A. Characterize whether following systems are: a) Linear, b) Shift Invariant, c) Memoryless, d) LSI, e) Causal, f) Stable:

i. $y[n]= 8x[n] + 2$
ii. $y[n]= x[n] + x[n-2] + x[n-4] + x[n-6] + x[n-8] + \ldots$
iii. $y[n]= x[n] + x[0]$
iv. $y[n]= 0$
v. $y[n]= 2x[n^2]$
vi. $y[n]= (x[n^2])^2$

a) Linear: ii, iii, iv, v b) Shift Invariant: i, ii, iv c) Memoryless: iv
d) LSI: ii, iv e) Causal: ii, iv f) Stable: i, iii, iv, v, vi

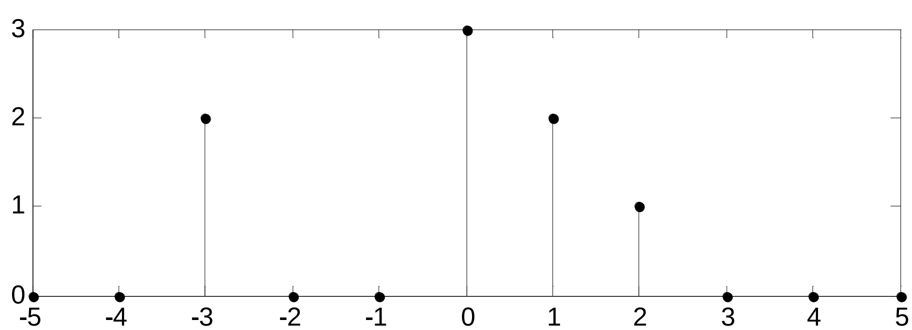
	Linear	Shift Invariant	Memoryless	LSI	Causal	Stable
$y[n]= 8x[n] + 2$	no	yes	no	no	no	yes
$y[n]= x[n] + x[n-2] + \ldots$	yes	yes	no	yes	yes	no
$y[n]= x[n] + x[0]$	yes	no	no	no	no	yes
$y[n]= 0$	yes	yes	yes	yes	yes	yes
$y[n]= 2x[n^2]$	yes	no	no	no	no	yes
$y[n]= (x[n^2])^2$	no	no	no	no	no	yes

B. Given the sequence, $x[n]$

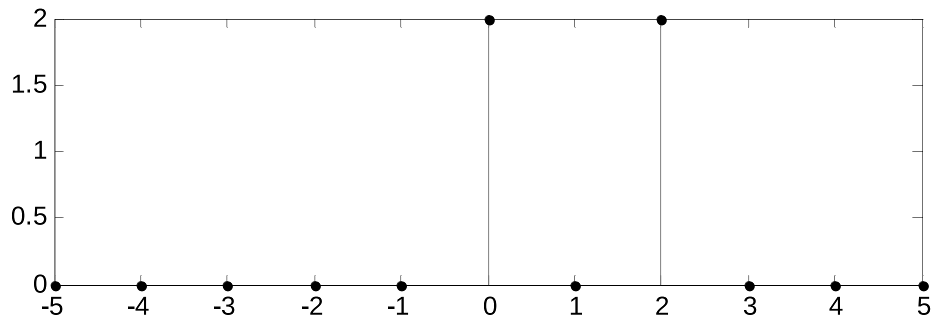
$$x[n] = 2\delta[n+3] + (3-n)(u[n]-u[n-3])$$

sketch the following sequences:

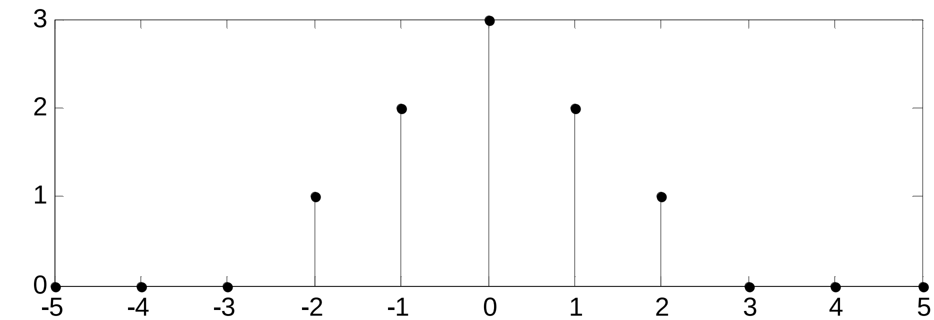
i. $y_1[n] = x[2n-3]$
ii. $y_2[n] = x[|n|]$
iii. $y_4[n] = x[½(n)+2]$



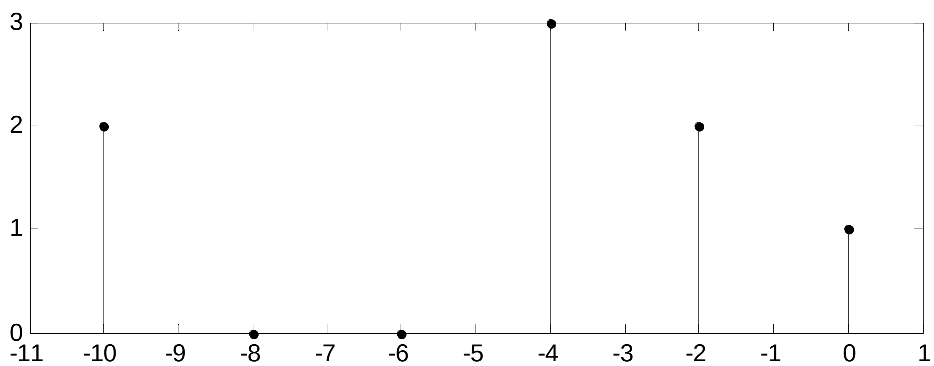
$x[n]$



$y_1[n] = x[2n-3]$



$y_2[n] = x[|n|]$



$y_4[n] = x[½(n)+2]$

$y_4[n]$ for all n odd is undefined

C. An LSI system responds to a step input ($u[n]$) with output ($g[n]$). Calculate the unit sample (impulse) response as a function of $g[n]$.

g[n]-g[n-1]

D. Can a LSI system be characterized completely by its response to one test input signal? However, in practice, it is not a good idea to only use one test to characterize a system. *Briefly (<100 words) give two reasons*

No. Need to do tests for linearity and shift invariant. Shift invariant means same single at two different times get same output at different time. In order to test the system's linearity, we need to have two test inputs x1[n] and x2[n] to perform the linearity test as shown in the slide 3.10.

E. A system is described by the LCCDE

$$y[n] - y[n-1] + y[n-2] = x[n-3]$$

The input is $x[n] = n(u[n]-u[n-4])$; initial conditions are $y[-3] = 2$ and $y[-4] = 1$. Show the response of the system from $n=-2$ to $n=+8$.

y[n] = x[n-3] + y[n-1] -y[n-2] , y[-3] = 2, y[-4] = 1				
x = {0 1 2 3 0 0 0}				
n	x[n-3]	y[n-1]	y[n-2]	y[n]
-2	0	2	1	0+2-1 = 1
-1	0	1	2	0+1-2 = -1
0	0	-1	1	0-1-1 = -2
1	0	-2	-1	0-2+1 = -1
2	0	-1	-2	0-1+2 = 1
3	0	1	-1	0+1+1 = 2
4	1	2	1	1+2-1 = 2
5	2	2	2	2+2-2 = 2
6	3	2	2	3+2-2 = 3
7	0	3	2	0+3-2 = 1
8	0	1	3	0+1-3 = -2

y[n] = {1 -1 -2 -1 1 2 2 2 3 1 -2}