Exercise 1. Consider the following four planes:

\begin{align*}
P_1 & : -4x - 2y + 2z = 4 \\
P_2 & : 5x + 2z = 5 \\
P_3 & : x - 4y + 3z = -1 \\
P_4 & : 6x + 3y - 3z = -6
\end{align*}

Which are parallel? Are any of them identical? For those pairs that are not parallel, determine their lines of intersection.

Exercise 2. Are the points \((1, -1, -2), (2, 4, -4)\) and \((5, 0, 2)\) colinear? If so, determine the line that contains them. If not, determine the plane that contains them, find the area of the triangle they form and determine if that triangle is right-angled.

Exercise 3. Do the lines \(\ell_1(s) = \langle -1 + s, 4 + s, 1 + 3s \rangle\) and \(\ell_2(t) = \langle -6t, 1 + 9t, -3t \rangle\) intersect? If so, find their point of intersection. If not, determine if they are skew or parallel and find the distance between them.

Exercise 4. Find the acute angle between two diagonals of a cube.

Exercise 5. Suppose that \(u \cdot (v \times w) = 2\). Find \((u \times v) \cdot w, u \cdot (w \times v), v \cdot (u \times w)\) and \((u \times v) \cdot v\).

Exercise 6. Parameterize the curve of intersection of the cylinder \(y^2 + 4z^2 = 1\) and the plane \(x + 2y + 3z = 0\). Find the tangent lines to this curve at the points \((-2, 1, 0)\) and \((-3/2, 0, 1/2)\) and the point where these lines intersect.

Exercise 7. Let \(f(x, y) = \sqrt{(x - 1)^2 + y^2} + \sqrt{(x + 1)^2 + y^2}\). Describe and sketch the contours \(g(x, y) = k\). What happens as \(k \to \infty\)? Use this information to sketch the graph of \(g\).
Exercise 8. Evaluate the following limits, or show that they do not exist.

a. \( \lim_{(x,y)\to(0,0)} \frac{x^2 y}{x^2 + 3y^2} \)

b. \( \lim_{(x,y,z)\to(0,0,0)} \frac{2x^2 + 2y^2 + z^2}{x^2 + 3y^2 + z^2} \)

c. \( \lim_{(x,y)\to(0,0)} \frac{\cos(y) \ln(x + 2)}{x^4 + y^2 + 2} \)

d. \( \lim_{(x,y)\to(0,0)} (x^2 + y^2) \ln(x^2 + y^2) \) [Hint: Substitute \( r = \sqrt{x^2 + y^2} \). What happens to \( r \) as \( (x, y) \to (0,0) \)?]