2-D & n-D Linear Systems with Complex Eigenvalues (3.4, 6.4)

For each of the following systems, find the **real valued** general solution, draw a phase portrait, and classify the fixed point. If an initial value is given, also solve the initial value problem.

1. $\mathbf{x}' = \begin{pmatrix} 1 & 2 \\ -5 & 1 \end{pmatrix} \mathbf{x}$

2. $\mathbf{x}' = \begin{pmatrix} 2 & -5 \\ 1 & -2 \end{pmatrix} \mathbf{x}, \quad \mathbf{x}(0) = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$

3. $\mathbf{x}' = \begin{pmatrix} -7 & 6 & -6 \\ -9 & 5 & -9 \\ 0 & -1 & -1 \end{pmatrix} \mathbf{x}$