1) The plane \( x + y + z = 0 \) intersects the surface \( 2z = x^2 + y^2 \) in an ellipse. Use Lagrange multipliers to find the largest and smallest distance on the ellipse, from the origin.

6) Find the maximum and minimum distance of \( P(0, 1) \) from the circle \( (x - 1)^2 + y^2 = 1 \).

7) Find the extremes of \( f(x, y) = xy \) subject to the constraint \( \frac{x^2}{4} + y^2 = 1 \).

8) Use Lagrange multipliers to find the point \( P(x, y) \) that is on the curve \( x^2 - y^2 = 1 \), and is closest to the point \( Q(1, 0) \).

9) Use Lagrange multipliers to find the point \( P(x, y) \) that is both on the curve \( x^2 + y^2 - xy = 1 \), and is closest to the origin.

2) Compute \[
\int \int_R x \, dA
\]
when \( R = \{(x, y) \mid x^2 + y^2 \leq 1; \ 0 \leq x \leq y\} \)

2) Compute \[
\int \int_R y \, dA
\]
when \( R \) is the quarter of the unit circle, in the second quadrant.

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3) Let $D$ be the region bounded by $x = y, x = y^2$.
   a) Write the limits of integration for $\int \int_D f(x, y) \, dx \, dy$
   b) Write the limits of integration for $\int \int_D f(x, y) \, dy \, dx$

4) Sketch the region $D$ in the integral
   \[
   \int_{-1}^{+1} \int_{0}^{1-x^2} f(x, y) \, dy \, dx
   \]
   b) Write the limits of integration for $\int \int_D f(x, y) \, dx \, dy$

5) Write the limits of integration for
   \[
   \int \int_D \, dx \, dy \int \int_D \, dy \, dx
   \]
   where $D$ is bounded by the curves $y = 1, x = -1, y = -x, y = \sqrt{x}$

1)(30 points) Let $z = f(x, y) = x^2 + y^2$. Let $R$ be the portion of the unit disc in the third and fourth quadrants. That is, $R$ is the region where $x^2 + y^2 \leq 1; y \leq 0$.
   a) Find the volume under $f$ above $R$
   b) Find the surface area of $f$ above $R$.

2) Let $f(x, y) = \sin(x^2 + y^2)$ Compute the volume under $f$ above the region $R = \{(x, y)| x^2 + y^2 \leq 1\}$.

3) Let $z = 2 - 2x - y$ Compute the surface area of the plane, above the region $f$ above the region $R$ bounded by $x = 0; y = 0; z = 0$.

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