Problem 1

(a) $R = \frac{v}{i} = \frac{10e^{-2t}}{0.4e^{-2t}} = 25\ \Omega$

$\tau = RC = \frac{1}{2}$ $\quad C = \frac{1}{2R} = 0.02F$

(b) $\tau = RC = \frac{1}{2}\ s = 0.5\ s$

(c) v(0)=10V, $\quad w_0 = \frac{1}{2}Cv(0)^2 = 0.5 \times 0.02 \times 100J = 1J$

(d) $0.5w_0$=0.5J, $\quad \frac{1}{2}Cv^2 = 0.5, \quad \Rightarrow \quad v = 7.071V$

$10e^{-2t} = 7.071 \Rightarrow$ t=0.173s

Problem 2

When t<0, $v_0 = 6 \times \frac{4||12}{4||12+2}V = 3.6V$.

When t>0, R=4//12KΩ =3KΩ

$\tau = RC = 3 \times 10^3 \times 50 \times 10^{-6}s = 0.15s$

$v_0 = v_t = 3.6e^{-\frac{t}{0.15}} = 3.6e^{-\frac{20}{3}t}$ V

Problem 3

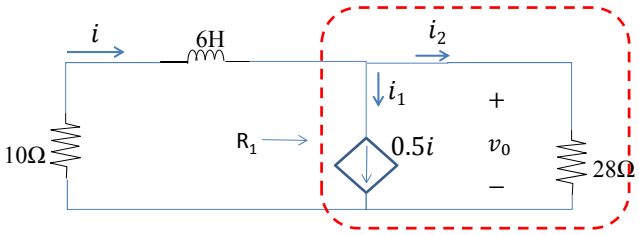
When t<0, R_{eq}=8+6//20//30Ω=12Ω, I=24/12A=2A

$i_L = I \cdot \frac{6}{6+20||30} = 2 \times \frac{1}{3}A = 0.667A$

When t > 0, R_{th}=20//30+6Ω =18Ω, $\tau = \frac{R}{L} = \frac{18}{4}s = 4.5s$

$i_L = 0.667e^{-4.5t}A, \quad i_0 = \frac{30}{20+30}i_L = 0.4e^{-4.5t}A$

Problem 4



When t = 0, i(0)=2A, i_1=0.5i=1A, i_2=i-i_1=1A,

$$R_1 = \frac{v_0}{i} = \frac{28i_2}{i} = \frac{28}{2} = 14\Omega$$

When t > 0, $R = R_1 + 10\Omega = 24\Omega$

$$\tau = \frac{R}{L} = \frac{24}{6}s = 4s$$

$$i(t) = 2e^{-4t}A$$

Problem 5

R=3+5//20Ω=7Ω $\tau = \frac{R}{L} = \frac{7}{2}s = 3.5s$

$$i(t) = 20e^{-3.5t}A$$

$$v(t) = -i(t) \cdot \frac{5}{20+5} \times 20 = -80e^{-3.5t}\ V$$

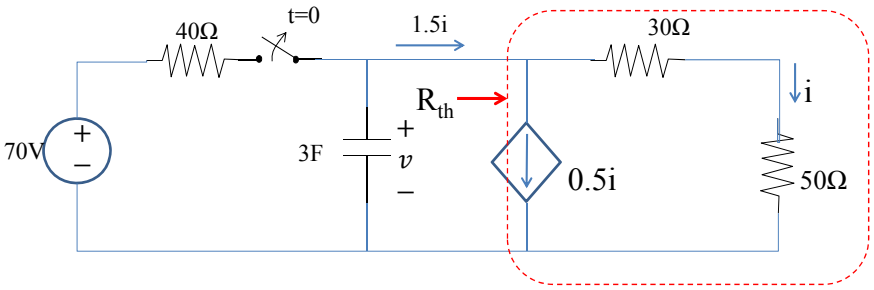
Problem 6

When t<0 v_0=14-2×4V=6V

When t>0 R=3Ω, $\tau = RC = 3 \times 2s = 6s$

$$v(t) = 6e^{-\frac{t}{6}}V$$

Problem 7



When t<0, $40 \times 1.5i + (30 + 50)i = 70 \Rightarrow$ i=0.5A

v(0)=80i=40V

For t >0, R_{th}=80i/1.5i=53.33Ω, $\tau = RC = 53.33 \times 3s = 160s$

$v(t) = 40e^{-\frac{t}{160}}V$

$i(t) = \frac{v(t)}{80} = 0.5e^{-\frac{t}{160}}\ A$