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

a) $\boxed{\text{Saddle Point}}$

b) $\boxed{\text{Local Maximum}}$

c) $\boxed{\text{Inconclusive}}$

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

a) $\boxed{f\left(-1,\frac{1}{2}\right)=11,\ \text{Local Maximum}}$

b) $\boxed{(0,0)\ \text{Saddle Point},\ f(1,1)=0\ \text{Local Minimum},\ f(-1,-1)=0\ \text{Local Minimum}}$

c) $\boxed{f(0,0)=0\ \text{Local Minimum},\ f\left(-\frac{5}{3},0\right)=\frac{125}{27}\ \text{Local Maximum},\ f(-1,\pm 2)=0\ \text{Saddle Points}}$

d) $\boxed{f(\pm 1,\pm 1)=f(\pm 1,\mp 1)=3\ \text{Local Minima}}$

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.

$$\boxed{f(0,3,-1) = 0 \text{ Absolute Minimum}}$$

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

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

a) $\boxed{f(2,0) = 9 \text{ Absolute Max, } f(0,3) = -14 \text{ Absolute Min}}$

b) $\boxed{f(2,3) = 13 \text{ Absolute Max, } f(0,0) = f(0,0) = 0 \text{ Absolute Min}}$

c) $\boxed{f(1,\sqrt{2}) = 2 \text{ Absolute Max, along } y = 0 \text{ and } x = 0 \text{ Absolute Min}}$

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

$$\boxed{d=\sqrt{3}}$$

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

$$\boxed{x=y=z=\frac{100}{3}}$$

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 $x+2y+3z=6$.

$$\boxed{V=\frac{4}{3}}$$

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

$$\boxed{x=y=z=\frac{8}{\sqrt{6}}}$$