Cross-Sections of Three-Dimensional Figures

Apply the skill to decisions and designs

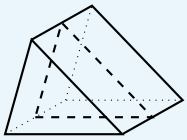
Name _____ **Date** _____ **Score** _____ / 6

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.

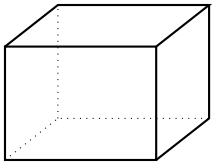


1. The plane is parallel to an end, so the cross-section has the same 3-sided outline.
2. Its perpendicular legs are the original 4 cm and 5 cm.
3. Use the triangle area formula: $(1/2)(4)(5) = 10$ cm^2.
Answer: Right triangle; area 10 cm^2.

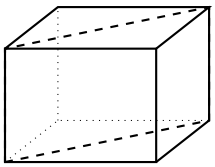
Practice Problems

Show your thinking.

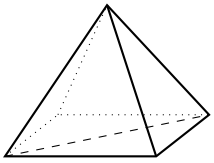
1. A box is 9 cm long, 6 cm wide, and 4 cm high. Choose the largest face-parallel divider that can be made from at most 40 cm^2 of material, ignoring cutting layout. Give the cut orientation and dimensions.



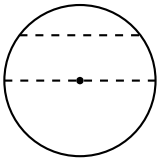
2. A divider in a 5 cm cube must be at least 6 cm wide and use at most 40 cm^2. Choose a vertical cut parallel to a side face or a vertical cut along a base diagonal. Use 7.07 cm as the diagonal estimate.



3. A right square pyramid needs a triangular panel spanning its tip and two opposite corners of the base. Choose a plane parallel to the base or a vertical plane through a base diagonal. Explain what forms the three edges of the panel.

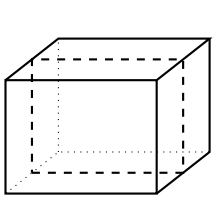


4. A fabricator wants a 6 cm square section from a vertical cut in a right cylinder of radius 4 cm and height 6 cm. Can a central or offset vertical cut work? Specify the base chord needed.

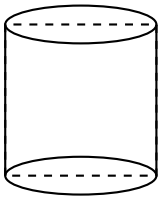


base view

5. A solid is either a right rectangular prism or a right circular cylinder. One vertical cut gives a rectangle. A cut parallel to the base gives a region with no corners. Which solid is it? Explain why the vertical cut alone does not decide.

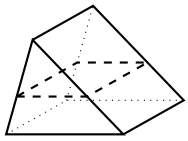


schematic cut



schematic cut

6. A right triangular prism is 8 cm long. A plane starts with a 3 cm segment joining two sides of one triangular end and runs straight along the length. Choose a rectangular panel or a triangular panel of the same area. Give the dimensions of the required panel.



Answer Key

1. Parallel to the length-by-height face; 9 cm by 4 cm, area 36 cm^2.
2. Use the diagonal cut: about 7.07 cm by 5 cm and 35.35 cm^2.
3. Use the vertical plane through the diagonal. The edges are the diagonal and two sloping edges to the tip.
4. Yes, use an offset cut through a base chord 6 cm long.
5. Right circular cylinder. Both solids can give a rectangle, but only the cylinder gives a circle.
6. Rectangular panel, 3 cm by 8 cm.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The length-by-width section needs $9(6) = 54$ cm^2, above the limit.

2. The other sections need $9(4) = 36$ cm^2 and $6(4) = 24$ cm^2.

3. 36 is the larger area below 40, so choose the length-by-height section.

Problem 2

1. A vertical cut parallel to a side face gives a 5 cm by 5 cm square, too narrow.

2. The diagonal plane goes straight up from the base diagonal. Its section is a rectangle about 7.07 cm wide and 5 cm tall.

3. The width clears 6 cm, and using the estimate gives area $7.07(5) = 35.35$ cm^2, below 40 cm^2.

Problem 3

1. An interior cut parallel to the square base has 4 sides and misses the tip.

2. The vertical plane through the diagonal contains the 2 opposite base corners and the tip, which is above the center.

3. The diagonal is one side of the triangle. The 2 pyramid edges from its endpoints to the tip are the other sides.

Problem 4

1. A central cut is $2(4) = 8$ cm wide and 6 cm high, so it is not square.

2. Moving the vertical plane away from the axis shortens its base chord from 8 cm toward 0 cm, without changing the 6 cm height.

3. Choose a chord of length 6 cm, giving a 6 cm by 6 cm square.

Problem 5

1. The first cut has 4 sides. A face-parallel vertical prism cut and an axial cylinder cut can both make rectangles.

2. A base-parallel cut in a rectangular prism has 4 corners, like its base.

3. A circular base-parallel cut has 0 corners, so the second cut identifies the cylinder.

Problem 6

1. The 3 cm segment crosses the end, and the 8 cm prism edges run perpendicular to that end.

2. The cut carries the segment through the full 8 cm length, giving a 3 cm by 8 cm rectangle.

3. The rectangle has area $3(8) = 24$ cm^2. A triangular panel of that area still has the wrong outline.

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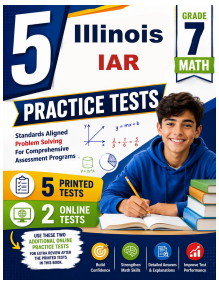

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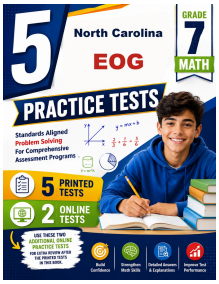

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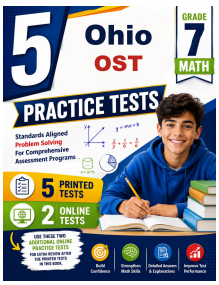

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