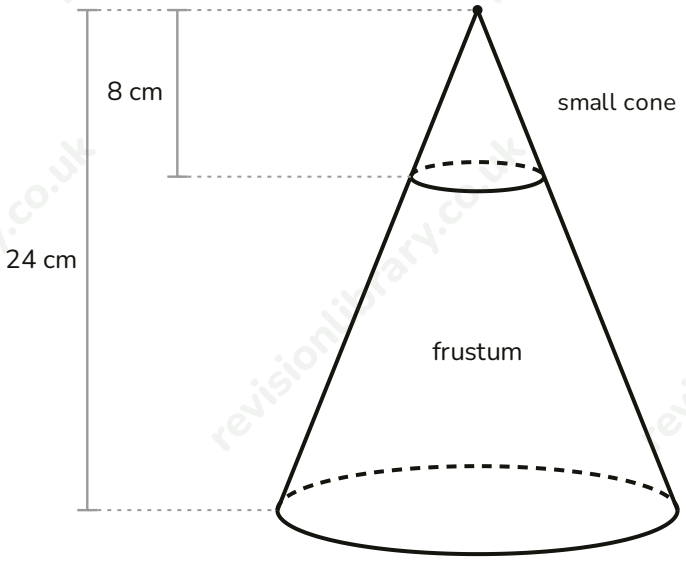
19 Vase P and vase Q are mathematically similar. The volume of vase P is 250 cm^3 and the volume of vase Q is 500 cm^3. The height of vase P is 18 cm. Work out the height of vase Q to 1 decimal place.

(Total for Question 19 is 4 marks)

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20 A cone has height 24 cm. It is cut by a plane parallel to the base, 8 cm from the vertex, forming a smaller cone (mathematically similar to the original cone) and a frustum. The whole cone has volume 900 cm^3.

Diagram NOT accurately drawn



(a) Work out the ratio of the volume of the small cone to the volume of the frustum. Give your answer in the form 1 : n. **(3)**

.....

(b) Work out the volume of the frustum. **(2)**

.....

(Total for Question 20 is 5 marks)

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21 Two mathematically similar solid glass ornaments are made from the same type of glass, so mass is proportional to volume. Ornament A has volume 45 cm^3 and mass 117 g. Ornament B has mass 351 g. The height of ornament A is 6 cm.

(a) Work out the volume of ornament B. **(2)**

.....

(b) Work out the height of ornament B, giving your answer correct to 3 significant figures. **(3)**

.....

(Total for Question 21 is 5 marks)

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22 Owen collects rainwater in two mathematically similar water butts. The curved surface area of the small water butt is 150 cm^2 and the curved surface area of the large water butt is 486 cm^2. The volume of the small water butt is 250 cm^3. Work out the volume of the large water butt.

(Total for Question 22 is 4 marks)

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23 Two mathematically similar trophies are made from the same solid metal, so mass is proportional to volume. The height of the smaller trophy is 15 cm and its mass is 2.4 kg. The height of the larger trophy is 22.5 cm.

(a) Work out the mass of the larger trophy. **(3)**

(b) A gold-effect coating is applied to the surface of each trophy. The surface area of the smaller trophy is 340 cm². Explain, with a calculation, whether the amount of coating needed for the larger trophy is more than double the amount needed for the smaller trophy. **(2)**

(Total for Question 23 is 5 marks)

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24 Rhys runs a pet shop with two mathematically similar aquarium tanks, tank A and tank B. Tank A holds 64 litres and tank B holds 216 litres. Tank A has a height of 40 cm and a rectangular base of area 800 cm².

(a) Find the linear scale factor from tank A to tank B. **(2)**

.....

(b) Work out the height of tank B. **(1)**

.....

(c) Work out the area of the base of tank B. **(2)**

.....

(Total for Question 24 is 5 marks)

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25 Block C and block D are mathematically similar solid blocks. A dimension of block C is (x + 3) cm and the corresponding dimension of block D is (4x - 6) cm. The volume scale factor from block C to block D is 8.

(a) Work out the value of x. **(3)**

.....

(b) The volume of block C is 54 cm³. Work out the volume of block D. **(2)**

.....

(Total for Question 25 is 5 marks)

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Mark scheme · 6.8 Similar Shapes (Area and Volume): 2-hour Pack

Question 1

cube root of (108/32) = 3/2	**M1**
8 x 3/2	**M1**
12 cm cao	**A1**

Answer: 12 cm

Question 2

area scale factor $(3)^2$ oe	**M1**
4 x 9 oe	**M1**
36 cm² cao	**A1**

Answer: 36 cm^2

Question 3

length scale factor $\sqrt{16/196}$ = 2/7	**M1**
42 x 2/7 oe	**M1**
12 cm cao	**A1**

Answer: 12 cm

Question 4

length scale factor $\sqrt{144/256}$ = 3/4	**M1**
3/4 oe	**A1**
volume scale factor $(3/4)^3$	**M1**
108 cm³ cao	**A1**

Answer: 108 cm^3

Question 5

area scale factor $(30/20)^2$ oe	**M1**
24 x 9/4	**M1**
54 ml cao	**A1**

Answer: 54 ml

Question 6

cube root of (162/48) = 3/2	**M1**
12 x 3/2	**M1**
18 cm cao	**A1**

Answer: 18 cm

Question 7

volume scale factor $(5/2)^3$ oe	**M1**
64 x 125/8 oe	**M1**
1000 cm³ cao	**A1**

Answer: 1000 cm^3

Question 8

cube root of (56/7) = 2	**M1**
6 x 2	**M1**
12 cm cao	**A1**

Answer: 12 cm

Question 9

volume scale factor $(5/2)^3$ oe	**M1**
16 x 125/8 oe	**M1**
250 cm³ cao	**A1**

Answer: 250 cm^3

Question 10

cube root of (54/16) = 3/2	**M1**
10 x 3/2	**M1**
15 cm cao	**A1**

Answer: 15 cm

Question 11

volume scale factor $(4/3)^3$ oe	**M1**
162 x 64/27 oe	**M1**
384 cm³ cao	**A1**

Answer: 384 cm^3

Question 12

volume scale factor $(5/2)^3$ oe	**M1**
56 x 125/8 oe	**M1**
875 cm³ cao	**A1**

Answer: 875 cm^3

Question 13

volume scale factor $(3/2)^3$ oe	**M1**
48 x 27/8 oe	**M1**
162 ml cao	**A1**

Answer: 162 ml

Question 14

(a) area ratio = 50/18 (=25/9) oe	**M1**
(a) 5/3 oe (awrt 1.67)	**A1**

(a) Answer: 5/3 (awrt 1.67)

(b) 6 x their (a)	**M1**
(b) 10 cao	**A1**

(b) Answer: 10 cm

Question 15

(a) volume ratio = 216/64 (=27/8) oe	**M1**
(a) 3/2 oe (=1.5)	**A1**

(a) Answer: 1.5 (3/2)

(b) 8 x their (a)	**M1**
(b) 12 cao	**A1**

(b) Answer: 12 cm

Question 16

$(1/20)^3$ set up	**M1**
1/8000 oe (=0.000125)	**A1**

Answer: 1/8000 (0.000125)

Question 17

linear scale factor = 5/2 (=2.5)	**M1**
area scale factor = 2.5^2 (=6.25)	**M1**
37.5 cao, units m^2	**A1**

Answer: 37.5 m^2

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Question 18

linear scale factor = 18/12 (=1.5) **M1**

volume scale factor = 1.5^3 (=3.375) **dM1**

1620 cao, units cm^3 **A1**

Answer: 1620 cm^3

Question 19

volume ratio = 500/250 (=2) **M1**

linear scale factor = $\sqrt[3]{2}$ **M1**

18 x $\sqrt[3]{2}$ **M1**

22.7 (cm) awrt **A1**

Answer: 22.7 cm (awrt)

Question 20

(a) linear scale factor (small cone : whole cone) = 8/24 (=1/3) **M1**

(a) volume ratio small:whole = $(1/3)^3$ = 1:27, so frustum:whole = 26:27 **M1**

(a) 1 : 26 cao **A1**

(a) Answer: 1 : 26

(b) volume of small cone = 900 x 1/27 (=33.33..); frustum = 900 - their small cone volume **M1**

(b) 866.67 cm^3 awrt (exact 866 2/3), cao **A1**

(b) Answer: 866.67 cm^3 (awrt, exact 866 2/3 cm^3)

Question 21

(a) mass ratio = 351/117 (=3) **M1**

(a) 135 (cm^3) cao **A1**

(a) Answer: 135 cm^3

(b) linear scale factor = $\sqrt[3]{3}$ (=1.442...) **M1**

(b) 6 x $\sqrt[3]{3}$ **M1**

(b) 8.65 (cm) awrt **A1**

(b) Answer: 8.65 cm (awrt)

Question 22

area ratio = 486/150 (=3.24) oe **M1**

linear scale factor = $\sqrt{3.24}$ (=1.8) **dM1**

volume scale factor = 1.8^3 (=5.832); 250 x 5.832 **dM1**

1458 cao, units cm^3 **A1**

Answer: 1458 cm^3

Question 23

(a) linear scale factor = 22.5/15 (=1.5) **M1**

(a) mass (volume) scale factor = 1.5^3 (=3.375) **dM1**

(a) 8.1 cao, units kg **A1**

(a) Answer: 8.1 kg

(b) area scale factor = 1.5^2 (=2.25); coating area for larger trophy = 340 x 2.25 (=765) **M1**

(b) correct conclusion with reason, e.g. yes, since 765 cm^2 is more than double 340 cm^2 (680 cm^2), oe **A1**

(b) Answer: Yes: the larger trophy needs 765 cm^2 of coating, which is more than double the smaller trophy's 340 cm^2 (double is 680 cm^2).

Question 24

(a) volume ratio = 216/64 (=3.375) oe **M1**

(a) 1.5 cao **A1**

(a) Answer: 1.5

(b) 60 cao, units cm (ft 40 x their (a)) **B1**

(b) Answer: 60 cm

(c) area scale factor = 1.5^2 (=2.25) **M1**

(c) 1800 cao, units cm^2 **A1**

(c) Answer: 1800 cm^2

Question 25

(a) linear scale factor = $\sqrt[3]{8}$ (=2) **M1**

(a) 4x - 6 = 2(x + 3) oe equation formed **dM1**

(a) x = 6 cao **A1**

(a) Answer: x = 6

(b) 54 x 8 **M1**

(b) 432 cao, units cm^3 **A1**

(b) Answer: 432 cm^3

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