Surface Area of Prisms, Cylinders, and Pyramids

Investigate mistakes and missing measures

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 student gives 60 as surface area of a 3 by 4 by 5 box, using $3(4)(5)$. Correct the answer.

2. A cube has surface area 150 square units. Recover its edge length.

3. A closed cylinder has radius 2 and total surface area 40π. Find its height.

4. A regular square pyramid has base side 4 and surface area 64. Recover face slant height ℓ.

5. A student includes two bases for an open-top cylinder of radius 3, height 4. Correct the exact exposed area.

6. A 6 by 2 rectangular prism has height h and closed surface area 88. Recover h.

7. A square pyramid has side 6, vertical height 4, and face slant height 5. A student uses 4 for triangular-face height. Correct total area.

8. Two cubes have edges 2 and 6. Find the surface-area factor, not the volume factor.

9. A closed cylinder has diameter 6, height 2. A student gives 96π. Correct the radius substitution.

10. A right-triangular prism has base legs $3, 4$, hypotenuse 5, and surface area 72. Recover prism length L.

Answer Key

1. 94 square units
2. 5 units
3. 8 units
4. $\ell = 6$ units
5. 33π square units
6. $h = 4$ units
7. 96 square units
8. 9
9. 30π square units
10. $L = 5$ units

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The product $3(4)(5) = 60$ measures volume, not surface area.

2. The face-pair sum is $2(3 \cdot 4 + 3 \cdot 5 + 4 \cdot 5) = 2(12 + 15 + 20) = 94$.

3. The correct surface area is 94 square units; a rectangular prism has six rectangular faces rather than one product of three lengths.

Problem 2

1. Six equal square faces give $6s^2 = 150$.

2. Divide by 6: $s^2 = 25$, so the positive edge length is $s = 5$.

3. The check $6(5^2) = 6(25) = 150$ verifies the cube. The value 25 is a face area, not an edge length.

Problem 3

1. The two bases contribute $2\pi(2)^2 = 8\pi$. Thus $8\pi + 2\pi(2)h = 40\pi$.

2. Cancel π: $8 + 4h = 40$, so $4h = 32$ and $h = 8$.

3. Checking $8\pi + 4\pi(8) = 40\pi$ confirms the height. The bases must be removed before dividing by circumference.

Problem 4

1. The base area is $4^2 = 16$, leaving $64 - 16 = 48$ for the four triangular faces.

2. The lateral formula gives $4(\frac{1}{2} \cdot 4\ell) = 8\ell = 48$, so $\ell = 6$.

3. The check $16 + 4(\frac{1}{2} \cdot 4 \cdot 6) = 16 + 48 = 64$ verifies the face slant height.

Problem 5

1. The curved area is $2\pi(3)(4) = 24\pi$; only one base contributes $\pi(3)^2 = 9\pi$.

2. The correct sum is $24\pi + 9\pi = 33\pi$, not $24\pi + 18\pi = 42\pi$.

3. The omitted top removes exactly 9π square units. An open top changes surface area but not the capacity formula.

Problem 6

1. Substitute into $2(lw + lh + wh)$: $2(12 + 6h + 2h) = 88$.

2. Then $24 + 16h = 88$, so $16h = 64$ and $h = 4$.

3. Check $2(12 + 24 + 8) = 88$ square units. The base dimensions remain 6 and 2 throughout the inverse calculation.

Problem 7

1. The base area is $6^2 = 36$. Each face uses slant height 5, giving $\frac{1}{2}(6)(5) = 15$.

2. The four faces contribute $4(15) = 60$, so total area is $36 + 60 = 96$.

3. Using vertical height 4 would give $36 + 48 = 84$, undercounting by 12 square units. Face height lies on the triangular surface.

Problem 8

1. The first area is $6(2^2) = 24$ square units; the second is $6(6^2) = 216$.

2. The ratio is $216/24 = 9$, which equals the squared edge ratio $(6/2)^2 = 3^2$.

3. The surface area grows by factor 9, not 3 or 27. The latter would be the volume factor.

Problem 9

1. The actual radius is $6/2 = 3$, so bases contribute $2\pi(3)^2 = 18\pi$.

2. The curved surface contributes $2\pi(3)(2) = 12\pi$, giving $18\pi + 12\pi = 30\pi$.

3. The student used $r = 6$: $72\pi + 24\pi = 96\pi$. Diameter must be halved before entering either term.

Problem 10

1. Two triangle bases have total area $2(\frac{1}{2} \cdot 3 \cdot 4) = 12$.

2. The lateral area is $(3 + 4 + 5)L = 12L$, so $12 + 12L = 72$ and $L = 5$.

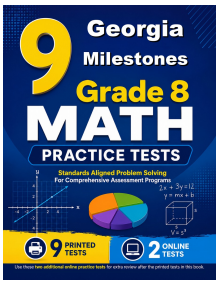
3. The check $12 + 12(5) = 72$ square units confirms the length. Base area and base perimeter serve different roles in the formula.

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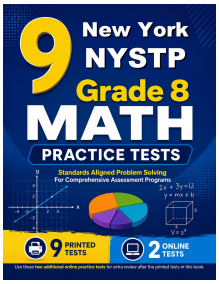
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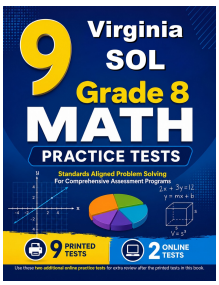
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