1. (a) (6 points) **Discrete Time Convolution**

Given that

$$x[n] = \delta[n] + 2\delta[n-1] - \delta[n-2]$$
$$h[n] = u[n] - u[n-5]$$

Calculate the convolution $y[n] = x[n] * h[n]$. Show your work (give some justification if using graphical methods).

$x[n] = \{1, 2, -1\}$ (arrow at $n=0$)

$h[n] = \{1, 1, 1, 1\}$ (arrow at $n=0$)

Using superposition:

$y[n] = 1 \cdot h[n] + 2h[n-1] - h[n-2]$

$= 1, 1, 1, 1$

$+ \quad 2, 2, 2, 2$

$\quad -1, -1, -1, -1$

$1, 3, 2, 2, 1, -1$

$\Rightarrow y[n] = \{1, 3, 2, 2, 1, -1\}$ (arrow at $n=0$)

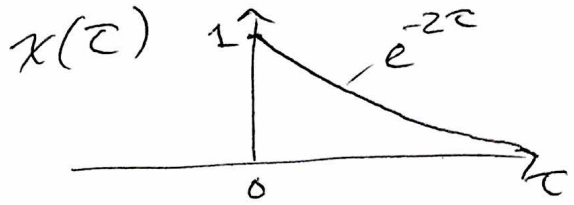
(b) (4 points) **Continuous Time Convolution**

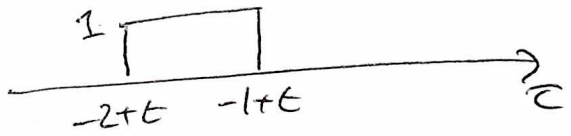
For the signal and system

$$x(t) = e^{-2t}u(t)$$

$$h(t) = u(t-1) - u(t-2)$$

Set up the integrals with the corresponding overlap regions (no-, partial-, and full-overlap). ***You do not need to solve the integrals, just set them up with correct integrands and limits.***





1) $-1+t<0$ $\quad t<1$, no overlap

(leading edge has not met $\tau=0$)

$y(t)=0$ for $t<0$

2) $-1+t>0$ $\quad -2+t<0$ $\quad 1<t<2$, partial overlap

(leading edge has passed $\tau=0$) (trailing edge has not met $\tau=0$)

$$y(t) = \int_0^{-1+t} e^{-2\tau}\,d\tau$$

3) $-2+t>0$ $\quad t>2$ full overlap

(trailing edge has passed $\tau=0$)

$$y(t) = \int_{-2+t}^{-1+t} e^{-2\tau}\,d\tau$$