3-5 求题 3-5 图中的电流 $i_C(t)$ 和 $i(t)$。

题 3-5 图

$$i_C(t) = C\frac{du}{dt} = \frac{1}{2}\cdot 4\cdot(e^{-2t}-2\cdot te^{-2t})$$
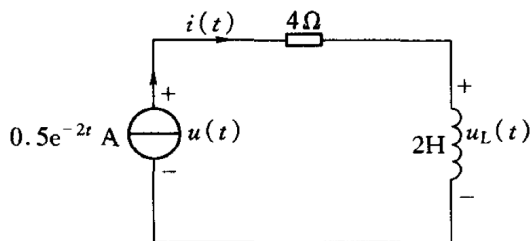
$$= 2e^{-2t}(2t-1)$$

$$i(t) = \frac{u(t)}{R} - i_C(t)$$

$$= 2te^{-2t} + 2e^{-2t}(1-2t)$$

$$= 2e^{-2t}(1-t)$$

3-11 求题 3-11 图中的电感电压 $u_L(t)$ 和电流源的端电压 $u(t)$。
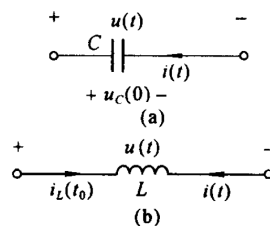

题 3-11 图

$$u_L(t) = L\frac{di(t)}{dt} = -2e^{-2t}$$

$$u(t) = 4i(t) + u_L(t)$$

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

$$= 0$$

3-13 根据题 3-13 图所给电路元件的性质以及图中标注的电流、电压的参考方向，判断下列每一答案是否正确。

(a) (1) $i(t) = C\frac{du(t)}{dt}$ ✗   (2) $u(t) = -\frac{1}{C}\int_0^t i(t)dt - u_C(0)$ ✗

(3) $i(t) = -C\frac{du(t)}{dt}$ ✓   (4) $u(t) = -\frac{1}{C}\int_0^t i(t)dt + u_C(0)$ ✓

(b) (1) $u(t) = -L\frac{di(t)}{dt}$ ✓   (2) $i(t) = -\frac{1}{L}\int_{t_0}^t u(t)dt - i_L(t_0)$ ✓

(3) $i(t) = -\frac{1}{L}\int_{t_0}^t u(t)dt + i_L(t_0)$ ✗   (4) $p(t) = u(t)i(t)$（吸收功率为正）✗
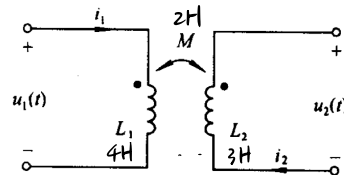

题 3-13 图

3-14 已知题 3-14 图中 $L_1 = 4$ H, $L_2 = 3$ H, $|M| = 2$ H。如果(1) $i_1 = 3e^{-2t}$ A, $i_2 = 0$; (2) $i_1 = 0.5e^{-3t}$ A, $i_2 = 2e^{-0.5t}$ A; (3) $i_1 = 10$ A, $i_2 = 0$; (4) $i_1 = 0$, $i_2 = 10\sin 100\,t$ A, 求电压 $u_1(t)$ 和 $u_2(t)$。

1)
$$u_1(t) = L_1\frac{di_1}{dt} = 4\times 3\times(-2)\times e^{-2t}$$
$$= -24e^{-2t}\ V$$

$$u_2(t) = |M|\frac{di_1}{dt} = -12e^{-2t}\ V$$

题 3-14 图

2). $u_1(t) = L_1\frac{di_1}{dt} - |M|\frac{di_2}{dt}$
$$= 4\times\frac{1}{2}\times(-3)\times e^{-3t} - 2\times 2\times(-\frac{1}{2})\times e^{-0.5t}$$
$$= (-6e^{-3t} + 2e^{-0.5t})V$$

$$u_2(t) = -L_2\frac{di_2}{dt} - |M|\frac{di_1}{dt}$$
$$= -3\times 2\times(-\frac{1}{2})e^{-0.5t} - 2\times\frac{1}{2}\times(-3)e^{-3t}$$
$$= (3e^{-0.5t} + 3e^{-3t})V$$

3) $u_1(t) = u_2(t) = 0\ V$

4). $u_1(t) = L_1\frac{di_1}{dt} - |M|\frac{di_2}{dt}$
$$= -2\times 10\times 100\times \cos 100t$$
$$= (-2000\cos 100t)V$$

$$u_2(t) = -L_2\frac{di_2}{dt} - |M|\frac{di_1}{dt}$$
$$= -3\times 1000\cos 100t$$
$$= -3000\cos 100t$$

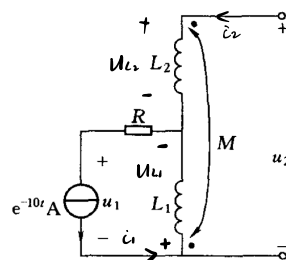3-17 已知题 3-17 图所示电路的参数为: $R = 10$ Ω, $L_1 = L_2 = 3$ H, $|M| = 2$ H。试求电压 u_1 和 u_2。

$$u_{L_1} = L_1\frac{di_1}{dt} + |M|\frac{di_2}{dt}$$
$$= 3\times(-10)e^{-10t} = -30e^{-10t}\ V$$

$$u_1 + u_{L_1} + i_1 R = 0$$
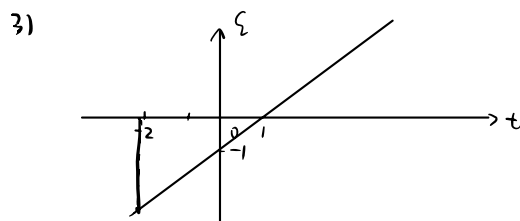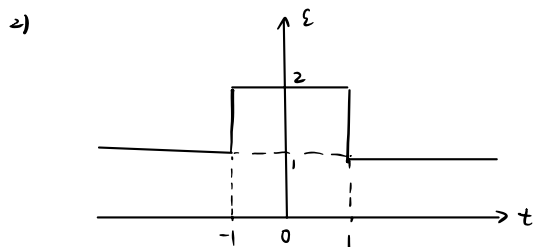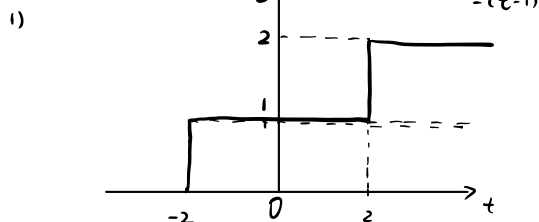
$$\therefore u_1 = 30e^{-10t} - 10e^{-10t} = 20e^{-10t}\ V$$

$$u_{L_2} = L_2\frac{di_2}{dt} + |M|\frac{di_1}{dt}$$
$$= 2\times(-10)\times e^{-10t} = -20e^{-10t}$$
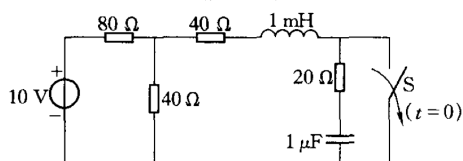
$$u_2 = u_{L_2} - u_{L_1} = 10e^{-10t}\ V$$

3-18 描出下列函数的波形:

(1) $\varepsilon(t-2)+\varepsilon(t+2)$;   (2) $\varepsilon(1-t)+\varepsilon(1+t)$;   (3) $(t-1)\varepsilon(t+2)$。

1)

2)

3)

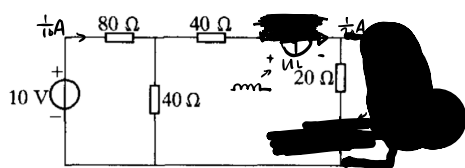3-24 题 3-24 图所示电路在换路前已工作了很长的时间,试求电路的初始状态以及开关断开后电感电流和电容电压的一阶导数的初始值。

1) $t=0_-$ 时

$$i_L(0_-)=\frac{10}{80+40\|40}\times\frac{1}{2}=\frac{1}{20}A$$

$$U_c(0_-)=0V$$

2) $t=0_+$ 时

$$i_L(0_+)=i_c(0_-)=\frac{1}{20}A \qquad U_c(0_+)=U_c(0_-)=0V$$

$$I_{\mp}=2i_L(0_+)=\frac{1}{10}A$$

$$\frac{1}{20}(40+20)+U_L(0_+)=10-\frac{1}{10}\times80 \Rightarrow U_L(0_+)=-1V$$

$$i_c(0_+)=i_L(0_+)=\frac{1}{20}A$$

$$\frac{1}{20}=C\frac{du_c}{dt} \qquad \therefore U_c'(0_+)=\frac{1}{20}V/s$$

$$L\frac{di_L}{dt}=U_L(0_+) \qquad \therefore i_L'(0_+)=-10^3 A/s$$

3-25 题 3-25 图所示电路在换路前已工作了很长的时间,试求开关闭合后电感电流和电容电压的一阶导数的初始值。

1) $t=0_-$ 时

$$i_L(0_-)=0A$$

$$80\|20=16\Omega$$

$$U_c(0_-)=16\times\frac{1}{2}=8V$$

2) $t=0_+$ 时

$$U_c(0_+)=U_c(0_-)=8V$$

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

由叠加定理:

$$i_c(0_+)=\frac{-8}{16\|20\|80}+\frac{16}{16}=0A$$

$$C\cdot U_c'(0_+)=i_c(0_+) \qquad U_c'(0_+)=0V/s$$

3-26 求题 3-26 图所示电路的初始状态、电容电压一阶导数的初始值和电感电流一阶导数的初始值。已知:$R_1=15\,\Omega, R_2=5\,\Omega, R=5\,\Omega, L=1\,H, C=10\,\mu F$。
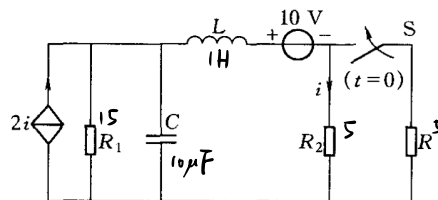
1) $t=0_-$ 时.
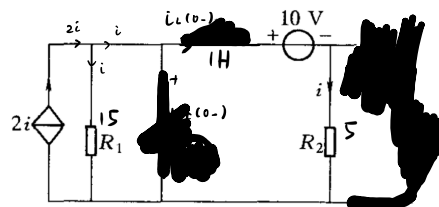
$$KVL: (2i-i)R_1-R_2i-10=0$$

$$\Rightarrow i(15-5)=10 \Rightarrow i=1A$$

$$i_L(0_-)=i=1A$$

$$U_c(0_-)=iR_1=15V$$

2) $t=0_+$ 时 $i_L(0_+)=i_c(0_-)=1A$
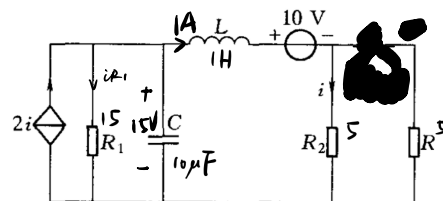
$$\underline{U_c(0_+)=U_c(0_-)=15V}$$

$$KVL: U_L(0_+)+10+1\times\frac{5}{2}=15$$

$$\therefore U_L(0_+)=\frac{5}{2}V$$
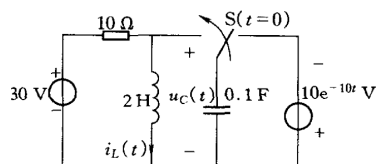
$$L i_L'(0_+)=U_L(0_+) \Rightarrow i_L'(0_+)=2.5A/s$$

$$i_{R_1}=\frac{15}{15}=1A$$

$$i=\frac{1}{2}i_L(0_+)=0.5A \qquad\qquad U_c'(0_+)=-10^5V/s$$

$$\therefore i_c(0_+)=i_L(0_+)=1A \qquad C U_c'(0_+)=i_c(0_+) \Rightarrow$$
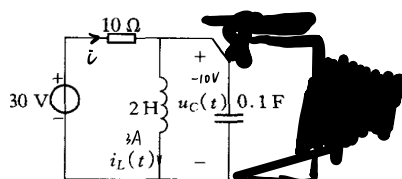
1) $t = 0_-$时
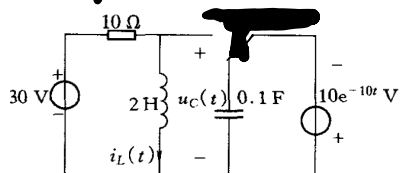
$$u_C(0_-) = -10V \qquad i_L(0_-) = \frac{30}{10} = 3A$$

$t = 0_+$时 $\quad u_C(0_+) = u_C(0_-) = -10V$

$$i_L(0_+) = i_L(0_-) = 3A$$

$KVL:\quad 30 = 10i - 10 \implies i = 4A$

$\therefore \quad i_C(0_+) = 4 - 3 = 1A$

$C u_C'(0_+) = i_C(0_+) \implies \underline{u_C'(0_+) = 10 V/s}$

$u_L(0_+) = u_C(0_+) = -10V$

$L \cdot i_L'(0_+) = u_L(0_+) \implies \underline{i_L'(0_+) = -5 A/s}$