

1. (4 points) Draw the phase line for $y' = (y - 1)(2y + 3)(4 - y)$ and then find and classify the critical points as either stable or unstable and as either a sink, source, or neither.

2. (6 points) Find and classify the three critical points for $\begin{cases} x' = x(x - 2y) \\ y' = (2x - y)(y + 1) \end{cases}$ as either stable or unstable and as either a node, saddle, or spiral. You may also declare them to be unclassifiable stability and/or unclassifiable type.

3. (5 points) Find the eigenvalues and a basis for the eigenfunctions for $X'' + \lambda X = 0$ if $X'(0) = 0$ and $X'(2\pi) = 0$. Show details.

4. (5 points) Find the general solution for $u_t = 2u_{xx}$ if $u_x(0, t) = 0$ and $u_x(2\pi, t) = 0$. Give steps as specified in lecture using your answer to problem 3.