Please work in groups and use the given time to think and try to do the problems. If you cannot solve a question please ask me for a hint or just pass that question.

1. Let \( A = (2, 1, 1) \), \( B = (-1, 1, 2) \), and \( P = (1, 1, 1) \). Calculate the distance from \( P \) to the plane through \( A \), \( B \) and the origin.

2. State the general form for the following quadric surfaces in general position and sketch them:
   (a) Ellipsoid: \( \left( \frac{x}{a} \right)^2 + \left( \frac{y}{b} \right)^2 + \left( \frac{z}{c} \right)^2 = 1 \)
   (b) Hyperboloid (one sheet): \( \left( \frac{x}{a} \right)^2 + \left( \frac{y}{b} \right)^2 = \left( \frac{z}{c} \right)^2 + 1 \)
   (c) Hyperboloid (two sheets): \( \left( \frac{x}{a} \right)^2 + \left( \frac{y}{b} \right)^2 = \left( \frac{z}{c} \right)^2 - 1 \)
   (d) Paraboloid (elliptic): \( z = \left( \frac{x}{a} \right)^2 + \left( \frac{y}{b} \right)^2 \)
   (e) Paraboloid (hyperbolic): \( z = \left( \frac{x}{a} \right)^2 - \left( \frac{y}{b} \right)^2 \)
   (f) Cone (elliptic): \( \left( \frac{x}{a} \right)^2 + \left( \frac{y}{b} \right)^2 = \left( \frac{z}{c} \right)^2 \)

3. An ellipsoid goes through the points \( (\pm 1, 0, 0) \), \( (0, \pm 3, 0) \), and \( (0, 0, \pm 5) \). Write down an equation for it.
   Plugin all the points into the equation for the ellipsoid. Find:
   \[ x^2 + \left( \frac{y}{3} \right)^2 + \left( \frac{z}{5} \right)^2 = 1. \]

4. Identify the following quadric surfaces:
   (a) \( z = \left( \frac{x}{4} \right)^2 + \left( \frac{y}{3} \right)^2 \)
      Elliptic paraboloid
   (b) \( -\left( \frac{x}{7} \right)^2 - \left( \frac{y}{5} \right)^2 + \left( \frac{z}{2} \right)^2 = 1 \)
      Multiply through by negative 1 and move the \( z^2 \) term to the right. You’ll see it’s a hyperboloid of two sheets.
   (c) \( z^2 = \left( \frac{x}{4} \right)^2 + \left( \frac{y}{3} \right)^2 \)
      Pretty straight forward, A CONEEEEEE!
   (d) \( 3x^2 - 7y^2 = z \)
      Hyperbolic paraboloid
   (e) \( x^2 - 3y^2 + 9z^2 = 1 \)
      You may find this one strange because of the weird signs. But add \( 3y^2 \) to both sides and it looks like the hyperboloid of one sheet but with \( y \) and \( z \) switched. This is what it is.

5. State the type of the quadric surface the describe the trace obtained by intersecting with the given plane.
   (a) \( x^2 + \left( \frac{y}{5} \right)^2 + z^2 = 1, y = 0 \)
      An ellipsoid. \( x^2 + z^2 = 1 \) is a circle.
   (b) \( \left( \frac{x}{2} \right)^2 + \left( \frac{y}{3} \right)^2 - 5z^2 = 1, x = 0 \)
      Hyperboloid of one sheet. \( (y/5)^2 - 5z^2 = 1 \) is a hyperbola.
   (c) \( 4x^2 + \left( \frac{y}{3} \right)^2 - 2z^2 = -1, z = 1 \)
      Hyperboloid of two sheets. At \( z = 1 \) we get the ellipse \( 4x^2 + (y/3)^2 = 1 \).
   (d) \( y = 3x^2, z = 27 \)
      This is a cylinder, and the cross section is a parabola (along with any \( z = \text{constant} \))