3-5 Linear Equations in Three Dimensions

Objective

Graph points and linear equations in three dimensions.

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Vocabulary

three-dimensional coordinate system
ordered triple
z-axis

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3-5 Linear Equations in Three Dimensions

A Global Positioning System (GPS) gives locations using the three coordinates of latitude, longitude, and elevation. You can represent any location in three-dimensional space using a **three-dimensional coordinate system**, sometimes called *coordinate space*.

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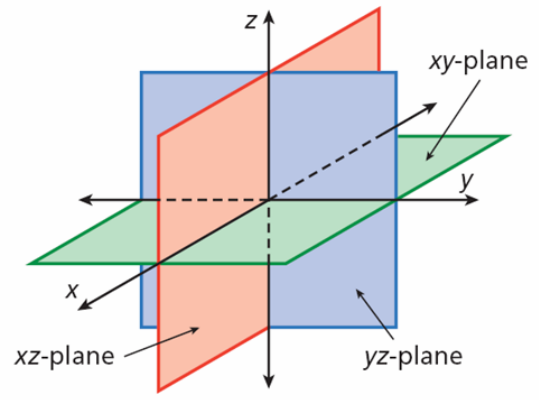
Each point in coordinate space can be represented by an **ordered triple** of the form (x, y, z). The system is similar to the coordinate plane but has an additional coordinate based on the ***z*-axis**. Notice that the axes form three planes that intersect at the origin.



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Helpful Hint

To find an intercept in coordinate space, set the other two coordinates equal to 0.

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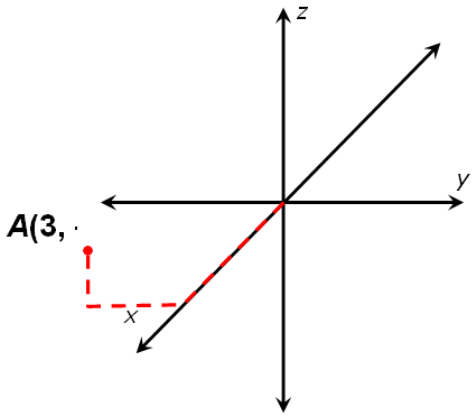
Example 1A: Graphing Points in Three Dimensions

Graph the point in three-dimensional space.

***A*(3, –2, 1)**

From the origin, move 3 units forward along the *x*-axis, 2 units left, and 1 unit up.



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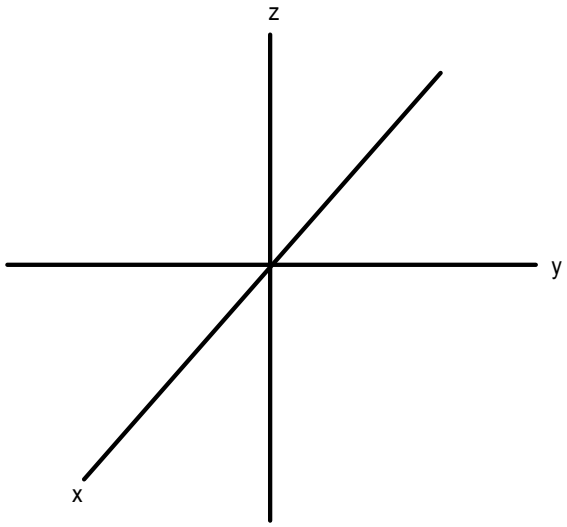
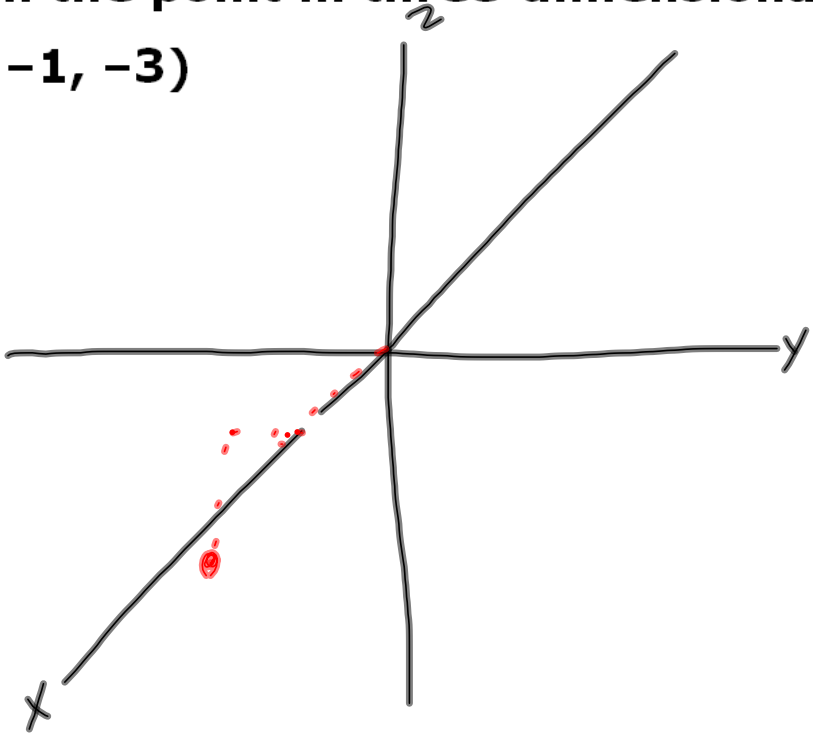
To graph these points notice that the positive direction is where your axis' are labeled. It is important you don't go the wrong way!



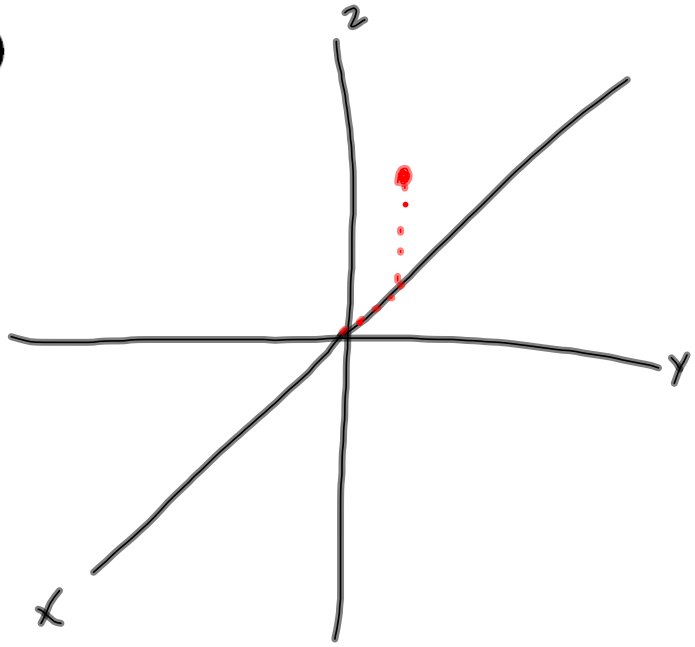
Graph the point in three-dimensional space.

***B*(2, −1, −3)**



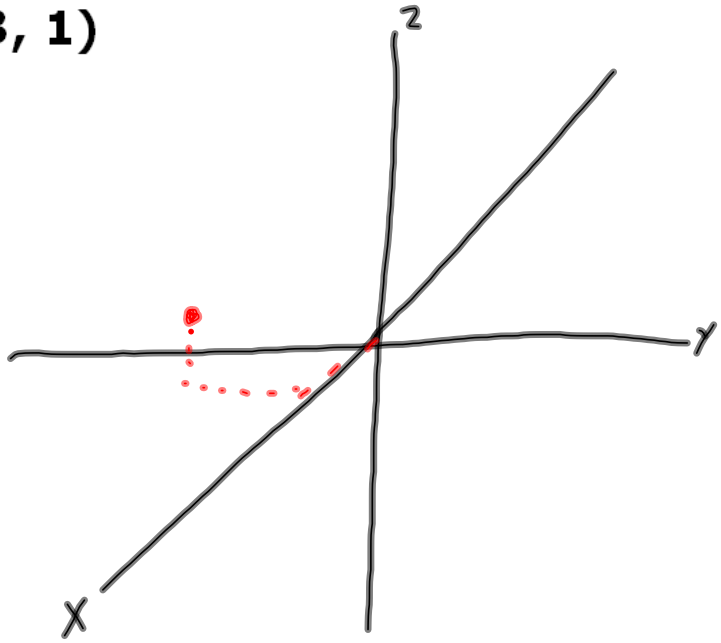
Graph the point in three-dimensional space.

$C(-1, 0, 2)$



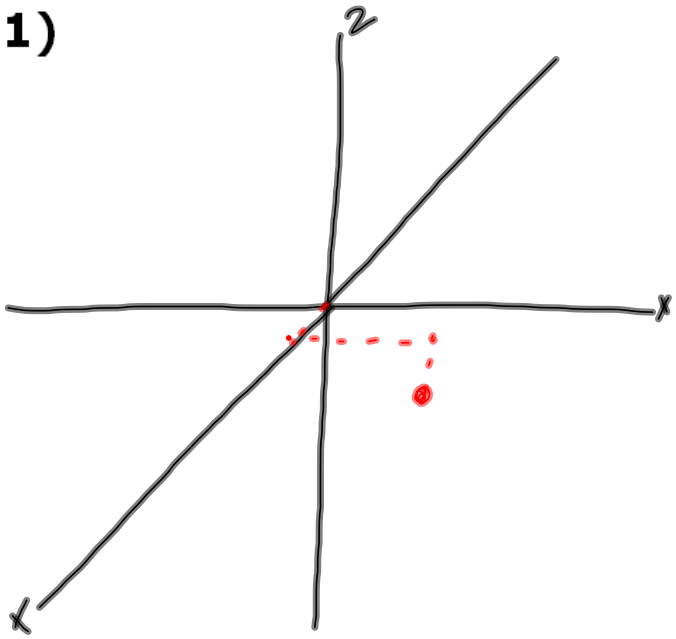
Graph the point in three-dimensional space.

$E(1, -3, 1)$



Graph the point in three-dimensional space.

$D(1, 3, -1)$



3-5 Linear Equations in Three Dimensions

Recall that the graph of a linear equation in two dimensions is a straight line. In three-dimensional space, the graph of a linear equation is a plane. Because a plane is defined by three points, you can graph linear equations in three dimensions by finding the three intercepts.

1) Find the intercepts
2) Plot them
3) Use those 3 points to form your plane

Graph the linear equation $2x - 3y + z = -6$ in three-dimensional space.

X-int:
$2x - 3(0) + 0 = -6$
$2x = -6$
$x = -3$ $(-3, 0, 0)$

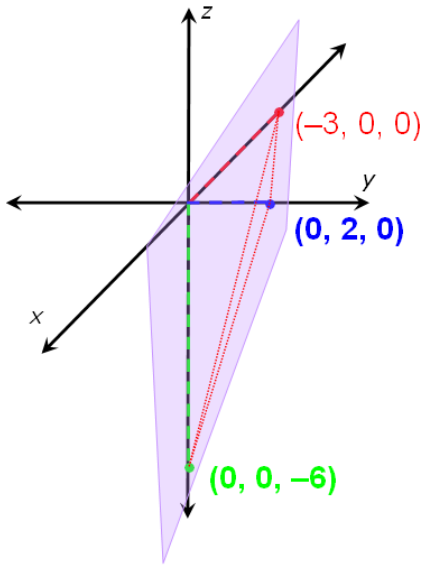
Y-int:
$2(0) - 3y + 0 = -6$
$-3y = -6$
$y = 2$ $(0, 2, 0)$

Z-int:
$2(0) - 3(0) + z = -6$
$z = -6$ $(0, 0, -6)$

3-5 Linear Equations in Three Dimensions

Example 2 Continued

Step 2 Plot the points (–3, 0, 0), (0, 2, 0), and (0, 0, –6). Sketch a plane through the three points.

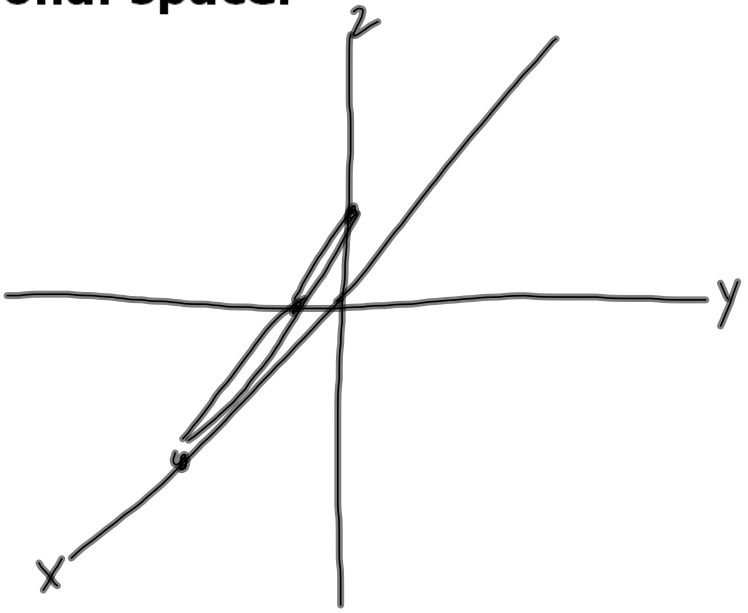


Graph the linear equation $x - 4y + 2z = 4$ in three-dimensional space.

X-int:
$x = 4$ (4, 0, 0)

y-int:
$y = -1$ (0, –1, 0)

z-int:
$z = 2$ (0, 0, 2)



Write a 3-dimensional equation for your partner. Have them graph it.

Track relay teams score 5 points for finishing first, 3 for second, and 1 for third. Lin's team scored a total of 30 points.

Write a linear equation in three variables to represent this situation.

$5x + 3y + z = 30$

If Lin's team finishes second in six events and third in two events, in how many events did it finish first?

$$30 = 5x + 3(6) + 2$$
$$30 = 5x + 18 + 2$$
$$30 = 5x + 20$$
$$10 = 5x$$
$$x = 2$$

Steve purchased \$61.50 worth of supplies for a hiking trip. The supplies included flashlights for \$3.50 each, compasses for \$1.50 each, and water bottles for \$0.75 each.

Write a linear equation in three variables to represent this situation.

$$3.50x + 1.50y + .75z = 61.50$$

Steve purchased 6 flashlights and 24 water bottles. How many compasses did he purchase?

x

z

$3.50(6) + 1.50y + .75(24) = 61.50$

$y = 15$

Homework:

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