

Surface Area Studio

Unfold surfaces, develop formulas, and solve covering problems.

GRADE 7 • 7.MG.1.b

7.MG.1.b "Develop the formulas for determining the surface area of rectangular prisms and right cylinders and solve problems, including those in contextual situations, using concrete objects, two-dimensional diagrams, nets, and formulas."

NAME _____

DATE _____

Materials and setup

Per pair: one closed rectangular cardboard box, one straight-sided cylindrical container, a ruler, string, and a sheet of plain paper. Use containers with no sharp edges. Do not cut the containers.

Wrap paper once around the cylinder with no overlap, mark the meeting line and top/bottom, and flatten the marked rectangle. Trace the top and bottom on the remaining paper. Use the actual objects for task 4.

FROM SURFACES TO A FORMULA

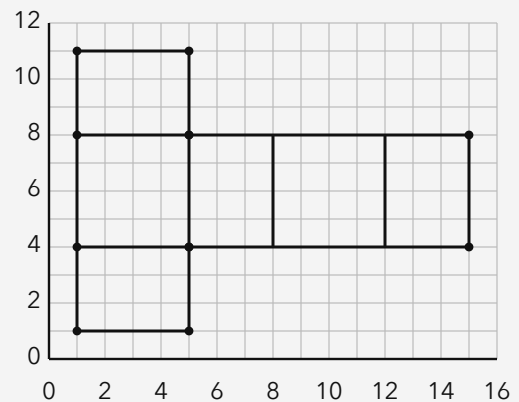
Surface area measures the total outside area of a closed solid. A net lays its surfaces flat. Count every face or curved surface once. Grid squares in the nets represent 1 cm by 1 cm; use the stated dimensions where an edge is not on a grid line. Surface area uses square units. Derive each formula by adding the parts before calculating.

WORKED EXAMPLE

The net represents a closed rectangular prism: length 4 cm, width 3 cm and height 4 cm. Identify the six faces, then add their areas.

1. Four rectangles in the horizontal strip have areas 16, 12, 16 and 12 cm².
2. The two attached rectangles each have area $4 \times 3 = 12$ cm².
3. Add: $16 + 12 + 16 + 12 + 12 + 12 = 80$ cm².

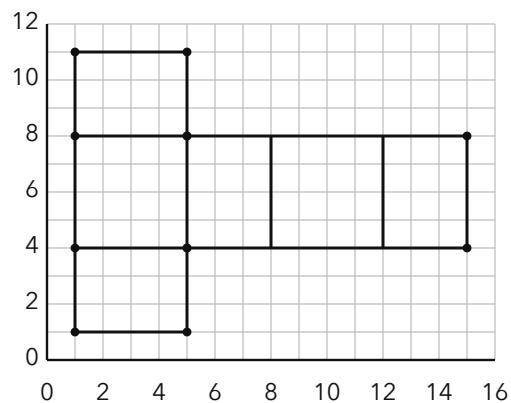
Answer: 80 cm². Every face is counted once.



PRACTICE 4 problems

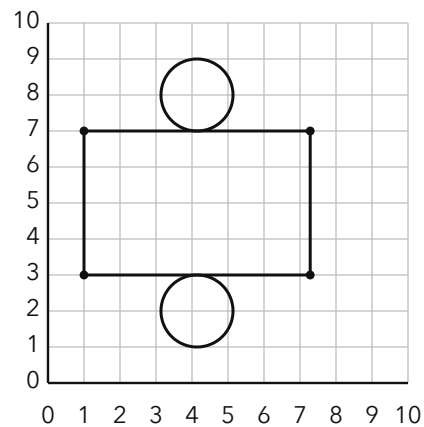
- 1** Use the worked net. Name the three pairs of matching faces using length l , width w and height h . Add their areas symbolically to develop a formula for any closed rectangular prism. Explain each factor of 2.

ANSWER _____



- 2** This closed-cylinder net has two circles of radius 1 cm and a rectangle of height 4 cm. Its rectangle width is 2π cm. Explain why that width is a circumference, not a diameter. Find the area of all three parts.

ANSWER _____



- 3** Generalize the cylinder net: let its base radius be r and its height be h . Develop the total surface-area formula by adding the two circles and the rectangle. Explain what each term measures.

ANSWER _____

- 4** Investigate the two supplied objects. For the box, measure length, width and height and identify matching face pairs. For the cylinder, use the prepared paper wrapping and string to compare the rectangle width with the base circumference. Record measurements and explain how both objects support the formulas.

ANSWER _____

APPLY IT Show your work

- 1** A closed prize box measures 12 in. by 8 in. by 5 in. Find the minimum paper area needed to cover every face, ignoring overlaps. Show how each face pair contributes.

ANSWER _____

- 2** A straight-sided closed cylindrical container has diameter 10 cm and height 6 cm. Find the material area covering the side and both circular ends, ignoring overlaps. Give an exact answer.

ANSWER _____

CHALLENGE One step up

A cylindrical cup has radius 3 cm and height 8 cm. It is open at the top and closed at the bottom. How does its outside surface area differ from a closed cylinder with these dimensions? Use the net idea to justify the difference.

PRACTICE 1

The pairs have areas lw , lh and wh . Each occurs twice, so $SA = 2lw + 2lh + 2wh = 2(lw + lh + wh)$. Each 2 counts one matching pair.

PRACTICE 2

The rectangle wraps around a full circular base, whose circumference is $2\pi r = 2\pi$ cm. The circles total 2π cm² and the rectangle has area 8π cm², so $SA = 10\pi$ cm².

PRACTICE 3

The two bases total $2\pi r^2$. The rectangle has width $2\pi r$ and height h , so its area is $2\pi rh$. $SA = 2\pi r^2 + 2\pi rh$.

PRACTICE 4

Answers vary. Box measurements in consistent units connect its six faces to $2(lw + lh + wh)$. The flattened wrap's width approximately matches one circumference measured by string; together with its height and two circular bases, it supports $2\pi rh + 2\pi r^2$. Allow measurement error.

APPLY IT 1

392 in²

$$2(12 \times 8) + 2(12 \times 5) + 2(8 \times 5) = 192 + 120 + 80 = 392 \text{ in}^2.$$

APPLY IT 2

110π cm²

Radius is 5 cm. The two ends total $2\pi(5^2) = 50\pi$. The side is $2\pi(5)(6) = 60\pi$. Total = 110π cm².

CHALLENGE

The open cup has one base and the curved side: $\pi(3^2) + 2\pi(3)(8) = 57\pi \text{ cm}^2$. The closed cylinder has $66\pi \text{ cm}^2$. Removing one circular base reduces the area by $9\pi \text{ cm}^2$.

Require development from the actual nets and objects, not formula copying alone. The prism net has six non-overlapping rectangular faces; shared edges are fold lines. Nets are drawn on equal-unit grids, with radius and rectangle width explicitly stated for the cylinder. The cylinder rectangle joins each circular edge when assembled; point contact in a flat textbook net indicates placement, not a single-point physical attachment. Object measurements vary, so assess reasoning and reasonable measurement agreement. All contextual problems idealize surfaces and ignore material thickness and overlaps.