KS3.M-G12 Volume and Surface Area of Prisms

AQA KS3.M-G12 · Calculators not allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Calculate the volume of a cuboid with length 5 cm, width 3 cm and height 4 cm. Give your answer in cubic centimetres.

(1)

2 Find the total surface area of a cuboid with dimensions 2 m by 3 m by 4 m. Give your answer in square metres.

(2)

3 Convert 3500 cm3 to litres. Give your answer in litres.

(1)

4 A triangular prism has a triangular end with base 6 cm and height 4 cm. The prism length is 10 cm. Calculate the volume of the prism in cubic centimetres.

(2)

5 A rectangular pool is 8 m long, 2 m wide and 1.5 m deep. How many litres of water does it hold when full? (1 m3 = 1000 L)

(1)

6 Show the net of a triangular prism has three rectangular faces and two triangular faces. If each triangular end has area 9 cm2 and the rectangles have areas 18 cm2, 30 cm2 and 24 cm2, calculate the total surface area of the prism.

(2)

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7 A cuboid box measures 25 cm by 20 cm by 10 cm. A label is stuck on one of the 25 cm by 20 cm faces. Calculate the area of that face and then the fraction of the total surface area that the label covers. Give the fraction in its simplest form.

(3)

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8 A prism has a regular hexagon cross section of area 20 cm2 and length 12 cm. Calculate its volume. Then convert your answer to litres.

(3)

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9 Calculate the volume of a cylinder approximated as a prism by using area of circular cross section. A cylinder has radius 7 cm and height 10 cm. Use $\pi = 3.14$. Give your answer to 1 decimal place in cm3.

(2)

10 A triangular prism has triangular end with sides 7 cm, 24 cm and 25 cm. The triangular area is needed to find the volume. First show that the triangle is right-angled, then find the volume of the prism with length 15 cm. Give your answer in cm3.

(3)

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11 A metal beam is a triangular prism. The triangle end is isosceles with base 8 cm and equal sides 5 cm. The beam is 40 cm long. Calculate the volume of the beam. (Hint: you may need to find the triangle height.)

(3)

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12 A rectangular prism has internal dimensions 120 cm by 80 cm by 60 cm. A decorator will line the inside and needs to buy lining that is sold by the square metre. Calculate how many square metres of lining the decorator needs, ignoring any waste. Give your answer to 1 decimal place.

(2)

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13 Sofia pours water into a triangular prism shaped tank. The triangular cross section has base 6 m and height 2 m. The tank length is 5 m. If Sofia pours 50 litres into the tank, by how many centimetres does the water level rise? (1 m3 = 1000 L)

(3)

14 A manufacturer makes open-top rectangular boxes by cutting squares from the corners of a 30 cm by 20 cm card and folding up the sides. The squares cut out have side x cm. Write an expression for the volume of the box in terms of x and then find the volume when x = 3 cm.

(2)

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15 A prism has a triangular cross section with base 10 cm and area 40 cm2. Calculate the height of the triangle, then the volume of the prism if its length is 18 cm.

(3)

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16 A solid is made by joining two identical rectangular prisms, each 6 cm by 4 cm by 3 cm, along a 6 cm by 4 cm face. Calculate the volume and the total external surface area of the resulting solid.

(2)

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17 Stretch question. A water trough is a right triangular prism with cross section an isosceles right triangle (two equal sides). The equal sides are 1.2 m long and form the legs. The trough is 3.5 m long. Calculate the capacity in litres. Give your answer to the nearest litre. (1 m3 = 1000 L)

(4)

18 Stretch question. A school needs to fill a model rectangular tank that measures 0.9 m by 0.6 m by 0.4 m. Water is delivered in drums of 25 L. How many full drums are needed to fill the tank? Show your working and give the final number of drums.

(4)

Mark scheme · KS3.M-G12 Volume and Surface Area of Prisms

Question 1

- **B1** 60 cm3 cao
- Answer: **60 cm3**

Question 2

- **M1** method: calculate areas of pairs of faces, e.g. 2(2x3 + 2x4 + 3x4) or listing areas
- **A1** 52 m2 cao
- Answer: **52 m2**

Question 3

- **B1** 3.5 L cao
- Answer: **3.5 L**

Question 4

- **M1** area of triangle = 1/2 x base x height = 1/2 x 6 x 4 = 12 cm2 or equivalent
- **A1** 120 cm3 cao
- Answer: **120 cm3**

Question 5

- **B1** 24000 L cao
- Answer: **24000 L**

Question 6

- **M1** method: add areas of two triangles and three rectangles
- **A1** 90 cm2 cao
- Answer: **90 cm2**

Question 7

- **M1** area of face = 25 x 20 = 500 cm2
- **M1** total surface area = 2(25x20 + 25x10 + 20x10) = 2(500 + 250 + 200) = 2 x 950 = 1900 cm2
- **A1** fraction 500/1900 = 5/19 cao
- Answer: **5/19**

Question 8

- **M1** volume method: area cross section x length = 20 x 12 = 240 cm3
- **M1** convert cm3 to litres: 240 cm3 = 0.24 L or show 240/1000
- **A1** 240 cm3 and 0.24 L cao
- Answer: **240 cm3; 0.24 L**

Question 9

- **M1** area = $\pi r^2 = 3.14 \times 7^2 = 3.14 \times 49 = 153.86$; volume = area x height = 153.86 x 10
- **A1** 1538.6 cm3 cao
- Answer: **1538.6 cm3**

Question 10

- **M1** show Pythagoras: $7^2 + 24^2 = 49 + 576 = 625 = 25^2$
- **M1** area of triangle = 1/2 x 7 x 24 = 84 cm2
- **A1** volume = 84 x 15 = 1260 cm3 cao
- Answer: **1260 cm3**

Question 11

- **M1** find triangle height using Pythagoras: half base = 4, height = $\sqrt{5^2 - 4^2} = \sqrt{25 - 16} = 3$ cm
- **M1** area triangle = 1/2 x base x height = 1/2 x 8 x 3 = 12 cm2
- **A1** volume = 12 x 40 = 480 cm3 cao
- Answer: **480 cm3**

Question 12

- **M1** total surface area in cm2 = 2(120x80 + 120x60 + 80x60) = 2(9600 + 7200 + 4800) = 2 x 21600 = 43200 cm2
- **A1** convert to m2: 43200 cm2 = 4.32 m2 so 4.3 m2 to 1 d.p. cao
- Answer: **4.3 m2**

Question 13

- **M1** convert 50 L to m3: 50/1000 = 0.05 m3 and find area triangle = 1/2 x 6 x 2 = 6 m2
- **M1** volume = area x height_along_length = 6 x rise x 5, so 6 x 5 x rise = 30 x rise, set 30 x rise = 0.05
- **A1** rise = 0.05/30 = 0.001666... m = 0.166666... cm so 0.17 cm to 2 d.p. cao
- Answer: **0.17 cm**

Question 14

- **M1** expression for dimensions after cutting: (30 - 2x)(20 - 2x)(x) so volume = x(30 - 2x)(20 - 2x)
- **A1** when x=3: volume = 3 x 24 x 14 = 1008 cm3 cao
- Answer: **x(30 - 2x)(20 - 2x); 1008 cm3**

Question 15

- **M1** use area triangle = 1/2 x base x height so height = 2 x area / base = 2 x 40 / 10 = 8 cm
- **M1** volume = area x length = 40 x 18 = 720 cm3
- **A1** height 8 cm and volume 720 cm3 cao
- Answer: **height 8 cm; volume 720 cm3**

Question 16

- **M1** volume = 2 x (6x4x3) = 2 x 72 = 144 cm3
- **A1** surface area: two prisms joined removes two 6x4 faces: total SA = 2 x SA(prism) - 2 x 24 = 2 x (2(6x4 + 6x3 + 4x3)) - 48 = compute gives 168 cm2 cao
- Answer: **144 cm3; 168 cm2**

Question 17

- **M1** area triangle = 1/2 x leg x leg = 1/2 x 1.2 x 1.2 = 0.72 m2
- **M1** volume = area x length = 0.72 x 3.5 = 2.52 m3
- **M1** convert to litres: 2.52 x 1000 = 2520 L
- **A1** capacity = 2520 L to nearest litre cao
- Answer: **2520 L**

Question 18

- **M1** volume tank = 0.9 x 0.6 x 0.4 = 0.216 m3
- **M1** convert to litres: 0.216 x 1000 = 216 L
- **M1** divide by 25 L per drum: 216/25 = 8.64 so need 9 drums
- **A1** 9 drums cao
- Answer: **9**