

**MATH 233 LECTURE 1 (§§12.1-2):  
VECTORS IN 3-SPACE**

**Points.**

- rectangular (Cartesian) coordinates of points in 3-space:  $P(x, y, z)$ .
- distance between points:  $|P_1P_2| = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$

**Spheres.**

- standard form for the equation of a sphere with center  $(a, b, c)$  and radius  $r$ :  
 $(x - a)^2 + (y - b)^2 + (z - c)^2 = r^2$ .
- completing the square to put equations in standard form

**Lines and planes.**

- distance from a point to a coordinate axis
- determining whether points are collinear (i.e. lie on a line)
- problems on planes and triangles (right? isosceles?)

**Vectors.**

- formally, an ordered pair (2-space) or triple (3-space); informally, given by a magnitude (length) and direction
- vectors from pairs of points  $\overrightarrow{PQ}$ ; adding and subtracting vectors; scalar multiplication
- finding unit vectors in a given direction
- tension in clothesline/related problems (where force vectors must add to the zero vector  $\vec{0}$ )