7-16.

$i_L(0^+)=i_L(0^-)=\frac{24}{4+4}=3A$, $R_{eq}=6\Omega$

$\tau=\frac{L}{R}=\cancel{8}\ 0.5s$

$i(\infty)=\frac{24}{4+\frac{4\times4}{4+4}}\times\frac{4}{4+4}=2A$

$i_L(t)=i(\infty)+(i(0^+)-i(\infty))e^{-\frac{t}{\tau}}$

$=2A+(3-2)e^{-2t}A$

$=2-e^{-2t}A$

$U_L(t)=L\cdot\frac{di}{dt}=6e^{-2t}V$

$U_R=U-U_L-4i_L$

$=16-2e^{-2t}V$

$i=\frac{U_R}{4}=4-0.5e^{-2t}A$

$P=Ui=96-12e^{-2t}W$

7-18.

$U_C(0^+)=U_C(0^-)=0V$

$i_L(0^+)=i_L(0^-)=9\times\frac{3}{3+6}=\cancel{3}\ 6A$

$U_C(\infty)=3\times\frac{2}{2+1}=2V$, $U_C(t)=U_C(\infty)+(U_C(0^+)-U_C(\infty))e^{-\frac{t}{RC}}=2(1-e^{-3t})V$

$i_L(\infty)=3A$

$i_L(t)=i(\infty)+(i(0)-i(\infty))e^{-\frac{Rt}{L}}=3(1+e^{-9t})A$

$U_L(t)=L\cdot\frac{di}{dt}=-27e^{-9t}$

$\therefore U(t)=U_C(t)-U_L(t)$

$=[2(1-e^{-3t})+27e^{-9t}]V$

7-20

$i_L(0^+)=i_L(0^-)=-\frac{8}{2}=-4A$

当 $t\to\infty$

$(2-i_1)\cdot 4=4i_1+2i_1$

$i_1=0.8$

$i_L(\infty)=2-i_1=1.2A$

$R=\frac{8i+2i}{i}=10\Omega$

$\tau=\frac{L}{R}=0.01s$

$\therefore i_L=i_L(\infty)+(i_L(0^+)-i_L(\infty))e^{-\frac{t}{\tau}}$

$=1.2-5.2\cdot e^{-100t}A$

$u_L=L\cdot\frac{di}{dt}=52\cdot e^{-100t}V$

7-21.

$i=-C\frac{du_C}{dt}=-0.25\frac{du_C}{dt}$

$u_L=L\frac{di}{dt}$

$=-\frac{1}{16}\frac{d^2u_C}{dt^2}$

$\therefore u_C-u_R-u_L=0$

$u_C+\frac{5}{8}\frac{du_C}{dt}+\frac{1}{16}\frac{d^2u_C}{dt^2}=0$

$\frac{d^2u_C}{dt^2}+10\frac{du_C}{dt}+16u_C=0$

$p^2+10p+16=0$

$p_1=-2,p_2=-8$

$\therefore u_C(t)=A_1e^{-2t}+A_2e^{-8t}V$

$u_C(0_-)=u_C(0^+)=6V$

$-C\frac{du_C}{dt}|(0_+)=i_{(0^+)}=0$

联立解得

$A_1=8, A_2=-2$

$\therefore u_{C(t)}=(8e^{-2t}-2e^{-8t})V$

$i(t)=-C\frac{du_C}{dt}=4(e^{-2t}-e^{-8t})A.$

(2). 易知，电路各微分方程为

~~$u_C+LC\frac{d^2u_C}{dt^2}+C$~~

$LC\frac{d^2u_C}{dt^2}+CR\frac{du_C}{dt}+u_C=0$

临界阻尼即

$C^2R^2-4LC=0$

$R=\sqrt{\frac{4LC}{C^2}}=2\Omega$

$\therefore$ 电阻应为 2Ω

7-23:

$u_C(0^+)=u_C(0^-)=50\times\frac{5}{5+5}=25V$

$i_L(0^+)=i_L(0^-)=\frac{50}{5+5}=5A$

$i_L=-C\frac{du_C}{dt}=-1\times10^{-4}u_C V$

$u_L=L\frac{di_L}{dt}=-CL\frac{d^2u_C}{dt^2}=-5\times10^{-5}V$

$u_C-25i_L-u_L=0$

$p=-\left(\frac{R_1+R_2}{2L}\right)\pm\sqrt{\left(\frac{R_1+R_2}{2L}\right)^2-\frac{1}{LC}}=-25\pm139.19j$

$\therefore u_{C(t)}=Ae^{-25t}\sin(139.19t+\theta)$

扫描全能王 创建

$u_C(0_+) = A\sin\theta = 25$

$i_L(0^+) = -C\frac{du_C}{dt}\Big|_{0_+} = -1\times10^{-4}(-25A\sin\theta + 139.19A\cos\theta) = 5$

$\theta = \arctan\left(\frac{w}{\delta - \frac{1}{5C}}\right) = -4.03°$

$A = \frac{25}{\sin\theta} = -355.61$

$\therefore u_C(t) = -355.61e^{-25t}\sin(139.13t \quad -4.03°)V$

7-26.

$i_L(0^+) = i_L(0_-) = 0$

$u_C(0_+) = \cancel{u_C(0_-) = 4V}$ $u_C(0_-) = 4V$

$i_L = C\frac{du_C}{dt}$

$u_L = L\cdot\frac{di}{dt} = LC\frac{d^2u_C}{dt^2}$

$6 = 2i_L + u_C + u_L$

$0.2\frac{d^2u_C}{dt^2} + 0.4\frac{du_C}{dt} + u_C = 6$

$\frac{d^2u_C}{dt^2} + 2\frac{du_C}{dt} + 5u_C = 30$

易知 通解为 $U_C = 6V$

特征方程:

$p^2 + 2p + 5 = 0$

$p = \frac{-4\pm\sqrt{4-20}}{2} = \frac{-4\pm4i}{2} = \pm2j - 1$

$\therefore u_C(t) = Ae^{-\delta t}\sin(wt + \theta) + 6$

其中 $\delta = 1, w = 2$

$\therefore u_C(0_+) = A\sin\theta = 4V$

$i_L(0^+) = C\frac{du_C}{dt} = C(-\delta A\sin\theta + wA\cos\theta) = 0$

$\theta = \arctan\frac{w}{\delta} = \arctan 2 = 63.43°$

$A = \dfrac{4-6}{\sin(63.43^\circ)} = -2.236$

$\therefore u_C(t) = u_C' + u_C'' = [6 - 2.23e^{-t}\sin(2t + 63.43^\circ)]V$

7-32. (1) 当 $t \in (0,2)$

$u_C(0^+) = u_C(0^-) = 0$

$u_C(\infty) = 10V$

$u_C(t) = u_C(\infty) + (u_C(0_+) - u_C(\infty))e^{-\frac{t}{RC}}$

$= 10(1 - e^{-100t})V \quad t \in (0,2)$

当 $t = 2$, $u_C = 10(1 - e^{-200})V$

当 $t \in (2,3)$

$u_C(2) = 10(1 - e^{-200})V$

$u_C(\infty)' = -20V$

$u_C = u_C(\infty)' + (u_C(2) - u_C(\infty)) \cdot e^{-\frac{t-2}{RC}}$

$= -20 + (10(1 - e^{-200}) + 20)e^{-100(t-2)}$

当 $t = 3$, $u_C(3) = 20(e^{-100} - 1) + 10e^{-100}(1 - e^{-200})$

当 $t \in (3, +\infty)$

$u_C(\infty) = 0$

$u_C = u_C(\infty) + (u_C(3) - u_C(\infty))e^{-\frac{t-3}{RC}}$

$= [20(e^{-100} - 1) + 10e^{-100}(1 - e^{-200})] \cdot e^{-100(t-3)} V \quad (t \in (3, +\infty))$

$\therefore u_C = \begin{cases} 0, & t \in (-\infty, 0) \\ 10(1 - e^{-100t})V, & t \in (0,2) \\ -20 + (10(1 - e^{-200}) + 20)e^{-100(t-2)} & t \in (2,3) \approx -20 + 30e^{-100(t-2)} \\ [20(e^{-100} - 1) + 10e^{-100}(1 - e^{-200})] \cdot e^{-100(t-3)} V & t \in (3, +\infty) \end{cases}$

$\approx -20e^{-100(t-3)}$

12). $u_C = 10(1-e^{-100t})\cdot(\varepsilon(t)-\varepsilon(t-2)) + (-20+30e^{-100(t-2)})[\varepsilon(t-2)-\varepsilon$

$+ (-20e^{-100(t-3)})\cdot\varepsilon(t-3)$