1. Find the absolute maximum and absolute minimum of \( f(x, y) = xy \) on the ellipse \( 4x^2 + y^2 = 4 \).

2. Find the maximum and minimum values of \( f(x, y, z) = x^2y^2z^2 \) subject to the constraint \( x^2 + y^2 + z^2 = 1 \).

3. A cylindrical can without a top is made to contain \( 64\pi \) cm\(^3\) of liquid. Find the dimensions that will minimize the cost of the metal to make the can \( (S = \pi r^2 + 2\pi rh) \).

4. Evaluate \( \iint_R x^2y^3e^{xy^2} \, dA \) where \( R = [0, 1] \times [0, 2] \).

5. Evaluate \( \iiint_D y \, dA \), where \( D \) is the region above the hyperbola \( xy = 1 \) and the line \( y = x \) but below the line \( y = 2 \).

6. Evaluate \( \int_0^\pi \int_x^{\sqrt{\pi}} \sin(y^2) \, dy \, dx \).

7. Sketch the polar curve \( r = \sin(2\theta) \).

8. Find the volume of the solid bounded below by the cone \( z = \sqrt{3x^2 + 3y^2} \) and above by the sphere \( x^2 + y^2 + z^2 = 4 \).

9. A lamina occupies the quarter-circle \( x^2 + y^2 \leq a^2 \) in the first quadrant. Find the moment about the \( x \)-axis and the \( y \)-coordinate of the center of mass if the density function is \( \rho(x, y) = xy^2 \).
10. Evaluate \( \iiint_E z^2 e^{x+y} \, dV \) if \( E = [0, 2] \times [1, 4] \times [-1, 1] \).

11. Evaluate \( \iiint_E x \, dV \) if \( E \) is the tetrahedron bounded by the planes \( x = 0, y = 0, z = 0, \) and \( 2x + y + z = 2 \).

12. Let \( E \) be the solid bounded by the parabolic cylinder \( x = y^2 \) and the planes \( z = 0, 2x + z = 2 \). Write \( \iiint_E f(x, y, z) \, dV \) as six different iterated integrals.