Solution of HW5, Problem 5

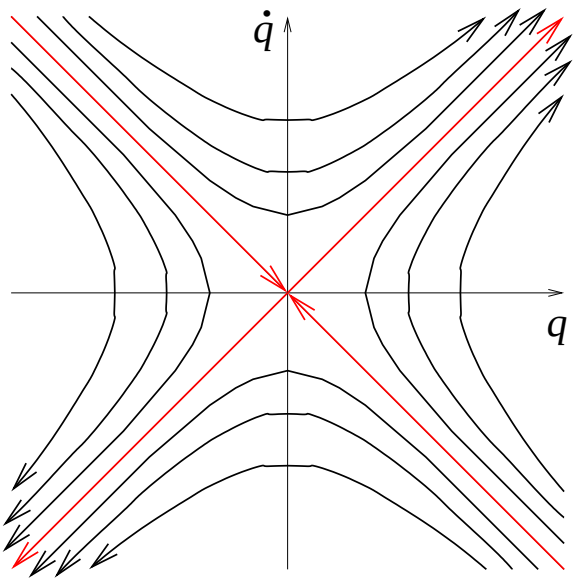

Fig. 1: Phase portrait of the "upside-down" harmonic oscillator, Problem 1(a) of Chapter 4 in [HF]. The red lines denote the separatrix. The conserved quantity is $H = \frac{1}{2}\dot{x}^2 - \frac{1}{2}x^2$. Despite the fact that the potential is unbounded from below, this is a conservative system, and $E = H$ is conserved.

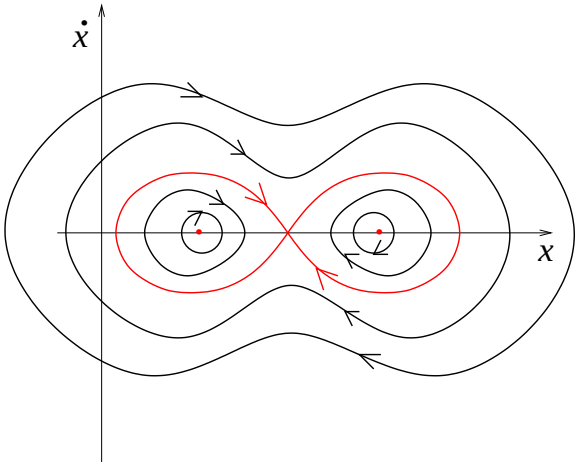

Fig. 2: Phase portrait of the system in the double-well potential, Problem 2 of Chapter 4 in [HF]. The red line again denotes the separatrix, while the two red dots are the points of stable equilibrium.