Distance between points in three dimensions

Given two points A and B in three-dimensional space,

$$A(x_1, y_1, z_1)$$

$$B(x_2, y_2, z_2)$$

we can calculate the distance between them using the distance formula.

$$D = \sqrt{\left(x_2 - x_1\right)^2 + \left(y_2 - y_1\right)^2 + \left(z_2 - z_1\right)^2}$$

It doesn't matter which point is A and which point is B. The fact that the square the differences inside the square root means that all of our values will be positive, which means we'll get a positive value for the distance between the points.

Example

Use the distance formula to

1. Find the distance between $(0,1,3)$ and $(-1,4,5)$.
2. Say which of $(0,1,3)$ and $(-1,4,5)$ lies in the yz-plane.
3. Say which of $(0,1,3)$ and $(-1,4,5)$ is closer to the xy-plane.

For the first part of the question, we'll use the distance formula to calculate the distance between the points.

$$D = \sqrt{\left(x_2 - x_1\right)^2 + \left(y_2 - y_1\right)^2 + \left(z_2 - z_1\right)^2}$$

$$D = \sqrt{(-1 - 0)^2 + (4 - 1)^2 + (5 - 3)^2}$$

$$D = \sqrt{1 + 9 + 4}$$

$$D = \sqrt{14}$$

For the second part of the question, we need to realize that in order for a point to be in the yz-plane, its x-coordinate must be 0. With that in mind, we can say that $(0,1,3)$ lies on the yz-plane, and that $(-1,4,5)$ does not lie in the yz-plane.

For the third part of the question, we need to realize that the z-value of the coordinate point will tell us how far the point is from the xy-plane. So if we just take the absolute value of the z-coordinate for each of our points, we'll be able to say which one is closer.

Point $(0,1,3)$ has $|z| = |3| = 3$

Point $(-1,4,5)$ has $|z| = |5| = 5$

Since the absolute value of z in the point $(0,1,3)$ is less than the absolute value of z in the point $(-1,4,5)$, we can say that $(0,1,3)$ is closer to the xy-plane.