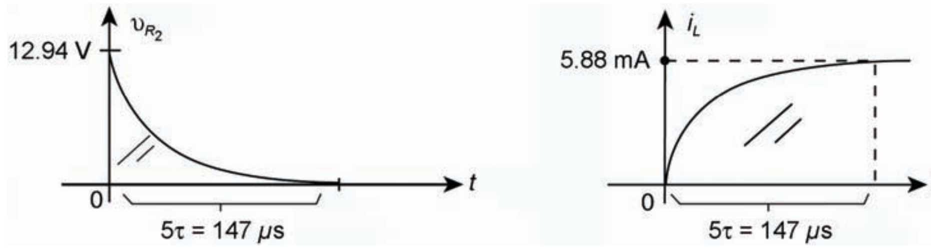
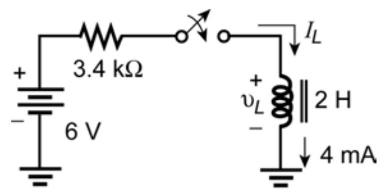
c.




18. a. Source conversion:



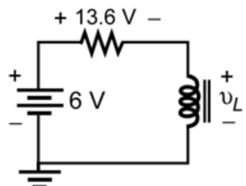

$$\tau = \frac{L}{R} = \frac{2\ \text{H}}{3.4\ \text{k}\Omega} = 588.2\ \mu\text{s}$$

$$i_L = I_f + (I_i - I_f)e^{-t/\tau}$$

$$I_f = \frac{6\ \text{V}}{3.4\ \text{k}\Omega} = 1.76\ \text{mA}$$

$$i_L = 1.76\ \text{mA} + (4\ \text{mA} - 1.76\ \text{mA})e^{-t/588.2\mu\text{s}}$$

$$i_L = \mathbf{1.76\ mA + 2.24\ mA}\ \boldsymbol{e^{-t/588.2\mu s}}$$



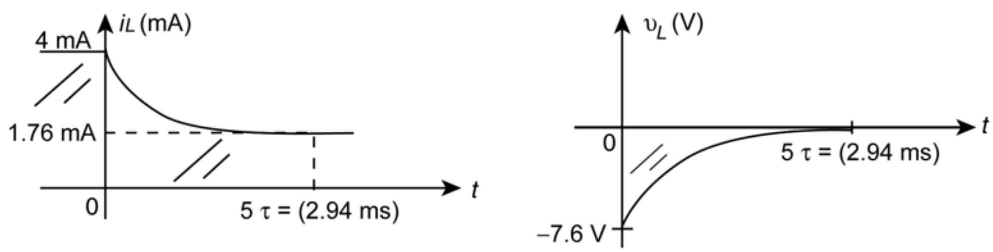

$\upsilon_R(0+) = 4\ \text{mA}(3.4\ \text{k}\Omega) = 13.6\ \text{V}$

KVL: $+6\ \text{V} - 13.6\ \text{V} - \upsilon_L(0+) = 0$

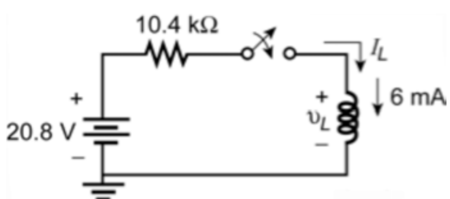
$\upsilon_L(0+) = -7.6\ \text{V}$

$\upsilon_L = \mathbf{-7.6\ V}\boldsymbol{e^{-t/588.2\mu s}}$

b.




19. a.



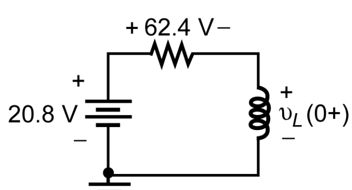

$$I_f = \frac{20.8\ \text{V}}{10.4\ \text{k}\Omega} = 2\ \text{mA}$$

$$\tau = \frac{L}{R} = \frac{200\ \text{mH}}{10.4\ \text{k}\Omega} = 19.23\ \mu\text{s}$$

$$i_L = I_f + (I_i - I_f)e^{-t/\tau}$$

$$= 2\ \text{mA} + (6\ \text{mA} - 2\ \text{mA})e^{-t/19.23\ \mu\text{s}}$$

$$i_L = \mathbf{2\ mA + 4\ mA}\boldsymbol{e^{-t/19.23\ \mu s}}$$

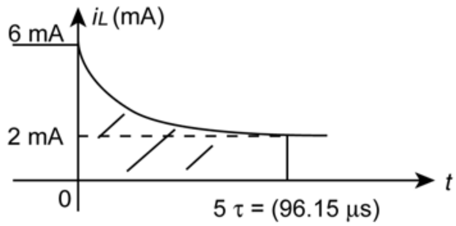


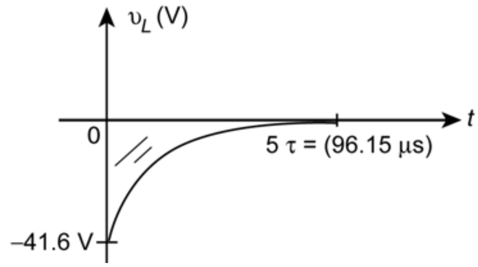

KVL: $20.8\ \text{V} - 62.4\ \text{V} - \upsilon_L(0+) = 0$

$\upsilon_L(0+) = -41.60\ \text{V}$

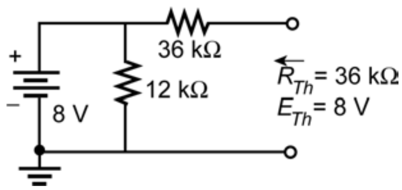
$\upsilon_L = \mathbf{-41.6\ V}\boldsymbol{e^{-t/19.23\ \mu s}}$

b.




20. a.




$\tau = \dfrac{L}{R} = \dfrac{10 \text{ mH}}{36 \text{ k}\Omega} = 0.278\ \mu\text{s}$

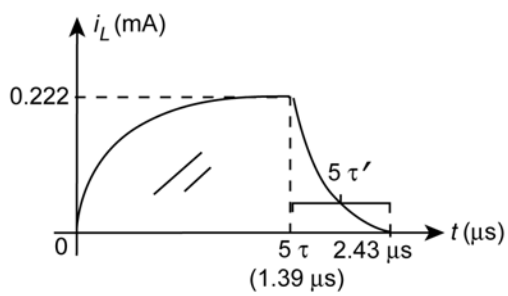
$\upsilon_L = \mathbf{8\ V}\boldsymbol{e}^{\mathbf{-t/0.278\mu s}},\ i_L = \dfrac{E}{R}(1 - e^{-t/\tau}) = \mathbf{0.222\ mA(1 - e^{-t/0.278\mu s})}$

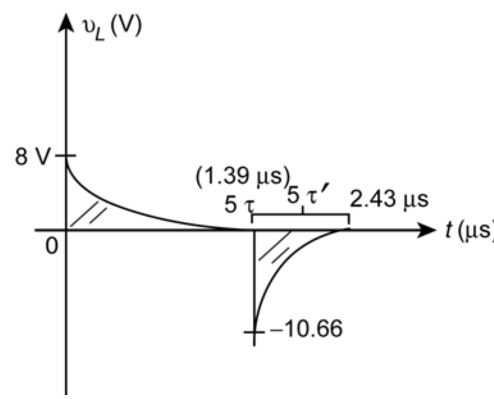
b. $5\tau \Rightarrow$ steady state

$\tau' = \dfrac{L}{R} = \dfrac{10 \text{ mH}}{12 \text{ k}\Omega + 36 \text{ k}\Omega} = 0.208\ \mu\text{s}$

$i_L = I_m e^{-t/\tau'} = \mathbf{0.222\ mA}\boldsymbol{e}^{\mathbf{-t/0.208\mu s}}$

$\upsilon_L = -(0.222 \text{ mA})(48 \text{ k}\Omega)e^{-t/\tau} = \mathbf{-10\ .66V}\boldsymbol{e}^{\mathbf{-t/0.308\mu s}}$




21. a. $\tau = \dfrac{L}{R} = \dfrac{4.7 \text{ mH}}{2 \text{ k}\Omega} = 2.35\ \mu\text{s}$

$i_L = \dfrac{E}{R}(1 - e^{-t/\tau}) = \dfrac{12 \text{ V}}{2 \text{ k}\Omega}(1 - e^{-t/\tau}) = \mathbf{6\ mA(1 - e^{-t/2.35\mu s})}$

$\upsilon_L = Ee^{-t/\tau} = \mathbf{12\ V}\ \boldsymbol{e}^{\mathbf{-t/2.35\mu s}}$

b. $i_L = 6 \text{ mA}(1 - e^{-t/2.35\mu s}) = 6 \text{ mA}(1 - e^{-1\mu s/2.35\mu s}) = 6 \text{ mA}(1 - e^{-0.426})$

$= 6 \text{ mA}(1 - .653) = 6 \text{ mA}(.347) = 2.08 \text{ mA}$

$\tau' = \dfrac{L}{R_1 + R_2} = \dfrac{4.7 \text{ mH}}{12 \text{ k}\Omega} = 392 \text{ ns}$

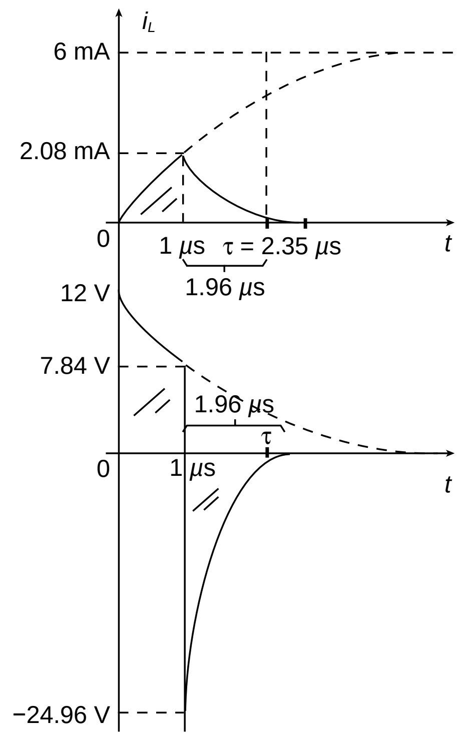
$\boldsymbol{i_L} = \mathbf{2.08\ mA}\boldsymbol{e}^{\mathbf{-t/392ns}}$

$\upsilon_L = 12 \text{ V}e^{-t/2.35\mu s} = 12 \text{ V}e^{-1\mu s/2.35\mu s} = 12 \text{ V}e^{-0.426}$

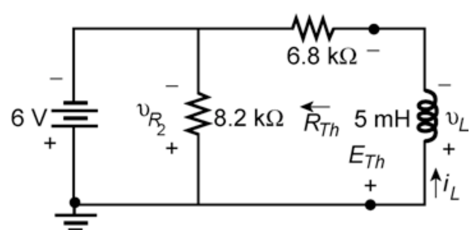
$= 12 \text{ V}(.653) = 7.84 \text{ V}$

At $t = 0^+$ after switch moved
$\upsilon_L = -(2.08\text{ mA})(12\text{ k}\Omega) = -24.96\text{ V}$
and $\upsilon_L = \mathbf{-24.96\ V}\boldsymbol{e^{-t/392\text{ns}}}$
$5\tau' = 1.96\ \mu\text{s}$

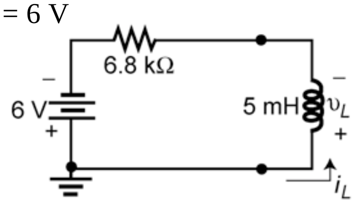
c.




22. a.




$R_{Th} = 6.8\text{ k}\Omega$
$E_{Th} = 6\text{ V}$

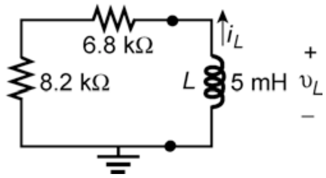



$$\tau = \frac{L}{R} = \frac{5\text{ mH}}{6.8\text{ k}\Omega} = 0.74\ \mu\text{s}$$

$$i_L = \frac{E}{R}(1 - e^{-t/\tau}) = \frac{6\text{ V}}{6.8\text{ k}\Omega}(1 - e^{-t/\tau}) = \mathbf{0.88\ mA(1 - e^{-t/0.74\mu s})}$$

$\upsilon_L = Ee^{-t/\tau} = \mathbf{6\ V}\boldsymbol{e^{-t/0.74\mu\text{s}}}$

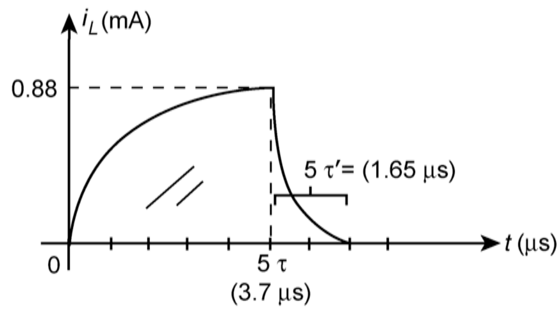
b. Assume steady state and $I_L = 0.88$ mA

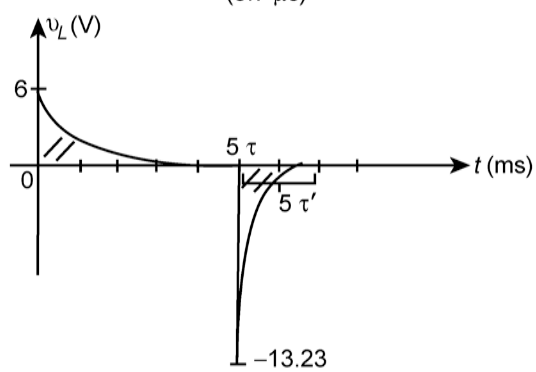



$$\tau' = \frac{L}{R} = \frac{5\text{ mH}}{15\text{ k}\Omega} = 0.33\ \mu\text{s}$$

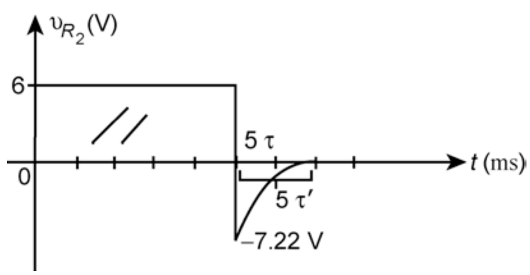
$i_L = I_m e^{-t/\tau'} = \mathbf{0.88\ mA}\ \boldsymbol{e^{-t/0.33\mu s}}$
$\upsilon_L = -V_m e^{-t/\tau'}$
$V_m = I_m R = (0.88\text{ mA})(15\text{ k}\Omega) = 13.23\text{ V}$
$\upsilon_L = \mathbf{-13.23\ V}\boldsymbol{e^{-t/0.33\mu s}}$

c.




d. $V_{R_{2\,max}} = I_m R_2 = (0.88\text{ mA})(8.2\text{ k}\Omega) = 7.22\text{ V}$




23. a. $R_{Th} = 2\text{ k}\Omega + 2.2\text{ k}\Omega + 6.2\text{ k}\Omega \parallel 3\text{ k}\Omega = 6.22\text{ k}\Omega$

$$E_{Th} = \frac{6.2\text{ k}\Omega(12\text{ V})}{6.2\text{ k}\Omega + 3\text{ k}\Omega} = 8.09\text{ V}$$

$$I_f = \frac{8.09\text{ V}}{6.22\text{ k}\Omega} = 1.3\text{ mA},\quad \tau = \frac{L}{R} = \frac{47\text{ mH}}{6.22\text{ k}\Omega} = 7.56\ \mu\text{s}$$