(a) The directional derivative of $f(x, y)$ at $(1, 1)$ in the direction of $\vec{u}_1 = \vec{i}$ is $\sqrt{2}$ and in the direction $\vec{u}_2 = \frac{1}{\sqrt{2}} \vec{i} + \frac{1}{\sqrt{2}} \vec{j}$ is -3. Find the directional derivative of $f(x, y)$ at $(1, 1)$ in the direction of $\vec{u}_3 = \frac{2}{\sqrt{7}} \vec{i} + \frac{3}{\sqrt{7}} \vec{j}$.

(b) Find the local maximum, local minimum and saddle points of a function $f(x, y) = -y^3 + 4xy - 2x^2 + 1$. 