Name: _____

Graphing in 3D with Geogebra

In this activity, we will explore how to use Geogebra for 3D graphing. To start go to https://geogebra.com/3d. For each problem below, when you are asked to do something on Geogebra, take a screenshot of what you entered at what you got out and submit that as your "answer" for the question. Some questions also ask you to do some additional work.

1. First, let's plot some points. To plot a point, enter its coordinates in parentheses separated by commas. Plot four points. Each one should be in a different octant.

2. Pick two points that appear to be the farthest distance from each other and compute that distance. (Not using Geogebra)

3. Let's check what you got before. Click on the Tools menu (Circle and Triangle) and then click More. Scroll down to measure and click Distance and Length. Click the two points and it will output the distance between them. Or, you can draw the line segment between them and it will output the length of that line segment. Do both of these. Did you get the right thing above?

4. Now, let's graph some surfaces. Recall that the equation of a sphere centered at the origin of radius r is

$$x^2 + y^2 + z^2 = r^2.$$

   Let's explore more general spheres. A general sphere can be written as

$$x^2 + ax + y^2 + by + z^2 + cz = d^2.$$

   Enter this into Geogebra. It will automatically create sliders for you for a, b, c, and d. Move those sliders around and see how that changes the sphere. Does each one change the center, the radius or both? Can you explain why? (Think about completing the square). What is the more standard way of writing the general equation of a sphere.

5. Now, let's explore some conic sections. Recall, you get a conic section by intersecting a cone and a plane. We will see soon that a plane has a general equation of

$$ax + by + cz = d.$$

   Enter this into Geogebra. (If you haven't already, you might want to get rid of the stuff from previous questions. To do this, either click the three dots on the right and delete or click the dot on the left to hide the graph). Move the a, b, c and d sliders around to see how these change the plane. What needs to be done to get a plane that passes through the origin? Why?

6. The equation of a (specific) cone through the origin is

$$x^2 + y^2 = z^2.$$

   Put this into Geogebra. Be sure the plane is still there. Then go to the Tools menu and click Intersect Two Surfaces. This will highlight the curve of intersection between the two. Now go back to the Algebra Menu and move the sliders around to get the different conic sections. (Circle, ellipse, hyperbola, parabola, and the degenerate ones: one point, two intersecting lines). Record the values of a, b, c and d that give each and a screenshot of each one. Note: the parabola is tough to get. You need the plane to be exactly parallel to the side of the cone.