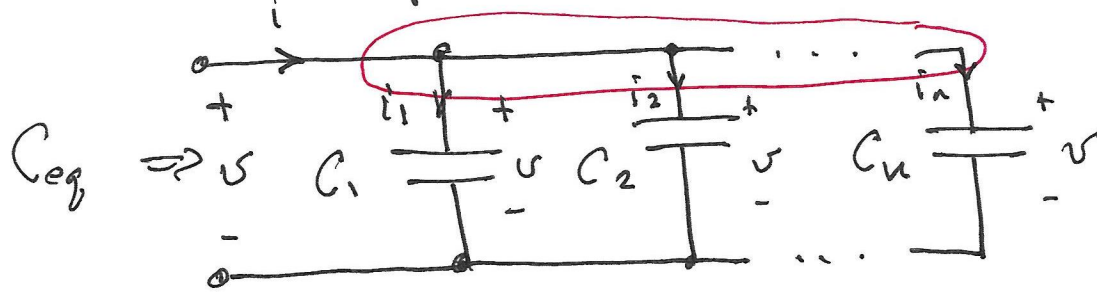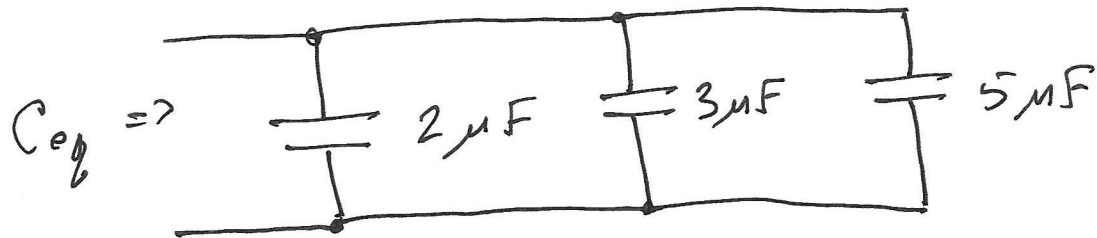# Capacitors in Parallel

$$i_1 = C_1 \dot{v}, \quad i_2 = C_2 \dot{v} \quad \cdots \quad i_n = C_n \dot{v}$$

$$i = i_1 + i_2 + \cdots + i_n$$

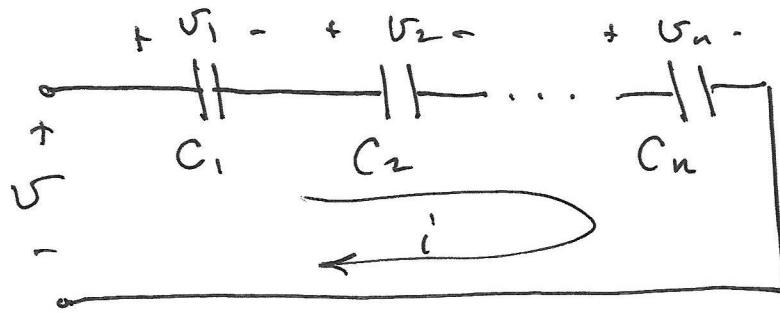$$= C_1 \dot{v} + C_2 \dot{v} + \cdots + C_n \dot{v}$$

$$i = \underbrace{(C_1 + C_2 + \cdots + C_n)}_{C_{eq}} \dot{v}$$

$$C_{eq} = C_1 + C_2 + \cdots + C_n$$

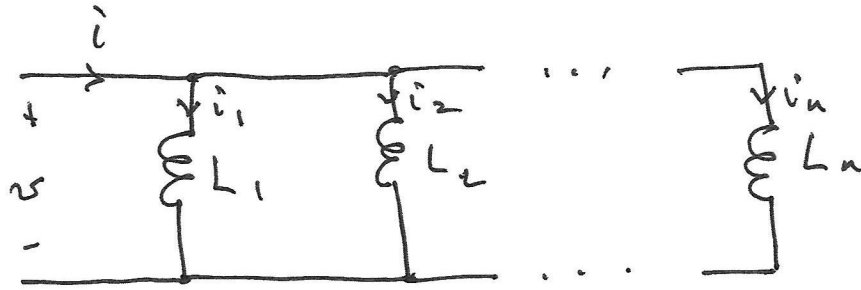$$C_{eq} = (2 + 3 + 5)\,\mu F \quad = \quad 10\,\mu F$$

Capacitors in Series

$$v = \frac{1}{C_1}\int i\,dt + \frac{1}{C_2}\int i\,dt + \cdots + \frac{1}{C_n}\int i\,dt$$

$$\underbrace{\phantom{\frac{1}{C_1}\int i\,dt}}_{v_1} \qquad \underbrace{\phantom{\frac{1}{C_2}\int i\,dt}}_{v_2} \qquad \underbrace{\phantom{\frac{1}{C_n}\int i\,dt}}_{v_n}$$

$$v = \underbrace{\left(\frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_n} \right)}_{\frac{1}{C_{eq}}} \int i\,dt$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots + \frac{1}{C_n}$$

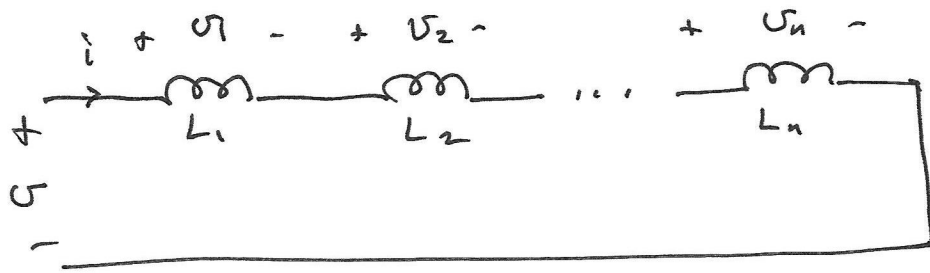$$C_{eq} = \frac{C_1 C_2}{C_1 + C_2}$$

Inductors in Parallel

$$i = \frac{1}{L_1}\int v\,dt + \frac{1}{L_2}\int v\,dt + \cdots + \frac{1}{L_n}\int v\,dt$$

$$\underbrace{\qquad}_{i_1} \qquad \underbrace{\qquad}_{i_2} \qquad \underbrace{\qquad}_{i_n}$$

$$i = \left(\frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_n} \right) \int v\,dt$$

$$\underbrace{\qquad\qquad}_{\frac{1}{L_{eq}}}$$

$$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \cdots + \frac{1}{L_n}$$
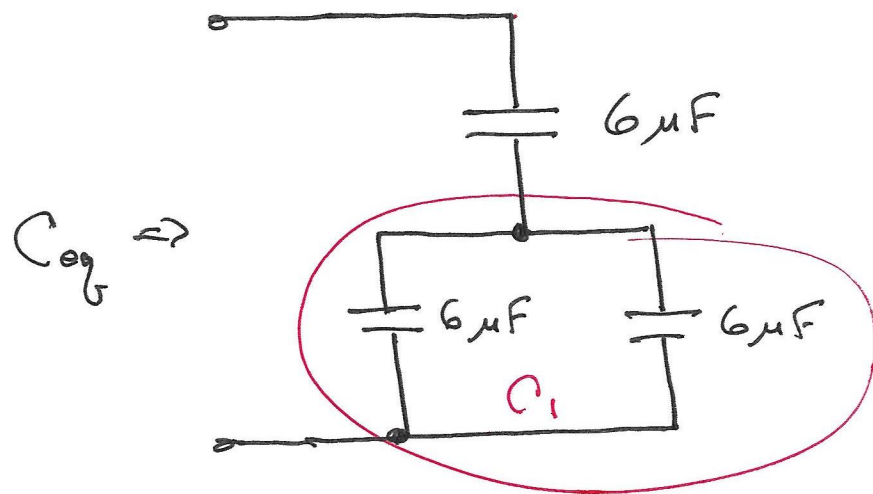
Inductors in Series

$$v_1 = L_1 \frac{di}{dt} \qquad v_2 = L_2 \frac{di}{dt} \quad \cdots \quad v_n = L_n \frac{di}{dt}$$
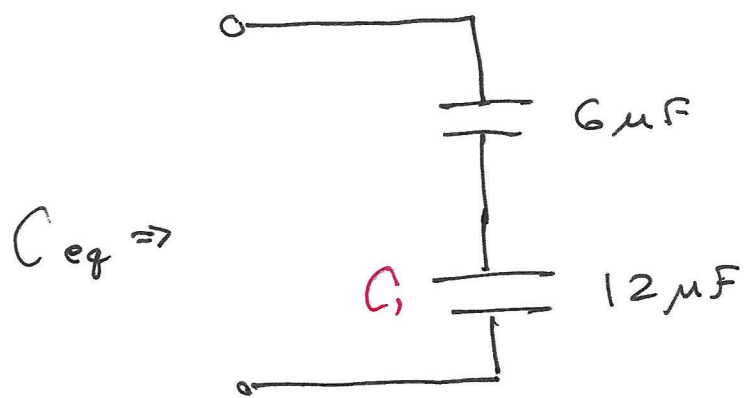
$$v = v_1 + v_2 + \cdots + v_n$$

$$= L_1 \frac{di}{dt} + L_2 \frac{di}{dt} + \cdots + L_n \frac{di}{dt}$$

$$v = \underbrace{(L_1 + L_2 + \cdots + L_n)}_{L_{eq}} \frac{di}{dt}$$

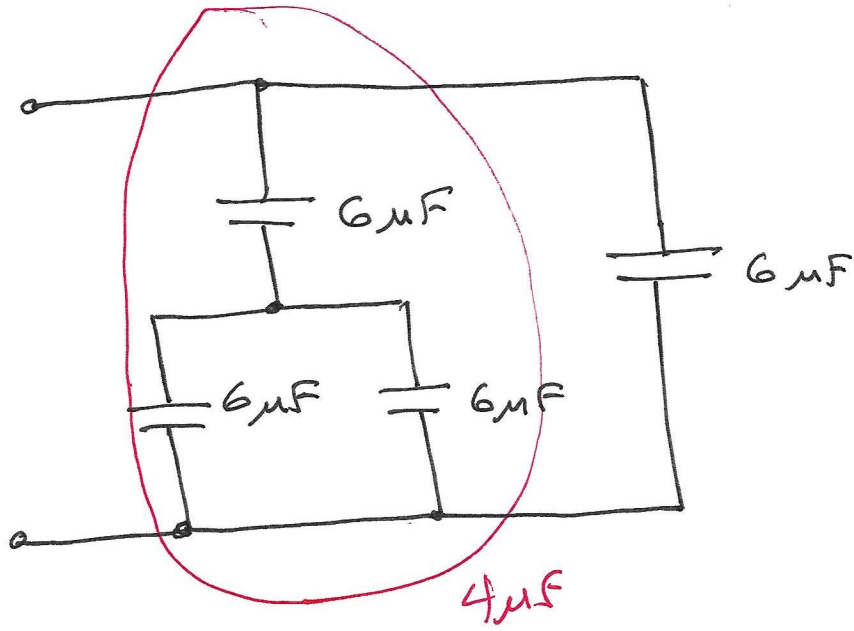$$L_{eq} = L_1 + L_2 + \cdots + L_n$$

$C_1 = 6\mu F + 6\mu F = 12\mu F$

$\dfrac{1}{C_{eq}} = \dfrac{1}{6\mu F} + \dfrac{1}{12\mu F}$

$= \dfrac{3}{12\mu F} = \dfrac{1}{4\mu F}$

$C_{eq} = 4\mu F$
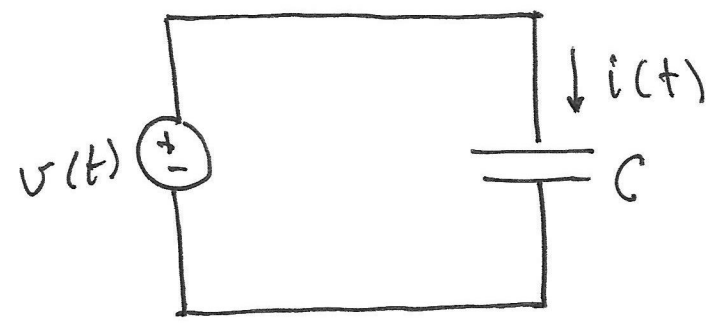
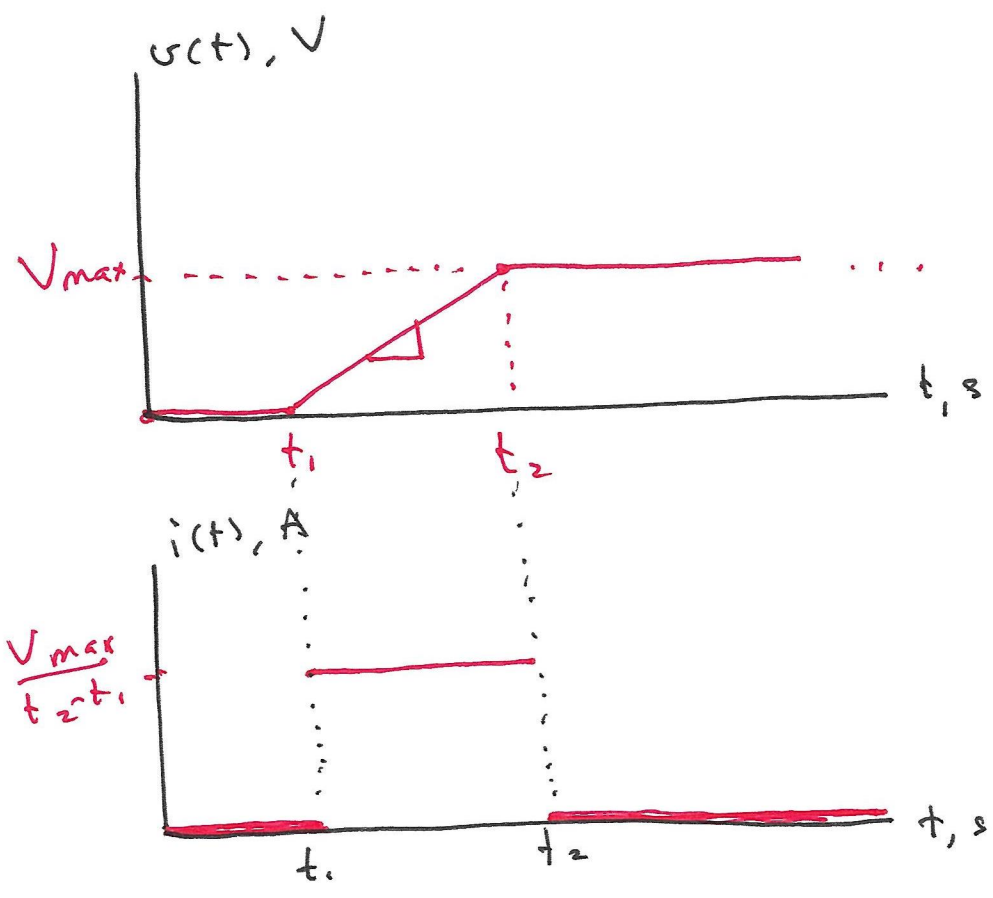or $\quad C_{eq} = \dfrac{6 \cdot 12}{6 + 12} = 4\mu F$

$C_{eq} \Rightarrow$
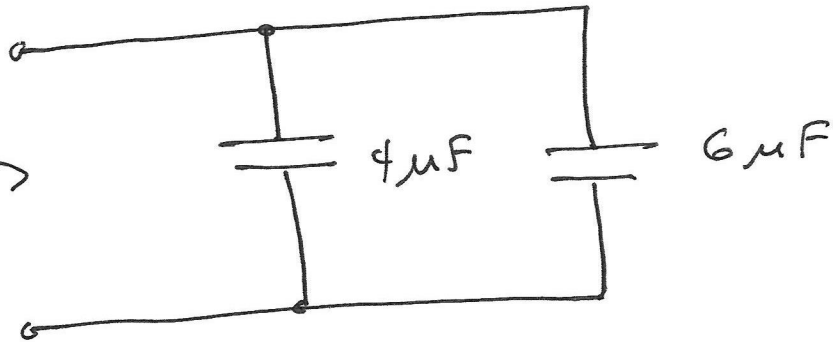
6 μF

6 μF

6 μF

6 μF

6 μF

4 μF

$C_{eq} \Rightarrow$

4 μF

6 μF

$C_{eq} = 10 \mu F$

$v(t)$ $\downarrow i(t)$

C

$i = C\dot{v}$

$v(t), V$

V_{max}

t, s

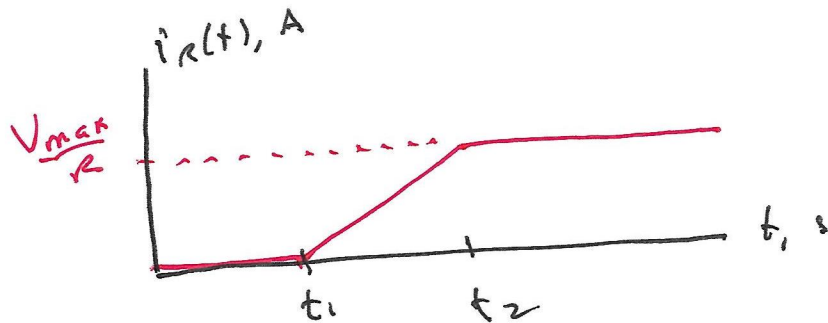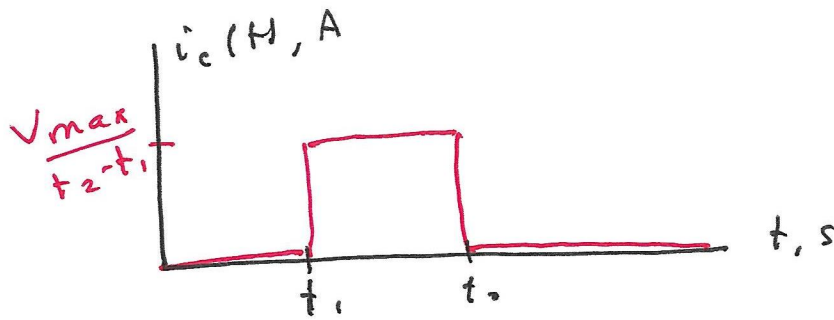t_1 t_2

$$\dot{v} = \frac{V_{max}}{t_2 - t_1}, \quad t_1 < t < t_2$$
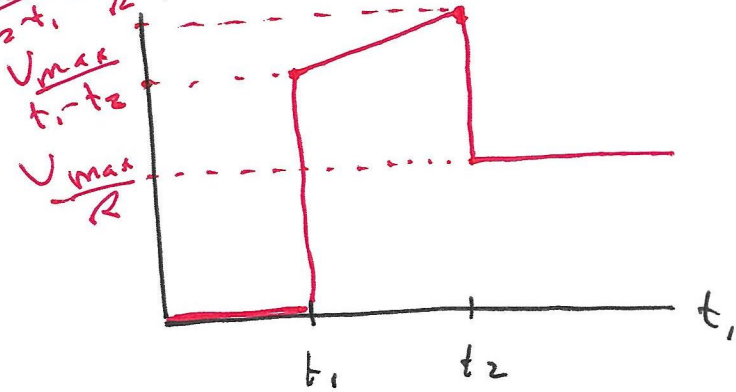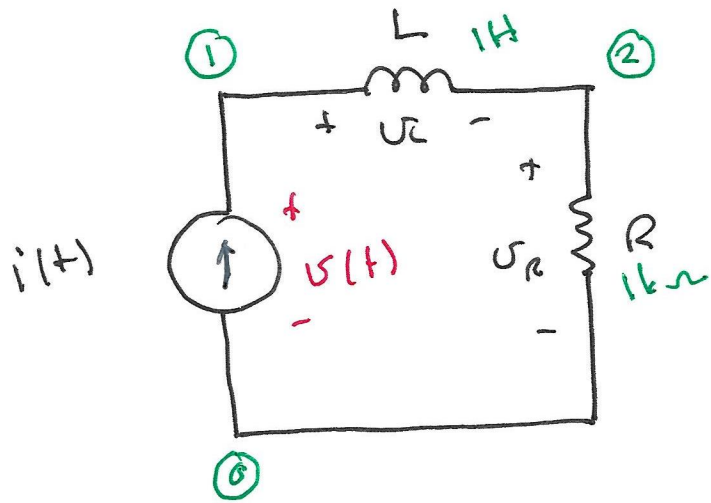
$i(t), A$

$\frac{V_{max}}{t_2 - t_1}$

t_1 t_2 t, s

$$i_R(t) = \frac{v(t)}{R}$$

$$i(t) = i_c(t) + i_R(t)$$

Circuit diagram
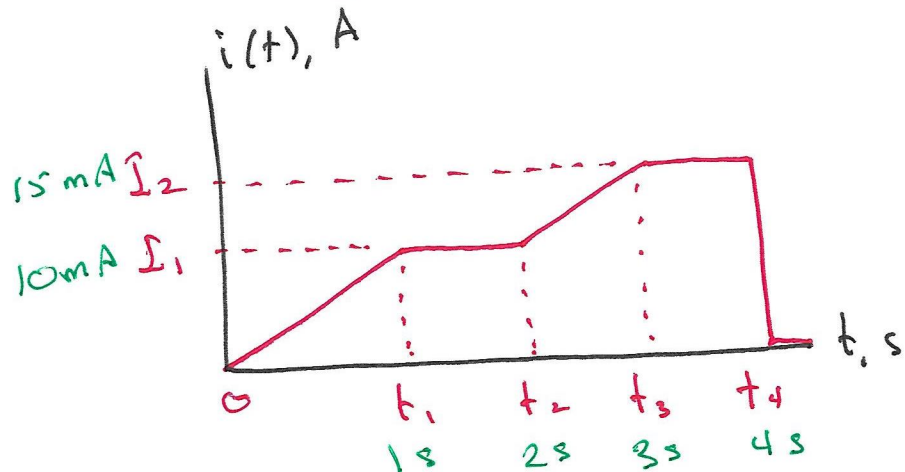
L 1H ① ②

$+$ U_L $-$

$i(t)$

$+$ $U(t)$ $-$

$+$ U_R R $1k\Omega$ $-$

⓪

$U_L = L\dfrac{dI}{dt}$

$U_R = R\,i(t)$

i(t), A graph

$15\,mA\ \hat{I_2}$

$10\,mA\ \hat{I_1}$

t_1 t_2 t_3 t_4

$1s$ $2s$ $3s$ $4s$

t, s

$U_R(t), V$ graph

15

10

1 2 3 4

t, s

$$U(t) = U_R(t) + U_C(t)$$

$U_L(t), V$ graph

$10mV$

$5mV$

1 2 3 4

t, s

V(t), V graph

$15.005V$
$15V$
$10.01V$
$10.005V$
$10.0V$

$10mV$

1 2 3 4

t, s
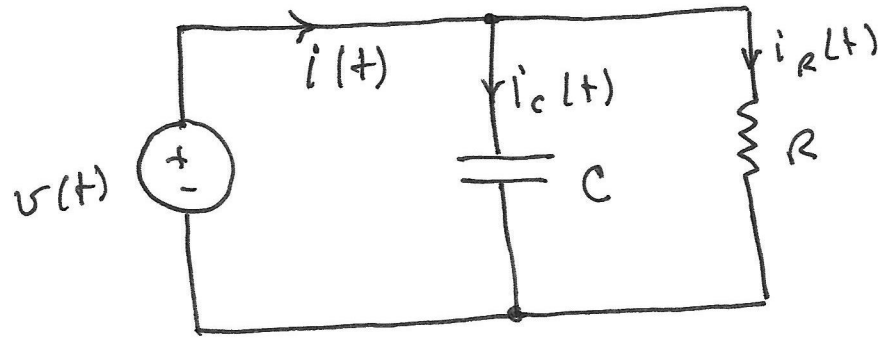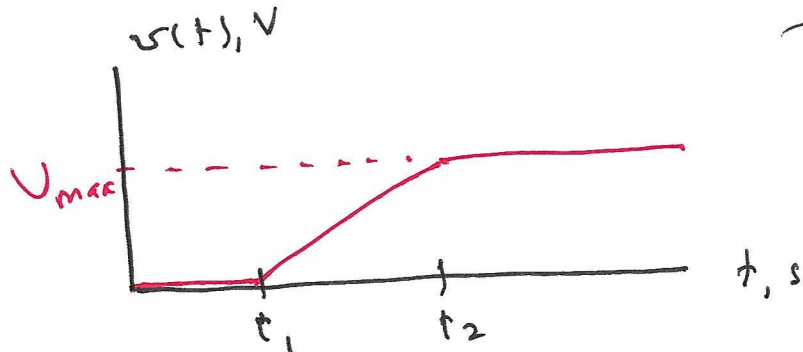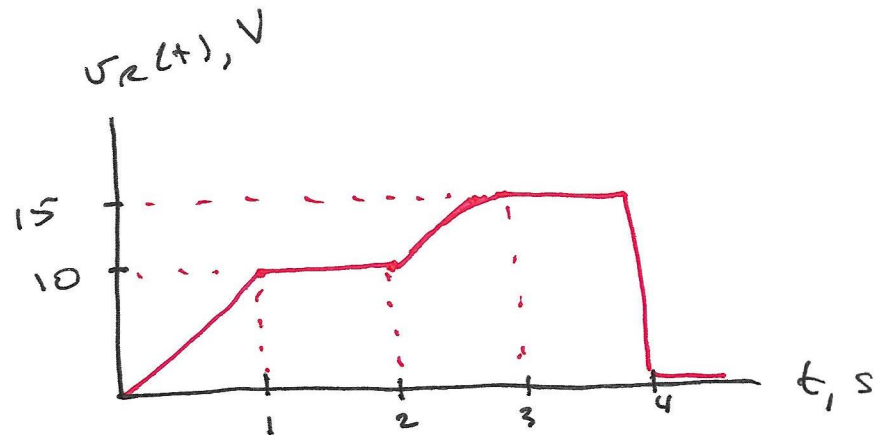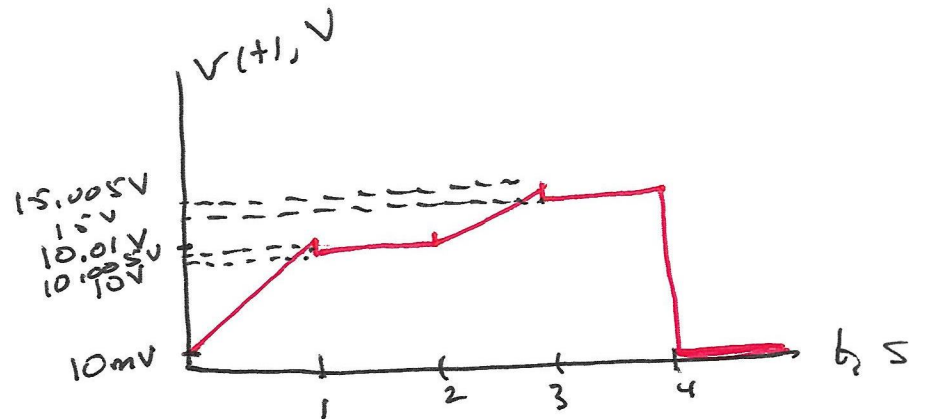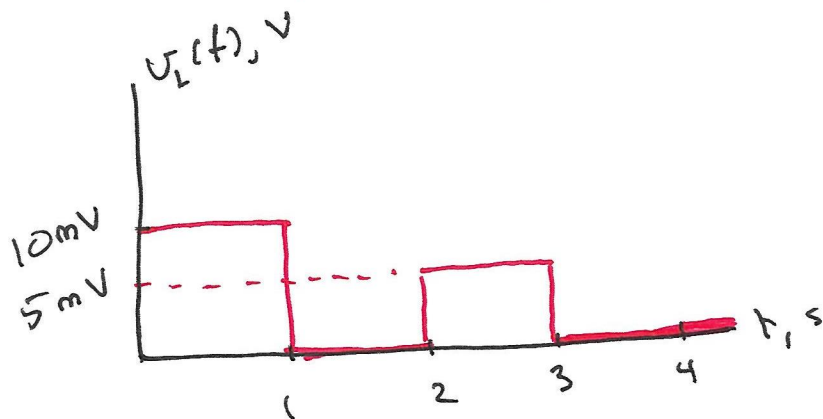
```
I    0   1   PWL(0  0,  1  10m,  2  10m,  3  15m,  4   15m,
+    4.001   0)
L    1   2   1       IC=0
R    2   0   1k
.TRAN    5m
```