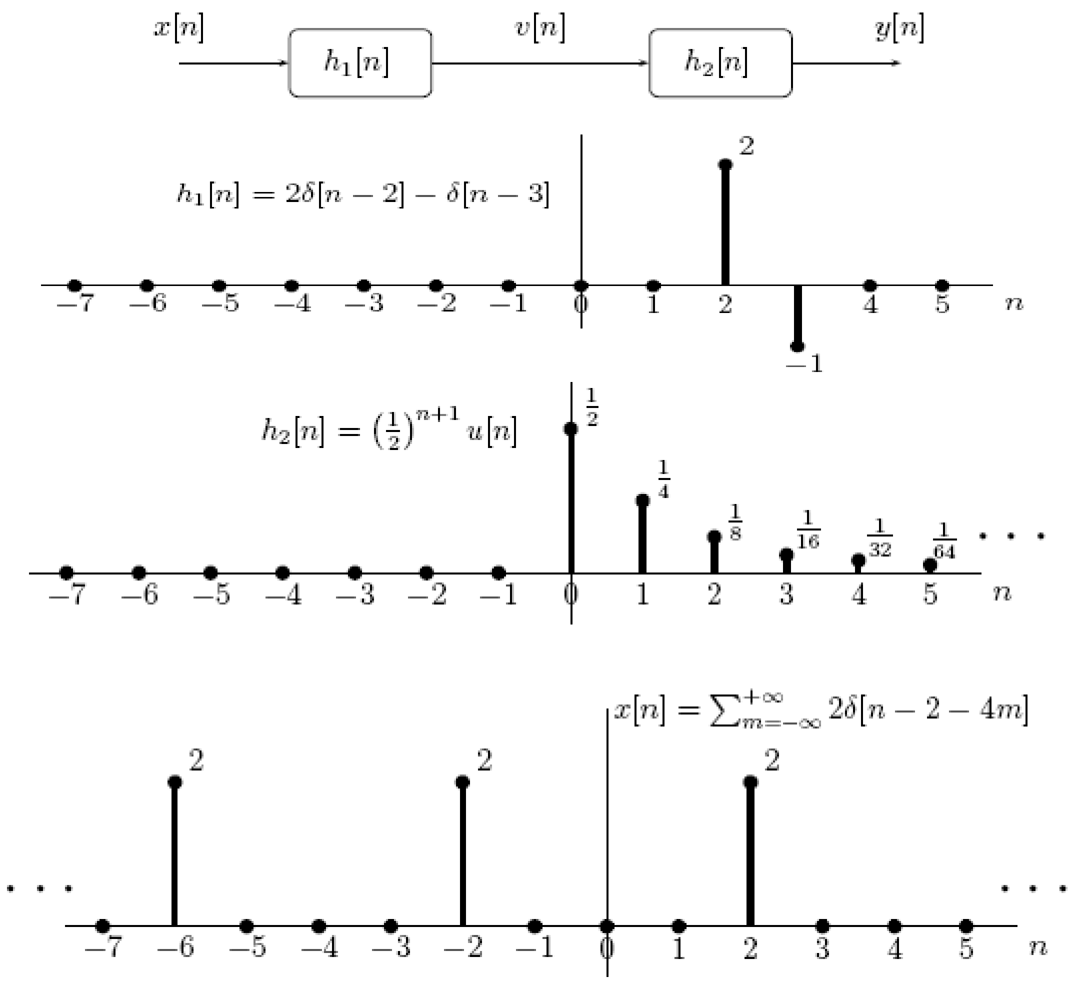
Problem 1
Consider the following cascade of two Discrete Time (DT) Linear Time Invariant (LTI) systems with unit sample response $h_1[n]$ and $h_2[n]$. The indicated input signal $x[n]$ is applied to the cascaded systems.



Part a. Plot the output $v[n]$ of the ***first*** system in the range $-5 \le n \le 5$. Label all values in your plot.

Part b. What is the value of the following sum?

$$\sum_{n=13}^{15} v[n] =$$

Part c. Plot the output of the cascaded systems $y[n]$ in the range $-5 \le n \le 5$. Label all values in your plot.

Problem 2
Consider the following two systems:

$$\text{SYSTEM A:} \qquad y(t) = x(t+2)\sin(\omega t + 2), \text{ where } \omega \neq 0$$

$$\text{SYSTEM B:} \qquad y[n] = \left(-\frac{1}{2}\right)^n (x[n] + 1)$$

Is the system linear ? Justify your answer.
Is the system time invariant ? Justify your answer.
Is the system causal ? Justify your answer.
Is the system stable ? Justify your answer.

Problem 3
Consider the LTI system y(t) = T[x(t)] where

$$\frac{dy(t)}{dt} = -ay(t) + x(t+1)$$

and the system is assumed to be initially at rest. i.e.

$$\lim_{t \to -\infty} x(t) = \lim_{t \to -\infty} y(t) = 0$$

a) Find the impulse response of the system.
b) Sketch the impulse response of the system for a = 1.
c) Prove or disprove that the system is causal.
d) Use the condition for BIBO stability of LTI systems to derive the values of ***a*** that yield a BIBO stable system? Be precise.