KS3.M-G20 3D Shapes, Plans and Elevations

AQA KS3.M-G20 · Calculators not allowed · about 50 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Write down the name of a solid that has 6 square faces, 12 equal edges and 8 vertices.

(1)

2 State how many faces, edges and vertices a rectangular prism (cuboid) has.

(2)

3 A cylinder has height 10 cm and base radius 3 cm. State how many curved faces, flat faces and edges it has.

(2)

4 A net is shown for a triangular prism made from two equilateral triangular faces and three rectangular faces. The triangular face has side 6 cm and each rectangle has height 8 cm. Calculate the total surface area of the prism.

(3)

5 Draw the front elevation and a top plan for a cube with a small square hole cut through the centre from the top to the bottom. The cube has side 6 cm. The hole is a square of side 2 cm centred on the cube. Describe the shapes seen in the front elevation and top plan.

(3)

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6 A cone and a cylinder have the same base radius 4 cm. The cylinder has height 9 cm. State whether the cone could have the same volume as the cylinder. Give a brief reason.

(2)

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7 Identify the net of a square-based pyramid from these descriptions and give a reason: (i) four triangles attached to one square, (ii) one square and four rectangles attached, (iii) one square and four isosceles triangles attached.

(2)

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8 A solid is made by attaching a hemisphere of radius 5 cm to the flat face of a cylinder of radius 5 cm and height 12 cm. Write down the shapes you would see in the top plan and the front elevation.

(3)

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9 A cube has side length 4 cm. A cross-shaped net is folded to make the cube. Calculate the length of the diagonal across one face and give the units.

(2)

10 A rectangular block measures 8 cm by 6 cm by 3 cm. Give the three different plans (top, front, side) in terms of rectangle dimensions. List them as width x depth.

(2)

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11 A solid is a right triangular prism with triangular cross-section sides 3 cm, 4 cm, 5 cm and length 10 cm. Calculate the volume of the prism. (Area of triangle = 1/2 x base x height.)

(3)

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12 A cube of side 10 cm has a smaller cube removed from one corner. The small cube has side 4 cm. Calculate the surface area of the remaining solid. (Remember new faces from the cut may be exposed.)

(3)

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13 Explain briefly how to tell from a plan and elevation whether a solid is a cylinder or a prism.

(2)

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14 A student folds a net of a cube but one face is attached in the wrong place. Which properties of plans and elevations would show that the folded solid is not a cube? Give two properties to check.

(2)

15 A model is made from a cuboid 12 cm by 8 cm by 5 cm with a triangular prism cut out along its length. The triangular prism removed has right triangle cross-section with legs 3 cm and 4 cm and length 8 cm. Calculate the volume of the remaining solid.

(3)

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16 A solid consists of a right circular cone of height 9 cm and base radius 4 cm sitting on top of a cylinder of height 12 cm and same base radius. Calculate the total surface area excluding the base of the cylinder that sits on the table (include the curved surfaces and the top of the cone). Give your answer in cm^2. Use π as π.

(4)

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17 A shape is built from 8 identical small cubes of side 2 cm arranged to form a larger cube, with one small cube missing from a corner. Draw the top plan and front elevation and calculate the total surface area of the resulting shape.

(4)

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18 A castle model has a rectangular tower 14 cm by 10 cm base and height 30 cm. On top of the tower sits a crenelated parapet formed by removing four equal square prisms of side 2 cm from the corners of a thin slab of thickness 2 cm. Calculate the surface area added to the tower by the parapet (include exposed top and sides of parapet and the new exposed faces on the tower where the parapet sits).

(3)

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Question 1

- **B1** Cube cao
- Answer: **Cube**

Question 2

- **M1** identification of two of the three values correctly eg faces = 6 and edges = 12 or edges = 12 and vertices = 8
- **A1** all three correct: faces = 6, edges = 12, vertices = 8 cao
- Answer: **Faces = 6, Edges = 12, Vertices = 8**

Question 3

- **M1** identifies two categories correctly (eg curved face = 1 and flat faces = 2)
- **A1** all three correct: 1 curved face, 2 flat faces, 2 edges cao
- Answer: **Curved faces = 1, Flat faces = 2, Edges = 2**

Question 4

- **M1** area of two equilateral triangles found or area of three rectangles found
- **M1** area values combined correctly
- **A1** total surface area = 144 + 18sqrt(3) cm^2, approximately 175.2 cm^2 cao
- Answer: **144 + 18sqrt(3) cm^2 (approx 175.2 cm^2)**

Question 5

- **M1** identifies front elevation shows a square with a smaller central square removed or drawn as hollow
- **M1** identifies top plan shows a square with a central square hole of side 2 cm
- **A1** both descriptions correct and refer to sizes or relative positions (eg central small square) cao
- Answer: **Front elevation: a square 6 cm by 6 cm with a central square hole (2 cm) visible; Top plan: a 6 cm square with a central 2 cm square hole centred inside**

Question 6

- **M1** some correct idea about relationship of cone and cylinder volumes e.g. cone volume = (1/3) cylinder volume if same height
- **A1** answer stating cone could not have same volume unless its height was 27 cm (cao) or explaining ratio 1:3
- Answer: **No. A cone with the same base and height has volume 1/3 of the cylinder; to equal the cylinder the cone would need height 27 cm (1/3 rule) so with height 9 cm it is smaller**

Question 7

- **B1** chooses (iii) as the correct net
- **B1** gives reason that a square-based pyramid has triangular faces meeting at a point (oe)
- Answer: **(iii) because a square base with four triangular faces (isosceles) forms a square-based pyramid**

Question 8

- **M1** identifies top plan shows a circle of radius 5 cm
- **M1** identifies front elevation shows a rectangle (cylinder height 12) topped by a semicircle (hemisphere) or a half-circle profile
- **A1** both descriptions correct and mention radius/height or semicircle shape cao
- Answer: **Top plan: circle radius 5 cm. Front elevation: rectangle 12 cm high with a semicircle of radius 5 cm on top (the hemisphere appears as a half-circle)**

Question 9

- **M1** uses Pythagoras correctly: diagonal$^2 = 4^2 + 4^2$
- **A1** diagonal = $4\sqrt{2}$ cm or 5.657… cm cao
- Answer: **$4\sqrt{2}$ cm**

Question 10

- **M1** gives two of the three plans correct
- **A1** all three correct: 8 x 6, 8 x 3, 6 x 3 cao
- Answer: **Top: 8 x 6, Front: 8 x 3, Side: 6 x 3**

Question 11

- **M1** finds area of triangular cross-section using base 3 and height 4 or recognises right triangle area = 1/2 x 3 x 4 = 6
- **M1** multiplies area by length 10 correctly to get volume method
- **A1** volume = 60 cm^3 cao
- Answer: **60 cm^3**

Question 12

- **M1** calculates original cube area 6 x 10^2 = 600 cm^2 or calculates area removed 6 x 4^2 = 96 cm^2
- **M1** accounts for newly exposed faces from the cut (three faces of size 6x6 appear) or equivalent method
- **A1** final surface area = 600 - 3*(4^2) + 3*(4^2) = 600 - 48 + 48 = 600 cm^2 cao (the removed and newly exposed corner faces are equal in area, so the total is unchanged)
- Answer: **600 cm^2**

Question 13

- **M1** identifies that top plan of cylinder is circular while prism top is polygonal (or corresponds to base shape)
- **A1** states elevation of cylinder shows curved face (rectangle with semicircle in elevation for hemisphere etc) or prism shows flat faces and straight edges, oe
- Answer: **Look at the plan: a cylinder has a circular plan while a prism has a polygonal plan matching its base. In elevation a cylinder shows curved outline while a prism shows flat faces and straight edges**

Question 14

- **B1** first correct property such as unequal face sizes or non-square faces
- **B1** second correct property such as misaligned vertices/edges so elevations do not match or incorrect number of faces visible in elevation
- Answer: **Check that all faces are squares of the same size; check that edges and vertices line up in the elevations (no misaligned edges or wrong number of faces visible)**

Question 15

- **M1** calculates volume of cuboid = 12 x 8 x 5 = 480 cm^3 or area of triangular cross-section = 1/2 x 3 x 4 = 6
- **M1** calculates volume removed = 6 x 8 = 48 cm^3
- **A1** volume remaining = 480 - 48 = 432 cm^3 cao
- Answer: **432 cm^3**

Question 16

- **M1** finds curved surface area of cylinder = 2 π r h = 2 π x 4 x 12 = 96 π
- **M1** finds slant height of cone correctly: l = $\sqrt{9^2 + 4^2}$ = $\sqrt{97}$
- **M1** finds curved surface area of cone = π r l = π x 4 x $\sqrt{97}$ correctly
- **A1** adds areas: total = 96 π + 4 π $\sqrt{97}$ (cao) written as (96 + 4 $\sqrt{97}$) π cm^2
- Answer: **(96 + 4 $\sqrt{97}$) π cm^2**

Question 17

- **M1** correct description or sketch of top plan and front elevation showing a 2x2 arrangement with one corner square missing (a step visible in one corner)
- **M1** finds surface area of the complete 2x2x2 cube (side 4 cm) = $6 \times 4^2 = 96$ cm^2, or equivalently $8 \times (6 \times 2^2) = 192$ total minus 96 cm^2 for the 12 internal shared faces
- **M1** recognises that removing a corner cube takes away 3 exterior faces ($3 \times 2^2 = 12$ cm^2) but exposes 3 new faces of equal total area ($3 \times 2^2 = 12$ cm^2), leaving the surface area unchanged
- **A1** final surface area = 96 cm^2 cao
- Answer: **96 cm^2**

Question 18

- **M1** calculates area of top slab before cuts = $14 \times 10 = 140$ and area removed by four corner squares = $4 \times 2^2 = 16$, so exposed top of parapet = 124
- **M1** calculates exposed vertical wall area of the parapet: each corner notch removes as much edge length as it adds, so the perimeter is unchanged at $2 \times (14+10) = 48$ cm, giving wall area = $48 \times 2 = 96$ cm^2, and adds the newly exposed tower-top area seen through the four notches = $4 \times 2^2 = 16$ cm^2
- **A1** gives final added surface area = $124 + 96 + 16 = 236$ cm^2 cao
- Answer: **236 cm^2**