1. A store’s profit is given by $P(x, y) = 2600 - x^2 + 24x - y^2 + 80y$ dollars, with $x$ salespeople and inventory of $y$ (thousand dollars). Determine the number of sales staff and amount of inventory to maximize the profit. What is the maximum profit?

*Answer: A maximum profit of $4344 will occur when 12 salespeople are used and inventory worth $40,000 is on hand.*

2. A sociology analysis indicates that a parameter measuring the crime rate depends on the amount spent on welfare and the amount spent on prisons according to the model $R(p, w) = w^3 + 6p^2 - 12p - 6pw + 30$ crimes per year. How should funds be allocated to reduce the crime rate as much as possible?

*Answer: The crime rate will be minimized when $2$ million is spent on welfare and $2$ million is spent on prisons.*

3. In a laboratory test the combined antibiotic effect of $x$ milligrams of medicine A and $y$ milligrams of medicine B is given by the function $f(x, y) = xy - 2x^2 - y^2 + 110x + 60y$. Find the amounts of the two medicines that will maximize the antibiotic effect.

*Answer: To maximize the antibiotic effect you should give 40 milligrams of medicine A and 50 milligrams of medicine B.*

4. A subject in a psychology experiment who practices a skill for $x$ hours and then rests for $y$ hours achieves a test score of $f(x, y) = xy - x^2 - y^2 + 11x - 4y + 120$ points. Find the numbers of hours of practice and rest that maximize the subject’s score. What is the maximum score?

*Answer: Six hours of practice and 1 hour of rest will give a maximum score of 151 points.*

5. The number of office workers who call in “sick” on a warm summer day is $f(x, y) = xy - x^2 - y^2 + 110x + 50y - 6635$ employees, where $x$ is the air temperature and $y$ is the water temperature. Find the air and water temperature that maximizes the number of absences. How many people would you expect to be “sick” on those days?

*Answer: When the air temperature is 90 degrees and the water temperature is 70 degrees, there is a maximum of 65 “sick” employees.*

6. Find and classify any relative minima, relative maxima, or saddle points for the multivariable functions.

   a. $f(x, y) = 2x^3 - 3y^2 - 24x + 18y + 7$

   *Answer: A saddle point is at (2, 3) and a relative maximum of 66 is located at (-2, 3).*

   b. $f(x, y) = 3x^2 + y^2 + 3xy + 3x + y + 6$

   *Answer: A relative minimum of 5 at (-1, 1).*