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"I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Honor Code, while taking this examination."

10/13/20

1. $x(t) = e^{-t}\left(\frac{e^{(1+j)t}}{1+j} + \frac{e^{(1-j)t}}{1-j}\right)$

$e^{-t}\left(\frac{e^{t}e^{jt}}{1+j} + \frac{e^{t}e^{-tj}}{1-j}\right)$

$\frac{e^{jt}}{1+j}\left(\frac{1-j}{1-j}\right)$

$e^{-t}\left(e^{t}\left(\frac{e^{jt}}{1+j} + \frac{e^{-tj}}{1-j}\right)\right)$

$1^2 - j^2 = 2$

$e^{-t}\left(e^{t}\left(\frac{e^{jt}(1-j)}{2} + \frac{e^{-tj}(1+j)}{2}\right)\right)$

$e^{-t}\left(e^{t}\left(\frac{e^{jt}}{2} - \frac{je^{jt}}{2} + \frac{e^{-tj}}{2} + \frac{je^{-tj}}{2}\right)\right)$

$\left(e^{-t}\left(e^{t}\left(\cos(t) + \frac{je^{-tj}}{2} - \frac{je^{tj}}{2}\right)\right)\right)$

$e^{-t}(e^{t}(\cos(t) + \cancel{\quad} -j$

$e^{-t}\left(e^{t}\left(\cos(t) + j\left(\frac{e^{-tj}}{2} - \frac{e^{tj}}{2}\right)\right)\right)$

$e^{-t}(e^{t}(\cos(t) + j(j\sin(t))))$

$e^{-t}(e^{t}(\cos(t) - \sin(t)))$

$x(t) = e^{-t}(e^{t}(\cos(t) - \sin(t)))$

$x(t) = \cos(t) - \sin(t)$

3. $x(t) = \frac{1}{2} r(t-1) - 3\,\delta(t+3)$

$$\int_{-\infty}^{t} \frac{1}{2} r(\tau-1) - 3 \int_{-\infty}^{t} \delta(\tau+3)\, d\tau$$

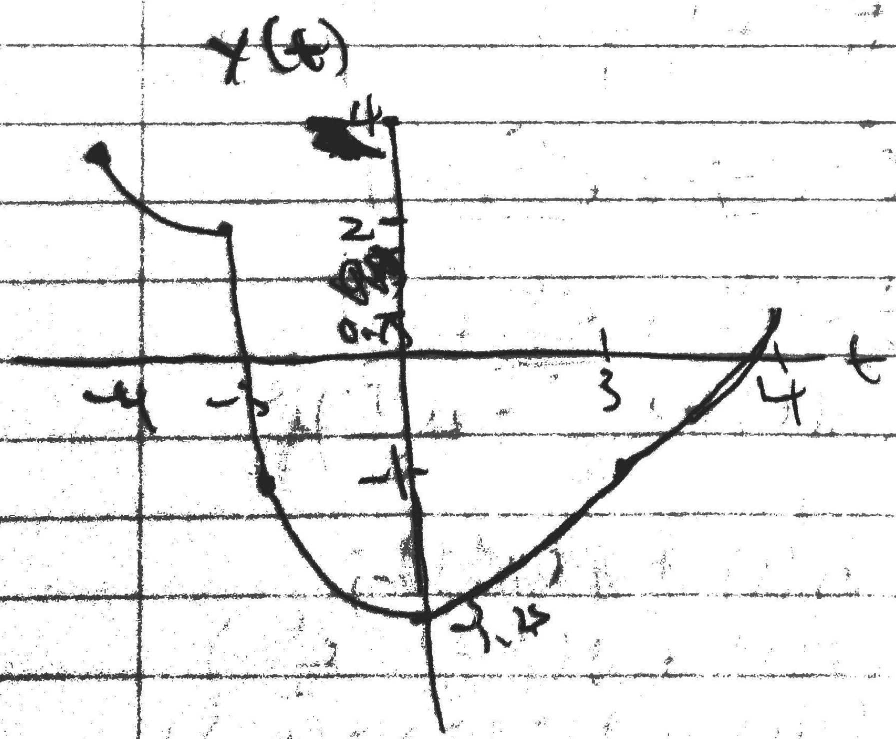
$$\int_{1}^{t} \frac{1}{2}(r(\tau-1)\, dt - 3\, u(t+3)$$

$$\int_{1}^{t} \frac{1}{2} \tau\, d\tau \quad - 3\, u(t+3)$$

$$y(t) = \frac{t^2-1}{4} - 3\, u(t+3)$$

~~graph~~ graph is $\frac{t^2-1}{4}$ till $t=-3$

Then becomes $\frac{t^2-1}{4} - 3$

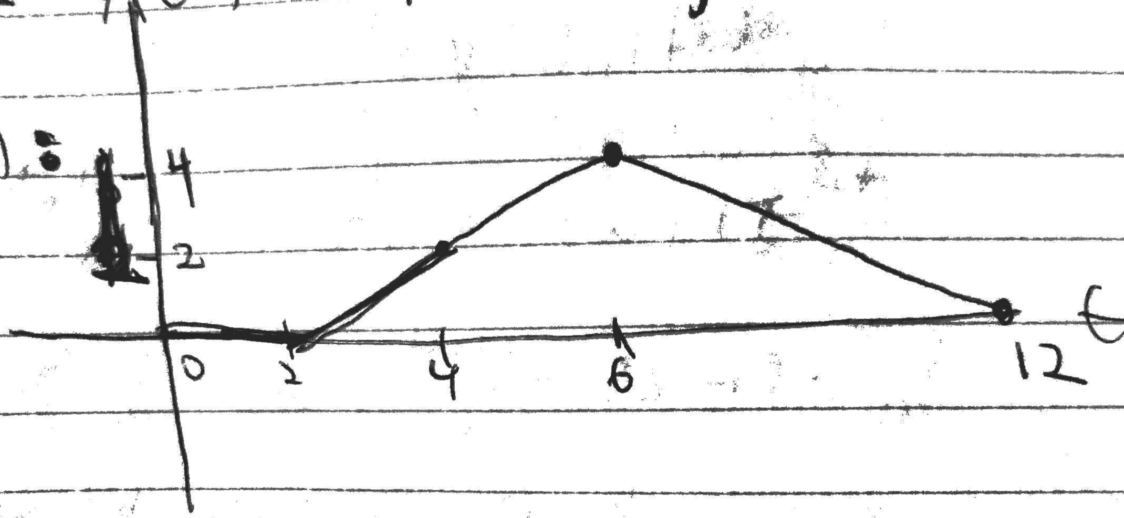


4. linear and time invariant. Arrival of signal does not matter. Scaling does not matter.

- double range $0-6 \rightarrow 0 \rightarrow 12$
- ~~[illegible]~~ - max value is full integral.

~~guess~~ $y_1(t) = x_1(t) * g(t)$?

$y_1(t)$:



5. $y(t) = x(t) * h_1(t) + x(t) * h_2(t)$

$x(t) = g(t) + g\left(\frac{t-3}{1}\right)$

$y(t) = h_1(t) * g(t) + h_1(t) * g(t-3) + h_2 * (g(t) + g(t-3))$

$\int_{-\infty}^{\infty} h_1(t)\, g(t)$

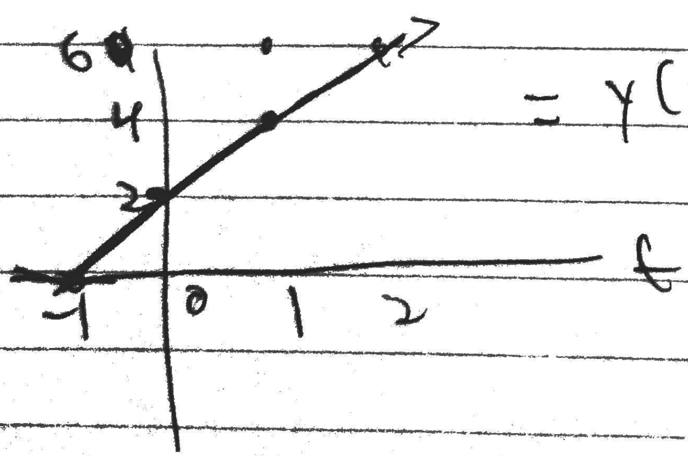
$\int_{-\infty}^{\infty} h_1(t)\, g(t-\tau)\, d\tau$

$\int_0^{t+1} -\tau+1\, d\tau + \int_3^{t+4} -\tau+1\, d\tau + \int_0^{t+1} \tau\, d\tau + \int_3^{t+4} \tau\, d\tau$

$\int_0^{t+1} -\tau+1\, d\tau + \int_3^{t+4} -\tau+1\, d\tau + \int_0^{t+1} \tau\, d\tau + \int_3^{t+4} \tau\, d\tau$

$y(t) = t+1 - \cancel{\frac{(t+1)^2}{2}} + t+1 - \cancel{\frac{(4+t)^2}{2}} + \cancel{\frac{9}{2}}$
$+ \cancel{\frac{(t+1)^2}{2}} + \cancel{\frac{(4+t)^2}{2}} - \cancel{\frac{9}{2}}$

$y(t) = 2t+2$



$= y(t)$

7. $x(t) = t\,g(t) + 2t\left(g\left(\frac{t-1}{0.5}\right)\right) + 2g\left(\frac{t-1.5}{0.5}\right)$

A: $x(t) = t(u(t) - u(t-1)) + 2t(u(t-1) - u(t-1.5))$
$+ 2(u(t-1.5) - u(t-2))$

B: $\int_{\cancel{-\infty}}^{3} x\left(\frac{2}{3}t\right) \delta(t-1)\, dt$ $0 \to 3$ in range of delta function

$= \int_0^3 x\left(\frac{2}{3}t\right) \delta(t-1)\, dt$

Only matters at $t = 1$

$= 1 \cdot x\left(\frac{2}{3}\right) = 1 \cdot \left(\frac{2}{3}\right) u\left(\frac{2}{3}\right) =$

$= \boxed{\frac{2}{3}}$

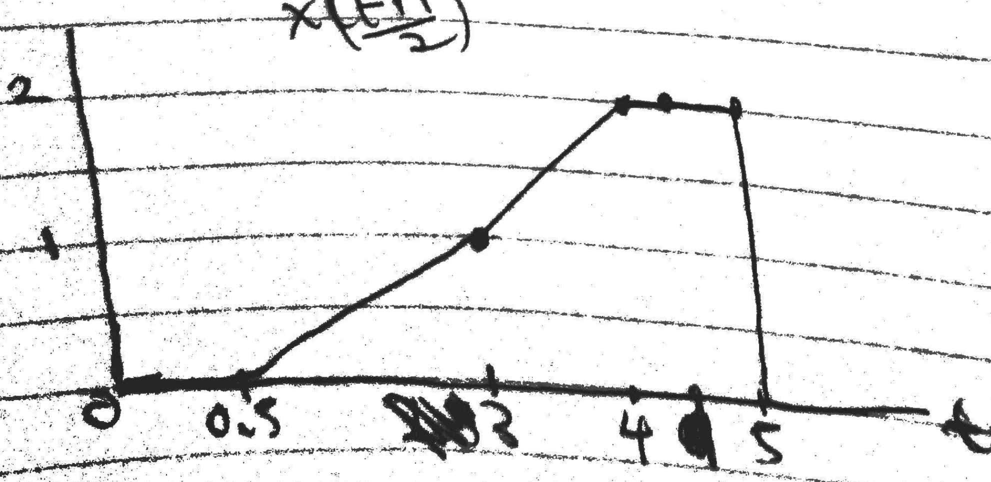
C: $x\left(\frac{t+1}{2}\right)$ ~~shift to left~~ by

$x\left(\frac{1}{2}t + \frac{1}{2}\right)$ shift left by $\frac{1}{2}$

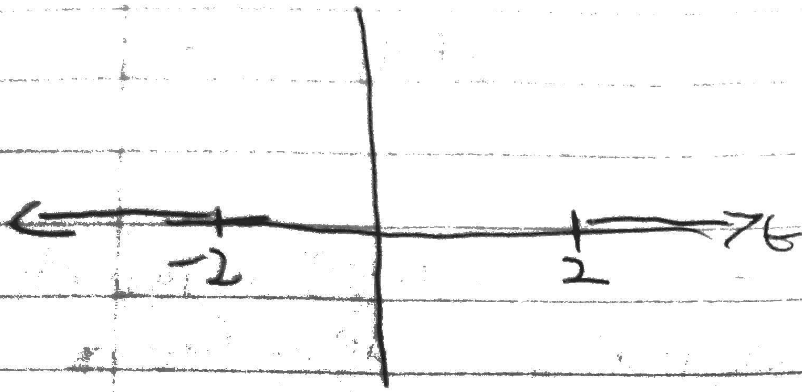
range multiply by 2

range goes from $0.5 \to 5$

$x\left(\frac{t+1}{2}\right)$



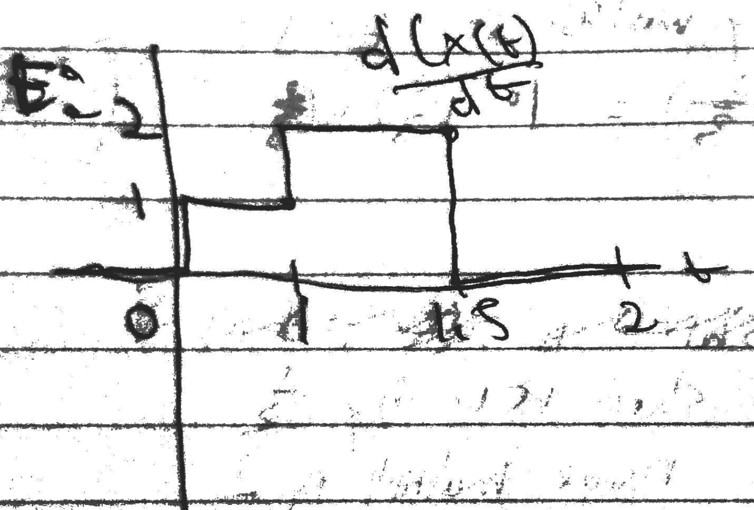
D: even $x(t)$

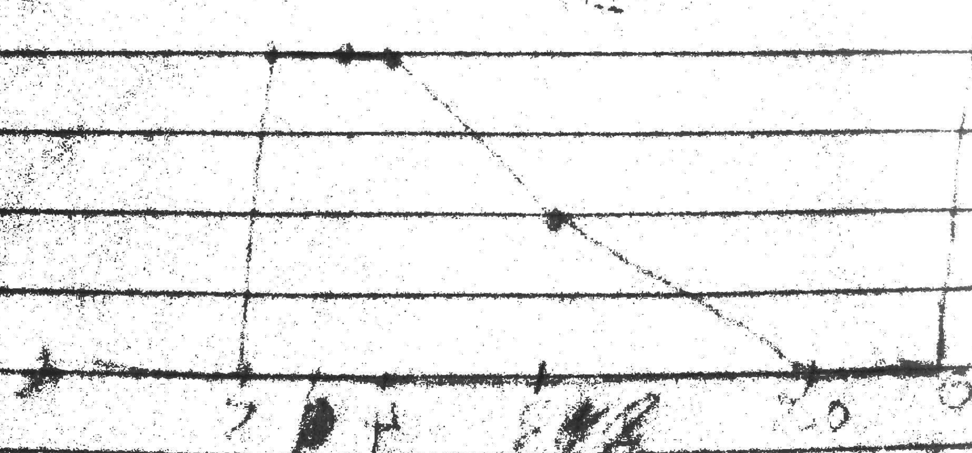


even for

$x(t>2)$ & $x(t<-2)$

E:





8.

A: not linear

B: not causal $x(t+1) \rightarrow$ depends on future

C: $x_1(t-\cancel{T}) \rightarrow y(t) = x(t-T+1)\sin(\cancel{\pi}t)$

$y(t-T) = x(t-T+1)\sin(\pi(t-T))$

not time invariant