1. Problem 6 of Exercises of Chapter 9 (page 211).

2. Problem 7 (a) (c) of Exercises of Chapter 9 (page 211).

3. Let $X_0$ be a strict local minimum of a $C^1$ function $V = V(X)$. Show that $X_0$ is an equilibrium point and that the function $V(X) - V(X_0)$ is a strict Liapunov function for the gradient system $\dot{X} = -\text{grad} V(X)$ at $X_0$.

4. Problem 8 (c) (d) of Exercises of Chapter 9 (page 211).

5. Find the Hamiltonian $H = H(x, y)$ for the system $\dot{x} = y$, $\dot{y} = -x + x^2$ and sketch the phase portrait for this system.

6. Prove that the linearization at an equilibrium point of a planar Hamiltonian system has eigenvalues either $\pm \lambda$ or $\pm \lambda i$ for some real number $\lambda$.

7. Problem 16 of Exercises of Chapter 9 (page 212).

8. (Optional) Prove that the flow associated with a planar Hamiltonian system preserves the area. (The general result, true for any $n$-dimensional Hamiltonian system, is known as Liouville’s theorem in statistical mechanics.)