Surface Area of Prisms, Cylinders, and Pyramids

Applications and design

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

Surface area adds exposed face areas. A closed rectangular prism uses $2(lw + lh + wh)$. A closed cylinder uses $2\pi r^2 + 2\pi rh$; omit a circular base for an open top. A regular square pyramid uses $s^2 + 4(\frac{1}{2}s\ell)$, where ℓ is face slant height, not vertical height. A net can separate bases and lateral faces. Use square units, not cubic units.

Worked example

Find surface area of a closed rectangular prism with length 6, width 3, and height 2.

1. The base area is $6(3) = 18$ square units. The two bases contribute $2(18) = 36$ square units.

2. The side faces contribute $2(6)(2) + 2(3)(2) = 24 + 12 = 36$ square units.

3. Add the exposed faces: $36 + 36 = 72$ square units. Each included face is counted once; no volume calculation is needed.

Answer: 72 square units

Practice Problems

Show your thinking.

1. A gift box is closed and measures 10 by 6 by 4 cm. Find wrapping area, ignoring overlap.

2. A lidless tray is 12 by 8 by 3 cm. Find the material area, ignoring thickness and seams.

3. A can label covers only the curved surface of a cylinder of radius 3 cm and height 12 cm. Find label area. Give an exact answer in terms of π.

4. A regular square-pyramid tent has base side 8 m and face slant height 5 m. Find fabric for its four sides, excluding the floor.

5. A closed box has surface area 240 cm^2. Allow 15% extra paper for overlap. Find total paper area.

6. A square-pyramid roof has base side 10 m and face slant height 6 m. Paint covers 25 m^2 per can. How many whole cans cover its four sides?

7. An open cylindrical bucket has inner radius 4 cm and depth 9 cm. Find interior coating area, including its bottom but not its top. Give an exact answer in terms of π.

8. Design a closed rectangular box with length 8 cm, width 5 cm, and surface area 210 cm^2. Find height.

9. Two cubes of edge 3 cm are joined along one whole face. Find exposed surface area of the combined solid.

10. A closed cylinder has radius 2 cm and height 5 cm. Coating costs $\$0.10$ per square centimeter. Find cost to the nearest cent using calculator π.

Answer Key

1. $248\ \text{cm}^2$
2. $216\ \text{cm}^2$
3. $72\pi\ \text{cm}^2$
4. $80\ \text{m}^2$
5. $276\ \text{cm}^2$
6. 5 cans
7. $88\pi\ \text{cm}^2$
8. 5 cm
9. $90\ \text{cm}^2$
10. $\$8.80$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The base area is $10(6) = 60\ \text{cm}^2$. The two bases contribute $2(60) = 120\ \text{cm}^2$.

2. The side faces contribute $2(10)(4) + 2(6)(4) = 80 + 48 = 128\ \text{cm}^2$.

3. Add the exposed faces: $120 + 128 = 248\ \text{cm}^2$. Each included face is counted once; no volume calculation is needed.

Problem 2

1. The base area is $12(8) = 96\ \text{cm}^2$. Only one base is included because the top is open.

2. The side faces contribute $2(12)(3) + 2(8)(3) = 72 + 48 = 120\ \text{cm}^2$.

3. Add the exposed faces: $96 + 120 = 216\ \text{cm}^2$. Each included face is counted once; no volume calculation is needed.

Problem 3

1. The curved surface unwraps to a rectangle with area $2\pi rh = 2\pi(3)(12) = 72\pi\ \text{cm}^2$.

2. There are 0 included circular bases, contributing $0\pi(3)^2 = 0\pi\ \text{cm}^2$.

3. The required area is $72\pi + 0\pi = 72\pi\ \text{cm}^2$. Count only the specified exposed surfaces, not enclosed volume.

Problem 4

1. Each face has area $\frac{1}{2}(8)(5) = 20\ \text{m}^2$; its slant height is perpendicular to the base edge within that face.

2. The four faces total $4(20) = 80\ \text{m}^2$. The base is not included.

3. The required area is $80 + 0 = 80\ \text{m}^2$. Vertical pyramid height would not replace face slant height.

Problem 5

1. The overlap allowance is $0.15(240) = 36\ \text{cm}^2$.

2. Add the allowance to the actual surface area: $240 + 36 = 276\ \text{cm}^2$.

3. The required paper is $276\ \text{cm}^2$. Multiplying by 0.15 alone would give only the extra amount, not the total.

Problem 6

1. The roof area is $4(\frac{1}{2} \cdot 10 \cdot 6) = 120\ \text{m}^2$; its base is not painted.

2. The required number before whole-can rounding is $120/25 = 4.8$.

3. Round upward to 5 cans, providing $125\ \text{m}^2$ of coverage. Four cans cover only $100\ \text{m}^2$, which is insufficient.

Problem 7

1. The curved surface unwraps to a rectangle with area $2\pi rh = 2\pi(4)(9) = 72\pi\ \text{cm}^2$.

2. There are 1 included circular bases, contributing $1\pi(4)^2 = 16\pi\ \text{cm}^2$.

3. The required area is $72\pi + 16\pi = 88\pi\ \text{cm}^2$. Count only the specified exposed surfaces, not enclosed volume.

Problem 8

1. The formula gives $2(8 \cdot 5 + 8h + 5h) = 210$, or $80 + 26h = 210$.

2. Subtract 80 and divide: $26h = 130$, so $h = 5$ cm.

3. The check $2(40 + 40 + 25) = 210\ \text{cm}^2$ verifies the design. All six faces are included because the box is closed.

Problem 9

1. Two separate cubes have total area $2(6 \cdot 3^2) = 108\ \text{cm}^2$.

2. The join hides two square faces, each $3^2 = 9\ \text{cm}^2$, so remove $2(9) = 18$.

3. The exposed area is $108 - 18 = 90\ \text{cm}^2$. Removing only one joining face would still count a hidden interior face.

Problem 10

1. The area is $2\pi(2)^2 + 2\pi(2)(5) = 8\pi + 20\pi = 28\pi\ \text{cm}^2$.

2. The cost is $0.10(28\pi) = 2.8\pi \approx 8.79646$ dollars.

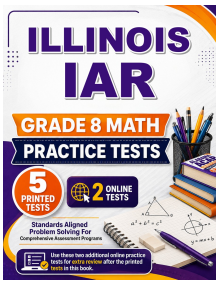
3. Round only the final cost to $\$8.80$. Rounding area to a whole number first could change the required cent-level answer.

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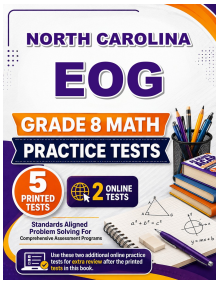
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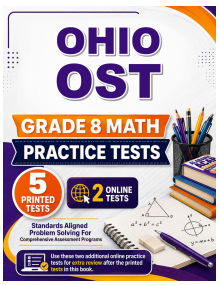
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