SECTION 12.7 (Extrema of Functions of Several Variables)
NAME:________________________________________________________________________

1. Locate all critical points and classify them: 
   \[ f(x, y) = 2x^2 + y^3 - x^2 y - 3y. \]

2. Find the absolute extrema of the function 
   \[ f(x, y) = x^2 + y^2 - 4xy \]
   on the region bounded by \( y = x, \ y = -3, \ & x = 3. \)

3. Find the absolute extrema of the function 
   \[ f(x, y) = x^2 + y^2 - 2x - 4y \]
   on the region bounded by \( y = x, \ y = 3, \ & x = 0. \)
4. Find the maximum of \( z = x^2 + y^2 \) on the square with \(-1 \leq x \leq 1\) and \(-1 \leq y \leq 1\).

5. Find the closest point on the cone \( z = x^2 + y^2 \) to the point \((2, -3, 0)\).

6. The **Hardy-Weinberg law** of genetics describes the relationship between the proportions of different genes in populations. Suppose that a certain gene has three types (e.g., blood types of A, B and O). If the three types have proportions \( p \), \( q \) and \( r \), respectively, in the population, then the Hardy-Weinberg law states that the proportion of people who carry two different types of genes equals \( f(p, q, r) = 2pq + 2pr + 2qr \) where \( p + q + r = 1 \). Show that the maximum value of \( f(p, q, r) \) is \( 2/3 \).