Problem 10.1: Consider the difference equation $y[n] - 0.4y[n-1] = x[n]$ that describes a causal LTI sytem with input $x[n]$ and output $y[n]$. Suppose the input is $x[n] = 2\delta[n]$. Use recursion to find the first five non-zero samples of the output. Can you generalize your results for further values of n? Use a straightedge to plot $y[n]$. Label both axes and all important features. Show the origin for reference.

Problem 10.2: Consider the difference equation $y[n] - y[n-1] = x[n] + 0.5x[n-2]$ that describes a causal LTI sytem with input $x[n]$ and output $y[n]$. Use recursion to find the first five non-zero samples of the impulse response $h[n]$. Can you generalize your results for further values of n? Use a straightedge to plot $y[n]$. Label both axes and all important features. Show the origin for reference.

Problem 10.3*: Consider the difference equation $y[n] - \alpha y[n-1] = x[n]$ that describes a causal LTI sytem with input $x[n]$ and output $y[n]$, where α is a real constant. Find the impulse response and use it answer the following question: What constraint should be placed on α in order to ensure the system is stable?

Problem 10.4: One can model a car's speed $y(t)$ by applying Newton's Second Law of Motion to the car. Suppose the car has mass m and experiences an input force from the engine $x(t)$. If the friction force is modeled as a drag force with coefficient ρ that is proportional to $y(t)$, the equation of motion is

$$x(t) - \rho y(t) = m\frac{dy(t)}{dt}.$$

Use proportional blocks, a differentiator, and a summer to represent this system as a block diagram.