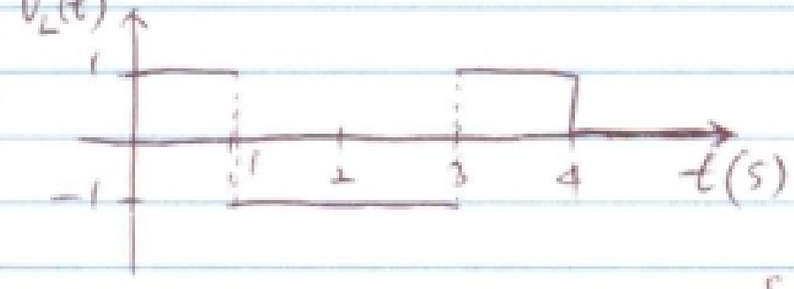
HW#15.

2

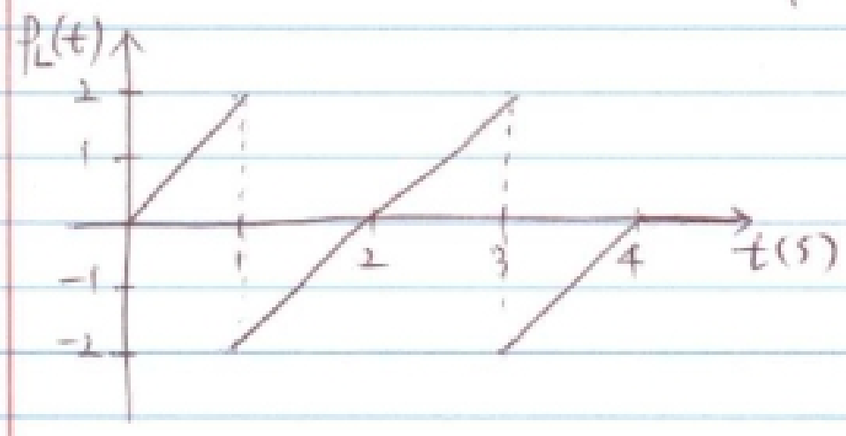
(a) $i_{in}(t) = \begin{cases} 2t & (0 \le t < 1) \\ -2t+4 & (1 \le t < 3) \\ 2t-8 & (3 \le t < 4) \\ 0 & (t \ge 4) \end{cases}$

$V_L(t) = L \cdot \frac{di_{in}(t)}{dt}$

$= 0.5 \times \frac{di_{in}(t)}{dt} = \begin{cases} 1 & (0 \le t < 1) \\ -1 & (1 \le t < 3) \\ 1 & (3 \le t < 4) \\ 0 & (t \ge 4) \end{cases}$



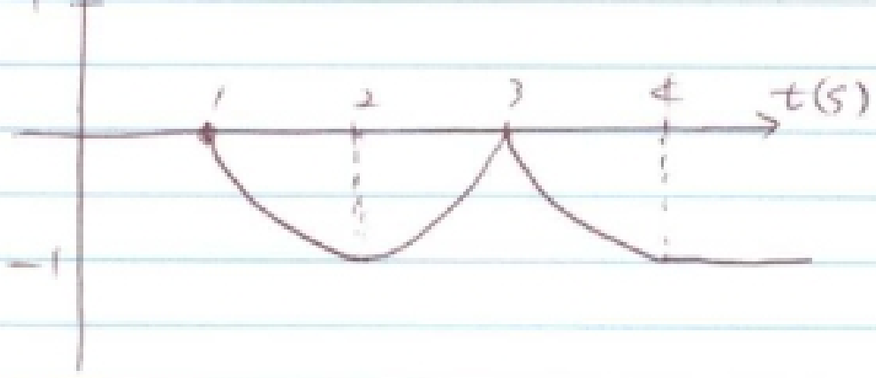

(b) $p_L(t) = V_L(t) \cdot i_{in}(t) = \begin{cases} 2t & (0 \le t < 1) \\ 2t-4 & (1 \le t < 3) \\ 2t-8 & (3 \le t < 4) \\ 0 & (t \ge 4) \end{cases}$



(c) $W_L(t_0, t_1) = \int_{t_0}^{t_1} p_L(\tau)\,d\tau = \frac{1}{2}L\left[i_m^2(t_1) - i_m^2(t_0)\right]$

$\therefore W_L(1, t) = \frac{1}{2} \times 0.5 \times \left[i_m^2(t) - i_m^2(1)\right] \quad (t \geq 1)$

$$\therefore W_L(1,t) = \begin{cases} \text{not defined} & (t < 1) \\ t^2 - 4t + 3 & (1 \leq t < 3) \\ t^2 - 8t + 15 & (3 \leq t < 4) \\ -1 & (t \geq 4) \end{cases}$$



4. $i_S(t) = 10\sin(2000t) \times 10^{-3}\ (A)$

(a) $V_m(t) = 0.2 \times 10^{-3} \times \frac{d\,i_S(t)}{dt}$

$= 0.2 \times 10^{-3} \times 10 \times 10^{-3} \times 2000 \times \cos(2000t)$

$= 4 \times 10^{-3} \times \cos(2000t)\ (V)$

$i_{out}(t) = \frac{1}{2 \times 10^{-3}} \times \int_0^t 10 \cdot V_m(\tau)\, d\tau$

$= 10^{-2}\sin(2000t)(A) = 10\sin(2000t)(mA)$

(b) $p(t) = V \cdot I$

$= 10\, V_m(t) \times i_{out}(t)$

$= 10 \times 4 \times 10^{-3}\cos(2000t) \times 10^{-2} \times \sin(2000t)$

$= 4 \times 10^{-4}\sin(2000t)\cos(2000t)\ (W)$

$= 2 \times 10^{-4}\sin(4000t)\ (W)$

$= 0.2 \times \sin(4000t)\ (mW)$

(c) $W_L(t) = \frac{1}{2} \times 2 \times 10^{-3} \times i_{out}^2(t)$

$= 10^{-3} \times 10^{-4}\sin^2(2000t)\ (J)$

$= 10^{-7} \times \sin^2(2000t)\ (J)$

$= 100\sin^2(2000t)\ (nJ)$