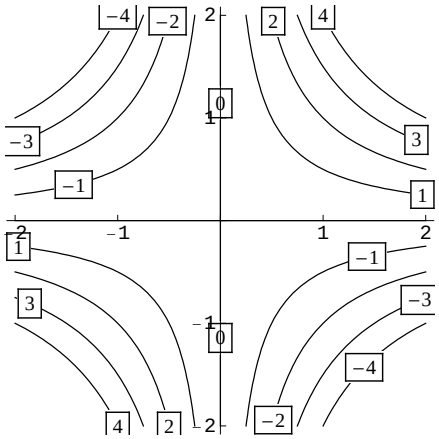
# Lagrange Multipliers

Here are some examples of problems that can be solved using Lagrange multipliers:

- The equation $g(x, y) = c$ defines a curve in the plane. Find the point(s) on the curve closest to the origin.
- The temperature in a room is given by $T(x, y, z) = 100x + xy + 5yz^2$. A bug walks on a spherical balloon which is given by the equation $x^2 + y^2 + z^2 = 3$. What is the warmest point the bug can reach?

1. Here is the level set diagram of $f(x, y) = 2xy$.




(a) Estimate the maximum and minimum values of $f$ on the ellipse $\dfrac{x^2}{4} + y^2 = 1$.

(b) Find the maximum and minimum values of $f$ on the ellipse $\dfrac{x^2}{4} + y^2 = 1$.

2. Minimize $2x + 4y + 6z$ if $x^2 + y^2 + z^2 = 14$.

3. Minimize $x^2 + y^2 + z^2$ subject to the constraints $x + y + z = 6$ and $x + 2y - 3z = 14$.

4. Maximize and minimize $f(x, y, z) = xyz$ subject to the constraint that $x^2 + y^2 + z^2 = 1$.