ELEC240 - Tutorial # 1

This tutorial assumes that following signal definitions for a step signal

$$s(t) = \begin{cases} 1 & ; t \geq 0 \\ \\ 0 & ; t < 0. \end{cases}$$

and a pulse signal

$$p(t) = s(t+1) - s(t-1) = \begin{cases} 1 & ; |t| \leq 1 \\ \\ 0 & ; |t| > 1. \end{cases}$$

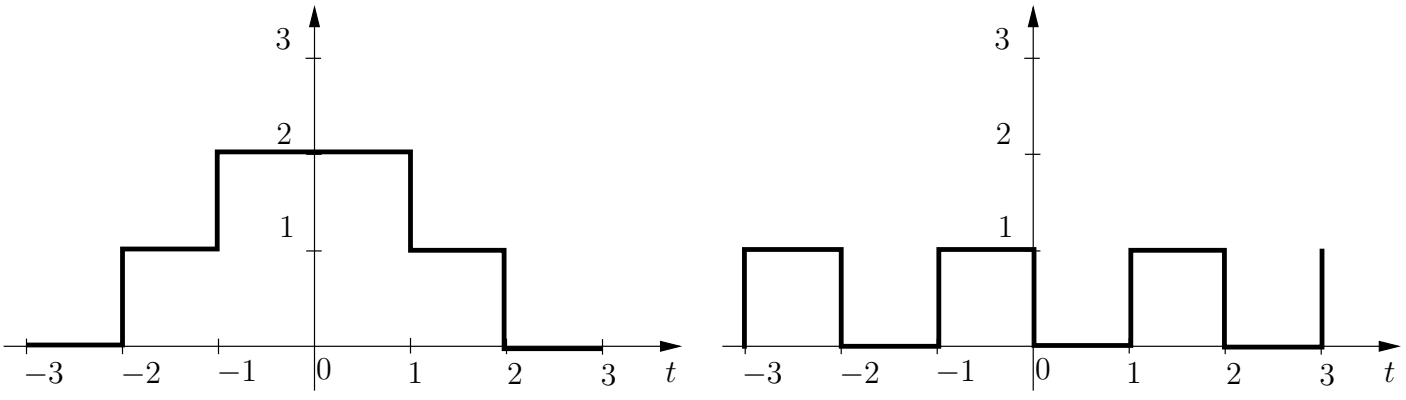
1. (a) Sketch $p(t)$
   (b) Show how the signals in figure 1 could be generated from $p(t)$
2. Show how the signals in figure 2 could be generated from $p(t)$ and $s(t)$.
3. Sketch the following signals

   (a)
   $$x(t) = s(t+1) - 2s(t-1) + s(t-3).$$

   (b)
   $$x(t) = (t+1)s(t-1) - ts(t) - s(t-2).$$

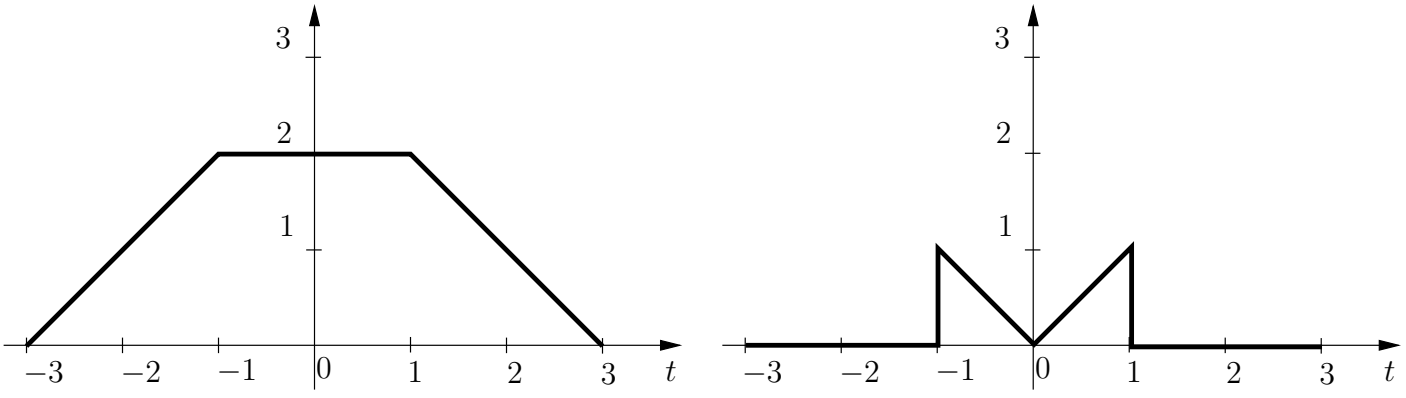
   (c)
   $$x(t) = e^{-t}s(t) + e^{-t}\left[e^{2t-4} - 1\right] s(t-2) - e^{t-4}s(t-4).$$

4. (a) Consider the circuit shown in figure 3(a). Assume that the switch in the circuit has been closed for a very long time, and is then opened at time $t = 0$. Assume that the voltage source signal $x(t)$ is zero for $t < 0$.
      i. Determine the initial condition $y(0)$.
      ii. Determine the differential equation relating $x(t)$ and $y(t)$ for $t \geq 0$.
      iii. Compute $y(t)$ for $t > 0$ when $x(t) = 0$ for all t.
5. Consider the RL circuit shown in figure 3(b).
   (a) Derive a differential equation that shows how the signals $x(t)$ and $v_L(t)$ depend upon one another.
   (b) Solve this differential equation to derive an explicit expression for $v_L(t)$ when $x(t)$ is a unit step signal $s(t)$ and it is assumed that $i(t) = 0$ for $t < 0$.



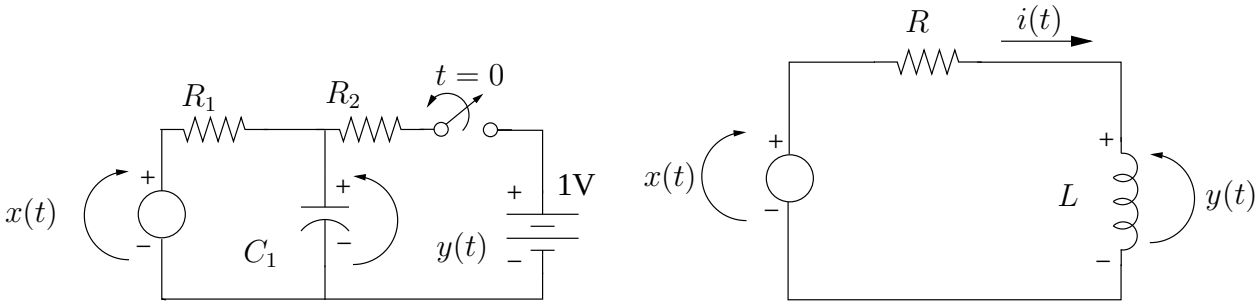
(a) (b)

Figure 1: *Signals pertaining to question 1*



(a) (b)

Figure 2: *Signals pertaining to question 2*



(a) Circuit for question 4(a) (b) Circuit for question 4(b)

Figure 3: *Circuits pertaining to question 4*