Problem 1. Evaluate \( \int \int_D x^2 \, dA \) where \( D \) is the region bounded by the parabolas \( y = 2x^2 \) and \( y = 1 + x^2 \).

Problem 2. Find the volume enclosed by the paraboloid \( z = 1 + 2x^2 + 2y^2 \) and the plane \( z = 7 \).

Problem 3. Change the order of integration to integrate \( \int_0^8 \int_{\sqrt{y}}^2 \sin(x^4) \, dx \, dy \).

Problem 4. Let \( R \) be the region bounded by the lines \( y + x = 0 \) and \( y + x = 5 \), \( y - x = 0 \) and \( y - x = 3 \). Use the change of variables \( x = \frac{u - v}{2} \) and \( y = \frac{u + v}{2} \) (i.e., \( u = x + y \) and \( v = y - x \)) to evaluate \( \int \int_R 2(x + y) \, dA \).

Problem 5. Completely set up, but do not evaluate, the following integrals:

(a) The volume of the tetrahedron bounded by the plane \( 3x + 2y + z = 6 \) in the first octant.

(b) The volume of ice-cream bounded by the cone \( z = \sqrt{x^2 + y^2} \) and the sphere \( x^2 + y^2 + z^2 = 16 \).

Problem 6. Evaluate \( \int \int \int_E x^2 + y^2 \, dV \) where \( E \) is the solid bounded by the paraboloids \( z = 2 - x^2 - y^2 \) and \( z = x^2 + y^2 - 2 \).
**Problem 7.** Use Lagrange multipliers to find the maximum and minimum values of the function $f(x, y) = x^2 + y^2 - 6x + 5$ on the ellipse $4x^2 + y^2 = 16$.

**Problem 8.** Find all the critical points of $f(x, y) = x^2 - y^2 + 4x + 6y - 16$, and classify them using the Second Derivative Test.

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**CHANGE OF VARIABLES FORMULAS:**

\[
\iint f(r, \theta) r \, dr \, d\theta, \text{ where } x = r \cos \theta, \ y = r \sin \theta
\]

\[
\iiint f(\rho, \phi, \theta) \rho^2 \sin \phi \, d\rho \, d\phi \, d\theta, \text{ where } x = \rho \sin \phi \cos \theta, \ y = \rho \sin \phi \sin \theta, \ z = \rho \cos \phi
\]

\[
\iint f(u, v) \left| \frac{\partial (x, y)}{\partial (u, v)} \right| \, du \, dv, \text{ where } \frac{\partial (x, y)}{\partial (u, v)} = \begin{vmatrix}
\frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\
\frac{\partial y}{\partial u} & \frac{\partial y}{\partial v}
\end{vmatrix}
\]