MA104 - Differential Calculus
Lesson 30: Mathematical Dimensions

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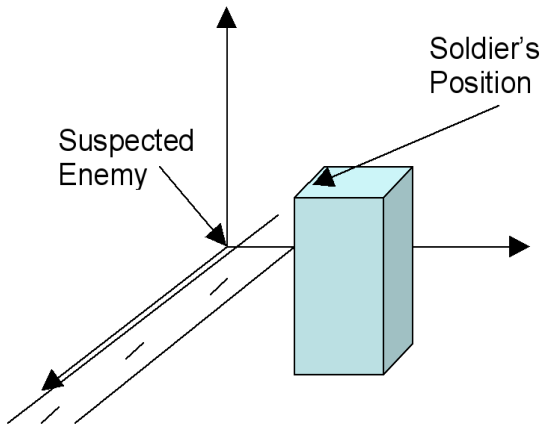
1. Draw the 3-D coordinate system and identify the coordinate planes (yz, xy, and xz-planes). Then, sketch the points $P = (3, 0, 1)$, $Q = (-1, 0, 3)$, and $R = (2, 4, -2)$ on the coordinate system.

2. Without the aid of the distance formula, find the distance of the point $A = (2, -6, 11)$ to the xy-plane, xz-plane, and yz plane. (Try projecting the point onto one of the planes. How far did the point move?)

3. Find an equation of the sphere with center $(6, 5, -2)$ and radius $\sqrt{7}$. Describe in words the defining property of every point on this surface.

4. A grenade is tossed by a soldier from the second floor of a building at a position given by $(3, 4, 5)$ with relation to it's target, an enemy hideout across an intersection. (All dimensions are in yards.) Assume the grenade's burst radius is 5 yards.



(a) Given this scenario, model the burst radius of the grenade. In other words, come up with an equation that models the "boundary" of the burst grenade.

(b) Is the soldier a safe distance from the grenade?

(c) As the platoon leader, you would like to have a little better observation on the suspected enemy position. You move into a building that is the same height as your first one, but is directly across the street to get a different look at the suspected enemy (think projection into that plane). What are the coordinates of your new position? Are you safe from the blast of the grenade if you move to the new position?

(d) After moving to the position on the other side of the road, you try and radio your squad leader who is located at your old position. He doesn't answer your radio calls, so you decide to throw a rock near him to get his attention. How far do you need to throw the rock?

5. A surface (think a 3D "graph") is a set of all points that satisfy a certain equation. In 2D, the set of all points that satisfy the equation $y = 2x$ is a line. What does it look like in 3D? Where is z?