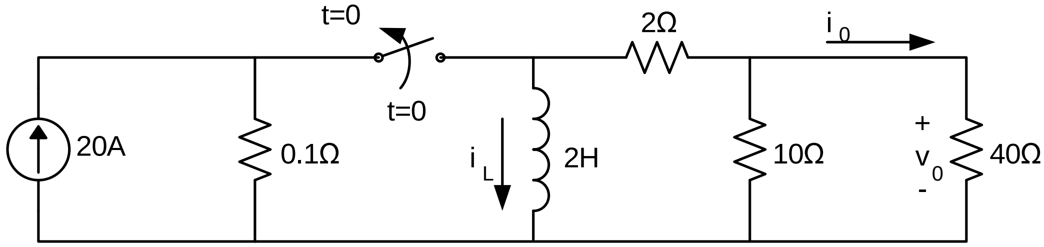
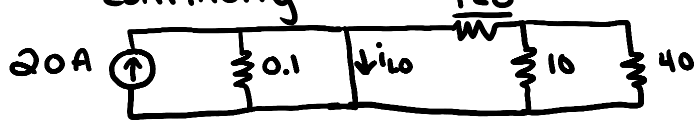
1.)



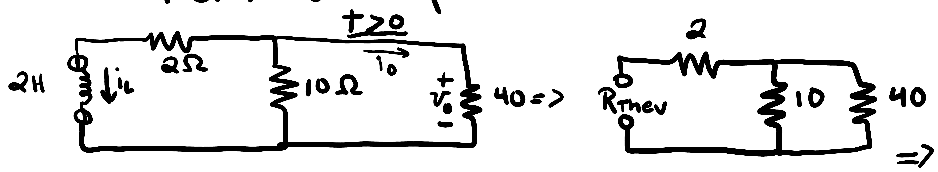
• Circuit is first order and has only DC sources, so use PnC method.

Step 1: Find $i_L(t=0)$ be drawing circuit for $t<0$, current continuity



by inspection, $i_{L0} = 20\,A$ (shorts the source)

Step 2: Find τ by redrawing ckt for $t>0$ and find R_{Th} from L's viewpoint



$= 2 + 10 \| 40$
$2 + 8$
$= 10$
$\Rightarrow \tau = L/R_{Thev} = 2/10 = 1/5$

a) Find: a) i_L , $t > 0$

a) $i_L(t) = i_L(0)e^{-t/\tau}$, $t \geq 0$

$= \boxed{20e^{-5t}A, \; t>0}$

Step 3: Use $i_L(t)$ to find any other requested variables

b) i_0 , $t > 0$

b) current divider law applied to the $t>0$ circuit (note i_L supplies current, divided between the 10Ω and 40Ω resistor)

$i_0 = -i_L \frac{10}{10+40} = -i_L \frac{1}{5}$

$\boxed{i_0 = -4e^{-5t}A, \; t>0}$

c) v_0 , $t > 0$

By Ohm's Law,

$v_0 = i_0 \cdot 40$

$v_0 = -160e^{-5t}\,V, \; t > 0$

d) percentage of total inductor energy that is dissipated in the 10Ω resistor.

initial energy stored in inductor is $\frac{1}{2}Li^2 = \frac{1}{2}(2)(20)^2 = 400\,J$

power dissapated in $10\Omega = i_0 \cdot v_0$ (found above) $= 2560e^{-10t}\,W$

energy dissipated in $10\Omega = \int_0^\infty 2560e^{-10t}\,df = 256\,J$

percentage of total energy diss in $10\Omega = \frac{256}{400} 100\% = 64\%$

2.) Find $\frac{d}{dt}\{e^{-t}\,v(t)\}$

Method 1: Math

$$\frac{d}{dt}\{e^{-t}u(t)\} = \frac{d}{dt}\{e^{-t}\}u(t) + e^{-t}\frac{d}{dt}\{u(t)\}$$

$$= -e^{-t}u(t) + e^{-t}\delta(t)$$

$$= -e^{-t}u(t) + \delta(t)$$ (since $\delta(t)$ non zero only at $t=0$)

Method 2: Graphics