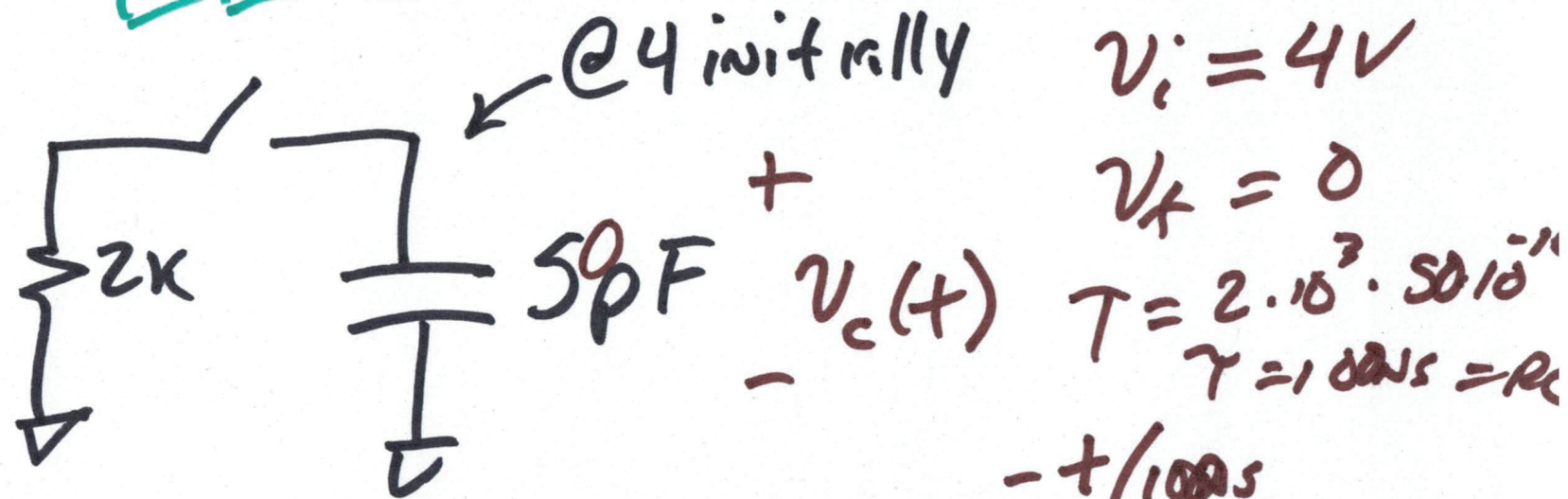


Study Session 2

OCT. 24, 2020

EE 220 circuits 1



$$v_i = 4V$$

$$v_f = 0$$

$$T = 2 \cdot 10^3 \cdot 50 \cdot 10^{-12}$$
$$T = 100ns = \tau_c$$

$$v_c(t) = v_f + (v_i - v_f) e^{-t/100ns}$$

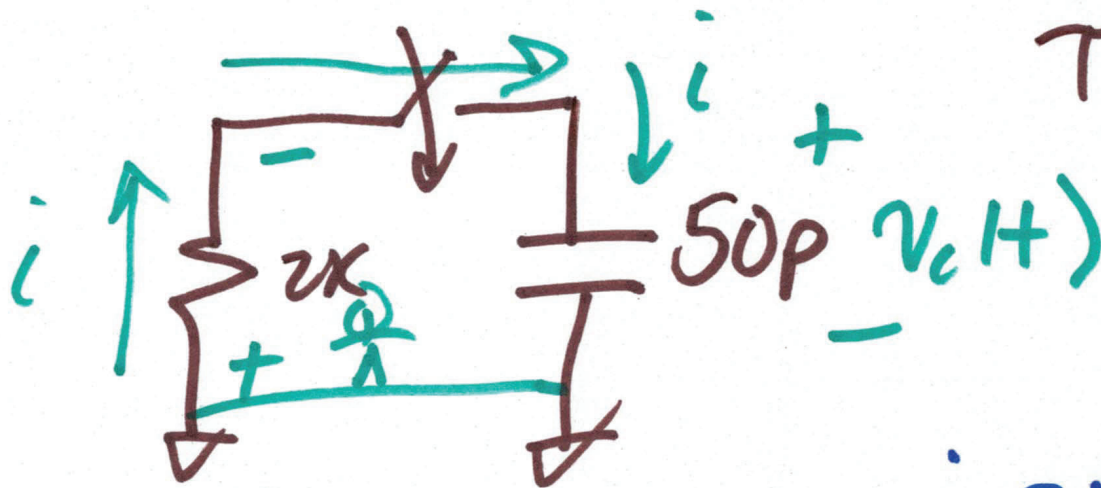
$$= 4e$$

$$v_c(t) = 4e^{-\frac{(t-20\text{ns})}{100\text{ns}}} \text{ V}$$

$$t \geq 20\text{ns}$$

$$v_c(t) = 4 \text{ V} \quad t \leq 20\text{ns}$$

$$\tau = RC = 100\text{ns}$$



$$-i \cdot 2k - v_c(t) = 0$$

$$i = C \frac{dv_c(t)}{dt}$$

50p

2)

$$\left(-500 \text{ F} \cdot \frac{dV_c(t)}{dt} \right) \cdot 2 \text{ k} = V_c(t)$$

$$-100 \text{ N} \cdot \frac{dV_c(t)}{dt} = V_c(t)$$

$$\int_{V_{\text{init}}}^{V_c(t)} \frac{dV_c(t)}{V_c(t)} = \int_0^t \frac{-dt}{100 \text{ N}}$$

$$\ln V_c(t) \Big|_{V_{\text{init}}}^{V_c(t)} = \frac{(t-0)}{-100 \text{ N}}$$

3)

$$\ln v_c(t) - \ln v_{init} = \frac{-t}{100\text{n}}$$

$$e^{\ln \frac{v_c(t)}{v_{init}}} = e^{\frac{-t}{100\text{n}}}$$

$$\frac{v_c(t)}{v_{init}} = e^{\frac{-t}{100\text{n}}}$$

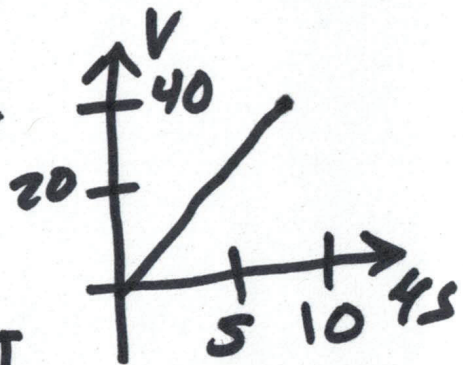
$$v_c(t) = v_{init} e^{\frac{-t}{100\text{n}}}$$

$$v_c(t) = 4 e^{\frac{-t}{100\text{n}}}$$

$$I = C \frac{dv}{dt} \rightarrow 20 \mu A = 5 p \cdot \frac{dv}{dt}$$

$$\frac{4 \cdot \cancel{5} \cdot 10^{-6}}{\cancel{5} \cdot 10^{-12}} = \frac{dv}{dt}$$

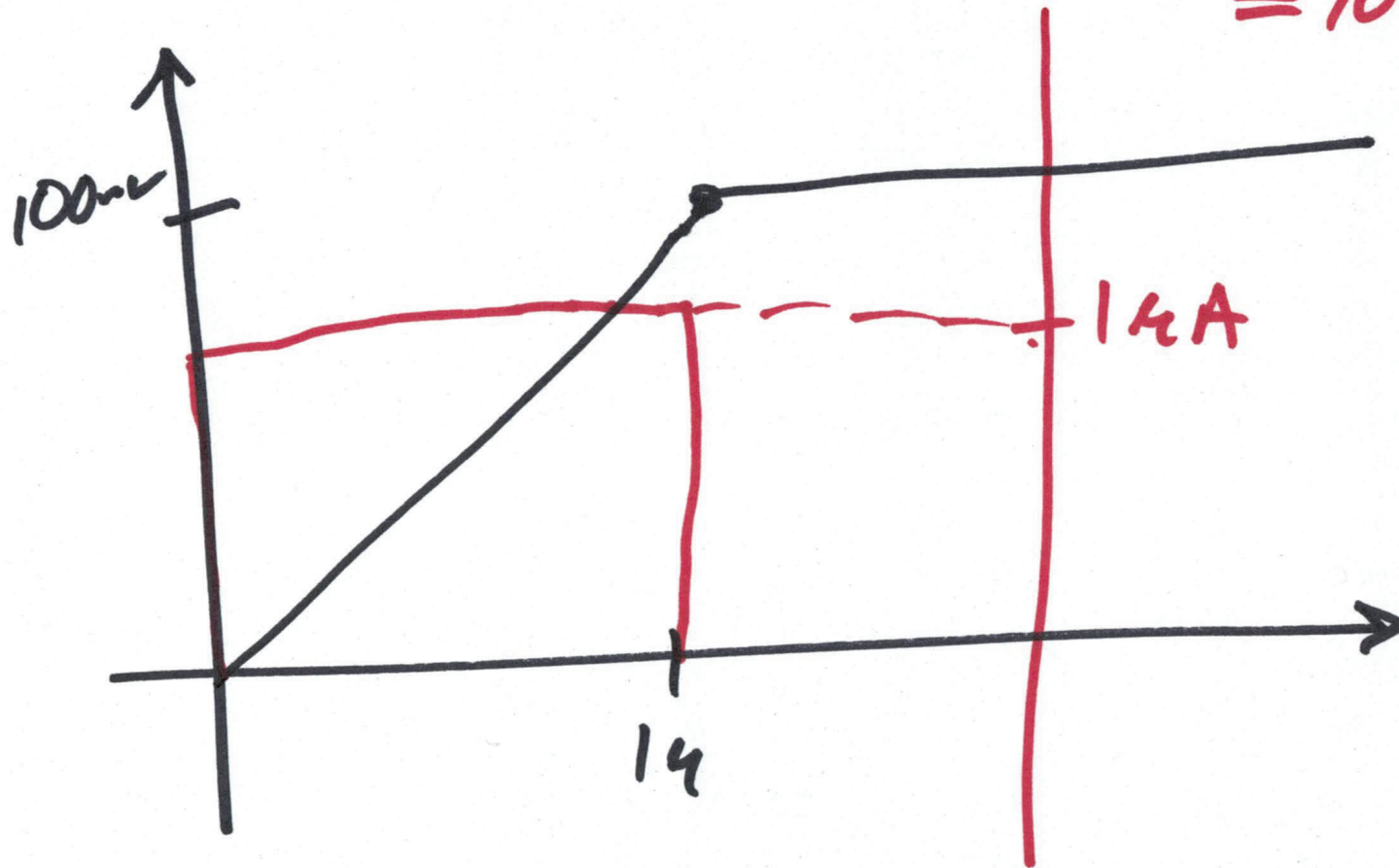
$$\frac{4V}{4s} = \frac{dv}{dt}$$
$$\int_0^{v_c(t)} dv = \frac{4V}{4s} \int_0^t dt$$

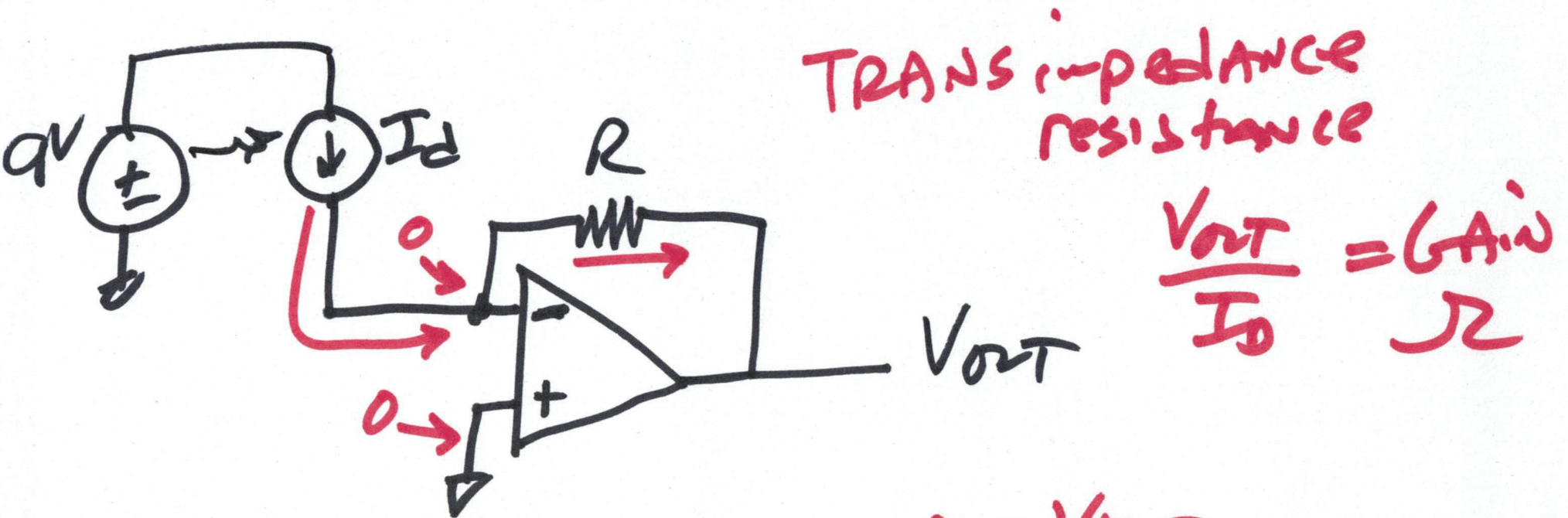


$$v_c(t) = \frac{4V}{4s} \cdot t$$

5)

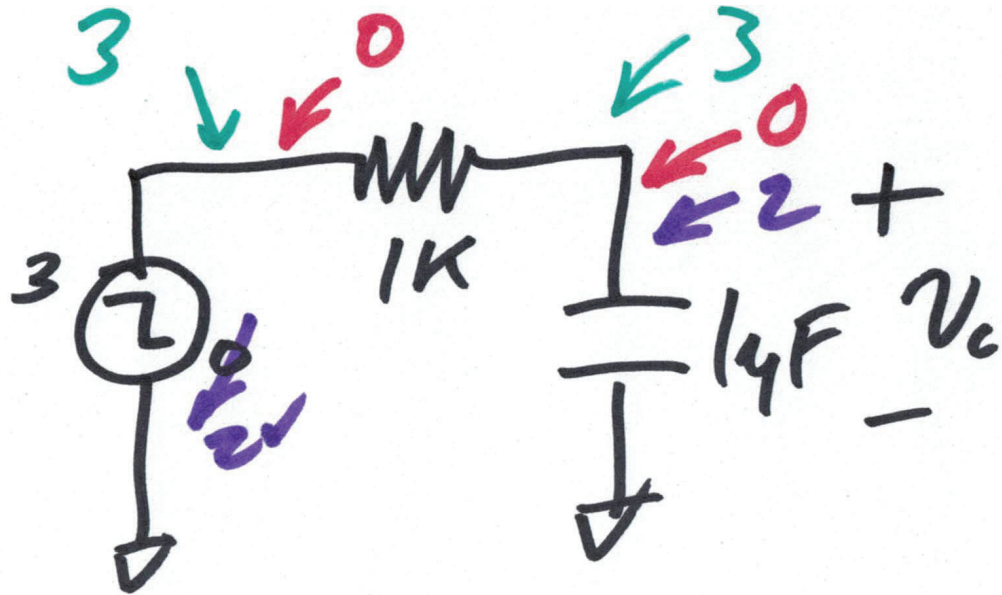
$$\frac{100\text{mV}}{1\mu\text{s}} = \frac{dV}{dt}, \quad I = C \frac{dV_c}{dt} = 10\text{pF} \cdot \frac{100\text{mV}}{1\mu\text{s}} = 10 \cdot 10^{-6} \cdot 0.1$$





$$I_D = \frac{0 - V_{OUT}}{R}$$

$$V_{OUT} = -I_D \cdot R$$

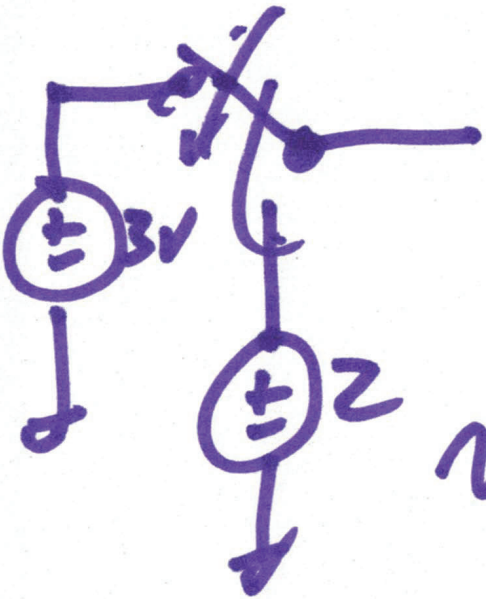


$$v_i = 3V$$

$$v_f = 0$$

$$v_c(t) = 3e^{-t/1\mu s}$$

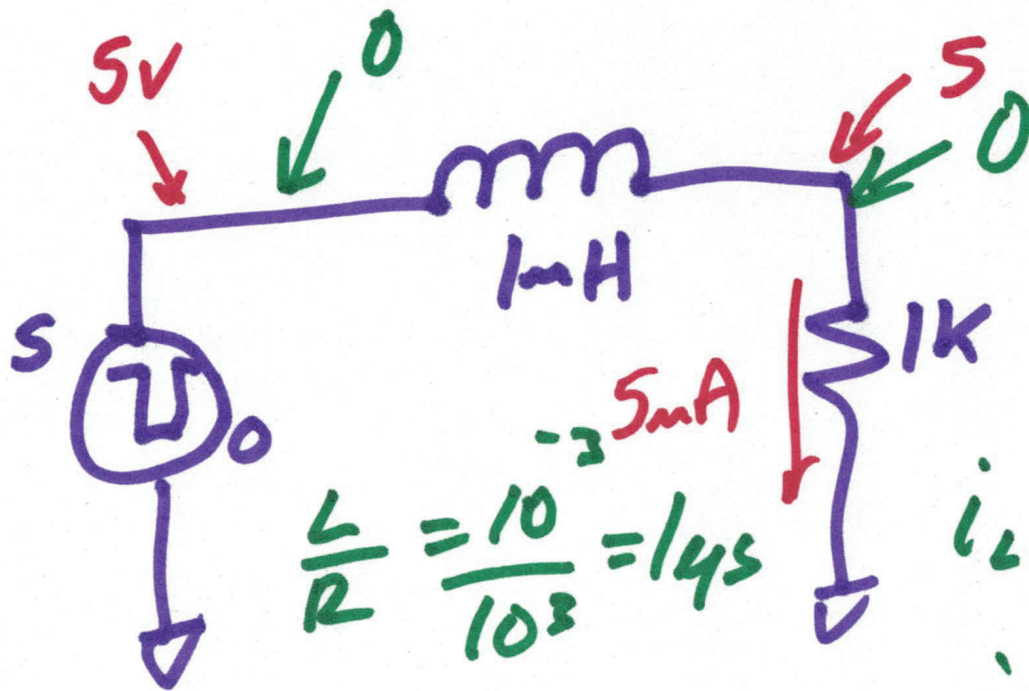
$$\tau = 1k \cdot 1\mu F$$



$$v_i = 3 \quad v_f = 2$$

$$v_c(t) = 2 + (3 - 2)e^{-t/1\mu s}$$

$$= 2 + 1e^{-t/1\mu s}$$

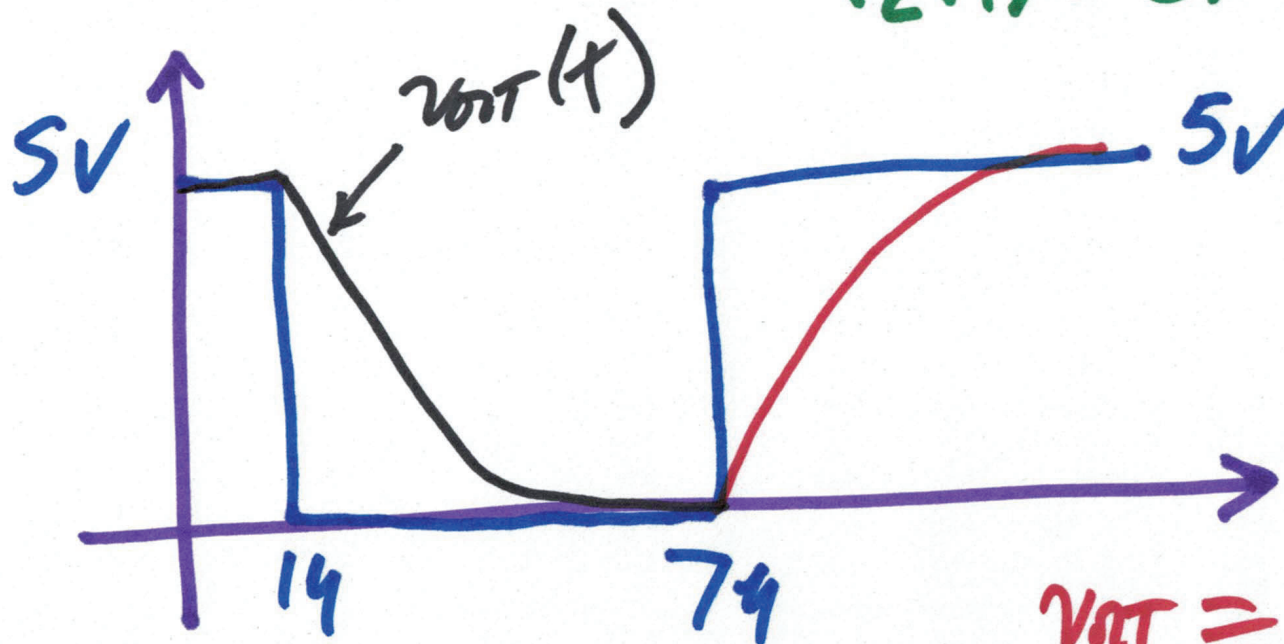


$$i_i = 5mA$$

$$i_f = 0$$

$$i_L(t) = i_f + (i_i - i_f)e^{-t/\tau}$$

$$i_L(t) = 5mA e^{-t/1\mu s}$$



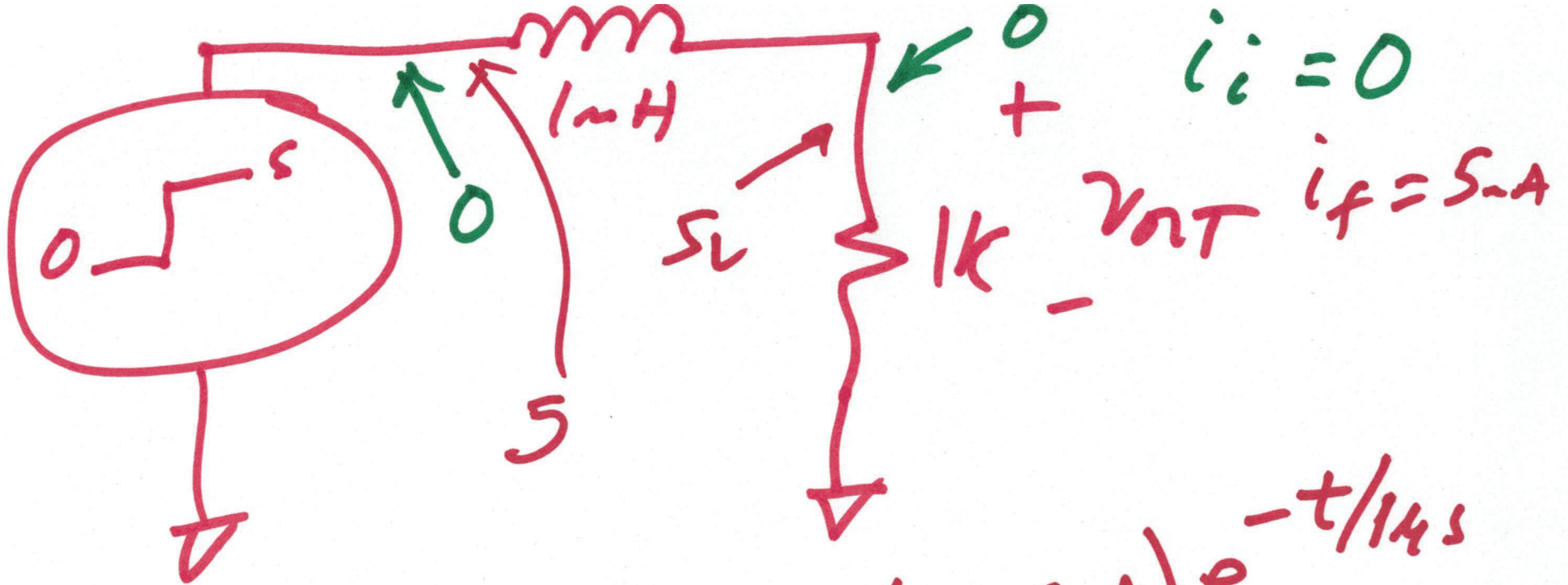
$$v_{out}(t) = 1K \cdot i_L(t)$$

$$= 5e^{-t/1\mu s}$$

$$v_{out} = 5e^{-\frac{(t-14)}{1\mu s}}$$

$$14 \leq t \leq 74$$

a)



$$i_L = 5\text{mA} + (0 - 5\text{mA})e^{-t/14\mu\text{s}}$$

$$= 5\text{mA}(1 - e^{-t/14\mu\text{s}})$$

$$V_{out} = 1\text{k} \cdot i_L(t) =$$

$$5\text{V}(1 - e^{-t/14\mu\text{s}})$$

$$V_{out}(t) = 5(1 - e^{-(t-7\mu\text{s})/14\mu\text{s}}) \quad t \geq 7\mu\text{s}$$