1.

causality $h(t)=0$ for $t<0$.

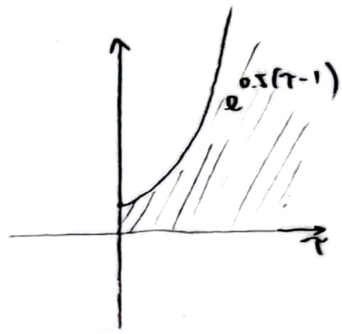
a)

i) $h(t)=e^{0.5(t-1)} \cdot u(t)$

$h(t)=0$ for $t<0$ because of $u(t)$

Therefore $\boxed{\text{causal}}$

ii) $\int_{-\infty}^{\infty} \left| e^{0.5(\tau-1)} u(\tau) \right| d\tau$



$= \int_{0}^{\infty} \left| e^{0.5(\tau-1)} \right| d\tau$

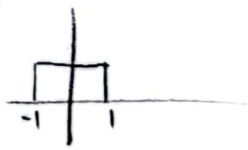
$= \infty$ because area under $e^{0.5(\tau-1)}$ is ∞.

$\boxed{\text{not stable}}$.

b)

i) $h(t) = (u(t+1)-u(t-1))(1-t^2)$

$u(t+1)-u(t-1)$:



$h(t) = 1-t^2 \quad -1<t<0$

$\neq 0$ therefore, $\boxed{\text{not causal}}$

ii)

$\int_{-\infty}^{\infty} \left| (u(\tau+1)-u(\tau-1))(1-\tau^2) \right| d\tau$

$= \int_{-1}^{1} (1-\tau)^2 \, d\tau \leq B < \infty$, where B is a constant.

$\boxed{\text{Therefore. stable.}}$

c)

i) $h[n] = a^{-|n|} \cos(\frac{\pi}{3}n)$, $|a|<1$

$h[n] = a^{n} \cos(\frac{\pi}{3}n)$ $n<0$

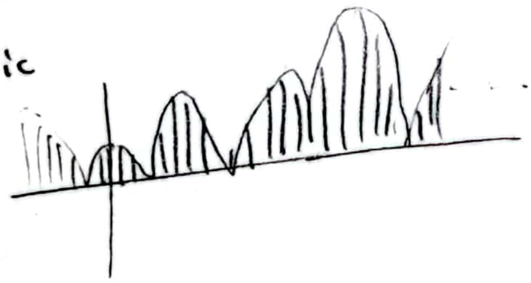
$h[n] \neq 0$ when $n<0$.

$\boxed{\text{not causal}}$

ii) $\sum_{\tau=-\infty}^{\infty} |a^{-|\tau|} \cos(\frac{\pi}{3}\tau)|$

$\lim_{\tau\to\pm\infty} a^{-|\tau|} = \infty$, do not enclose an area

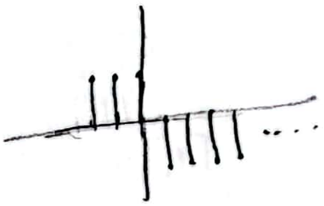
$\cos(\frac{\pi}{3}\tau)$ is periodic



Therefore : $\sum_{\tau=\infty}^{\infty} |a^{-|\tau|} \cos(\frac{\pi}{3}\tau)|$

area under the function is ∞,

$\boxed{\text{not stable}}$.



d) i) $h[n] = u[n+2] - 2u[n-1]$

$h[n] = 1$ $-2 \leq n < 0$

$h[n] \neq 0$ $n<0$

$\boxed{\text{not causal}}$

ii) $\sum_{k=-\infty}^{\infty} |u[n+2] - 2u[n-1]| = \infty$

$\boxed{\text{not stable}}$

2.

$$3\frac{d}{dt}\left[u(t) * \underbrace{\delta(t-1)}_{h_1} * h_2\right] = g(t)$$

$$3\frac{d}{dt}\left[u(t-1) * h_2\right] = g(t)$$

$$3\frac{d}{dt}\int_{-\infty}^{\infty} h_2 \cdot u(t-\tau-1)\, d\tau = g(t)$$

$$3\frac{d}{dt}\int_{-\infty}^{t-1} h_2(\tau)\, d\tau = g(t)$$

$$= 3\, h_2(t-1) = g(t)$$

$$h_2(t-1) = \frac{1}{3} g(t)$$

$$h_2 = \frac{1}{3} g(t+1)$$

3. $h[n] = (h_2 * h_3 - h_1) * h_4$

$h[n] = \underline{h_2 * h_3} * h_4 - h_1 * h_4$

$h_2 * h_3$

$= e^{-n} u[n] * e^{-\frac{n}{2}} u[n-1]$

$= \sum_{k=-\infty}^{\infty} e^{-k} u[k] \, e^{-(\frac{n-k}{2})} u[n-k-1]$

$= \sum_{k=0}^{n-1} e^{-k} e^{-(\frac{n-k}{2})} \cdot u[n-1]$

$= \sum_{k=0}^{n-1} e^{-k} e^{-\frac{n}{2}} e^{\frac{k}{2}} u[n-1]$

$= e^{-\frac{n}{2}} \sum_{k=0}^{n-1} e^{-\frac{k}{2}} u[n-1]$ $\qquad r = e^{-\frac{1}{2}}$

$= e^{-\frac{n}{2}} \left(\frac{1-(e^{-\frac{1}{2}})^n}{1-e^{-\frac{1}{2}}} \right) u[n-1]$

$h_2 * h_3 * h_4 = e^{-\frac{n}{2}} \left(\frac{1-e^{-\frac{n}{2}}}{1-e^{-\frac{1}{2}}} \right) u[n-1] * (\delta[n] - \delta[n-1])$

$= e^{-\frac{n}{2}} \left(\frac{1-e^{-\frac{n}{2}}}{1-e^{-\frac{1}{2}}} \right) u[n-1] - e^{\frac{-(n-1)}{2}} \left(\frac{1-e^{\frac{-(n-1)}{2}}}{1-e^{-\frac{1}{2}}} \right) u[n-2]$

$-h_1 * h_4 = -\delta[n-1] * [\delta[n] - \delta[n-1]]$

$= -\delta[n-1] + \delta[n-2]$

$h[n] = e^{-\frac{n}{2}} \left(\frac{1-e^{-\frac{n}{2}}}{1-e^{-\frac{1}{2}}} \right) u[n-1] - e^{\frac{-(n-1)}{2}} \left(\frac{1-e^{\frac{-(n-1)}{2}}}{1-e^{-\frac{1}{2}}} \right) u[n-2] - \delta[n-1] + \delta[n-2]$