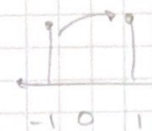
1204

(1) $y[n] = 2x[1-n] = y[n] = 2x[-n+1]$

$-(n+1)$

$-n-1$

$1-n$



Memory because of (+1)

Time Invariant?

$y[0] = 2x[1]$

$y[1] = 2x[0]$

$y[2]$

$y_1[n] = 2x[-n+1]$

Shift n let $x[n-n_0] = x[n]$ $\quad 2x[1-n-n_0]$

$y_2[n] = \cancel{2x[-n-n_0+1]} \rightarrow \cancel{2x[-(n-n_0+1)]}$

2 $\quad 2x[-n+n_0+1]$

$y_1[n-n_0] = 2x[-n-n_0+1]$

$2x[1-n-n_0] \quad 2x[-(n-n_0+1)]$

Time Invariant

Linear?

$x_1(t) \rightarrow y_1[n] = 2x_1[1-n]$

$x_2(t) = y_2[n] = 2x_2[1-n]$

$x_3 = ax_1 + bx_2 \rightarrow \cancel{y_3[n]} \Rightarrow x_3[n] = a(2x_1[1-n]) + b(2x_2[1-n])$

$= 2ax_1[1-n] + 2bx_2[1-n]$

$= a(2x_1[1-n]) + b(2x_2[1-n])$

$= ay_1[n] + by_2[n]$ ✓

Linear ✓

Causal? Yes

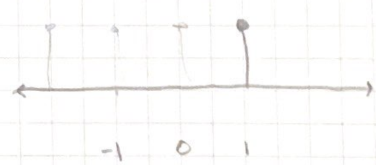
$y[2] = 2x[1-2]$

$= 2x[-1]$ past

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

$= 2x[-2]$ past

Stable? Yes



Invertible?

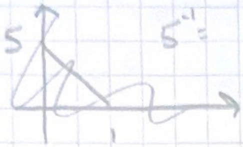
Yes.

Answers

- Time Invariant
- Linear
- Causal
- Stable
- Invertible

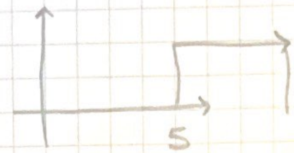
Q2 $y(t) = x(t) * h(t)$

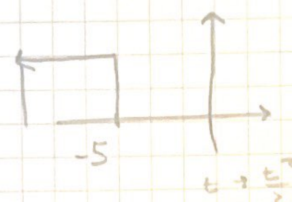
CT convolution $\int_{-\infty}^{\infty} x(\tau)\, h(t-\tau)$

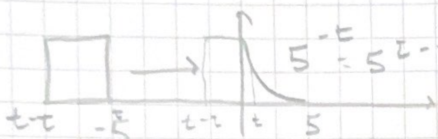
$x(t) =$ 

$5^{-t} =$

$x(t) =$ 

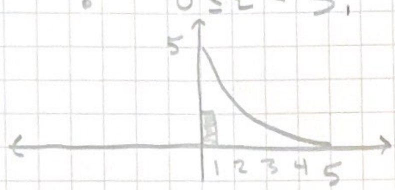
$h(t) = \delta(t-5)$ 

$h(-\tau)$ 



$5^{-t} = 5^{\tau - t}$

- $0 > t = 0$
- $0 \leq t < 5,$

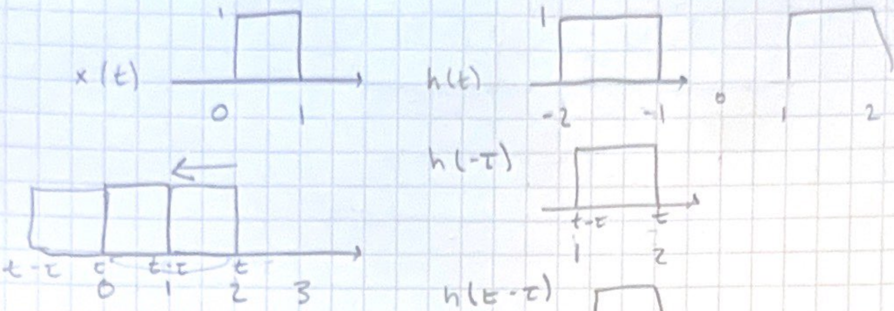


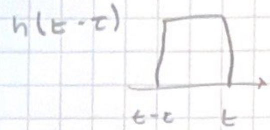
$\int_0^5 1 \cdot 5^{\tau - t + \tau}\, d\tau$ $\quad \int 5^x = \ln(x)$

$= 5^{-t} \Big|$

$$\boxed{x(t) \begin{cases} 0, & 0 > t \\ 0 \leq t < 5, & 5^{\tau - t} \\ t > 5, & 0 \end{cases}}$$

Q3 $y(t) = x(t) * h(t)$





- $t > 2 = 0$
- $2 \geq t > 0$, $\int_2^0 h(t-\tau)\,d\tau$

$$= \int_2^0 t\,d\tau - \int_2^0 \tau\,d\tau$$

- $t < 0 = 0$

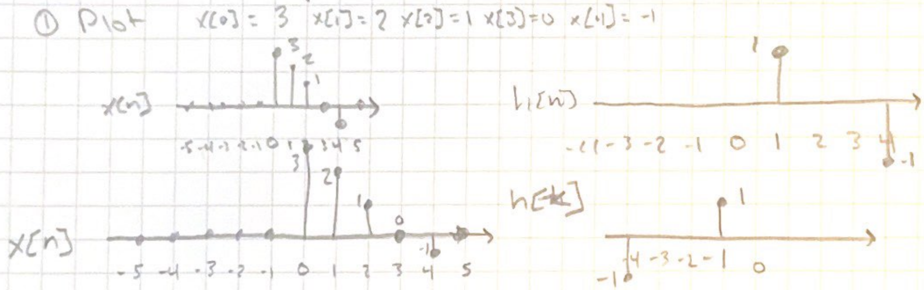
$$\boxed{y(t) = \begin{cases} 0, & t > 2 \\ -2t+2, & 2 \geq t \geq 0 \\ 0, & t < 0 \end{cases}} = t\tau\Big|_2^0 - \frac{\tau^2}{2}\Big|_2^0 = (0-2t)-[-2]$$

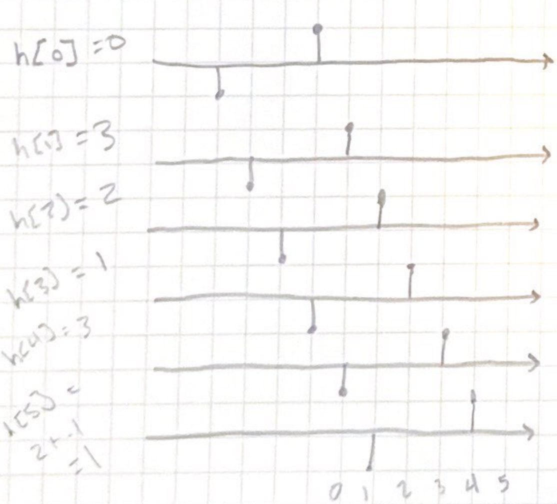
$$\underline{-2t+2}$$

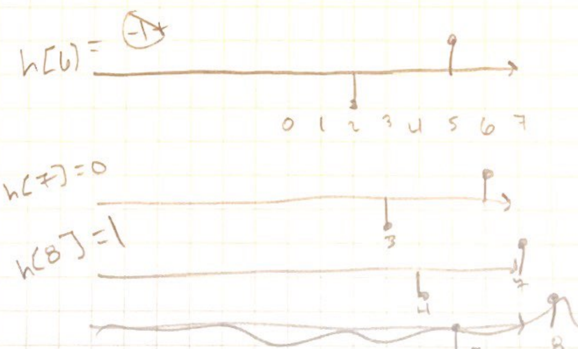
Q4 Provide pictoral description $y[n] = x[n] * h(n)$

$$x[n] = \begin{cases} -n+3 & 0 \leq n \leq 4 \\ 0 & \text{other} \end{cases} \qquad h[n] = u[n-1] - u[n-4]$$

① Plot $x[0] = 3$ $x[1] = 2$ $x[2] = 1$ $x[3] = 0$ $x[4] = -1$







$h[0] = 0$

$1 =$

$h[1] = 3$

$h[2] = 2$

$h[3] = 1$

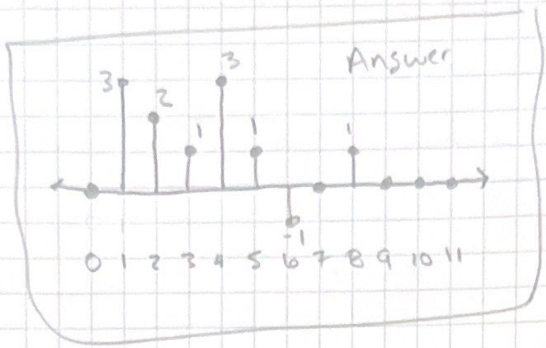
$h[4] = 3$

$h[5] = 1$

$h[6] = -1$

$h[7] = 0$

$h[8] = 1$



Q5 . Determine [illegible]

$\underline{a_0 = 2}$

$$\omega_0 = \frac{2\pi}{N} = \frac{\pi}{3}$$

$Sn =$

$$\sin(\pi n) = (e^{j\pi n} - e^{-j\pi n})$$

$$x(t) = \frac{1}{6}(e^{j\pi t} + e^{-j\pi t}) = 2\left(\frac{1}{6}e^{j\pi t} - \frac{1}{6}e^{-j\pi t}\right)^2 = \boxed{\frac{5}{3}}\ 0$$

time shift

$$x(t - t_0) = \frac{2\pi}{N} = 3$$

$$x(t) = \frac{1}{6}e^{\frac{1}{3}\pi n} + \frac{1}{6}e^{-j\frac{1}{3}\pi n} + \frac{1}{3} = \frac{1}{6}e^{\frac{1}{3}\pi n} + \frac{1}{6}e^{-j\frac{1}{3}\pi n} = \frac{1}{3}$$

$$\boxed{x(t) = \begin{cases} 2, & t = 0 \\ 0, & 0 < t < \pi \\ 1/3, & t > 2 \end{cases}}$$

Q6

- $x(t)$ is real

  $x(t)$ $T_0 = 6$ ~~and~~ is the fundamental T.P.

$$\omega_0 = \frac{2\pi}{T} = \frac{\pi}{3}$$

- $X[k] = 0$ for $k = 0$ and $|k| > 1$

  possible values $X[\pm 1]$

- $x(t) = -x(-t)$ Reflection

$$-e^{-j\omega_0 k} \quad X[k]$$

- $X[1] = -(-1)^{-1}, X[1] = 1$
- $X[-1] = -(-1)\, X[1] = X[1]$

- $\frac{1}{6}\int_{-3}^{3} |x(t)|^2 dt = -\frac{1}{2}$ $\quad |X(t)|^2 + |X[-1]|^2 = -\frac{1}{2}$

$$X[-1]^2 = -\frac{1}{2}$$

$$X[1]^2 = -\frac{1}{4}j \rightarrow X[1] = +-\frac{1}{2}j$$

$X[1]$ Positive imaginary

$$\boxed{x(t) = X[1]\, e^{j\omega_0 t} \quad X[-1]\, e^{-j\omega_0 t} = -\frac{1}{2}\left(e^{j\frac{\pi}{3}t} + e^{j\frac{\pi}{3}t}\right) \cos\left(\frac{\pi}{3}t\right)}$$