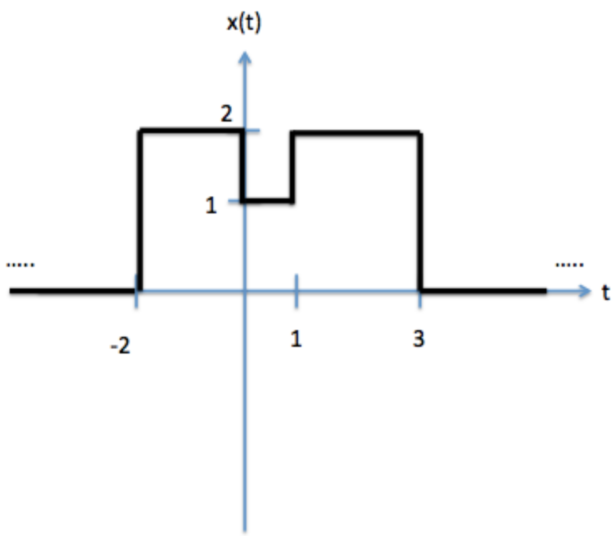
Answers to Practice Final. F14 Section 1

P1. $v_c(t) = 5(1 + \exp(-100t))$ for $t>0$

P2

(a)



(b-1) $3\sin((2\pi/3)n + \pi/3) + 4\cos((\pi/2)n - \pi/6)$

(b-2) $3\sin(4000\pi t\ \pi/3) + 4\cos((3000\pi t - \pi/6)$

(b-3) No because the 2nd term is aliased as the sampling rate is < 2x the frequency of 4500Hz.

(c-1) $6/(2^{10}-1)$ ~= 6mV

(c-2) ~3mV

(c-3) 1 V

(d) $X(\omega) = 2\exp(-j2\omega)(1/1 + j2\omega)$

P3

(a) At DC and as $\omega\to\infty$ $v_0(t) = 0$

(b) $R+ j(\omega L + (1/ \omega C))$

(c) Call the result in (b) $Z_T(\omega)$. Then $\mathbf{V_o} = R/Z_T(\omega)$.

(d) Yes. At DC, the first term in the denominator = 0 but the 2nd $\to\infty$ so the fraction = 0. As $\omega\to\infty$ the 2nd term in the denominator goes to 0 but the 1st $\to\infty$ so the fraction -> 0.

(e) $R_{eq} = 20k\Omega$, $L_{eq} = 15mH$

P4

(a) if we put ground at the node where the – side of the source, one of the 20Ω resistors and the 40Ω resistor are connected, and let V_a and V_b represent the node voltages at the nodes labeled as a and b, we get

$$\begin{bmatrix} 1/8 & -1/20 \\ -1/20 & 3/20 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

(b) If we let I_1 be the mesh current for the loop that has the source, the 20Ω, and the 40 Ω resistors, I_2 be the mesh current for the loop that has the 3 20Ω resistors, and I_3 be the mesh current for the loop that has the 2 20Ω resistors and one 40Ω resistor, we get

$$\begin{bmatrix} 60 & -20 & -40 \\ -20 & 60 & -20 \\ -20 & -40 & 80 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 20 \\ 0 \\ 0 \end{bmatrix}$$

(c) $V_{th} = 10/3$ V, $R_{th} = 70/3$

P5

(a) $1 + R_1 / (R_2 (1 + j\omega CR_1))$

(b) $V_o(\omega) = V_s(\omega) (1 + R_1 / (R_2 (1 + j\omega CR_1)))$

(c) $v_o(t) = 10 + 10/\sqrt{13} \cos(250t + 7\pi/12 - \tan^{-1}(5))$