1. Find the critical points, if any, of the function 
   \[ f(x,y) = x^3 + y^3 - 3x - 12y + 25 \]
   and determine their nature.

2. What is the minimum value of \( f(x,y) = \frac{3}{x} + 5xy + \frac{2}{y} \), for positive values of \( x \) and \( y \)?

3a. A parabola of the form
   \[ f(x) = a + bx^2 \]
   is to be fit to the points \( \{(x_i,y_i), i=1\ldots n \} \). Find a formula for the values of \( a \) and \( b \) which minimize the sum of the squared deviations between the \( y_i \)'s and the values \( f(x_i) \).

3b. Use your formula to find \( a \) and \( b \) for the points \( (0,0), (1,1) \) and \( (-1,2) \).

4. A surgeon is faced with the problem of grafting an artery. She wishes to minimize the resistance to the resulting flow. Resistance \( R \) to laminar flow in a pipe is given by Poiseuille's law to be
   \[ R = \frac{L}{r^4} \]
   where \( L \) and \( r \) are the length and radius of the pipe. The graft must run from a main artery of radius \( r_1 \) to a point 5 cm. from the main artery, using a connecting artery of radius \( r_2 \). Coordinatize the problem by assuming that the main artery runs along the \( x \)-axis and the connecting artery needs to run to the point \( (10,5) \).

Write the total resistance from the origin to the point \( (10,5) \) assuming that the graft occurs at \( (x,0) \) and write a necessary condition for \( x \) to minimize the resistance. Solve your condition for the optimal angle in terms of the radii.