Problem 1 (7 points) Find the curvature of \( \mathbf{r}(t) = \langle \sin t, e^t, t \rangle \) at the point \((0, 1, 0)\). Find the radius of the circle of curvature.
Problem 2 7 points Find the limit if it exists or show that the limit does not exist.

\[
\lim_{(x,y) \to (0,0)} \frac{x^2 \sin 4y}{x^3 + 5y^3}
\]

ANSWER
Problem 3 (10 points) Find the ABSOLUTE maximum and minimum values of \( f(x, y) = 3x^2 - 2y^2 + 6x \) on the set \( D \). \( D \) is the disc \( x^2 + y^2 \leq 4 \). Do NOT forget to sketch the set and mark the critical points and critical numbers.

ANSWER
Problem 4 (7 points) (a) Sketch the solid whose volume is given by the iterated integral and then (b) rewrite this integral as an equivalent iterated integral in the order $dydxdz$

$$
\int_0^2 \int_0^{2-y} \int_0^{1-y^2} dxdzdy
$$

ANSWER
Problem 5 (7 points) Find an equation of the tangent plane to the surface $x^2y + e^{xz} + zy^2 = 13$ at $(0,2,3)$.
Problem 6 (14 points) Verify that the Stokes’ theorem is true for the vector field $\mathbf{F}(x, y, z) = -2yz\mathbf{i} + y\mathbf{j} + 3x\mathbf{k}$, $S$ is the part of the paraboloid $z = 5 - x^2 - y^2$ that lies above the plane $z = 1$ oriented upward. (a) write the theorem (2 points); (b) LHS (6 points) (c) RHS (6 points)
Problem 7 (8 points) (a) Determine whether or not the vector field \( F(x, y, z) \) is conservative. (b) If conservative find the potential function \( f \)

\[
F(x, y, z) = < e^y, xe^y + e^z, ye^z >
\]
**BONUS Problem (3 points)** Evaluate the line integral

\[ \oint_C \vec{F}(x, y) \cdot d\vec{r}, \quad \vec{F}(x, y, z) = < e^y, xe^y + e^z, ye^z > \]

where \( C \) is the ellipse \( 4x^2 + 9y^2 = 36 \) with counterclockwise orientation. EXPLAIN!!!

**ANSWER**