Cross-Sections of Three-Dimensional Figures

Spot mistakes, reason, and work backward

Name _____ **Date** _____ **Score** _____ / 6

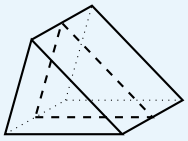
QUICK REVIEW

A cross-section is the flat region where a plane cuts a solid. Identify where the plane meets the solid, then use only the lengths in that plane. A cylinder cut parallel to its base gives a circle of area πr^2. Figures are schematic.

Worked example

A plane cuts a right triangular prism parallel to its triangular ends. The ends have perpendicular legs 4 and 5 cm. Name the section and find its area.

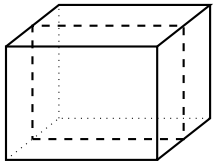
1. The plane is parallel to an end, so the cross-section has the same 3-sided outline.
2. Its perpendicular legs are the original 4 cm and 5 cm.
3. Use the triangle area formula: $(1/2)(4)(5) = 10$ cm^2.
Answer: Right triangle; area 10 cm^2.



Practice Problems

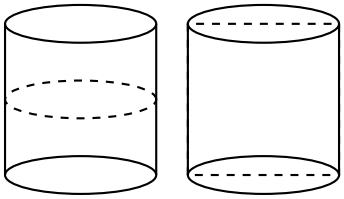
Show your thinking.

1. A right rectangular prism is 7 cm long and 3 cm wide. A cut parallel to its length-by-height face has area 35 cm^2. Recover the prism height and explain why the width is not needed.



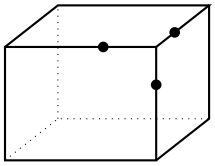
schematic cut

2. A right cylinder has radius 3 cm and height 5 cm. Compare a base-parallel cut and a cut through the axis. Name both shapes, give their exact areas, and use $\pi \approx 3.14$ to decide which area is greater.

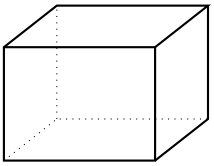


schematic cut schematic cut

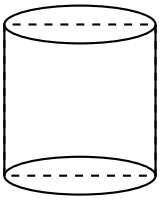
3. A plane crosses exactly the three marked edges near one vertex of a cube, without hitting the vertex. A student expects a square because the faces are squares. What shape results, and what kind of cut would give a square instead?



4. A box is 8 cm long, 5 cm wide, and 5 cm high. A face-parallel cut has area 40 cm^2. Which face orientations could produce it? Can you tell which one was used?

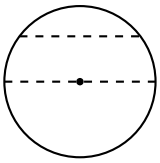


5. A plane through the axis of a right cylinder gives a 10 cm by 6 cm rectangle. The 6 cm edge is the cylinder height. Find the radius and the exact area of a different section cut parallel to the base.



schematic cut

6. A right cylinder has radius 5 cm and height 7 cm. One vertical cut passes through the axis. A second, parallel cut meets the base along an 8 cm chord. Name both section shapes and find how much larger the central section is.



base view

Answer Key

1. Height 5 cm; the 3 cm width is perpendicular to the section.
2. Circle 9π cm^2; rectangle 30 cm^2. The rectangle is larger.
3. Triangle. A cut parallel to a cube face would give a square.
4. Length-by-width or length-by-height; the area does not select one.
5. Radius 5 cm; the base-parallel section has area 25π cm^2.
6. Both are rectangles. The central section is 14 cm^2 larger.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The cut is a rectangle with length 7 cm and unknown height h.

2. Use $7h = 35$ to get $h = 35/7 = 5$ cm.

3. The 3 cm width points across the plane, not along an edge of the cut.

Problem 2

1. The base-parallel section is a circle of radius 3 cm, with area 9π cm^2.

2. The axial section is a rectangle of width $2(3) = 6$ cm and height 5 cm, with area $6(5) = 30$ cm^2.

3. Using 3.14 for π, the circle has area about 28.26 cm^2, less than 30 cm^2.

Problem 3

1. The plane meets the 3 marked edges at 3 distinct points, one on each edge.

2. Those points are the vertices of the section. Joining the 3 vertices gives a triangle, not a square.

3. A plane parallel to a face and passing inside the cube would have the same 4-sided square outline as the face.

Problem 4

1. A base-parallel cut has area $8(5) = 40$ cm^2.

2. A length-by-height cut also has area $8(5) = 40$ cm^2.

3. A width-by-height cut has area $5(5) = 25$ cm^2. Two different orientations match the given area.

Problem 5

1. The axial section spans the full base diameter, so the 10 cm edge is the diameter.

2. The radius is $10/2 = 5$ cm.

3. A base-parallel section is a circle of that radius, with area $\pi(5)^2 = 25\pi$ cm^2.

Problem 6

1. Both cuts extend through the 7 cm height. Their widths are the chords where they meet the base.

2. The central chord is the diameter $2(5) = 10$ cm, so the central rectangle has area $10(7) = 70$ cm^2.

3. The other rectangle has area $8(7) = 56$ cm^2. The difference is $70 - 56 = 14$ cm^2.

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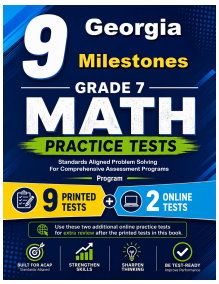

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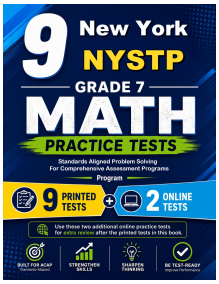

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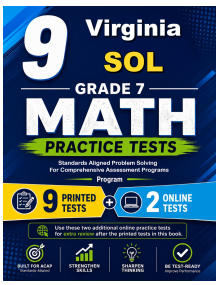

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