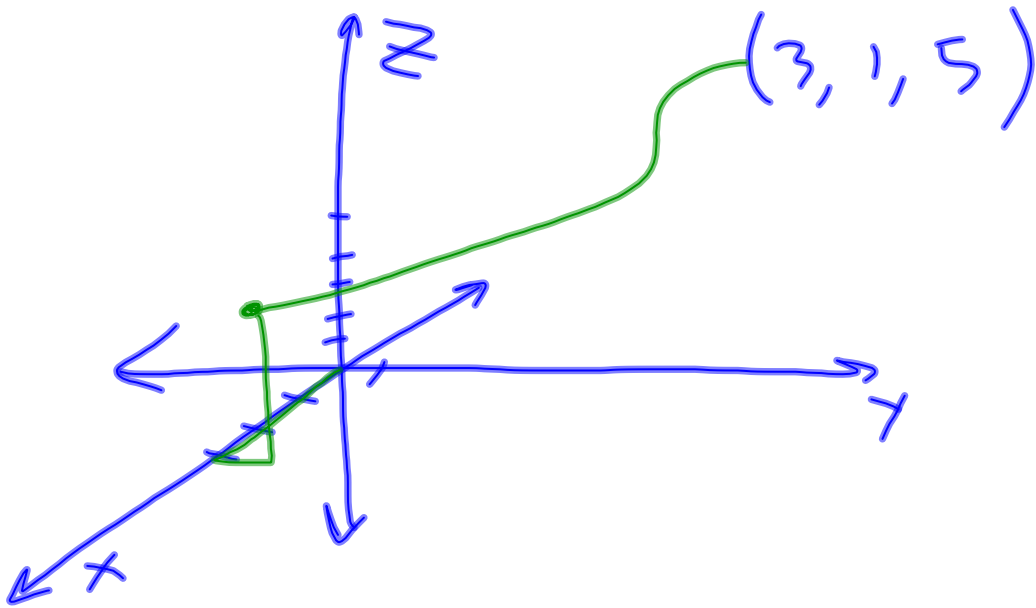## 10-1   The Three Dimensional Coordinate System

Distance formula in space:

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

Midpoint formula in space:

$$M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2} \right)$$
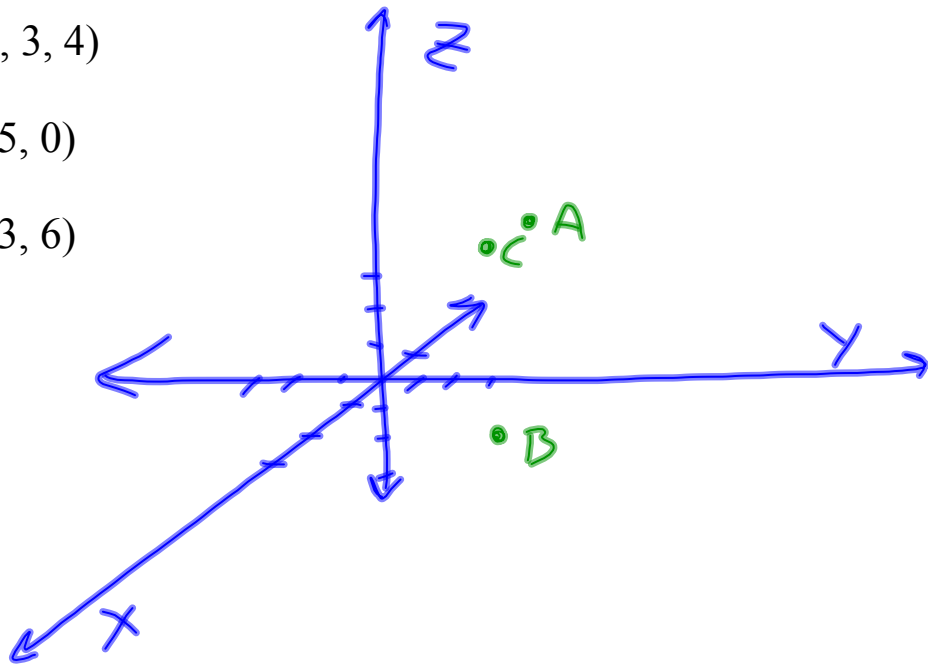
Equation of a sphere:

$$(x - h)^2 + (y - k)^2 + (z - j)^2 = r^2$$

Ex 1   Plot each point:

A (-1, 3, 4)

B (2, 5, 0)

C (1, 3, 6)

Ex 2   Find the distance between (-1, 4, 1) and (2, 5, -6).

$$D = \sqrt{(2--1)^2 + (5-4)^2 + (-6-1)^2}$$

$$d = \sqrt{3^2 + 1^2 + -7^2}$$

$$d = \sqrt{9+1+49}$$

$$d = \sqrt{59} \approx 7.7$$

Ex 3   Find the distance between (7, 4, 8) and (3, 2, -5).

$$d = \sqrt{(3-7)^2 + (2-4)^2 + (-5-8)^2}$$

$$d = \sqrt{16 + 4 + 169}$$

$$d = \sqrt{189} \approx 13.7$$

Ex 4   Find the standard equation of the sphere with center (1, 5, -2) and radius 4.

$$(x-1)^2 + (y-5)^2 + (z+2)^2 = 16$$

Ex 5   Find the standard equation of the sphere with
        center (-5, 8, 0) and radius 7.

$$(x+5)^2 + (y-8)^2 + z^2 = 49$$

Ex 6   Find the center and radius of the sphere given by

$$x^2 + y^2 + z^2 + 4x - 2y + 8z + 10 = 0$$

$$\left(x^2 + 4x + \underline{4}\right) + \left(y^2 - 2y + \underline{1}\right) + \left(z^2 + 8z + \underline{16}\right) = -10$$

$$\begin{array}{c} +4 \\ +1 \\ +16 \end{array}$$

$$(x+2)^2 + (y-1)^2 + (z+4)^2 = 11$$

$$C: (-2, 1, -4)$$

$$r: \sqrt{11}$$

Ex 7   Find the center and radius of the sphere given by

$$x^2 + y^2 + z^2 - 4x + 2y - 6z + 10 = 0$$

$$(x-2)^2 + (y+1)^2 + (z-3)^2 = 4$$

$$C: (2, -1, 3)$$

$$r: 2$$

Practice

Find the equation of the sphere that has the points (3, -2, 6) and (-1, 4, 2) as endpoints of a diameter.