Surface Area & Volume of 3-D Objects (Grade 9)

MARKING GUIDELINE

MARKS	DURATION	QUESTIONS
45	1 hour 10 minutes	4

Name: _____ Class: _____

Date: _____

MARK ____ / 45

INSTRUCTIONS AND INFORMATION

1. Answer **ALL** the questions in this question paper.
2. Answer QUESTION 1 by **circling** the letter (A–D) in the answer grid at the end of that section.
3. Show **ALL** calculations clearly.
4. Show all units where applicable.
5. Number the answers correctly according to the numbering system used in this question paper.
6. A non-programmable calculator may be used, unless stated otherwise.
7. Write neatly and legibly.

QUESTION 1 [10 MARKS]

Four options are given as possible answers to the following questions. Choose the correct answer and circle the letter (A–D) in the grid at the end of this section. If you want to change your choice, put a cross through the wrong letter and circle your new choice.

1.1 The volume of a cylinder of radius 5 cm and height 10 cm ($\pi \approx 3{,}14$) is ... (1)

A) 314 cm^3 **B)** 1 570 cm^3

C) 157 cm^3 **D) 785 cm^3 ✓**

Answer: D — $V = \pi r^2 h = 3{,}14 \times 25 \times 10$.

- **A** — used $2r$ instead of r^2: $3{,}14 \times 10 \times 10$
- **B** — squared the height instead of the radius: $\pi r h^2$
- **C** — used $\pi r h$ instead of $\pi r^2 h$

1.2 The volume of ANY prism equals ... (1)

A) length × breadth × height **B)** perimeter × height

C) area of the CROSS-SECTION × length ✓ **D)** ½ × base × height

Answer: C — The cross-section is stacked along the length.

- **A** — that works only for a rectangular prism
- **B** — perimeter gives a surface, not a volume
- **D** — that is the area of a triangle

1.3 A cube has a volume of 125 cm^3. Its SURFACE AREA is ... (1)

A) 25 cm^2 **B)** 125 cm^2

C) 750 cm^2 **D) 150 cm^2 ✓**

Answer: D — Side $= \sqrt[3]{125} = 5$ cm, so SA $= 6 \times 25$.

- **A** — that is ONE face
- **B** — that is the volume again
- **C** — used the volume instead of a face

1.4 $1\ 000\ \text{cm}^3$ is the same as ... (1)

A) $1\ \ell$ ✓ **B)** $100\ \text{m}\ell$

C) $1\ \text{m}\ell$ **D)** $10\ \ell$

> **Answer: A** — $1\ \text{cm}^3 = 1\ \text{m}\ell$, so $1\ 000\ \text{cm}^3 = 1\ 000\ \text{m}\ell = 1\ \ell$.
> - **B** — too small by a factor of 10
> - **C** — that is $1\ \text{cm}^3$
> - **D** — too large by a factor of 10

1.5 If the HEIGHT of a cylinder is doubled and the radius is unchanged, the volume is multiplied by ... (1)

A) 2 ✓ **B)** 1

C) 8 **D)** 4

> **Answer: A** — Volume is directly proportional to the height.
> - **B** — the volume certainly changes
> - **C** — that needs all dimensions doubled
> - **D** — that would need the RADIUS to double

1.6 If the RADIUS of a cylinder is doubled and the height is unchanged, the volume is multiplied by ... (1)

A) 2 **B)** 8

C) 4 ✓ **D)** 6

> **Answer: C** — Volume depends on r^2.
> - **A** — that is the factor for the height
> - **B** — that needs the HEIGHT doubled as well
> - **D** — 6 is not a power of 2; the factor comes from squaring

1.7 The surface area of a closed cylinder is ... (1)

A) $2\pi r^2 + 2\pi rh$ ✓ **B)** $\pi r^2 h$

C) $2\pi rh$ **D)** $\pi r^2 + 2\pi rh$

> **Answer: A** — Two circular ends plus the curved surface.
> - **B** — that is the VOLUME
> - **C** — that is the curved surface only
> - **D** — that counts only ONE circular end

1.8 A triangular prism has a cross-section of area $24\ \text{cm}^2$ and a length of 15 cm. Its volume is ... (1)

A) $39\ \text{cm}^3$ **B)** $720\ \text{cm}^3$

C) $360\ \text{cm}^3$ ✓ **D)** $180\ \text{cm}^3$

> **Answer: C** — $24 \times 15 = 360$.
> - **A** — added instead of multiplying
> - **B** — doubled the answer
> - **D** — halved the answer unnecessarily

1.9 If ALL the dimensions of a solid are doubled, its VOLUME is multiplied by ... (1)

A) 2 **B)** **8** ✓

C) 4 **D)** 6

> **Answer: B** — Volume scales by the CUBE of the length factor.
> - **A** — that is the length factor
> - **C** — that is the AREA factor
> - **D** — that is the number of faces of a cube

1.10 A rectangular tank is 40 cm by 30 cm by 25 cm. Its capacity in litres is ... (1)

A) 0,3 ℓ **B)** **30 ℓ** ✓

C) 3 ℓ **D)** 300 ℓ

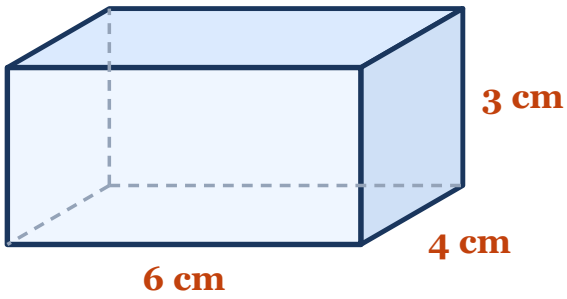
> **Answer: B** — Volume $= 30\,000\ \text{cm}^3 = 30\,000\ \text{m}\ell = 30\ \ell$.
> - **A** — divided by 100 000
> - **C** — divided by 10 000
> - **D** — divided by 100

ANSWER GRID — MARKING GUIDELINE

1.1	A	B	C	**(D)**
1.2	A	B	**(C)**	D
1.3	A	B	C	**(D)**
1.4	**(A)**	B	C	D
1.5	**(A)**	B	C	D
1.6	A	B	**(C)**	D
1.7	**(A)**	B	C	D
1.8	A	B	**(C)**	D
1.9	A	**(B)**	C	D
1.10	A	**(B)**	C	D

QUESTION 2 [10 MARKS]

The diagram below shows a rectangular prism.



2.1 Calculate the volume of the prism. **(3)**

> $V = 6 \times 4 \times 3$ *(2)* $= \mathbf{72\ cm^3}$ *(1)*

2.2 Calculate the surface area of the prism. **(4)**

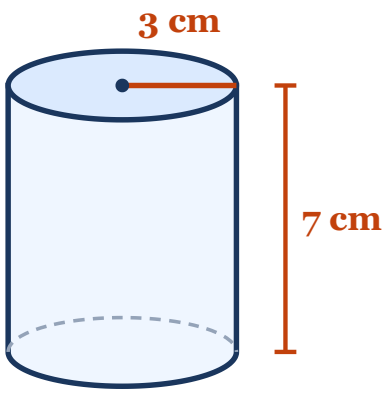
> $SA = 2(lb + lh + bh)$ *(1)*
> $= 2(24 + 18 + 12)$ *(2)*
> $= \mathbf{108\ cm^2}$ *(1)*

2.3 A cube has sides of 5 cm. Calculate its volume and its total surface area. **(3)**

> $V = 5^3 = \mathbf{125\ cm^3}$ *(2)*
> A cube has 6 identical square faces, so $SA = 6 \times 5^2 = \mathbf{150\ cm^2}$ *(1)*

QUESTION 3 [13 MARKS]

The diagram below shows a cylinder. Use $\pi \approx 3{,}14$ and round off to TWO decimal places where necessary.



3.1 Write down the formula for the volume of a cylinder, and explain how it follows from "area of the cross-section × length". (3)

> $V = \pi r^2 h$ *(1)*
> The cross-section of a cylinder is a circle, whose area is πr^2 *(1)*
> Multiplying by the height h stacks that circle all the way along the cylinder *(1)*

3.2 Calculate the volume of the cylinder. (3)

> $V = 3{,}14 \times 3^2 \times 7$ *(2)*
> $= \mathbf{197{,}82\ cm^3}$ *(1)*

3.3 Calculate the total surface area of the cylinder. (4)

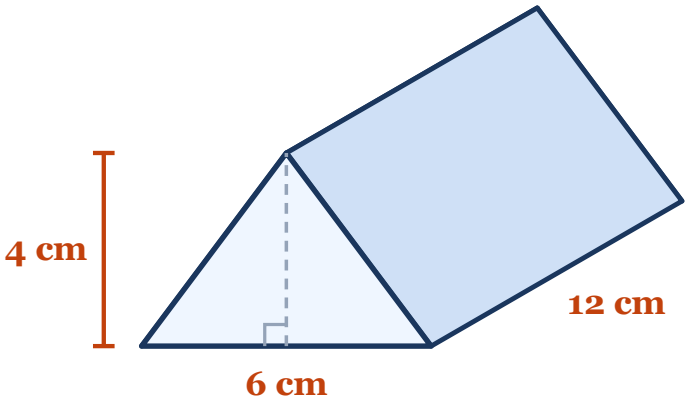
> $SA = 2\pi r^2 + 2\pi rh$ *(1)*
> $= 56{,}52 + 131{,}88$ *(2)*
> $= \mathbf{188{,}40\ cm^2}$ *(1)*

3.4 The radius of the cylinder is doubled while the height stays the same. Determine by what factor the volume increases, and give a reason. (3)

> The volume becomes **4 times** as big *(2)*
> The radius is SQUARED in the formula, so doubling it multiplies the volume by 2^2 *(1)*

QUESTION 4 [12 MARKS]

The diagram below shows a triangular prism.



4.1 Calculate the volume of the prism. **(3)**

> $V = \frac{1}{2} \times 6 \times 4 \times 12$ *(2)*
> $= \mathbf{144\ cm^3}$ *(1)*

4.2 The prism is filled with water. Write down its capacity in millilitres, and then in litres. **(3)**

> $1\ cm^3 = 1$ mℓ, so the capacity is **144 mℓ** *(2)*
> $= \mathbf{0{,}144\ ℓ}$ *(1)*

4.3 Explain why the volume of ANY prism can be found by multiplying the area of its cross-section by its length. **(2)**

> A prism has the same cross-section all the way along *(1)*, so it is that shape stacked up along its length *(1)*

4.4 The triangular end is isosceles. Show that each of its two sloping sides is 5 cm, and hence calculate the total surface area of the prism. **(4)**

> The perpendicular height cuts the 6 cm base in half, giving 3 cm *(1)*
> Sloping side $= \sqrt{3^2 + 4^2} = 5$ cm *(1)*
> Two ends $= 2 \times \frac{1}{2} \times 6 \times 4 = 24\ cm^2$; three rectangles $= (6 + 5 + 5) \times 12 = 192\ cm^2$ *(1)*
> SA $= 24 + 192 =$ **$216\ cm^2$** *(1)*

TOTAL: 45 marks

This question paper consists of 4 questions.

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