

# Homework 4 – Due February 5

- \* 7.2.12, 7.2.13 (all parameters are positive), 7.2.14, 7.2.15, 7.2.17.
- \* Show that the Jacobian matrix for a  $2d$  gradient system is symmetric. Show that a  $2 \times 2$  real symmetric matrix has real eigenvalues. Therefore, no fixed point in such a system can be a spiral. Does this make intuitive sense?
- \* Sketch a phase portrait for the system in midterm problem 4, namely

$$\dot{x} = y(4x + 4 - y^2), \quad \dot{y} = x.$$

Recall that this system is reversible but not conservative. Check your sketch with software for plotting phase portraits, if you have some.