Name: ________________________________

Write all of your responses on the extra paper provided. Make sure that you show all of your work. Answers without supporting work will receive no credit. Remember that there is no sharing of calculation devices on this exam. Do one and only one problem from each part. Each part will be worth 25 points.

Part 1:
1. Find the scalar and vector projections of \( \langle 4, -5, 7 \rangle \) onto \( \langle -3, 5, -2 \rangle \).
2. Find the direction angles (in radians) and direction cosines of the vector \( \langle 2, 5, 9 \rangle \).

Part 2:
1. Find an equation for the plane that passes through the point \((2, 5, -2)\) and is parallel to the plane \(7x - 3y + 8z - 9 = 0\).
2. Find the parametric equations for the line passing through the point \((1, 2, 3)\) and orthogonal to the plane passing through the points \((2, 5, -2), (3, -7, 1)\) and \((4, 2, -7)\).

Part 3:
1. Find an equation of the tangent line to the curve \(r(t) = \langle t^3, -4t^2, -7t \rangle\) at \((1, -4, -7)\).
2. Find the length of the curve \(r(t) = \langle t^2, 2t, \ln(t) \rangle\) between the points \((e^2, 2e, 1)\) and \((e^4, 2e^2, 2)\).

Part 4:
1. Find an equation for the normal plane to the curve \(r(t) = \langle t^2, t^3, t^5 \rangle\) at \((4, -8, -32)\).
2. Find the curvature of \(r(t) = \langle e^t \cos(t), e^t \sin(t), t \rangle\) at \((1, 0, 0)\).

Part 5:
1. Use the chain rule to find \( \frac{\partial z}{\partial s} \) and \( \frac{\partial z}{\partial t} \) of \( z = \sin(\alpha) \tan(\beta) \) if \( \alpha = 3s^2 + \sin(t) \) and \( \beta = \cos(s - t) \).
2. Find the absolute maximums and minimums of \( f(x, y) = \frac{x^2 - y^2}{x^2 + y^2 + 1} \) on the domain \([-5, 5] \times [-5, 5]\). A few images of this surface are below.
Part 6:
1. Find an equation of the tangent plane to \( z = e^x \ln(y) \) at the point \((3, 1, 0)\).
2. If you are standing on the hyper-surface \( f(x, y, z) = x^2 y^3 z^4 \) at the point \((1, 1, 1)\), in which direction would you walk in order to go down the fastest?

Part 7:
1. Find
\[
\int_0^3 \int_0^3 y \sin(x^2) \, dx \, dy
\]
2. Find the surface area of the part of the sphere \( x^2 + y^2 + z^2 = 4 \) that lies above the plane \( z = 1 \).

Part 8:
1. Find the volume of the solid that lies within the sphere \( x^2 + y^2 + z^2 = 4 \), in the first octant and below the cone \( z = \sqrt{x^2 + y^2} \). A few images of the surfaces that bound this volume are below.

2. Use the transformation \( x = v - u, y = u - 3v \) to find the integral
\[
\int \int_R y x^2 + x y^2 \, dA
\]
where \( R \) is region bounded by the points \((-1, -1), (-4, 2), (1, -7) \) and \((-2, -4)\).