Vectors in Three Dimensions

1. Write the equation of the plane passing through the point (1,1,1) that is parallel to the xy-plane.

$z = 1$

2. Find the equation of the sphere in standard form that is centered at (-1,7,4) and has a radius of 4.

$(x + 1)^2 + (y - 7)^2 + (z - 4)^2 = 16$

3. If P(-2,5,-8) and M(1,-7,4) where M is the midpoint of the line segment $\overline{PQ}$, what are the coordinates of the point Q ?

Let Q be $Q(x, y, z)$. Then

$$1 = \frac{-2 + x}{2}, \quad -7 = \frac{5 + y}{2}, \quad 4 = \frac{-8 + z}{2}$$

$$\implies x = 4, \quad y = -19, \quad z = 16.$$