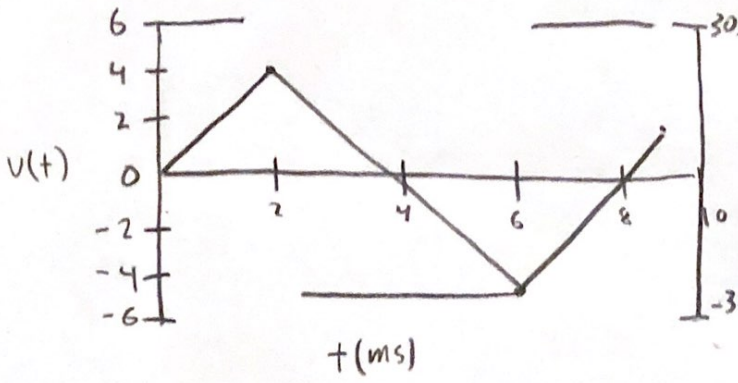
Chris Hunt | Homework 10 | ENGR201

10.1)



$C = 15\,\mu F$

$$v(t) = \begin{cases} 2t & 0 < t \le 2 \\ -2t & 2 < t \le 6 \\ 2t & 6 < t \le 9 \end{cases}$$

$$I_c = C\frac{dV(t)}{dt}$$

$$I_c = \begin{cases} 30\mu A & 0 < t \le 2 \\ -30\mu A & 2 < t \le 6 \\ 30\mu A & 6 < t \le 9 \end{cases}$$

10.2) Find voltage across a capacitor at $t = 800ms$

$V_0 = 5v$ at $t = 0$ $\quad C = 480\mu F$ $\quad I_c(t) = 30t\ \mu A$

$$v(t) = \frac{1}{C}\int_{t_0}^{t} I(t)\,dt + V_0$$

$$v(.8s) = \frac{1}{C}\int_{0}^{.8} 30t\,dt + V_0$$

$$v(.8s) = \frac{30\times10^{-6}}{480\times10^{-6}}\int_{0}^{.8} t\,dt + 5v$$

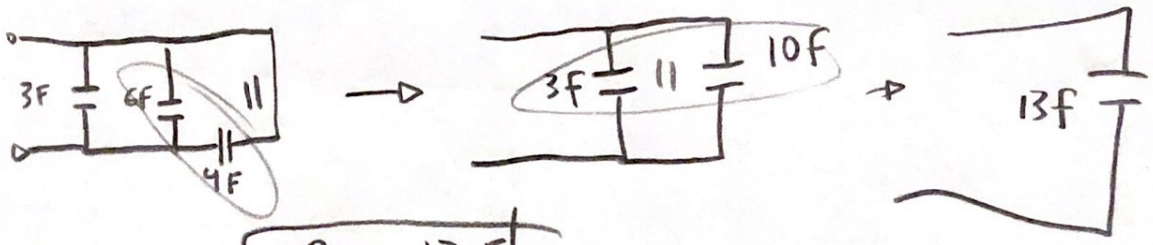
$$v(.8)_s = .0625\cdot\left(\frac{t^2}{2} - \frac{t^2}{2}\right)\Big|_0^{.8} + 5$$

$$\boxed{v(.8)_s = 5.02v}$$

Chris Hunt

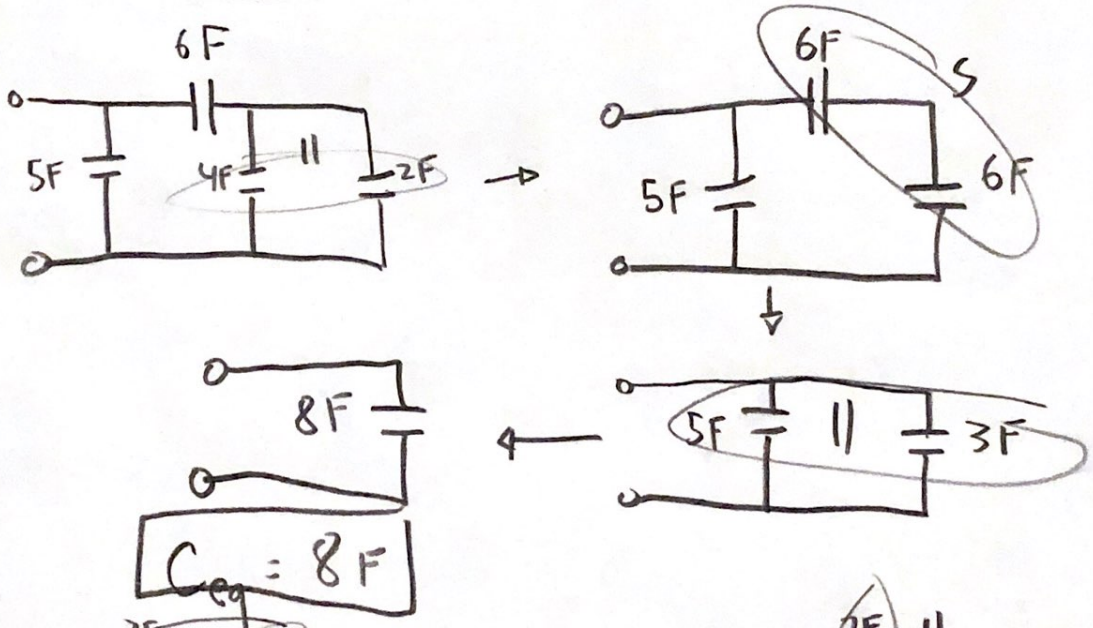
10.3) Determine Equivalent Capacitance

a)



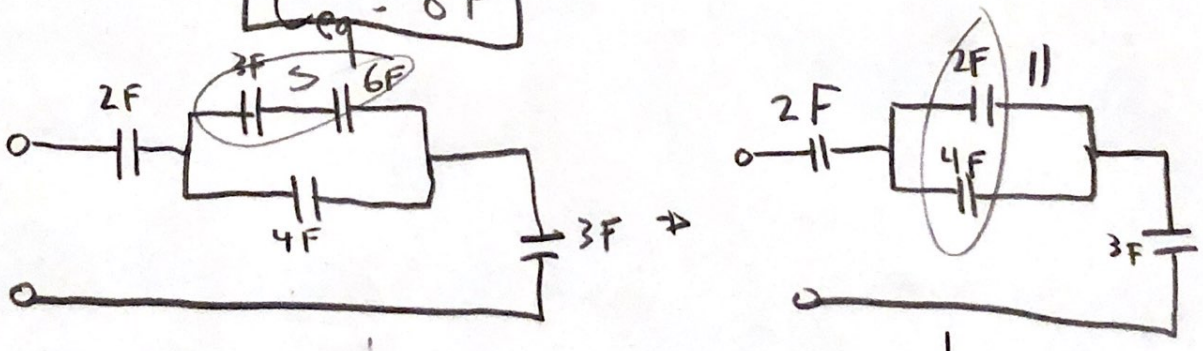
$C_{eq} = 13\,F$

b)



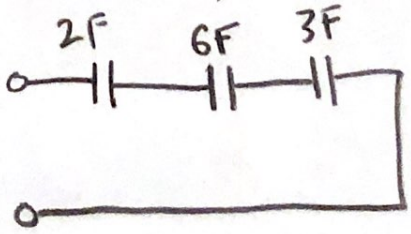
$C_{eq} = 8\,F$

c)



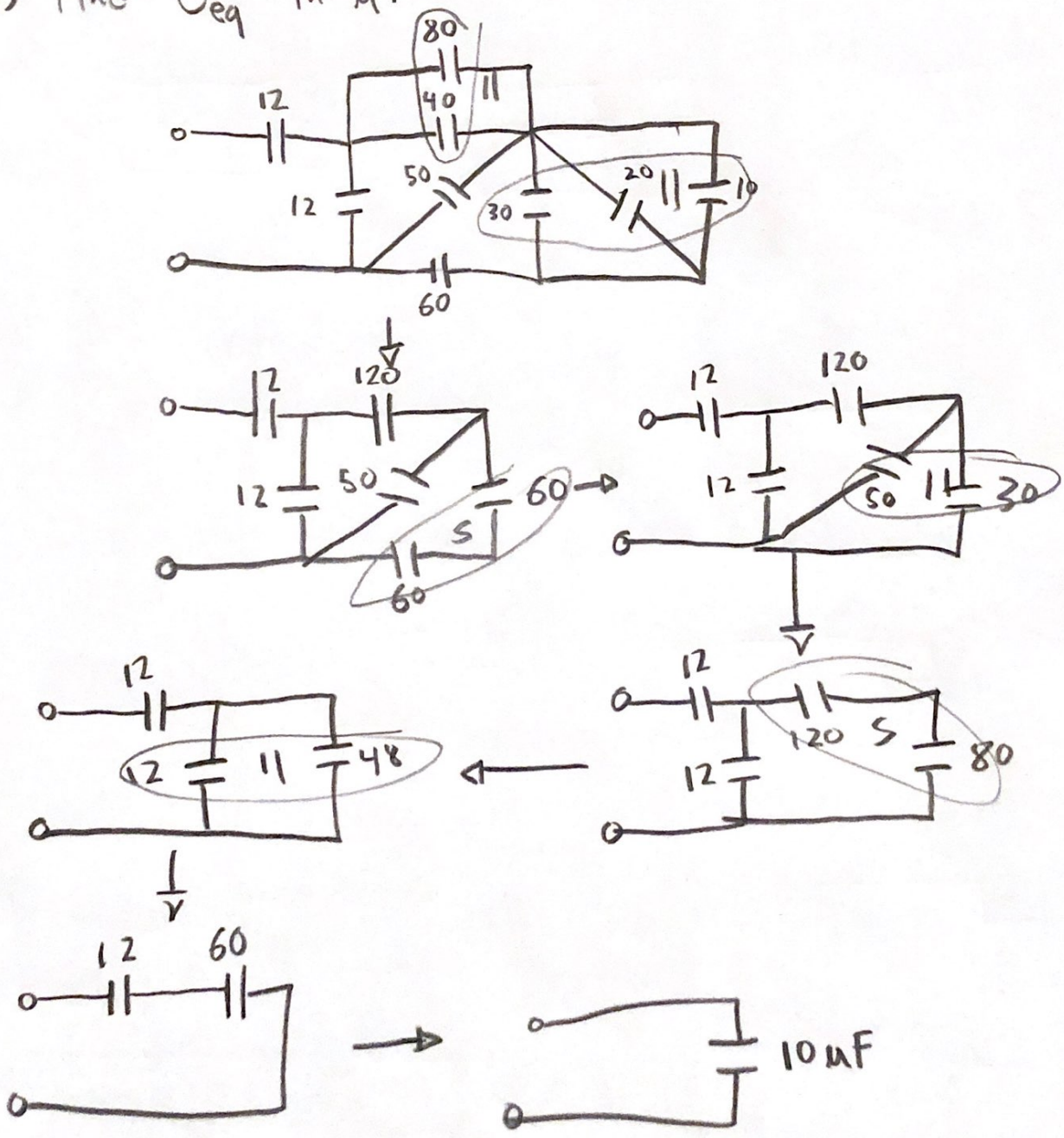
$$C_{eq}^{-1} = \frac{1}{2} + \frac{1}{6} + \frac{1}{3}$$

$C_{eq} = 1\,F$



Chris Hunt

10.4) Find C_{eq} in μF



$C_{eq} = 10\,\mu F$

Chris Hunt

10.5) Find $V(t)$ $\quad t>0$

$L = 40\,mH$ $\quad I_L(t) = te^{-2t}\ A$

$V(t) = \frac{1}{L}\int te^{-2t}\,dt$ → Integration by parts $\int u\cdot dv = uv - \int v\,du$

$u = t \quad du = 1\,dt$

$dv = e^{-2t}dt \quad v = -\frac{1}{2}e^{-2t}$ → $\int te^{-2t}dt = t\cdot\frac{-1}{2}e^{-2t} - \int -\frac{1}{2}e^{-2t}dt$

$-\frac{1}{2}te^{-2t} + \frac{1}{2}\int e^{-2t}dt \rightarrow -\frac{1}{2}te^{-2t} - \frac{1}{4}e^{-2t} = I_L(t)$

$\frac{1}{L} = \frac{1}{40\times10^{-3}} = 25$

$$V(t) = -12.5te^{-2t} - 6.25e^{-2t}\ V$$

10.6) Find V at 1, 3, 5, 7 ms

$L = .002\ H$

$$I_L(t) = \begin{cases} 5t & 0<t<2\ ms \\ 0 & 2\le t<4\ ms \\ -5t & 4\le t<6\ ms \\ 0 & t\ge 6\ ms \end{cases}$$

$V(.001) = \frac{1}{.002}\int 5t\,dt$

$V(.001) = \frac{1}{.002}\cdot 5$ → $V(.001) = 2500\ V$

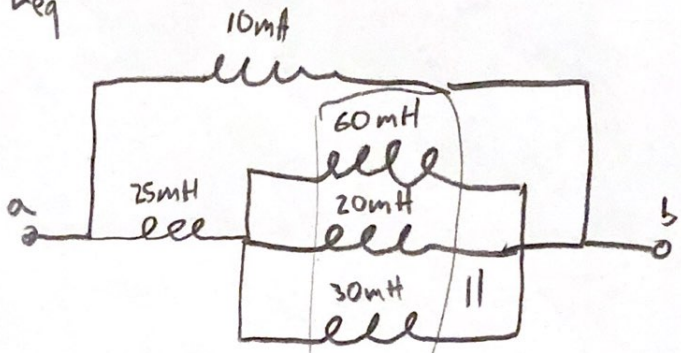
$V(.003) = \frac{1}{.002}\cdot 0$ → $V(.003) = 0\ V$

$V(.005) = \frac{1}{.002}\cdot -5$ → $V(.005) = -2500\ V$

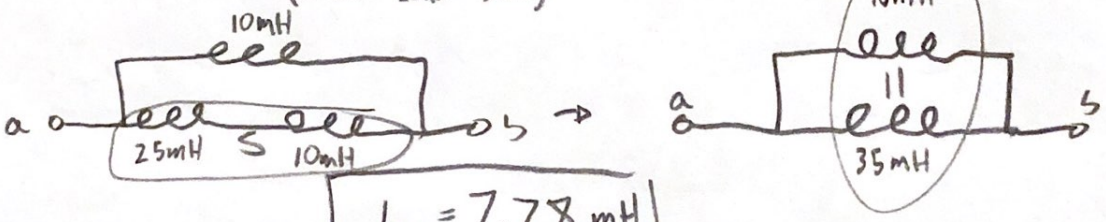
$V(.007) = \frac{1}{.002}\cdot 0$ → $V(.007) = 0\ V$

Chris Hunt

10.7) Find L_{eq}

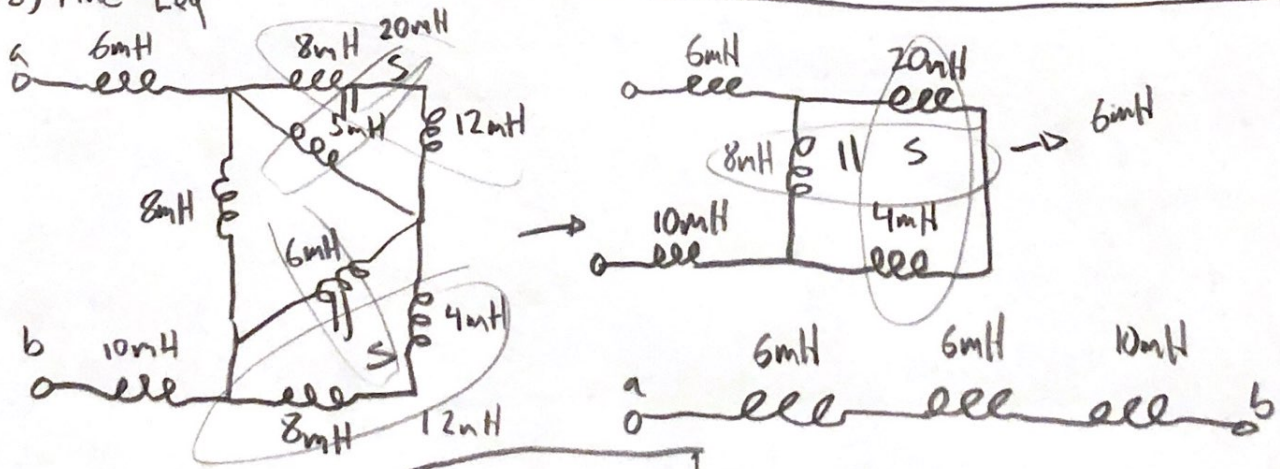


$$\left(\frac{1}{60mH} \cdot \frac{1}{20mH} \cdot \frac{1}{30mH}\right)^{-1} = 10mH$$



$L_{eq} = 7.78\ mH$

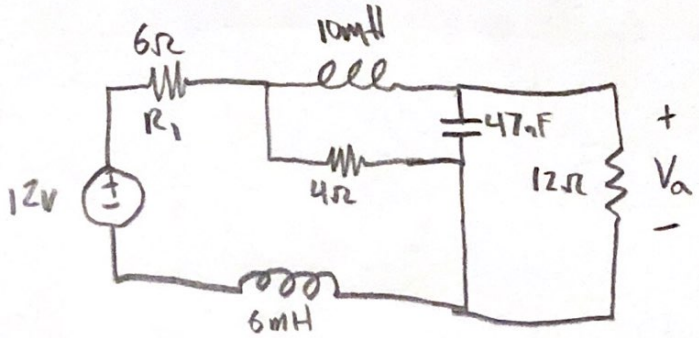
10.8) Find L_{eq}



$L_{eq} = 22mH$

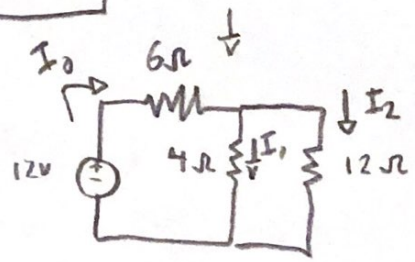
Chris Hunt

10.9) Find V_a



Inductors at constant current act as short circuits.

Conductors at constant voltage act as open circuits.



$R_{eq} = 6\Omega + 4\Omega \| 12\Omega$

$R_{eq} = 9\Omega$

$I_o = \frac{12V}{9\Omega} \rightarrow I_o = \frac{4}{3}A$

$V_a = 12\left(\frac{3}{4}\right)$

$V_a = 4V$