

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

3. $\mathbf{x}' = \begin{pmatrix} -1 & -2 & 0 \\ 2 & -1 & 0 \\ 0 & 0 & -1 \end{pmatrix} \mathbf{x}$ (*note: Only find the real valued general solution*)

4. $\mathbf{x}' = \begin{pmatrix} 3 & 0 & -2 \\ -1 & 1 & 1 \\ 4 & 0 & -1 \end{pmatrix} \mathbf{x}$ (*note: Only find the real valued general solution*)

5. (*if there is time*) Discuss what a typical trajectory might look like in number 3.