Problem 1 6 points Find PARAMETRIC equations for the line of intersection of the planes $z = 2x - y - 5$ and $z = 4x + 3y - 5$
Problem 2 6 points Find the limit if it exists (and prove it!) or show that the limit does not exist.

\[
\lim_{(x,y) \to (0,0)} \frac{x^2y^2}{-7x^4 + 3y^4}
\]

ANSWER

Problem 3 6 points Find an equation for the tangent plane to the surface of \(xy + yz + zx = 3\) at \((1,1,1)\).
Problem 4 6 points Find the ABSOLUTE maximum and minimum values of \( f(x, y) = e^{-x^2-y^2}(x^2 + 2y^2) \) on the set D. D is the disc \( x^2 + y^2 \leq \frac{1}{4} \).

ANSWER
**Problem 5** 6 points Use the transformation $x = u^2$, $y = v^2$, $z = w^2$ to (A) calculate the Jacobian and (B) SET UP (but do not evaluate the integral) for the volume of the region bounded by the surface $\sqrt{x} + \sqrt{y} + \sqrt{z} = 1$ and the coordinate planes.

**ANSWER (A)**

**ANSWER (B)**

**Problem 6** 6 points Write down the following theorems and for each theorem sketch an example of an appropriate contour $C$, surface $S$, solid $E$ or region $D$.

(A) Green’s Theorem

(B) Stokes’ Theorem
Problem 7 6 points Let $\mathbf{F}(x, y) = \langle x \sin y, x^2 + 2y^2 + 3 \rangle$. Use Green’s Theorem to evaluate the integral.

$$\oint_C \mathbf{F}(x, y) \cdot d\mathbf{r}$$

where $C$ is the path which begins at $(0,0)$ and goes around the triangle bounded by $x = 0$, $x + y = 1$, $y = 0$ in the counterclockwise direction.

ANSWER
**Problem 8 6 points** Given the vector field \( \vec{F}(x, y) = < e^y, xe^y, (z + 1)e^z > \). (A) Prove that the vector field is or is not conservative. (B) Evaluate

\[
\int_C \vec{F}(x, y, z) \cdot d\vec{r}
\]

where \( C \) is the curve parameterized by \( \vec{r} = < t, t^2, t^3 >, \ 0 \leq t \leq 1 \). If \( \vec{F} \) is conservative you may use the Fundamental Theorem.
Problem 9 6 points. Evaluate the surface integral $\iint_S \mathbf{F} \cdot d\mathbf{S}$

$$\mathbf{F}(x, y, z) = x^2 \mathbf{i} + xy \mathbf{j} + z \mathbf{k}$$

$S$ is the part of the paraboloid $z = x^2 + y^2$ below the plane $z = 1$ with upward orientation.

Answer
Problem 10 6 points Use the Divergence theorem to calculate the surface integral \( \iint_S \mathbf{F} \cdot d\mathbf{S} \). S is sphere with radius 1 and center the origin.

\[
\mathbf{F}(x, y, z) = 4x^3z \mathbf{i} + 4y^3z \mathbf{j} + 3z^4 \mathbf{k}
\]
**BONUS 5 points**

Let \( \mathbf{F}(x, y, z) = \langle x^2yz, yz^2, z^3e^{xy} \rangle \). Use Stokes Theorem to evaluate \( \iint_S \text{curl} \mathbf{F} \cdot d\mathbf{S} \).

\( S \) is the part of the sphere \( x^2 + y^2 + z^2 = 5 \) that lies above the plane \( z = 1 \) and \( S \) is oriented upward.

**ANSWER**