ch4 ch6 ①

1. $i(t) = C\frac{dv}{dt} = 5\frac{d(12te^{-3t})}{dt} = \boxed{10(e^{-3t} - 3te^{-3t})\ A}$

$p = vi = 10(2te^{-3t})(e^{-3t} - 3t)e^{-3t} = \boxed{20t(1-3t)e^{-6t}\ W}$

2. $C = 20\mu F \quad w(t) = 10\cos^2 377t$

$w(t) = \frac{1}{2}Cv^2 \Longrightarrow v(t) = \pm\frac{\sqrt{2w(t)}}{C} = \pm 10^3 \cos 377t\ J$

$i(t) = C\frac{dv}{dt} = \pm 20\times10^{-6}\times10^3 \sin 377t \cdot 377 = \boxed{\pm 7.54\sin 377t\ A}$

4. $v = \frac{1}{C}\int_0^t i\,dt + v(t_0) \quad i(t) = 6\sin 4t\ A,\ C = 2\ F$

$v(t_0) = v(0) = 1$

$= \frac{1}{2}\int_0^t 6\sin 4t\,dt + 1$

$= 3\left(-\frac{\cos 4t}{4}\right)\Big|_0^t + 1 = \boxed{\left(\frac{3}{4}(1-\cos 4t) + 1\right)V}$

5. $i(t) = C\frac{dv(t)}{dt} \Rightarrow i(t) = \begin{cases} 20\,mA & 0 < t < 2ms \\ -20\,mA & 2ms < t < 6ms \\ 20\,mA & 6ms < t < 8ms \end{cases}$

6. $v(t) = \begin{cases} 150\,mA & 0 < t < 2ms \\ 0 & 2ms < t < 4ms \\ -150\,mA & 4ms < t < 8ms \\ 0 & 8ms < t < 10ms \\ 150\,mA & 10ms < t < 12ms \end{cases}$

9. $C = 0.5F,\ i = 6(1-e^{-t}),\ v(0) = 0$

$V = \frac{1}{C}\int_0^t i\,dt + v(0) = \frac{1}{0.5}\int_0^2 6(1-e^{-t}) = 12(t + e^{-t})\Big|_0^2$

$= 13 + e^{-2} = \boxed{13.624V}$

$$P_{t=2} = vi = 6(13+e^{-2})(1-e^{-2}) = \boxed{70.66\,W}$$

11. $C = 4\,mF$, $V(0) = 10V$

$$V(t) = \frac{1}{C}\int_0^t i(t)\,dt + V(0)$$

$$i(t) = \begin{cases} 15mA & 0<t<2\,s \\ -10mA & 2<t<4\,s \\ 0 & 4<t<6\,s \\ 10mA & 6<t<8\,s \end{cases} \Rightarrow V(t) = \begin{cases} 10+3.75t & 0<t<2\,s \\ 22.5-2.5t & 2<t<4\,s \\ 12.5 & 4<t<6\,s \\ 2.5t-2.5 & 6<t<8\,s \end{cases}$$

14. $C = \frac{20\times60}{20+60} + \frac{30\times70}{30+70} = \boxed{36\,pF}$

15. (a) parallel, $C_{eq} = 20+30 = 50\,mF$, $V = 10dV$

$$q = C_{eq}V = 50\times10^{-6}\times100 = 5\,mC$$

~~$V_1 = \frac{q}{C_1} = \frac{5\times10^{-3}}{20\times10^{-6}}$~~

$$W_1 = \frac{1}{2}C_1V^2 = \frac{1}{2}\times20\times10^{-6}\times10^4 = \boxed{100mJ}$$

$$W_2 = \frac{1}{2}C_2V^2 = \frac{1}{2}\times30\times10^{-6}\times10^4 = \boxed{300\,mJ}$$

(b) Serial $C_{eq} = \frac{20\times30}{20+30} = 12\,mF$

$$q = C_{eq}V = 12\times10^{-6}\times100 = 1.2\,mC$$

$$V_1 = \frac{q}{C_1} = \frac{1.2\times10^{-3}}{20\times10^{-6}} = 60V, \quad W_1 = \frac{1}{2}\times20\times10^{-6}\times3600 = \boxed{36\,mJ}$$

$$V_2 = \frac{q}{C_2} = \frac{1.2\times10^{-3}}{30\times10^{-6}} = 40V, \quad W_2 = \frac{1}{2}\times30\times10^{-6}\times1600 = \boxed{24\,mJ}$$

16. $C_{eq} = 14 + \frac{80\,C}{80+C} = 30$

$\Rightarrow C = 20\,\mu F$

17 (a) C_{12}, C_4 serial, $= \frac{12\times4}{12+4} = 3F$

$C_3 . C_6 . C_3$ paralell. $= 3+6+3 = 12F$

$C_{12} . C_4$ serial $= \frac{12\times4}{12+4} = 3F$, $\boxed{C_{eq} = 3F}$

(b) $C_4 . C_2$ paralell $= 4+2 = 6F$

$C_6 . C_6$ serial $= \frac{6}{2} = 3F$

$C_3 . C_5$ paralell $= 3+5 = 8F$ $\boxed{C_{eq} = 8F}$

(c) $C_3 . C_6$ serial $= \frac{3\times6}{3+6} = 2F$, $C_2 . C_4$ paralell $= 2+4 = 6F$

$C_2 . C_6 . C_3$ serial $= \frac{1}{\frac{1}{2}+\frac{1}{6}+\frac{1}{3}} = 1F$, $\boxed{C_{eq} = 1F}$

34. $V = L\frac{di}{dt} = 10\times10^{-3}\times(-3)e^{-t/2}$

$V(3) = -3\times10^{-2}\times e^{-3/2} = \boxed{6.69\ mV}$

$i(3) = 6\times e^{-\frac{3}{2}} = 1.34\,A$

$P = Vi = 6.69\times1.34 = \boxed{8.96\ mW}$

45. $i(t) = \frac{1}{L}\int_{t_0}^{t} v(t)\,dt + i(t_0)$

$$v(t) = \begin{cases} 5t & 0 \le t < 1\,s \\ -5t + 10 & 1 \le t < 2\,s \end{cases} \Rightarrow i(t) = \begin{cases} 0.25t^2\,kA & 0 \le t < 1s \\ 1 - t + 0.25t^2\,kA & 1 < t < 2s \end{cases}$$

52. L_4, L_6 serial $= 4 + 6 = 10H$

L_{10}, L_{10} parallel $= \frac{10}{2} = 5H$

L_5, L_3, L_7 serial $= 5 + 3 + 7 = 15H$

L_5, L_{15} parallel $= \boxed{3.75H}$