Unit 9 · Perimeter, Area and Volume

HARDER PRACTICE QUESTIONS · ANSWER KEY

Full marks 35

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Spot the errors

ANSWER U · 4

i. **290 cm** (2.9 m). 1.2 m is 120 cm: 120 + 90 + 80 = 290. She added meters to centimeters.

ii. **150 cm².** A cube has 6 square faces: $6 \times 5^2 = 6 \times 25 = 150$. 5^3 is its volume, in cm^3.

iii. **1,000 liters.** $2 \times 1 \times 0.5 = 1$ **m^3**, and 1 m^3 = 1,000 l.

iv. **88 cm.** 14 cm is the radius, so $c = 2\pi r = 2 \times \frac{22}{7} \times 14 = 88$. She put the radius into πd.

MARKING SCHEME

- ✓ i. 290 cm: change 1.2 m to 120 cm first.
- ✓ ii. 150 cm^2: six faces, not the cube of the edge.
- ✓ iii. 1,000 l: 1 m^3 is 1,000 liters.
- ✓ iv. 88 cm: a radius goes into $2\pi r$.

2 Two triangles, or none

ANSWER HA · 4

i. If 8 cm is one of the equal sides, the sides are 8, 8 and 30 − 16 = 14 cm: **8 cm, 8 cm and 14 cm**. If 8 cm is the third side, the equal sides share 30 − 8 = 22 cm: **11 cm, 11 cm and 8 cm**.

ii. 8 + 8 = 16 is more than 14, and 11 + 8 = 19 is more than 11: any two sides are longer than the third, so **both are triangles**.

iii. If 16 cm is an equal side, the third side is 30 − 32 = −2 cm: impossible. If 16 cm is the third side, the equal sides are (30 − 16) ÷ 2 = 7 cm each, but 7 + 7 = 14 is **less than 16**, so the two short sides can't meet.

iv. **14 cm.** A side of 15 cm or more is too long: the other two sides would make 15 cm or less, not more than it. 14 cm works both ways: 14, 14 and 2 cm, or 8, 8 and 14 cm.

MARKING SCHEME

- ✓ i. 8, 8 and 14 cm.
- ✓ i. 11, 11 and 8 cm.
- ✓ iii. Both cases fail: −2 cm, and 7 + 7 is less than 16.
- ✓ iv. 14 cm.

3 Cutting and joining

ANSWER A · 4

i. Each piece is **14 cm × 14 cm × 7 cm**.

ii. The cube: $6 \times 14^2 = 6 \times 196 =$ **1,176 cm²**. One piece: $2(14 \times 14 + 14 \times 7 + 14 \times 7) = 2(196 + 98 + 98) = 784$ cm^2, so the two together have **1,568 cm²**. New surface: 1568 − 1176 = **392 cm²**, the two new faces of $14 \times 14 = 196$ cm^2 each.

iii. **No.** The wood is the same: $14^3 = 2744$ cm^3, and the pieces have $2 \times 14 \times 14 \times 7 = 2744$ cm^3.

iv. The rod is 10 cm × 2 cm × 2 cm: $2(10 \times 2 + 2 \times 2 + 10 \times 2) = 2(20 + 4 + 20) =$ **88 cm²**. Five cubes have $5 \times 24 = 120$ cm^2. At each of the 4 joins, two faces of 4 cm^2 are glued together and hidden: $4 \times 2 \times 4 = 32$ cm^2, and 120 − 32 = 88.

MARKING SCHEME

- ✓ i. 14 cm × 14 cm × 7 cm.
- ✓ ii. 1,176 cm^2 and 1,568 cm^2: 392 cm^2 of new surface.
- ✓ iii. Same volume, 2,744 cm^3.
- ✓ iv. 88 cm^2: the glued faces are hidden.

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4 The tank on the roof

ANSWER A · 4

i. $V = 1.5 \times 1 \times 0.8 = 1.2\ \text{m}^3 = 1.2 \times 1000 =$ **1,200 liters**.

ii. $300\ \text{l} = 0.3\ \text{m}^3$. The water is a cuboid 1.5 m × 1 m, so its height falls by $0.3 \div (1.5 \times 1) = 0.2$ m = **20 cm** a day. (Check: the tank is 80 cm high, and $80 \div 20 = 4$ days.)

iii. $1200 \div 300 = 4$ days: Sunday, Monday, Tuesday and Wednesday. It runs dry at the end of **Wednesday**.

iv. The cube holds $1^3 = 1\ \text{m}^3 = 1000$ l. Sushant's tank holds **200 liters more**.

MARKING SCHEME

✓ i. 1,200 liters.

✓ ii. 20 cm a day.

✓ iii. Wednesday.

✓ iv. Sushant's, by 200 liters.

5 Double the edge

ANSWER HA · 4

i. $6 \times 3^2 =$ **54 cm²** and $3^3 =$ **27 cm³**.

ii. $6 \times 6^2 =$ **216 cm²** and $6^3 =$ **216 cm³**. The surface area is **4 times** bigger (216 ÷ 54), the volume **8 times** (216 ÷ 27): each face is 2 × 2 times bigger, and the space inside 2 × 2 × 2 times.

iii. **She is wrong.** $4 \times 3 \times 2 = 24\ \text{cm}^3$, but $8 \times 6 \times 4 = 192\ \text{cm}^3$, which is **8 times** as much, not twice.

iv. **The cube with edges of 12 cm**: $6 \times 12^2 = 864\ \text{cm}^2$ and $12^3 = 1728\ \text{cm}^3$, and $2 \times 864 = 1728$. (For 10 cm: 600 and 1,000; for 11 cm: 726 and 1,331. The volume is a times a^2, the surface area 6 times a^2, so the volume is twice as big when $a = 12$.) One number is cm^2 and the other cm^3, so "twice" compares the numbers, not the sizes.

MARKING SCHEME

✓ i. 54 cm^2 and 27 cm^3.

✓ ii. 216 cm^2 and 216 cm^3: 4 times and 8 times.

✓ iii. 192 cm^3: 8 times, not twice.

✓ iv. The cube with 12 cm edges.

6 One wire, three shapes

ANSWER A · 4

i. $3 \times 22 =$ **66 cm**.

ii. $2\pi r = 66$, so $2 \times \frac{22}{7} \times r = 66$, $\frac{44}{7} r = 66$ and $r = 66 \times \frac{7}{44} =$ **10.5 cm**.

iii. $(66 - 20) \div 2 = 46 \div 2 =$ **23 cm**.

iv. **No.** The base would be $66 - 30 = 36$ cm, and $15 + 15 = 30$ is less than 36: the two sides can't meet.

MARKING SCHEME

✓ i. 66 cm.

✓ ii. 10.5 cm.

✓ iii. 23 cm.

✓ iv. No: the base would be 36 cm, longer than 15 + 15.

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7 Big wheels and small wheels

ANSWER A · 4

i. Back: $\frac{22}{7} \times 126 = 22 \times 18 =$ **396 cm** (3.96 m). Front: $\frac{22}{7} \times 84 = 22 \times 12 =$ **264 cm** (2.64 m).

ii. $250 \times 3.96 =$ **990 m**.

iii. $990 \div 2.64 =$ **375 times**: a front wheel rolls $264 \div 396$, two thirds as far, in a turn, so it turns one and a half times as often ($250 \times 1.5 = 375$).

iv. $1500 \times 2.64 = 3960$ m = **3.96 km**, and a back wheel turns $3960 \div 3.96 =$ **1,000 times** ($1500 \div 1.5$).

MARKING SCHEME

- ✓ i. 3.96 m and 2.64 m.
- ✓ ii. 990 m.
- ✓ iii. 375 times.
- ✓ iv. 3.96 km and 1,000 turns.

8 Think: a longer string

ANSWER HA · 4

i. $\frac{22}{7} \times 14 =$ **44 cm**.

ii. The new string is 88 cm, so $d = 88 \times \frac{7}{22} =$ **28 cm**. The diameter grew by 14 cm, half on each side: the gap is **7 cm**.

iii. The rope was $\frac{22}{7} \times 70 = 220$ m; now it is 220.44 m, so $d = 220.44 \times \frac{7}{22} = 70.14$ m. The diameter grew by 0.14 m = 14 cm: the gap is again **7 cm**.

iv. **7 cm**, the same. Every extra $\frac{22}{7} \times 14 = 44$ cm of length adds 14 cm to the diameter, whatever the size of the circle, because the circumference is always π times the diameter. Half of 14 cm is the gap.

MARKING SCHEME

- ✓ i. 44 cm.
- ✓ ii. 28 cm across, a gap of 7 cm.
- ✓ iii. A gap of 7 cm.
- ✓ iv. 7 cm: 44 cm more length always adds 14 cm to the diameter.

9 Make your own

ANSWER A · 3

For example:

i. 4 cm × 3 cm × 3 cm: $2(12 + 9 + 12) = 66$ cm^2; 6 cm × 3 cm × 2 cm: $2(18 + 6 + 12) = 72$ cm^2. The first, nearer a cube, needs less paper. (Others: $6 \times 6 \times 1$, 96 cm^2; $9 \times 2 \times 2$, 80 cm^2; $9 \times 4 \times 1$, 98 cm^2; $12 \times 3 \times 1$, 102 cm^2; $18 \times 2 \times 1$, 112 cm^2; $36 \times 1 \times 1$, 146 cm^2.)

ii. "A triangle has a perimeter of 20 cm and two sides of 3 cm and 5 cm. Find the third side." The third side would be 12 cm, but $3 + 5 = 8$ is less than 12, so no such triangle exists.

iii. A diameter of 50 cm: $3.14 \times 50 = 157$ cm. (Any multiple of 50 cm works too: 100 cm, 150 cm, …)

Any correct answers are right.

MARKING SCHEME

- ✓ i. Two cuboids of 36 cm^3, the one nearer a cube needing less paper.
- ✓ ii. A question whose third side is too long to make a triangle.
- ✓ iii. A diameter giving a whole circumference.

See it at Science Playground

Exhibits and plants at the center, Bhaktapur, that go with this unit. Book a class visit at science-playground.com/booking.

- **Woods of Nepal** (exhibit): Lift a wood block: a cube with 10 cm edges. Each of its 6 faces is $10 \times 10 = 100$ cm^2, so its total surface area is 600 cm^2.

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- **The Unit Circle** (exhibit): Its radius is 1 unit, so its diameter is 2 and its circumference is $2\pi r = 2 \times 3.14 \times 1 \approx 6.28$ units: just over 3 diameters.
- **Geometric Shapes Set** (exhibit): The round top is marked 90 across, so its circumference is about $3.14 \times 90 \approx 283$. Surprise: every constant-width shape 90 across has that same perimeter.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	0	4	19	12	**35**

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