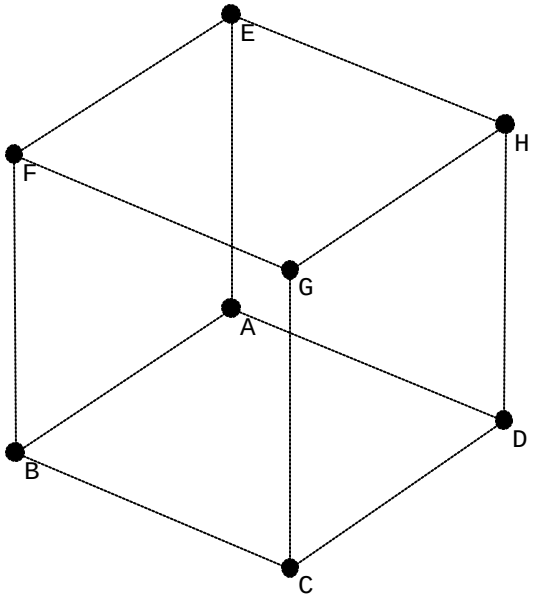
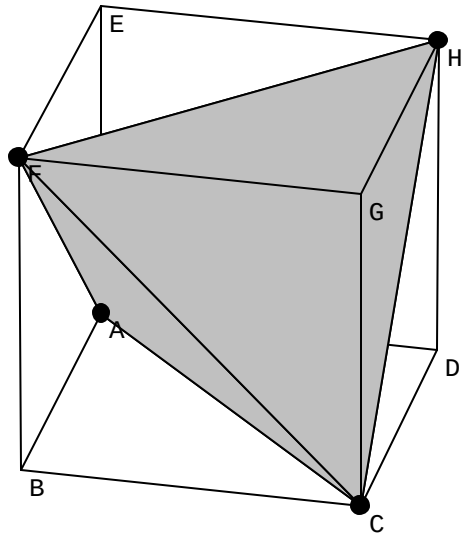
COORDINATES FOR THE PLATONIC SOLIDS

Let's form a cube so that the two opposite vertices, A and G, below, have coordinates A(-1,-1,-1) and G(1,1,1). Determine the coordinates of the remaining vertices.

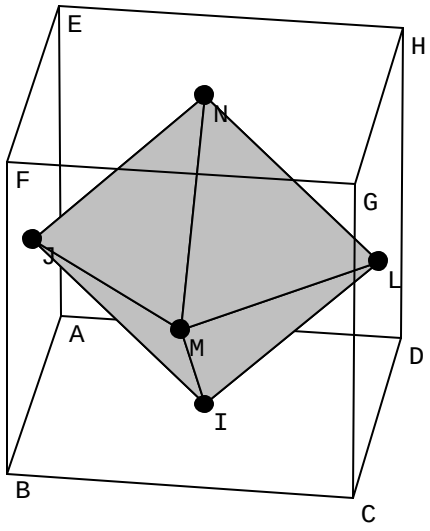
You can view this picture as a Wingeom file cube.wg3. If you have a computer with a Windows operating system go to the website http://math.exeter.edu/rparris/wingeom.html and download Wingeom (click "Wingeom" in the upper left corner). Click the downloaded file to install it. Then download the file cube.wg3 from the course website. Start the program Wingeom. Select Window→2-dim. Select File→Open. Select the file cube.wg3. You can then use the arrow keys to turn it around.



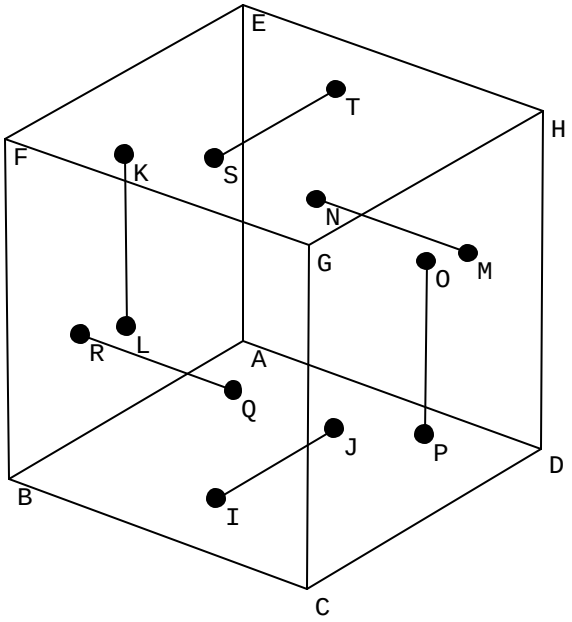
Now you can construct a regular tetrahedron by using “every other” vertex of the cube. Download and view the file tetrahedron.wg3.



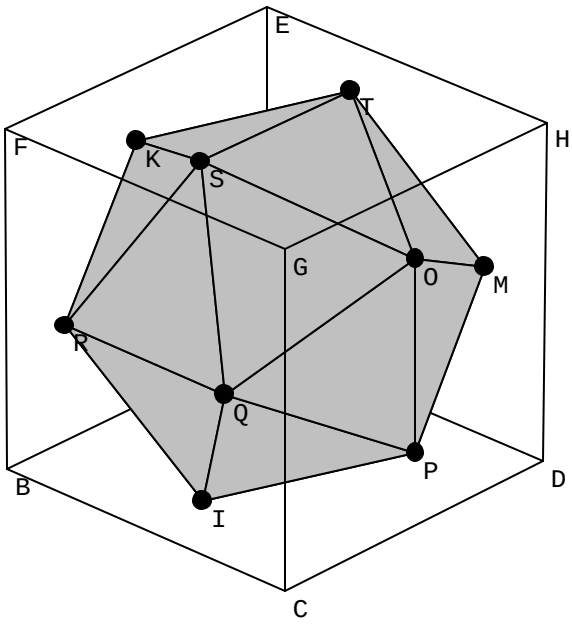
The vertices of an octahedron can be taken to be the centers of the six squares of the cube. The following comes from the file octahedron.wg3.



The icosahedron is trickier. First, center six line segments in each of the six faces of the cube as shown below. For example, the coordinates of the points I and J will be I(t,0,-1) and J(-t,0,-1), where t is a positive number between 0 and 1 yet to be determined. Similarly, the coordinates of the points K and L will be K(0,-1,t) and L(0,-1,-t) for the same value of t. The following comes from the file preicosahedron.wg3.



The goal is to determine the value of t so that when the points are joined as shown below, each of the resulting triangles is equilateral. Calculate the value of t. The picture comes from the file icosahedron.wg3.



Once you have the coordinates of the vertices of the icosahedron, the vertices of the dodecahedron can be taken to be the centers of each of the icosahedron's triangles. You can get the coordinates of such a center point by averaging each of the coordinates of the vertices of the triangle. The following comes from the file icosahedron2.wg3.