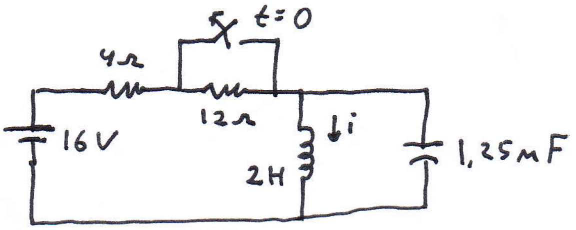
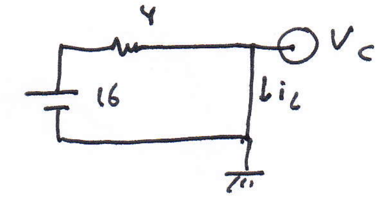
9.17 Find i for $t>0$ if the circuit is in steady state at $t=0^-$



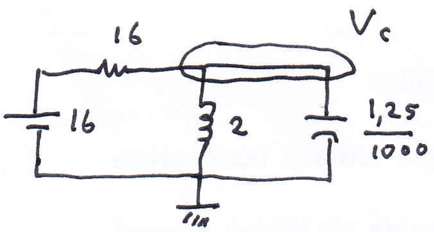
circuit at $t=0^-$



$i_L = \frac{16}{4} = 4A$

$V_c = 0$

circuit at $t=0^+$



node V_c:

$$\frac{V_c-16}{16} + \frac{1}{2}\int V_c\,dt + k + \frac{1{,}25}{1000}\frac{dV_c}{dt} = 0$$

$$\frac{V_c-16}{16} + \frac{1}{2}\int V_c\,dt + k + \frac{1}{800}\frac{dV_c}{dt} = 0 \quad \times 800$$

$$50V_c - 50\cdot 16 + 400\int V_c dt + k + \frac{dV_c}{dt} = 0$$

diff:

$$50\frac{dV_c}{dt} + 400V_c + \frac{d^2V_c}{dt^2} = 0$$

Transformasi:

$$s^2 + 50s + 400 = 0$$

$$s_{1,2} = \frac{-50 \pm \sqrt{2500-1600}}{2} = \frac{-50 \pm \sqrt{900}}{2}$$

$$= -25 \pm 15$$

$s_1 = -40 \qquad s_2 = -10$

$$V_{cN} = A_1 e^{-40t} + A_2 e^{-10t}$$

$$i_{LN} = \frac{1}{L}\int V_{cN}\,dt$$

$$\approx C_1 e^{-40t} + C_2 e^{-10t}$$

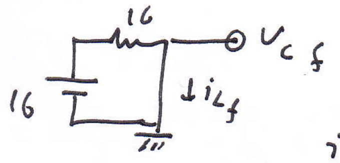
$$V_{LN} = L\frac{di_{LN}}{dt}$$

$$= 2\cdot -40C_1 e^{-40t} - 2\cdot 10 C_2 e^{-10t}$$

$$= -80C_1 e^{-40t} - 20C_2 e^{-10t}$$

force response untuk constant forcing dapat diperoleh dari keadaan steady state.

circuit at steady state:



$V_{cf} = 0$

$i_{Lf} = 1$

complete response:

$i_L = i_{LN} + i_{Lf}$

$V_c = V_{cN} + V_{cf}$

at $t=0$

$i_L = 4 = C_1 + C_2 + 1$

$V_c = 0 = -80C_1 - 20C_2$

$$\begin{array}{l|l} C_1 + C_2 = 3 & \times 20 \\ -80C_1 - 20C_2 = 0 & \times 1 \end{array}$$

$20C_1 + 20C_2 = 60$

$-80C_1 - 20C_2 = 0$ +

$-60C_1 = 60$

$C_1 = -1$

$C_2 = 3 - C_1 = 4$

$$\therefore i_L = -e^{-40t} + 4e^{-10t} + 1$$