**Introduction to graphing in 3D**

Similar to graphing in 2D, graphing in 3D has its own notations and coordinate system. Recall that the 1D coordinate system is denoted by  and the 2D coordinate system is denoted by and has coordinates (x, y). For the 3D coordinate system, it is often denoted as  with the following coordinate system:



Note that this is the standard placement of the axes. The axes are shown in the positive direction, and extended in the appropriate direction if the negative axes are needed.

The general point P is denoted as (x, y, z) and sits in the general 3D space. If a point lies in the purple region (point S), it is in the xz-plane and has points denoted by (x, 0, z). If a point is in the blue region (point R), it is in the yz-plane and has points denoted by (0, y, z). Building on our previous knowledge of the 2D coordinate system, points in the yellow region (points Q) are in the xy-plane and are now denoted by (x, y, 0). The xz, yz and xy planes are sometimes known as the coordinate planes.

Example 1

Graph x= 2 in ℝ, ℝ2, and ℝ3

In ℝ, x= 2 is represented as a point on a line



In, ℝ2, x=2 is represented as a line on the graph



Finally, in ℝ3, x=2 is represented as a plane. This plane extends infinitely in the x, y and z direction.



Activity: Graphing the Stars in 3D

Use a sheet of graphing paper. Draw the x, y, and z axes on the graph.

Note- The z-axis is usually a line drawn vertically on the page. Unlike in 2D, the y-axis is horizontal to the page. Finally, the x-axis is drawn diagonally from the origin.

Plot the following stars on a single grid, using 3 dimensional coordinates.

|  |  |  |  |
| --- | --- | --- | --- |
| **Star** | **X** | **Y** | **Z** |
| Sun | 0.0 | 0.0 | 0.0 |
| Sirius | -3.5 | -3.0 | 7.0 |
| Alpha Centauri | -2.0 | 0.0 | 4.0 |
| Wolf 359 | 4.0 | 4.5 | 5.0 |
| Procyon | -1.0 | 5.5 | -8.0 |
| Tau Ceti | -7.0 | -8.5 | 2.5 |
| Zubenelgenubi | -16.0 | -8.0 | 9.0 |

If the resources are possible, use the following link to plot the points:

<http://hotmath.com/learning_activities/interactivities/3dplotter.swf>

Questions

1. Which star looks the closest to the Sun? Which star looks the farthest?
* The closest star is Alpha Centauri
* The farthest star is Zubenelgenubi
1. Is this method of graphing more accurate than two-dimensional graphing? Less accurate? Explain your thinking.
* Answers may vary
* More accurate because it takes into account that space is in a three-dimensional region
1. How could you calculate the distance between the stars? Predict a method using your previous knowledge.
* Answers may vary
* Utilize a formula similar to the Pythagorean Theorem from two-dimensional planes.

Formula: **d=** 