

Name: _____

Mathematics 110 - Fall 2005
Lab Four - The Platonic Solids

Pre-lab: Cut fifteen of the straws in your kit exactly in half. The kit booklet contains a template to help you make accurate cuts.

A **polygon** is a two-dimensional object made up of three or more points joined together by straight line segments; common examples are triangles and quadrilaterals. A polygon is **regular** if its sides are all of equal length and its angles are all of equal measure; a common example is a square.

Exercise 1: Regular Polygons.

- (a) In the space provided, draw a regular triangle, a regular quadrilateral, a regular pentagon, and a regular hexagon.

- (b) How many regular polygons could you draw that are different from the ones above (and from each other)?

As curious mathematicians, we wonder if the answer to part (b) above remains the same in three dimensions. To investigate this question, we need to look at regular solids.

A **regular solid** (or **regular polyhedron**) is a three-dimensional object made up of several regular polygons attached at their edges in such a way that every vertex (corner) looks the same (same number of edges meeting at the vertex). The Greeks were very interested in such objects, so regular solids are often called **Platonic solids**.

Exercise 2: A Common Platonic Solid. A well-known example of a Platonic solid is the **cube** or **hexahedron**. It is made up of six faces, each a regular quadrilateral (square).

- (a) How many faces does the cube have?
- (b) How many vertices does the cube have?
- (c) How many edges does the cube have?

Exercise 3: Constructing More Platonic Solids. By using the pipe cleaners to connect the red tubes provided in your kit, construct the following regular solids. As you do so, fill in the table on the next page. Some of these will take a while to put together, so you may want to divide them up among the members of your group.

- (a) the **tetrahedron**, made up of four regular triangles
- (b) the **octahedron**, made up of eight regular triangles (Hint: it looks like two square-based pyramids attached together at their bases.)
- (c) the **dodecahedron**, made up of twelve regular pentagons (Hint: three edges meet at each vertex.)
- (d) the **icosahedron**, made up of twenty regular triangles (Hint: five edges meet at each vertex.)

	vertices	edges	faces	edges per vertex	edges per face
tetrahedron					
cube					
octahedron					
dodecahedron					
icosahedron					

Exercise 4: Finding Patterns, Making Connections, and Looking Ahead.

(a) What do you notice about the table entries for the cube and the octahedron?

(b) What do you notice about the table entries for the dodecahedron and the icosahedron?

(c) For each of the Platonic solids in the table, compute the value of the **Euler** (pronounced “oiler”) **characteristic**. This is equal to the expression $vertices - edges + faces$.

(d) How many more Platonic solids do you think there are?