In the problems below indicate your answers by drawing boxes or circles around them. When the problem is not multiple choice, you must show your work to get credit for a problem. For multiple choice questions, only the answer is considered.

1. For \( P(1, -1, 0), Q(2, 3, 0), R(2, -1, 2) \) find the cosine of the angle between vectors \( \overrightarrow{PQ}, \overrightarrow{PR} \). Is the angle bigger or smaller than \( \pi/2 \)?

2. For \( P(1, -1, 0), Q(2, 3, 0), R(2, -1, 2) \) find the scalar projection of \( \overrightarrow{PQ} \) onto \( \overrightarrow{PR} \).
3. Find two **unit** vectors perpendicular to both \(<1, 2, 1>\) and \(<1, 0, -1>\).

4. Find the slope in the \(x\)-direction at the point \(P(0, 2, f(0, 2))\) on the graph of \(f\) when \(f(x, y) = 3(2x + y)e^{-xy}\).
   
   1. slope = -6
   2. slope = -12
   3. slope = -4
   4. slope = -8
   5. slope = -10
5. Find the **z-intercept** of the plane \( Q \) given by the equation \( 2x + 3y - 4z = 8 \). Then find the **parametric** equations of the line through the z-intercept and perpendicular to \( Q \).
6. The trace of the surface $z^2 - 2y^2 - 5x + 4z = 0$ in the plane $x = 1$ is a conic section. Find the equation describing this trace, identify the type of conic section it is, and sketch its graph in the plane $x = 1$. Find the coordinates of any vertices of this conic section (the vertices are the intersections of the conic section with its axis).
7. **Sketch** the graph of the equation \( x^2 - z^2/9 = y^2 + 8x - 15 \). Remember to put labels and arrows on the coordinates axes to indicate the coordinate to which they correspond and the positive direction in those coordinates. **State** what kind of a surface it is.
8. Find and classify any critical points of \( f(x, y) = \frac{1}{3}x^3 + y^2 - 11x - 3y + 2xy \). You needn’t give the value of the function at these points.
9. Find the extreme values (max and min) of $f(x, y) = -x^2 - y^2 + 2x + 6y - 8$ on the line segment in the $(x, y)$-plane between the points $(0, 0)$ and $(2, 4)$. (Note: this is a problem you would face in finding the extreme values of $f(x, y)$ over a region in the plane that has the given line segment as part of its boundary).