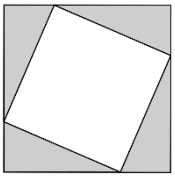
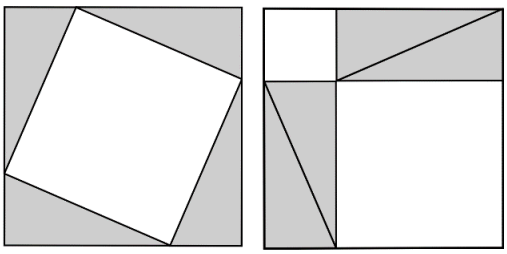
Pythagorean Theorem

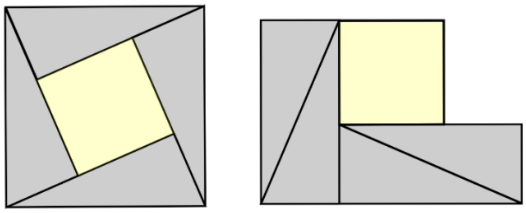
1. Use the picture (right) to prove the Pythagorean Theorem. You will need to use some algebra to justify the theorem.



2. Explain one of the "proofs without words" of the Pythagorean Theorem using this picture. Don't use algebra.



3. Explain another "proof without words" of the Pythagorean Theorem using this picture. Don't use algebra.

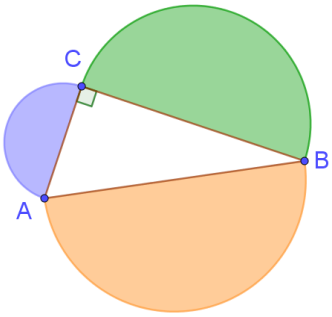


4. Formulate a generalization of the Pythagorean theorem that would help you solve the following problem:

   Decide if a triangle with the following side lengths is acute, right or obtuse:

   a. 10, 15, 19; b. 14, 8, 12; c. 8, 10, 6. (https://www.geogebra.org/m/tyDEfT51)

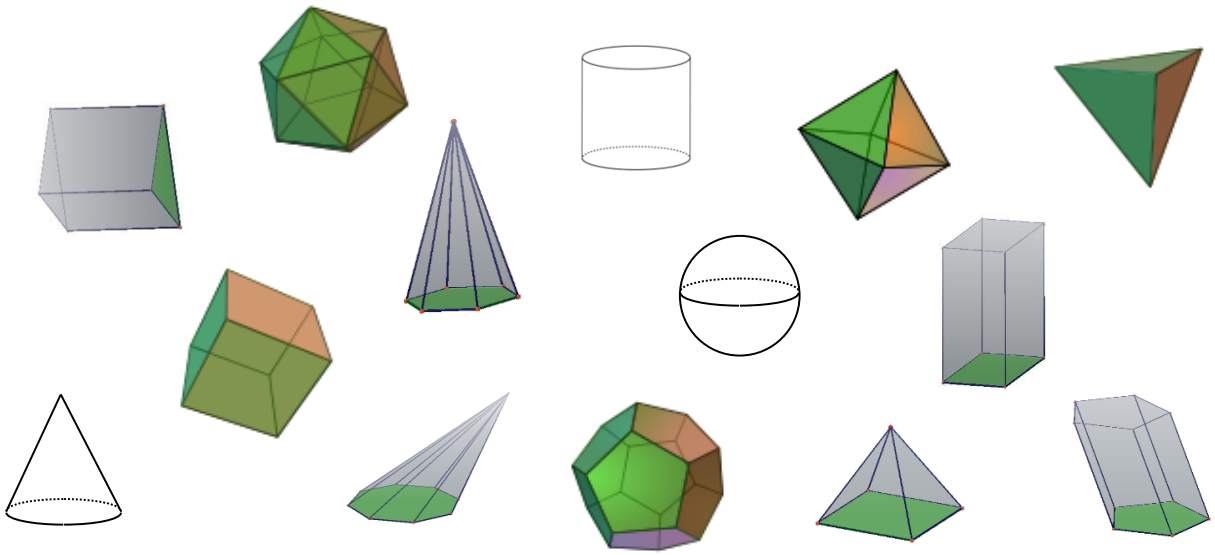
5. Formulate the theorem in terms of the areas of certain squares. Observe the picture below and explain how it can be generalized to include other shapes. What shapes would work?



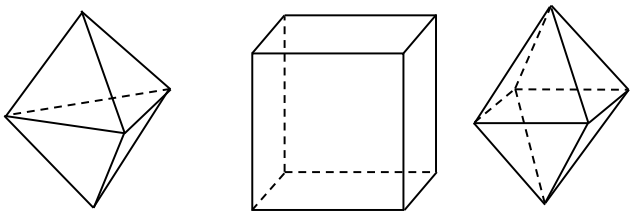
Solids and measurement in 3D

Classification of solids

6. Name the solids depicted in the following picture. Be as specific as you can (don't just state "pyramid"; specify what kind of pyramid it is). Sort out the solids using categories *polyhedron*, *prism*, *pyramid* and *platonic solid*. (Note: Some do not belong to any category and some may belong to more than one group).



7. Sketch a cube. Sketch a triangular prism. Sketch a square pyramid. Sketch a cone and cylinder.
8. Name all Platonic Solids and describe them. Provide the number and shape of their faces).
9. Are the depicted solids regular, semiregular, or none of the above? Explain. (All faces in the depicted solids are regular polygons: equilateral triangles and squares)
10. Right prisms, oblique prisms and antiprisms. What property makes them "a prism"? What important property distinguishes them?



Nets and Cross sections

(You will be allowed to use paper and scissors and/or the Polydron set on the exam.)

11. What is a net of a solid? Draw 5 different nets of a cube. Draw a net of a tetrahedron. Draw a net of a square pyramid.
12. How many different nets does a cube have? Decide if the following patterns are nets of a cube. If it is not a net of a cube, provide a brief justification. https://www.geogebra.org/m/EBiXpAvn
13. Identify solids if given their nets. https://www.geogebra.org/m/pstiFBiv

14. Draw a net of a cylinder and two “different” nets of a cone. How about a sphere? Does it have a net? Explain.

The following two questions will not be included in the chapter test. They will be discussed on the last day and may be included on the final exam.

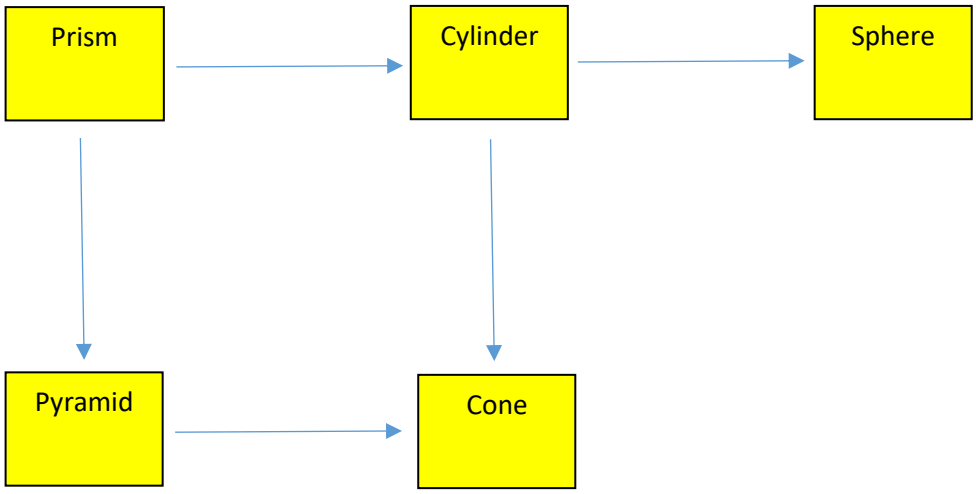
15. Decide if a cross-section of a cube can form the following polygons. If it can, sketch a picture. https://www.geogebra.org/m/T89bENMC
    a. Equilateral triangle?
    b. Regular hexagon?
    c. Rectangle that is not a square?
    d. Square?
16. Describe cross sections of a cone. http://tube.geogebra.org/student/m881499

Volume and Surface Area

You should be familiar with basic formulas for the volume and surface area. The focus is on understanding how these formulas are developed and their proper application.

Volume

17. Explain why the volume of a prism can be calculated as the area of the base x height. How can the formula be explained by using “cube buildings”?
18. Based on the above, explain why the volume of a rectangular prism can be calculated as length x width x height .
19. The chart below shows the relationships between the volume formulas of various solids.
    a. Write the volume formula for each of the solids.
    b. Arrows represent certain ways of deriving these formulas. Explain each of the arrows showing work as necessary. For example, to explaining the arrow from Cylinder to Sphere, you would briefly explain an experiment and then use algebra to arrive at the sphere volume formula.



Surface Area

20. Explain the formula for the surface area of a rectangular prism 2(wl+hl+hw).
21. Derive the formula for the surface area of a cylinder.
22. Explain (or derive) the formula for the surface area of a cone.
23. There is interesting relationship between the surface area of a cylinder and its inscribed sphere. Use it to derive the surface area formulas for a sphere.
24. Describe an activity, in which students could discover the sphere surface area formula without any algebraic derivation.

Application problems

25. You should be able to apply formulas to calculate the volume and surface areas of various solids:
    a. https://www.geogebra.org/m/zYyzFC8n
    b. https://www.geogebra.org/m/O1LxLka2
    c. https://www.geogebra.org/m/r1yEzrBp
    d. https://www.geogebra.org/m/q1QJSbbq
    e. https://www.geogebra.org/m/SoeYq9xX