Name : Danish Hayat

Student ID: 14566

Subject : Signal & System

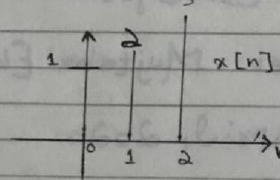
Instructor: Engineer Mujtaba Ehsan

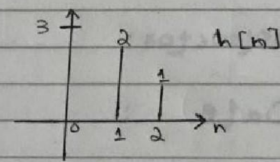
Date : 24th April, 2020

Signature :

Question No : 1 (a) ;

Evaluate $y[n]$ using convolution summation.





Solution :

As we know that;

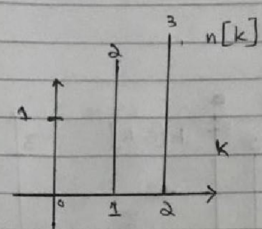
$$y[n] = x[n] \times h[n]$$

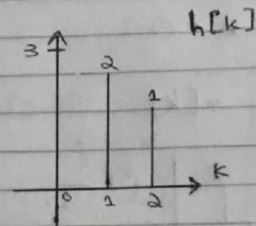
$$y[n] = \sum_{k=-\infty}^{\infty} x[k]\, h[n-k] \rightarrow \text{"a"}$$

Step No: 1;

At first, we're going to replace "n" with "k" in given signal & impulse response

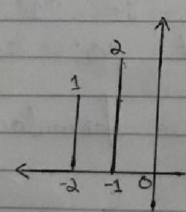
So,





Step No : 2 ;

In the second step we're going to Reflect the signal (impulse response $h[k]$ to get $h[-k]$

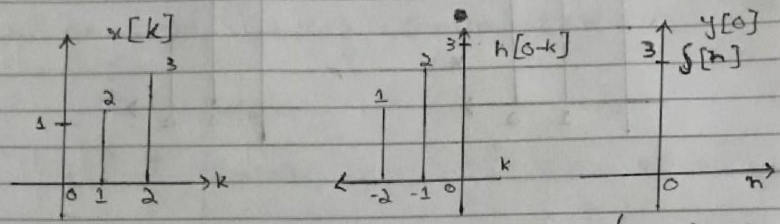


$h[-k] = h[0-k]$

Step No : 3

$h[n-k]$ is a value between $-\infty$ and 0 , So when $h[n-k]$ is multiplied by $x[k]$ the output is zero.

for $n = 0$:



(Resultant)

As we know,

$$y[0] = \sum_{k=-\infty}^{\infty} x[k]\, h[0-k]$$

As signal at "0" is "1" & impulse response at "0" is "3"

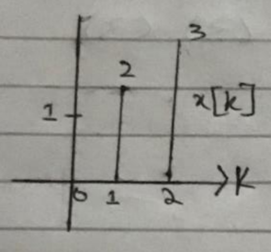
Putting in above formula we get,

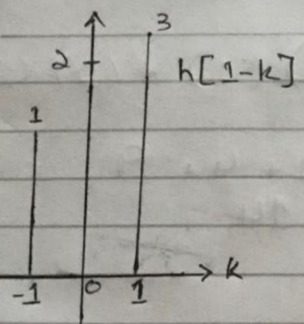
$$y[0] = (1)(3)$$

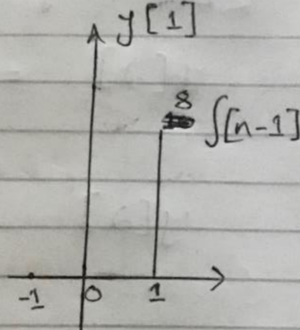
$$y[0] = 3$$

$$y[0] = 3\delta[n] \rightarrow (i)$$

For n = 1 :







(Resultant)

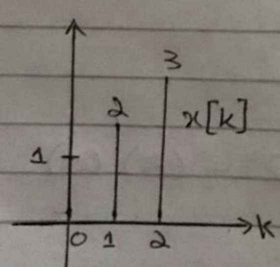
As, Putting the values in "a" we get

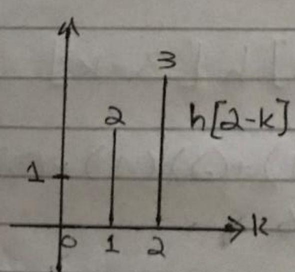
$y[1] = \sum x[k]\, h[1-k]$

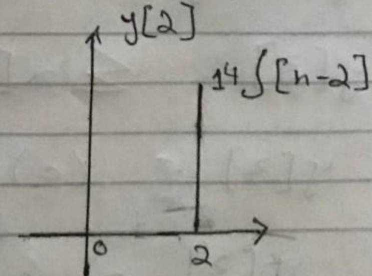
$= (1)(2) + (2)(3)$

$y[1] = 8$

for n = 2:







(Resultant)

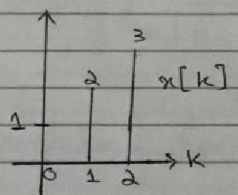
Putting the above values in "a"

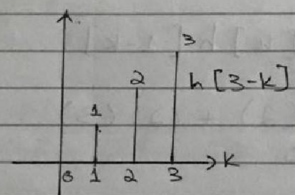
$y[2] = (1)(1) + (2)(2) + (3)(3)$

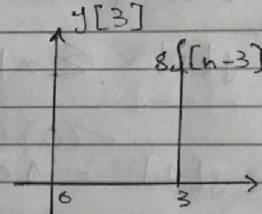
$= 1 + 4 + 9$

$y[2] = 14$

for $n = 3$:







(Resultant)

Putting the above values in "a"

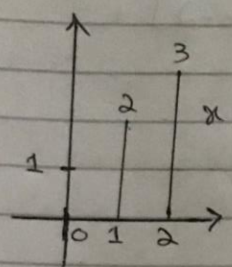
$y[3] = \sum x[k]\, h[3-k]$

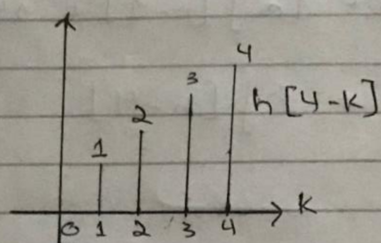
$y[3] = (0)(1) + (2)(1) + (3)(2) + (3)(0)$

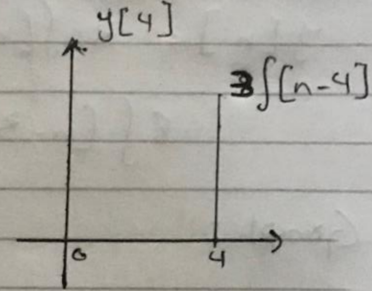
$= 2 + 6$

$y[3] = 8$

for $n = 4$:







(Resultant)

Putting the above values in "a"

~~$y[4] = (0)(1) + (2)(1) + (3)(2) + (3)(0) + (4)(0)$~~

$y[4] = (3)(1)$

$y[4] = 3$

for $n > 4$:

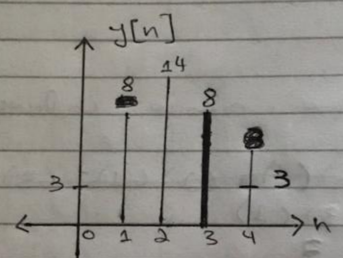
There is no overlaping of the signal and impulse response.

So $y[n] = 0$

Result:

$$y[n] = 3\delta[n] + 10\delta[n-1] + 14\delta[n-2] + 8\delta[n-3] + 8\delta[n-4]$$

Graph:



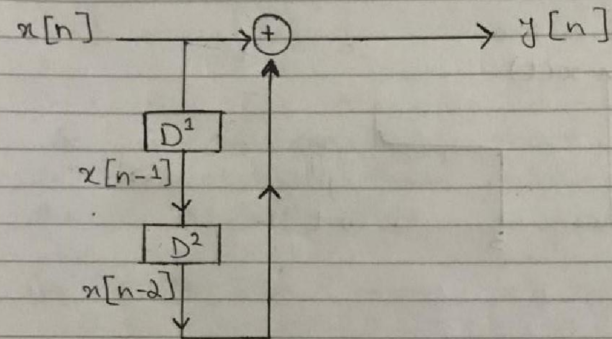
Question No: 1 (b)

Sketch the block diagram of

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

Solution:

Block Diagram:



Result:

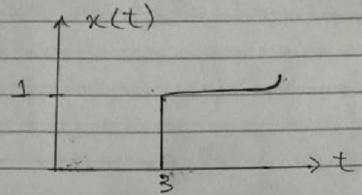
$y[n] = x[n] + x[n-2]$

Question No: 2 (a)

Sketch the transform version for the signal $x(t)$ mentioned in "i" & "ii"

(i) $x(t+5)$ and $x(3t)$
(ii) $x(t/4)$ and $x(t-2)$

Graph:



Solution:
(i) $x(t+5)$ and $x(3t)$

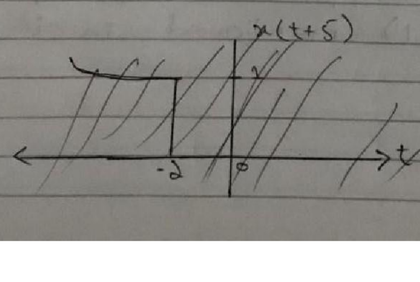
for $x(t+5)$:

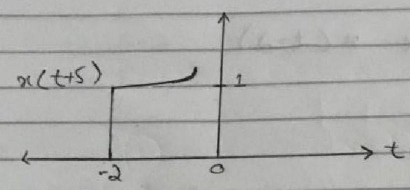
As

$$t = 3 \quad , \quad x(t) = 1$$

$$t+5 = 3 \quad , \quad x(t+5) = 1$$
$$t = 3 - 5$$
$$t = -2$$

Graph:





As we can see the above figure is translated from right side to the left side.

for $x(3t)$:

As

$t = 3, \quad x(t) = 1$

So

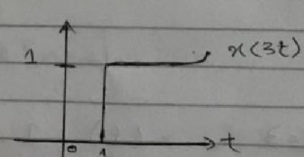
$3t = 3, \quad x(3t) = 1$

$3t = 3$

$t = \frac{\cancel{3}1}{\cancel{3}}$

$t = 1$

Graph:



As we can see the above graph is compressed.

(ii) $x(t/4)$ & $x(t-2)$

for $x(t/4)$:

At $t=3$, $x(t)=1$

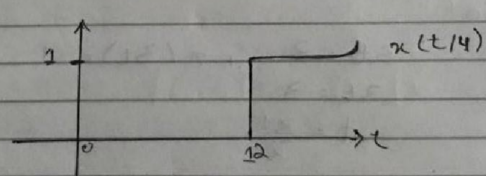
At $t/4=3$, $x(t/4)=1$

$$\frac{t}{4}=3$$

$$t=3(4)$$

$$t=12$$

Graph :



As we can see the graph is ~~examp~~ expanded.

for $x(t-2)$:

At $t=3$, $x(t)=1$

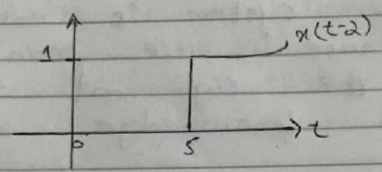
At $t-2=3$, $x(t-2)=1$

$t-2=3$

$t = 3+2$

$t = 5$

Graph:



The above graph is expanded.

Question No: 2 (b)

Outline the given system as invertible or non-invertible, linear or non-linear, causal or non-causal. Give the reason for your answer too.

(i) $y[n] = x^2[n]$

(ii) $y[n] = x[n+2]$

Answer:

(i) $y[n] = x^2[n]$

The above system is non-invertible system, because we can not determine the sign of the input from the knowledge of the output.

Example:

$y[n] = x^2[n]$

$= (-16)^2 = 256$

OR $= (16)^2 = 256$.

(ii) $y[n] = x[x+2]$

The above system is non-causal because it is dependent on the future value. OR the output involves future value of the input.

Example:

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

Question No: 3

If a time shift in the input signal results in an identical time shift in the output signal, the system is said to be "Time Invariance"