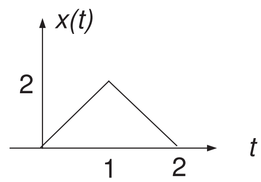
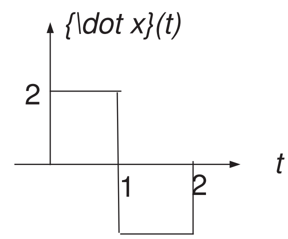
520:214: Recitation Problem Set 2

1. Answer student questions on Homework 1.
2. Represent $x(t)$ in terms of singularity signals. Sketch $\dot{x}(t)$. A: $(2r(t) - 4r(t-1) + 2r(t-2))$

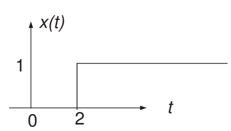




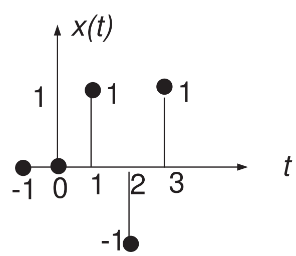
3. Sketch the signal

$$x(t) = \int_{-\infty}^{t} [\delta(\sigma - 2) + u(1 - \sigma)u(\sigma - 1)]\, d\sigma$$

A:



4. Given:



What is $x[2n - 4]$?

A: $(-\delta[n-3])$.

5. Is $x[n] = \cos^2\left(\frac{\pi}{2}n\right)$ periodic? If so, what is the fundamental period N_0?

   A: $\frac{\pi}{2} = \frac{1}{4} \cdot 2\pi \Rightarrow \cos\left(\frac{\pi}{2}n\right)$ periodic with $N_0 = 4$. Plotting $\cos\left(\frac{\pi}{2}n\right)$ and squaring shows $x[n]$ periodic with $N_0 = 2$.

6. Is the signal

   $$x(t) = e^{j3\pi t} - e^{j4\pi t}$$

   periodic? If so, what is the fundamental period?

   A: Frequencies 3π and 4π are integer multiples of $\omega_0 = \pi$, so $x(t)$ is periodic. This is the largest such ω_0, so $T_0 = 2\pi/\pi = 2$.

7. Is the signal

   $$x[n] = e^{j(3\pi/8)n} - e^{j(\pi/2)n}$$

   periodic? If so, what is the fundamental period?

   A:

   - $e^{j(3\pi/8)n}$ is periodic, and $3\pi/8 = (3/16)2\pi \Rightarrow N_0 = 16$
   - $e^{j(\pi/2)n}$ is periodic, and $\pi/2 = (1/4)2\pi \Rightarrow N_0 = 4$.
   - From class, $x[n]$ is periodic, and a period is $N = (4)(16) = 64$.
   - To find N_0, consider $x[m + N] = x[n]$; *i.e.,*

   $$e^{j\frac{3\pi}{8}n}e^{j\frac{3\pi}{8}N} - e^{j\frac{\pi}{2}n}e^{j\frac{\pi}{2}N} = e^{j\frac{3\pi}{78}n} - e^{j\frac{\pi}{2}n}$$

   - Find smallest integer N such that $(3\pi/8)N = k2\pi, \quad (\pi/2)N = \ell 2\pi$ for some integers.
   - Note: $N = 8$ does not work but $N_0 = 16$ does work.