Math 113 homework due 2/13

> *We could present spatially an atomic fact which contradicted the laws of physics, but not one which contradicted the laws of geometry.*
>
> – Wittgenstein

(1) Build (yes, physically, out of paper or whatever[1]) either a dodecahedron, an icosahedron, or an octahedron. There are "nets" (things that you can fold up to make the solid) that you can copy on pages 353-355 of the course notes.

(2) Enumerate the types of symmetries of the solid that you built, (types of flips and rotations) as we did in class with the cube.

(3) Count how many possible symmetries there are, like we did in class, using the argument "vertex 1 can go anywhere, then there are X many options for vertex 2..."

(4) (not to hand in) By moving around your polyhedron, convince yourself that you really can achieve any of the positions that you counted in the previous question. (i.e. you can move vertex 1 anywhere, then rotate...). You will have to imagine what a "flip" looks like.

(5) Suppose you number the vertices of the polyhedron that you built. Why can you not physically move it into a position as the vertices would be after a flip?

(6) Look at the cube at the top of page 325 of the course notes. What is the permutation that corresponds to doing a flip through a horizontal plane? (that would be a plane that slices through each of the vertical edges of the cube)

(7) Draw the image of the cube after doing this permutation $\begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\ 2 & 3 & 4 & 1 & 7 & 8 & 6 & 5 \end{pmatrix}$
Does this come from having done a symmetry of the cube? If so, which one? If not, why not?

(8) To be worked on in tutorial:
a) Find some patterns in the n-dimensional cubes. How many edges are connected to each vertex of an n-dimensional cube? How many vertices and edges are there in total?
b) [optional/challenge] Find the corresponding pattern for the triangle – tetrahedron – *simplex* version

** Don't forget to get started on your independent project **

[1] gingerbread? you might want to see this: http://www.math.uchicago.edu/undergraduate/math112.shtml (scroll down to the bottom of the page)