H3-08A

Problem 1(a):

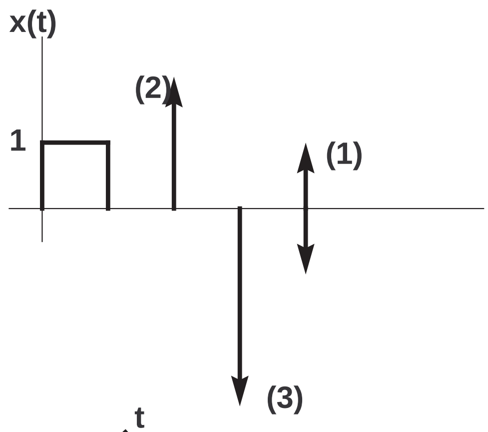
$$\begin{aligned} x(t) &= \delta(t-2)r(t) + \frac{d}{dt}\left[u(t) - r(t-1)\right] \\ &= 2\delta(t-2) + \delta(t) - u(t-1) \end{aligned}$$

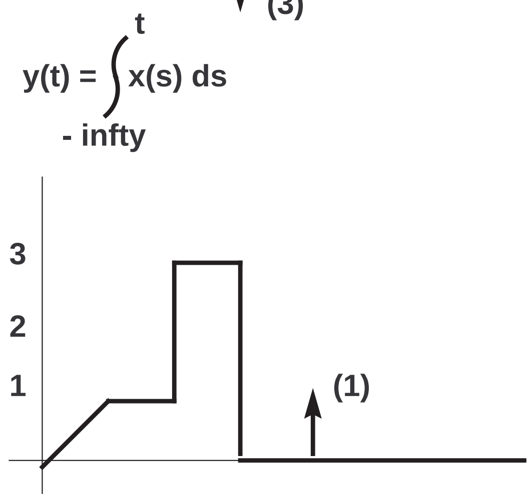
Problem 1(d):

$$\begin{aligned} x(t) &= \int_{-\infty}^{t} \delta(\tau+2)d\tau + \frac{d}{dt}[u(t+2)r(t)] \\ &= u(t+2) + \delta(t+2)\cdot r(t) + u(t)\cdot u(t+2) \\ &= u(t+2) + u(t) \end{aligned}$$

Problem 2(a):

$$\begin{aligned} x(t) &= u(t) - u(t-1) + 2\delta(t-2) - 3\delta(t-3) + \dot{\delta}(t-4) \\ \int_{-\infty}^{t} x(\sigma)d\sigma &= r(t) - r(t-1) + 2u(t-2) - 3u(t-3) + \delta(t-4) \end{aligned}$$

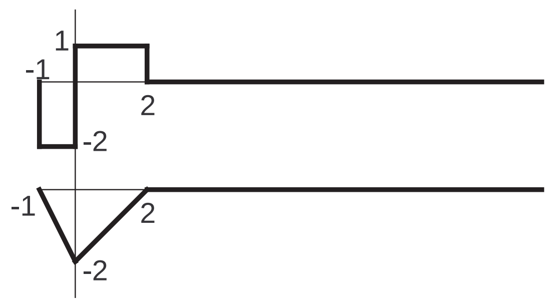




Problem 2(b):

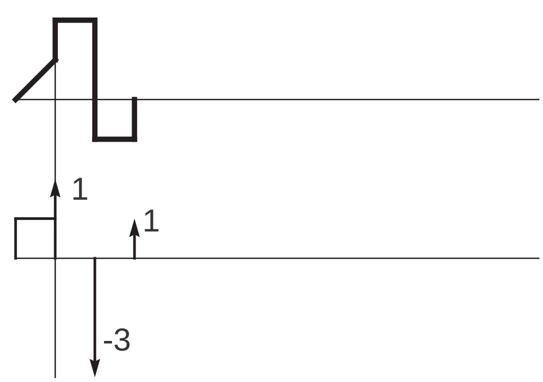
$$\int_{-\infty}^{t} x(\tau)d\tau = -2r(t+1) + 3r(t) - r(t-2)$$

$x(t)$ is the top plot, the integral is beneath it.



Problem 3:

$$\begin{aligned} x(t) &= r(t+1) - r(t) + u(t) - 3u(t-1) + u(t-2) \\ \dot{x}(t) &= u(t+1) - u(t) + \delta(t) - 3\delta(t-1) + \delta(t-2) \end{aligned}$$



Problem 4:

$$\begin{aligned} x(t) &= u(t) - r(t) + r(t-2) + u(t-3) \\ \dot{x}(t) &= \delta(t) - u(t) + u(t-2) + \delta(t-3) \end{aligned}$$

Plot using same methods as in Problem 2.

Problem 5(a):

$$x[n] = e^{j\frac{20}{3}\pi n} = e^{j\frac{10}{3}2\pi n}$$

$$\Rightarrow \textit{Periodic with } N_o = 3$$

Problem 5(b):

$$x[n] = e^{j4\pi n} - e^{-j\frac{\pi}{4}n} = 1 - e^{-j\frac{-\pi}{4}n}$$

Clearly, $x[n]$ is periodic if and only if $e^{j\frac{-\pi}{4}n}$ is periodic:

$$\omega_o = \frac{m}{N}2\pi \Rightarrow \frac{-\pi}{4} = \frac{m}{N}2\pi$$

$\Rightarrow m = -1$ and $N = 8$ works.
$\Rightarrow x[n]$ periodic, and $N_o = 8$, since adding a constant signal doesn't change N_o.

Problem 5(c):
Periodic since both phasors are periodic. Fundamental period is least N_o such that

$$\begin{aligned} \frac{5}{7}N_o\pi &= k2\pi \\ \frac{-3}{4}N_o\pi &= l2\pi \qquad k, l \text{ integers} \\ N_o &= 56 \end{aligned}$$