HOMEWORK 1.

1. Evaluate the following expressions:
   a. $3t^4\delta(t-1)$
   b. $\int_{-\infty}^{\infty} t\delta(t-2)dt$
2. Express the voltage waveform $v(t)$ shown in the figure 1. As a sum of unit steps functions for the time interval $-1 < t < 7s$.

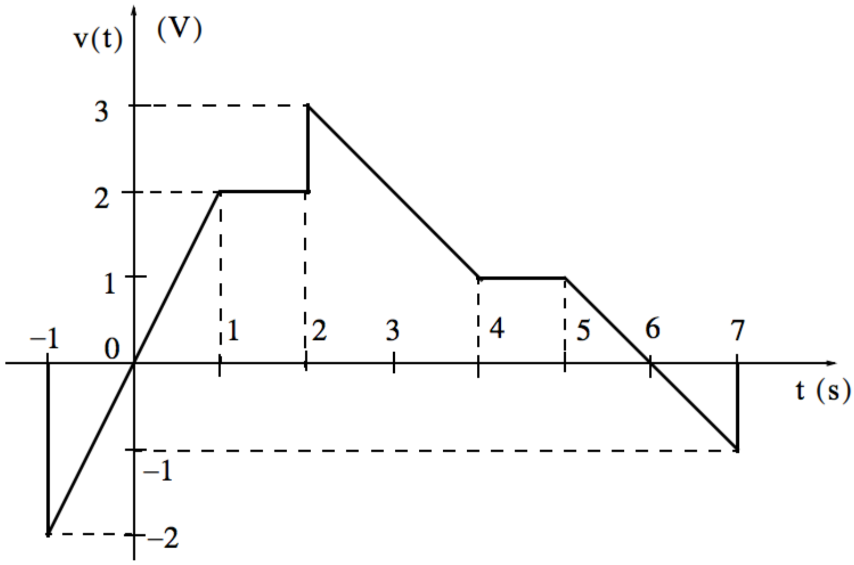


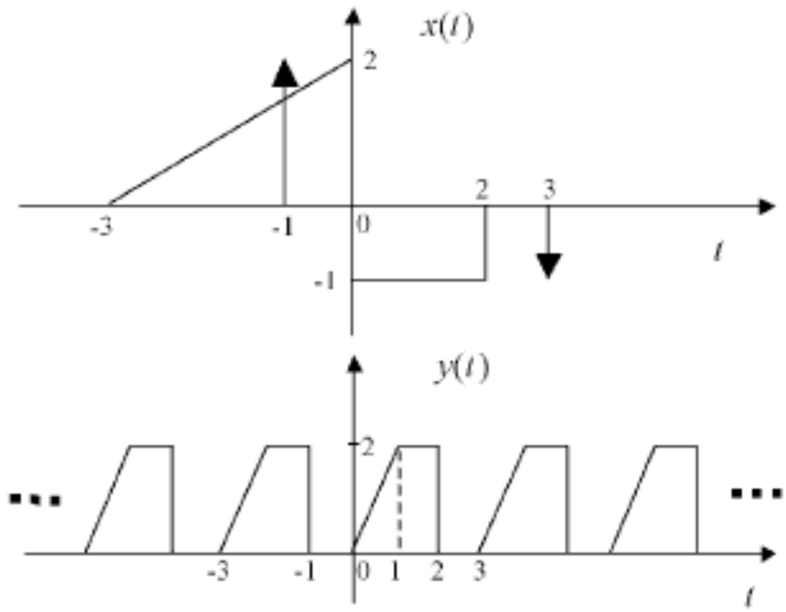
Figure 1. Waveform for problem 2.

3. Using the results of problem 2., compute the derivative of v(t) and sketch its waveform.
4. Given the signal

$$x(t) = 4(t+2)\hat{u}(t+2) - 4t\hat{u}(t) - 4\hat{u}(t-2) - 4(t-4)\hat{u}(t-4) + 4(t-5)\hat{u}(t-5)$$

   Plot the figure for $x(2t-4)$
5. Given the signal $x(t) = 5\hat{u}(t+2) - \hat{u}(t) + 3\hat{u}(t-2) - 7\hat{u}(t-4)$
   Plot the figure for $x(-2t-5)$

6. Find the fundamental periods (*T* for continuous-time signals, *N* for discrete – time signals of the following periodic signals
   a. $x(t) = \cos(13\pi t) + 2\sin(4\pi t)$
   b. $x[n] = e^{j7.351\pi n}$
7. Sketch the signals $x[n] = \hat{u}[n+3] - \hat{u}[n] + 0.5^n\hat{u}[n] - 0.5^{n-4}\hat{u}[n-4]$ and $y[n] = n\hat{u}[-n] - \delta[n-1] - n\hat{u}[n-3] + (n-4)\hat{u}[n-6]$.
8. Find the expressions for the signals shown in Figure 2.



9. Determine whether the following systems are: (1) memoryless, (2) time-invariant, (3) linear, (4) causal, or (5) BIBO stable. Justify your answers.
   a. $y[n] = x[1-n]$
   b. $y(t) = \frac{x(t)}{1+x(t-1)}$
   c. $y(t) = tx(t)$
   d. $y[n] = \sum_{k=-\infty}^{0} x[n-k]$

10. Properties of even and odd signals

   a. Show that if $x[n]$ is an odd signal, then $\sum_{-\infty}^{+\infty} x[n] = 0$.

   b. Show that if x_1 is odd and $x_2[n]$ is even, then their product is odd.

   c. Let $x[n]$ be an arbitrary signal with even and odd parts $x_e[n], x_o[n]$. Show that $\sum_{-\infty}^{+\infty} x^2[n] = \sum_{-\infty}^{+\infty} x_e^2[n] + \sum_{-\infty}^{+\infty} x_o^2[n]$.

11. Evaluate the following functions:

   a. $\sin(t)\,\delta(t - \frac{\pi}{6})$

   b. $\cos(2t)\,\delta(t - \frac{\pi}{4})$

   c. $cos^2(t)\,\delta(t - \frac{\pi}{2})$

   d. $\tan(2t)\,\delta(t - \frac{\pi}{8})$

   e. $\int_{-\infty}^{\infty} t^2 e^{-t}\,\delta(t-2)dt$