1) Suppose $(0, 2)$ is a critical point of a function f with continuous second derivatives. In each case, what can you say about f ?

   a) $f_{xx}(0,2) = -1$, $f_{xy}(0,2) = 6$, $f_{yy}(0,2) = 1$

   b) $f_{xx}(0,2) = -1$, $f_{xy}(0,2) = 2$, $f_{yy}(0,2) = -8$

   c) $f_{xx}(0,2) = 4$, $f_{xy}(0,2) = 6$, $f_{yy}(0,2) = 9$

2) Find the local maximum and minimum values and saddle point(s) of the function.

   a) $f(x, y) = 9 - 2x + 4y - x^2 - 4y^2$

   b) $f(x, y) = x^4 + y^4 - 4xy + 2$

   c) $f(x, y) = 2x^3 + xy^2 + 5x^2 + y^2$

   d) $f(x, y) = x^2 + y^2 + \dfrac{1}{x^2 y^2}$

3) Find the critical points of the function $f(x,y,z)=x^2+(y-3)^2+(z+1)^2$ from the form of the function determine whether a relative maximum or a relative minimum occurs at each point.

4) Find the absolute maximum and minimum values of f on the set D.

   a) $f(x,y)=1+4x-5y$, D is the closed triangular region with vertices $(0,0)$, $(2,0)$, $(0,3)$.

   b) $f(x,y)=4x+6y-x^2-y^2$, $D=\{(x,y)\,|\,0\le x\le 4, 0\le y\le 5\}$

   c) $f(x,y)=xy^2$, $D=\{(x,y)\,|\,x\ge 0, y\ge 0, x^2+y^2\le 3\}$

5) Find the shortest distance from the point $(2,1,-1)$ to the plane $x+y-z=1$.

6) Find three positive numbers whose sum is 100 and whose product is a maximum.

7) Find the volume of the largest rectangular box in the first octant with three faces in the coordinate planes and one vertex in the plane $x+2y+3z=6$.

8) Find the dimensions of the rectangular box with largest volume if the total surface area is given as 64 cm^2.