

HW#9 Solutions

P 6.5 [a] $0 \leq t \leq 1 \text{ s}$:

$$v = -100t$$

$$i = \frac{1}{5} \int_0^t -100x \, dx + 0 = -20 \left. \frac{x^2}{2} \right|_0^t$$

$$i = -10t^2 \text{ A}$$

$1 \text{ s} \leq t \leq 3 \text{ s}$:

$$v = -200 + 100t$$

$$i(1) = -10 \text{ A}$$

$$\begin{aligned} \therefore i &= \frac{1}{5} \int_1^t (100x - 200) \, dx - 10 \\ &= 20 \int_1^t x \, dx - 40 \int_1^t dx - 10 \\ &= 10(t^2 - 1) - 40(t - 1) - 10 \\ &= 10t^2 - 40t + 20 \text{ A} \end{aligned}$$

$3 \text{ s} \leq t \leq 5 \text{ s}$:

$$v = 100$$

$$i(3) = 10(9) - 120 + 20 = -10 \text{ A}$$

$$\begin{aligned} i &= \frac{1}{5} \int_3^t 100 \, dx - 10 \\ &= 20t - 60 - 10 = 20t - 70 \text{ A} \end{aligned}$$

$5 \text{ s} \leq t \leq 6 \text{ s}$:

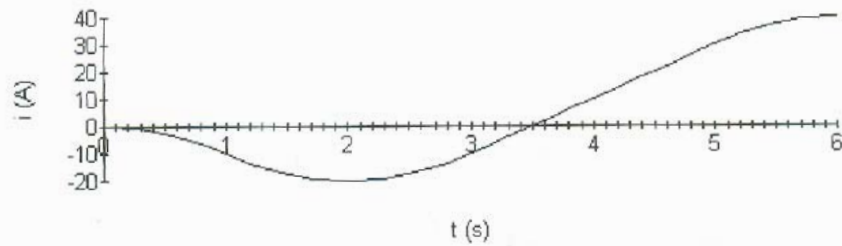
$$v = -100t + 600$$

$$i(5) = 100 - 70 = 30$$

$$\begin{aligned} i &= \frac{1}{5} \int_5^t (-100x + 600) \, dx + 30 \\ &= -20 \int_5^t x \, dx + 120 \int_5^t dx + 30 \\ &= -10(t^2 - 25) + 120(t - 5) + 30 \\ &= -10t^2 + 120t - 320 \text{ A} \end{aligned}$$

[b] $i(6) = -10(36) + 120(6) - 320 = 720 - 680 = 40 \text{ A}, \quad 6 \leq t < \infty$

[c]



P 6.8 [a] $i(0) = A_1 + A_2 = 0.04$

$$\frac{di}{dt} = -10,000A_1e^{-10,000t} - 40,000A_2e^{-40,000t}$$

$$v = -200A_1e^{-10,000t} - 800A_2e^{-40,000t} \text{ V}$$

$$v(0) = -200A_1 - 800A_2 = 28$$

Solving, $A_1 = 0.1$ and $A_2 = -0.06$

Thus,

$$i = 0.1e^{-10,000t} - 0.06e^{-40,000t} \text{ A}, \quad t \geq 0$$

$$v = -20e^{-10,000t} + 48e^{-40,000t} \text{ V}, \quad t \geq 0$$

[b] If $p = 0$ then either $i = 0$ or $v = 0$. Suppose $i = 0$:

$$i = 0.1e^{-10,000t} - 0.06e^{-40,000t} = 0$$

$$\therefore 0.1e^{30,000t} = 0.06 \quad \text{so} \quad t = -17.03 \mu\text{s}$$

This answer is impossible! So assume that $v = 0$:

$$v = -20e^{-10,000t} + 48e^{-40,000t} = 0$$

$$\text{Then,} \quad -20e^{30,000t} = -48 \quad \therefore \quad t = 29.18 \mu\text{s}$$

This answer makes sense; therefore, the power is 0 at $t = 29.18 \mu\text{s}$.

P 6.14 $i_C = C(dv/dt)$

$0 < t < 0.5 :$

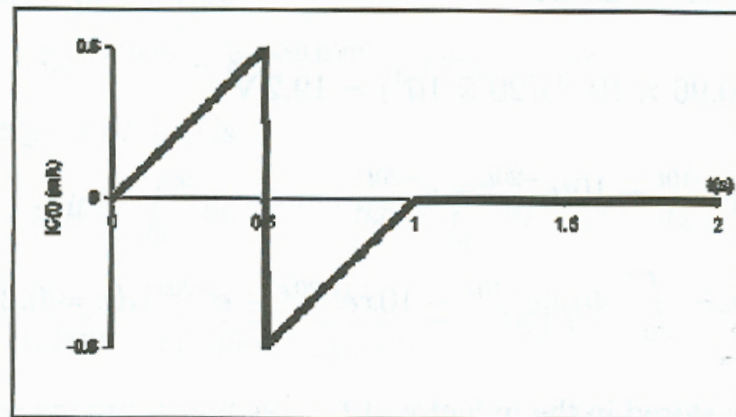
$$v_c = 30t^2 \text{ V}$$

$$i_C = 20 \times 10^{-6}(60)t = 1.2t \text{ mA}$$

$0.5 < t < 1 :$

$$v_c = 30(t - 1)^2 \text{ V}$$

$$i_C = 20 \times 10^{-6}(60)(t - 1) = 1.2(t - 1) \text{ mA}$$



P 6.21 $30 \parallel 20 = 12 \text{ H}$

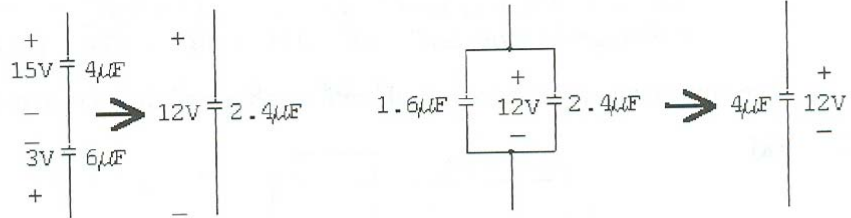
$$80 \parallel (8 + 12) = 16 \text{ H}$$

$$60 \parallel (14 + 16) = 20 \text{ H}$$

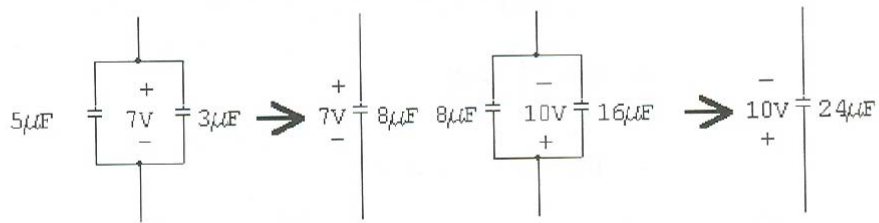
$$15 \parallel (20 + 10) = 20 \text{ H}$$

$$L_{ab} = 5 + 10 = 15 \text{ H}$$

P6.25 $\frac{1}{4} + \frac{1}{6} = \frac{5}{12} \therefore C_{eq} = 2.4 \mu\text{F}$



$\frac{1}{4} + \frac{1}{12} = \frac{4}{12} \therefore C_{eq} = 3 \mu\text{F}$



$\frac{1}{24} + \frac{1}{8} = \frac{4}{24} \therefore C_{eq} = 6 \mu\text{F}$

