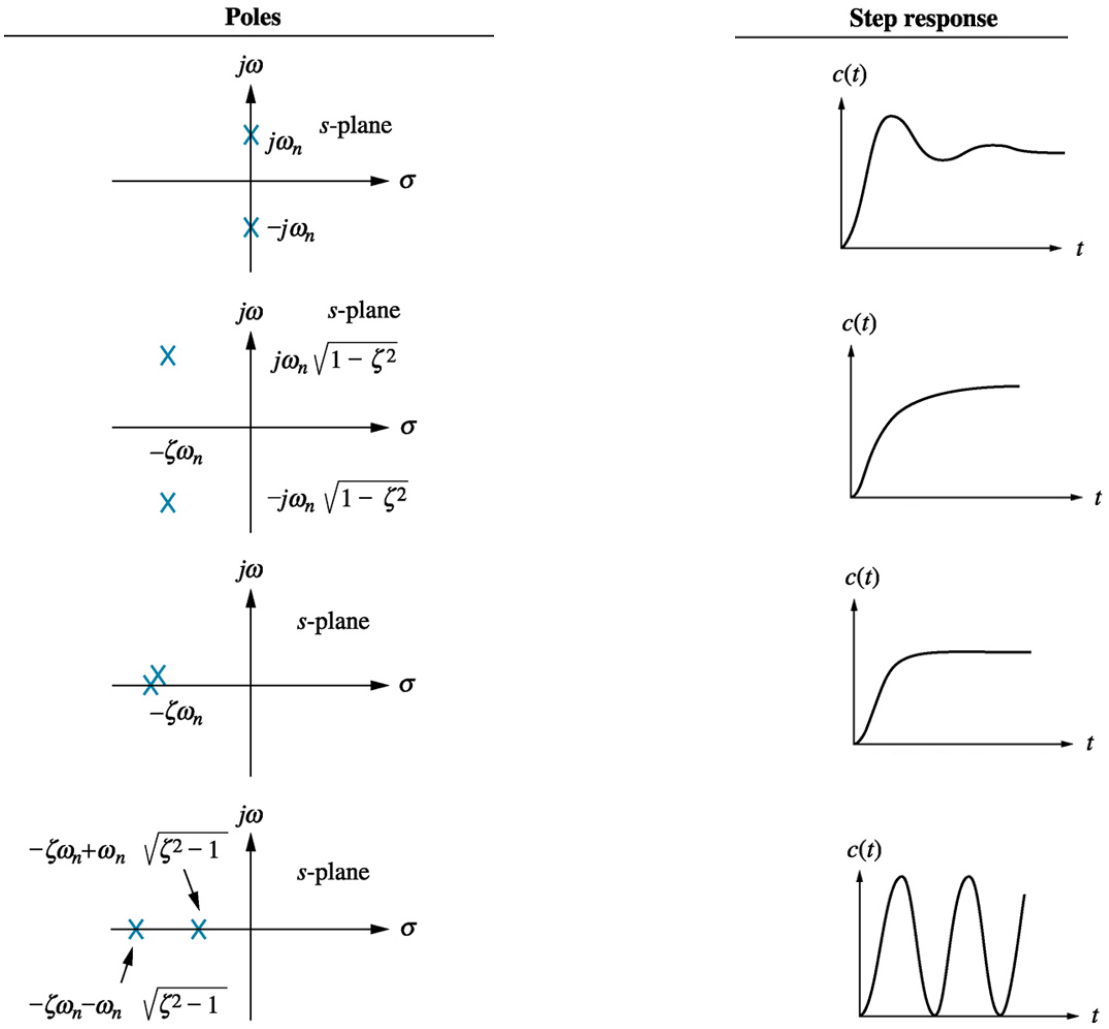
Tutorial Sheet 2: Solving System Equations

1) Match the following pole plots to the step responses.



2) Find the poles of the following systems, and state whether they are stable or unstable*:*

$$\dot{\mathbf{x}} = \begin{bmatrix} -4 & -1.5 \\ 4 & 0 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 2 \\ 0 \end{bmatrix}u(t)$$

$$y = \begin{bmatrix} 1.5 & 0.625 \end{bmatrix}\mathbf{x}$$

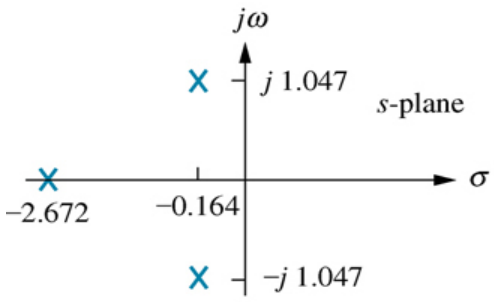
$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -3 & -2 & -5 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 0 \\ 0 \\ 10 \end{bmatrix} r$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}\mathbf{x}$$

$$\dot{\mathbf{x}} = \begin{bmatrix} 2 & -3 & -8 \\ 0 & 5 & 3 \\ -3 & -5 & -4 \end{bmatrix}\mathbf{x} + \begin{bmatrix} 1 \\ 4 \\ 6 \end{bmatrix} r$$

$$y = \begin{bmatrix} 1 & 3 & 6 \end{bmatrix}\mathbf{x}$$

3) Consider the pole plots below. What order is the system? Is the system stable? Sketch the response to a step-input.



4) Find the time-domain response to a state equation as shown in Nise Example 4.12 and Skill-Assessment Exercise 4.10 [Nise, N.S., "Control Systems Engineering"].