Ray-tracing

1. You are given a ray with direction $\vec{R}_d = (\frac{\sqrt{2}}{2}, 0, -\frac{\sqrt{2}}{2})$, pointing towards a point with viewport coordinates $p_v = (3, 0, -1)$. Assume the viewport is 8x8 units, centered at the origin.

   (a) Verify that $\vec{R}_d$ is a unit vector.

   (b) What view (right, left, top, bottom, back, front) would be most helpful for drawing this setup? Draw this view below, showing the viewport, ray, and point.

   (c) What is the location of the camera $\vec{R}_0 = (c_x, c_y, c_z)$ if it is $t = 6$ units away from this point?

   (d) If the screen is 400x400 pixels, what are the screen coordinates (p_c) of this point?

2. **Determining the direction of a ray:** Given a camera positioned at $\vec{R}_0 = (6, -3, 2)$ and a point on the viewport at $p_v = (2, -3, -1)$, determine the unit vector in the direction of the ray, $\vec{R}_d$.

3. **Ray-plane intersection:** Say there is a "side wall" in the world, represented by a plane with equation $x = -2$. Where does the ray from (2) intersect this plane? Call this point p_w. How far is p_w from the camera (i.e. what is t)? *Hint: find t first, then p_w.*

4. **Visualization:** Draw a picture of this setup from the "top" view. Label all the points. Does this visually agree with your answers from (2) and (3)?