

## Quiz # 3 Solutions.

- (1) The sphere of radius 5 with center  $x = 0, y = 0, z = -3$ .  
(2) Half a plane. The full plane is  $x = 3$ , that is, all the points on this plane are 3 units away from the  $y, z$  plane. But  $y \geq 0$  means we only have the half of the plane “to the right of” the  $x, z$  plane.
- [The graph is best described in words by the above. It is difficult for me to post pictures ... ]
- Since  $\overrightarrow{PQ} \cdot \overrightarrow{PR} = 0$ , the angle between  $\overrightarrow{PQ}$  and  $\overrightarrow{PR}$  is 90 degrees. Therefore I should draw a right triangle where the legs have length 1 and  $\sqrt{3}$ . The hypotenuse is  $QR$ . Its length, that is,  $|\overrightarrow{QR}|$ , is  $2 = \sqrt{1 + 3}$ .
- First,

$$\mathbf{r}(t) = -16t^2\mathbf{j} + 30t\mathbf{i} + 40t\mathbf{j} + \mathbf{c}$$

but since the particle starts at the origin,  $\mathbf{r}(0) = \overrightarrow{0}$ , so  $\mathbf{c} = \overrightarrow{0}$ .

Next, maximum height is achieved when the particle is not moving up anymore, that is, when the  $\mathbf{j}$  component of  $\mathbf{v}(t)$  is zero. That is, when

$$-32t + 40 = 0,$$

or  $t = 5/4$ .

Finally, the particle lands when  $\mathbf{r}(t)$  has no  $\mathbf{j}$  component. That is, when

$$-16t^2 + 40t = 0,$$

or  $t = 5/2$ . Note  $t = 0$  is also a solution because it started at the origin. Note  $5/2 = 2(5/4)$ , so maximum height was halfway in time.