1. Find all points \((x, y)\) such that the matrix
\[
A = \begin{bmatrix}
1 & 2 & 3 & 4 \\
x & 1 & 1 & 2 \\
3 & 2 & 0 & y \\
1 & 1 & 1 & 1
\end{bmatrix}
\]
is not invertible.

2. Find an orthogonal basis for the subspace \(W\) of \(\mathbb{R}^4\) given by
\[
W = \{(x, y, z, w) : x + y + z + w = 0\}.
\]

3. Find the volume of the 3-dimensional parallelepiped spanned by \((1, 2, 3, 4), (1, 0, 0, 1),\) and \((0, 1, 1, 1)\).

4. Find \(\oint_C \mathbf{F} \cdot d\mathbf{r}\), where \(C\) is the ellipse along which the cylinder \(x^2 + y^2 = 1\) intersects the plane \(x + 2y + 3z = 0\), and where
\[
\mathbf{F}(x, y, z) = (-z, e^y, x).
\]

5. Let \(F(x, y) = (xy, x - y)\). Find the area of \(F(Q)\), where \(Q\) is the triangle with corners at \((1, 1)\), \((5, 1)\), and \((1, 4)\).

6. Let \(S\) be the parametric surface defined by \(r(u, v) = (uv, u + v, u - v)\). Let \(P\) be the region in the \(uv\) plane where \(u^2 + v^2 \leq 1\).

(a). Find a normal vector to \(S\) at the point \(r(u, v)\).

(b). Find the surface integral of \(\mathbf{F}(x, y, z) = xi + y^2j + k\) across \(r(P)\).

6. Let \(\mathbf{F}(x, y, z) = -xi - yj + (1 + 2z)k\). Let \(S\) be the surface
\[
z = e^x(1 - x^2 - y^2), \quad x^2 + y^2 \leq 1.
\]
Find the surface integral \(\iint_S \mathbf{F} \cdot \mathbf{n} \, dA\). (Orient \(S\) with the normal whose \(e_3\) component is positive.)

**Hint:** Use the divergence theorem.

(To be continued...)