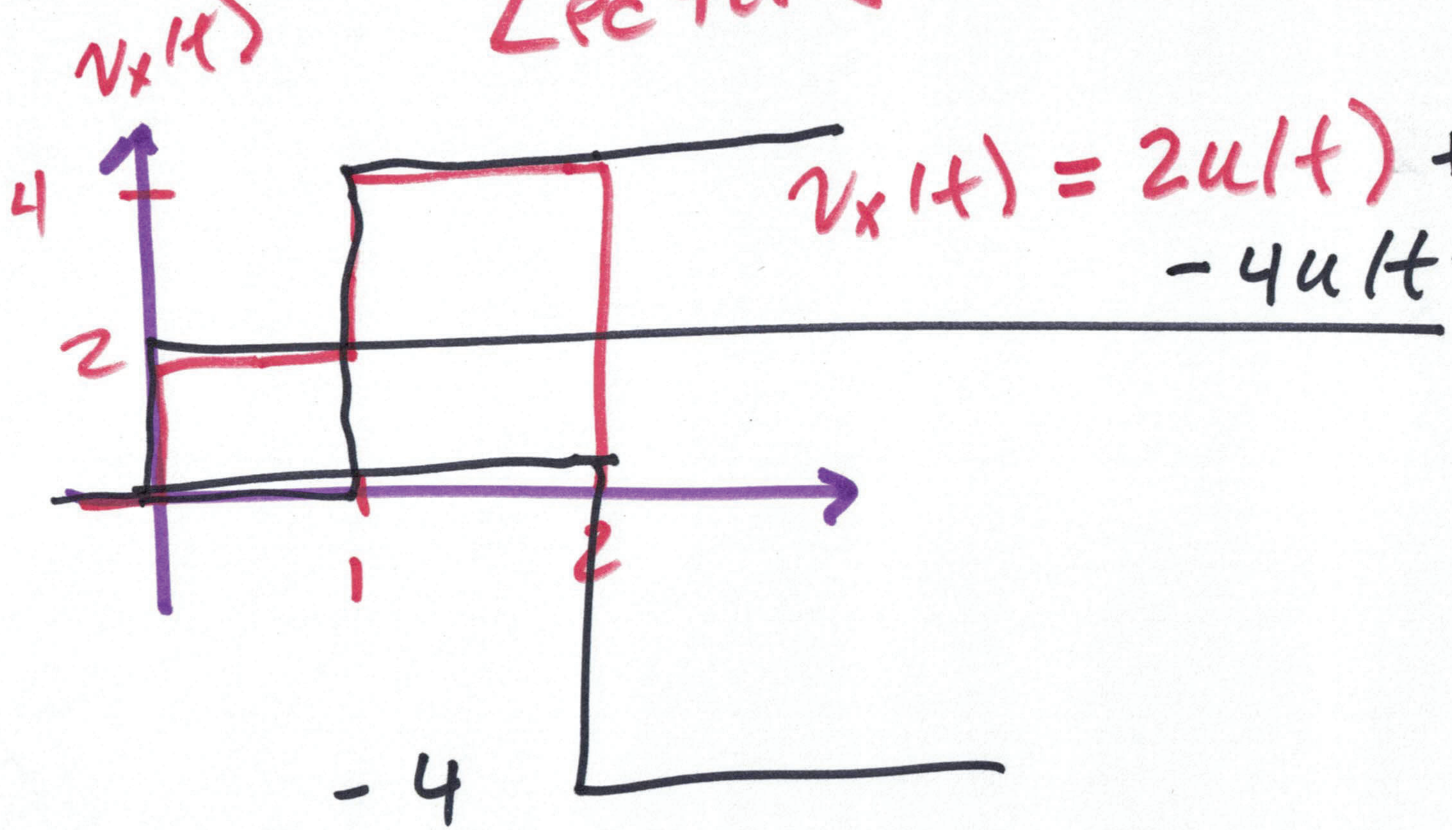
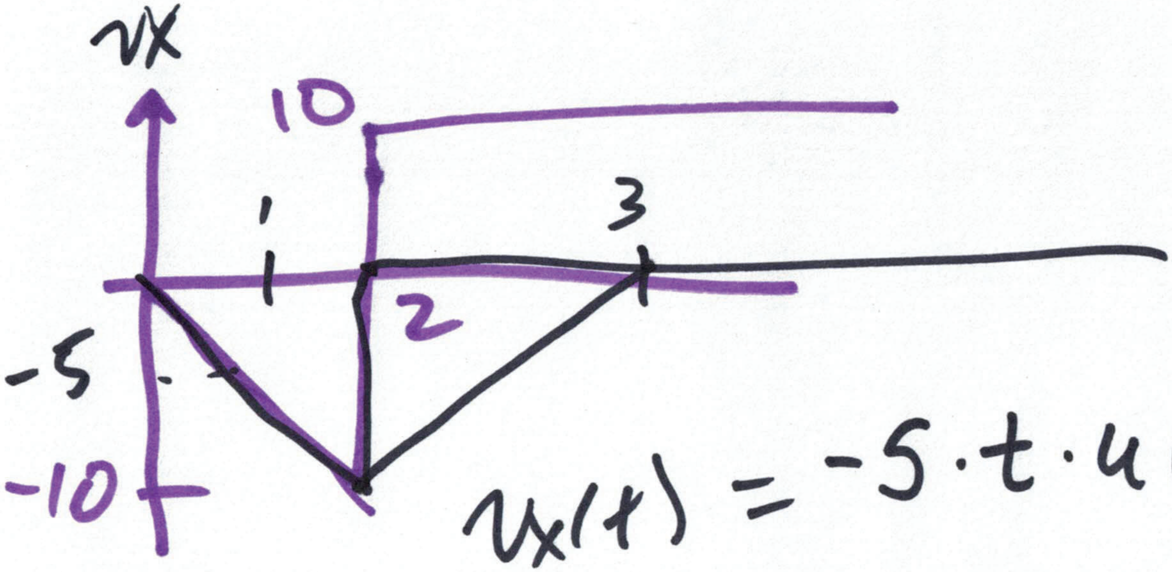
EE 221 Circuits II

April 3, 2023

Lecture 18

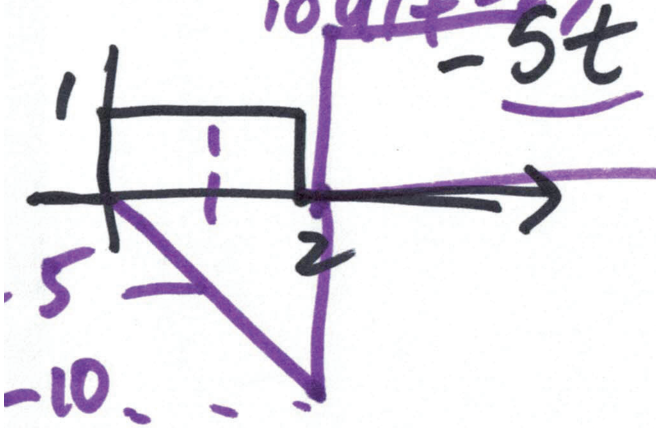


$$v_x(t) = 2u(t) + 2u(t-1) - 4u(t-2)$$

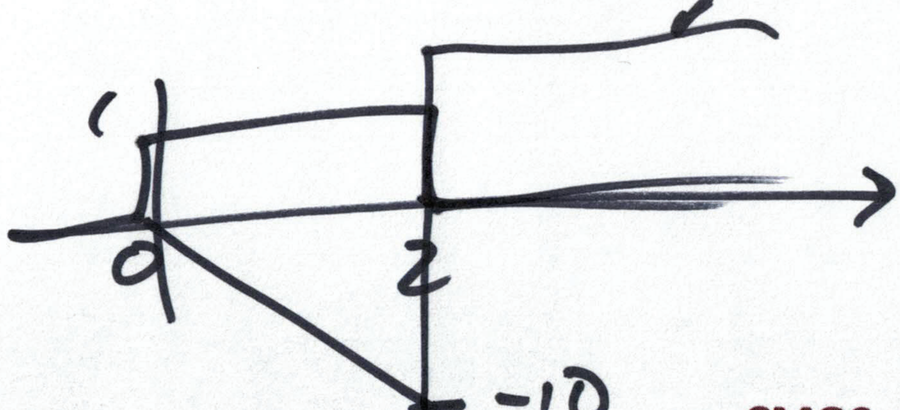


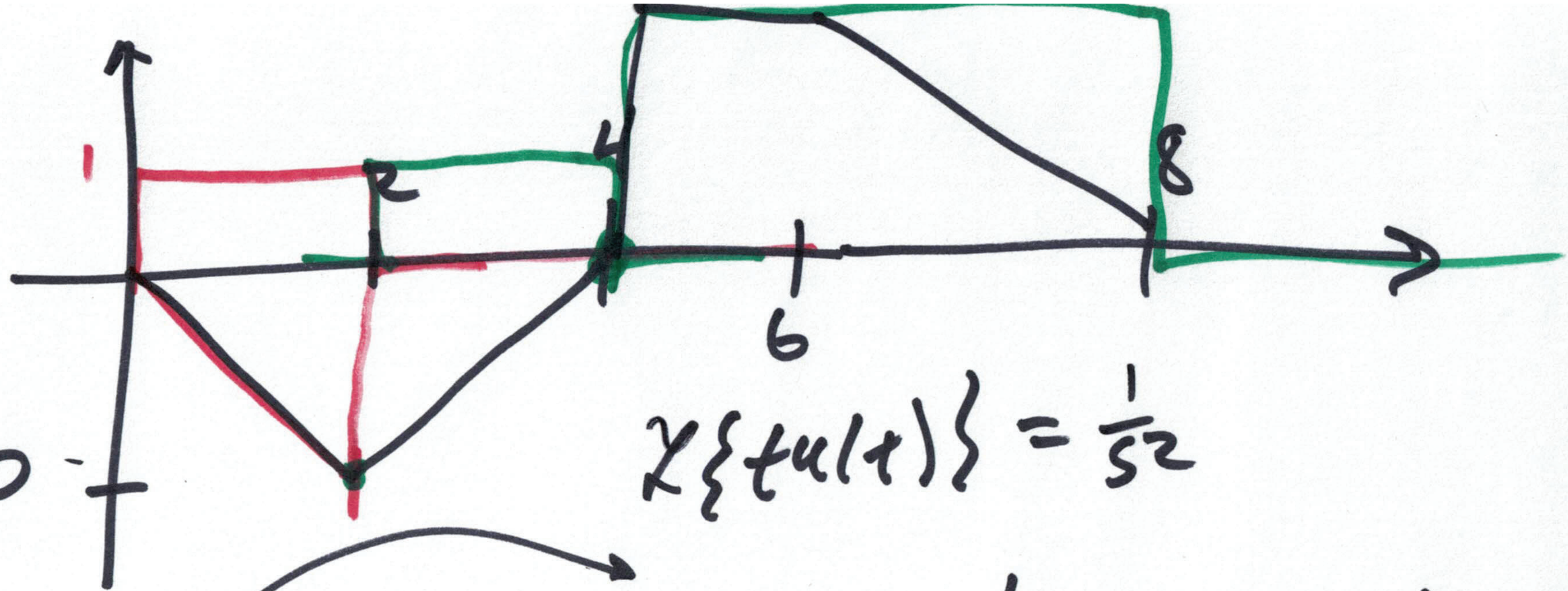
$$v_x(t) = -5\cdot t\cdot u(t) + \frac{5}{5}(t-2)\,u(t-2) + 20\,u(t-2)$$

$u(t) - u(t-2)$



$$= -5(t)\cdot\big(u(t) - u(t-2)\big) + 10\,u(t-2)$$





$$\mathcal{L}\{t\,u(t)\} = \frac{1}{s^2}$$

$$-5t\big(u(t) - u(t-2)\big) + \big(u(t-2) - u(t-4)\big)\cdot\big(-10 + 5(t-2)\big)$$

$$-\frac{5}{s^2} \quad + \frac{5}{s^2}e^{-2s}$$

$$+ 10\big(u(t-4) - u(t-8)\big)$$

$$+ \cdot\big(u(t-6) - u(t-8)\big)\big(-5(t-6)\big)$$

$$f_6(t) = 20te^{-2t}\sin 4t \cdot u(t)$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!}$$

$$f_6(t) = 20te^{-2t}\left(4t - \frac{(4t)^3}{3!} + \frac{(4t)^5}{5!} \cdots\right.$$

$$= e^{-2t}\left(80t^2 - \frac{20t(4t)^3}{3!} + \frac{20t(4t)^5}{5!} + \cdots\right.$$

$$e^{-2t}\left(80t^2 - \frac{20t(4t)^3}{3!} + \frac{20t(4t)^5}{5!} \cdots\right.$$

$e^{-2t}\left(80t^2 - \frac{20}{3!}\cdot 4^3 \cdot t^4 + \frac{20\,4^5}{5!} t^6 \ldots\right.$

$$\int t^N \cdot e^{-at} \cdot dt$$

let $u = t^N \cdot dt$

$$\frac{du}{dt} = (N)\ldots$$

$$\int v \cdot du = uv - \int u \cdot dv$$

$$N t^{N-1}$$

$$dv = e^{-at}$$

$$v =$$

5)

$$f_6(t) = 20t \cdot e^{-2t} \sin 4(t)\, u(t)$$

Euler's formula

$$\sin x = \frac{e^{jx} - e^{-jx}}{2j}$$

$$= 20te^{-2t} \cdot \left(\frac{e^{j4t} - e^{-j4t}}{2j}\right)$$

$$= \frac{20}{2j} \cdot t \cdot \left(e^{-2t+j4t} - e^{-2t-j4t}\right)$$

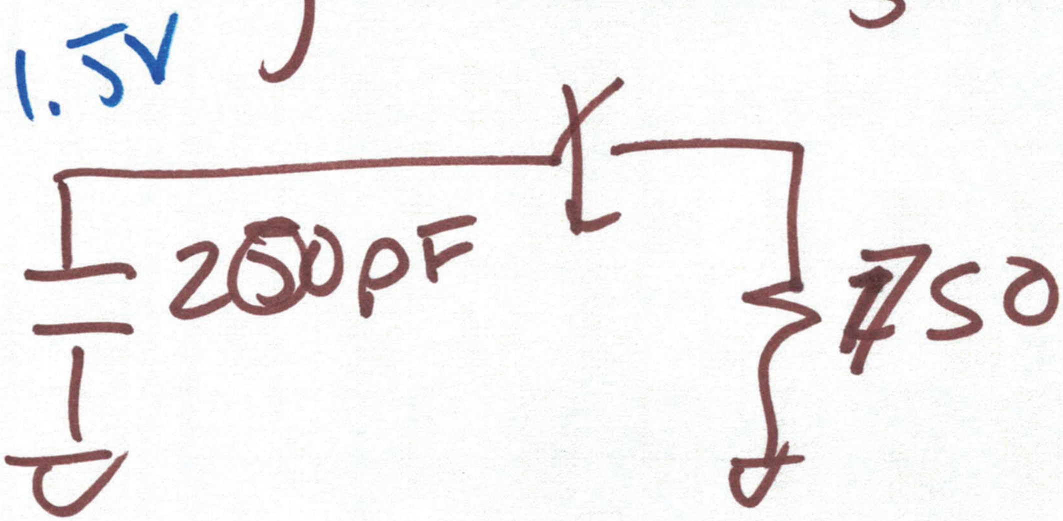
$$\frac{20}{2j}\left(t e^{(-2t+j4t)} - t e^{-2t-j4t} \right) u(t)$$

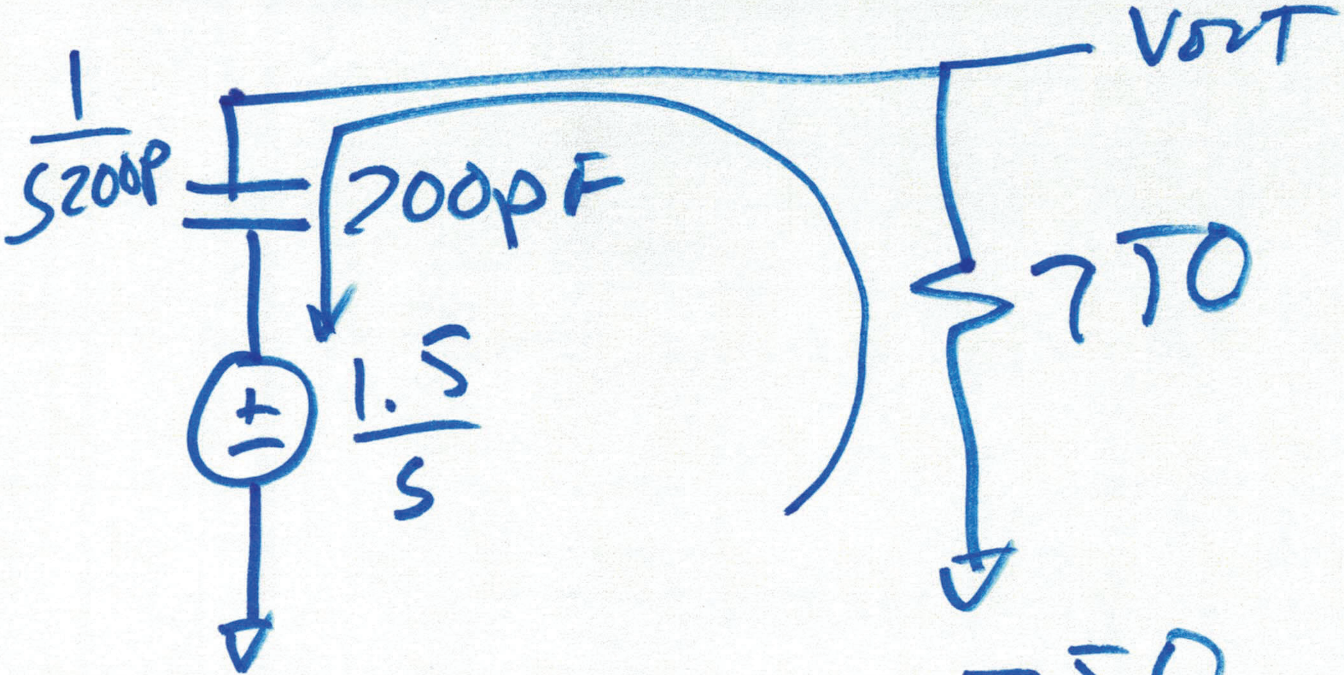
$$\mathcal{L}\{ t e^{-at} \cdot u(t) \} = \frac{1}{(s+a)^2}$$

$$\frac{20}{2j}\left(\frac{1}{(s+(2t-j4))^2} - \frac{1}{(s+(+2t+j4t))^2} \right)$$

$$\frac{d\,f(t)}{dt} \Rightarrow s \cdot F(s)$$

$$\int f(t) \Rightarrow \frac{1}{s} F(s)$$





$$V_{OUT}(s) = \frac{1.5}{s} \cdot \frac{750}{750 + \frac{1}{s \cdot 200\times10^{-12}}} \quad e^{-100s}$$

$$= \frac{1.5}{s} \cdot \frac{750 \cdot 200\times10^{-12} \cdot s / \tau}{\frac{1}{\tau}(750 \cdot 200\times10^{-12} \cdot s + 1)}$$

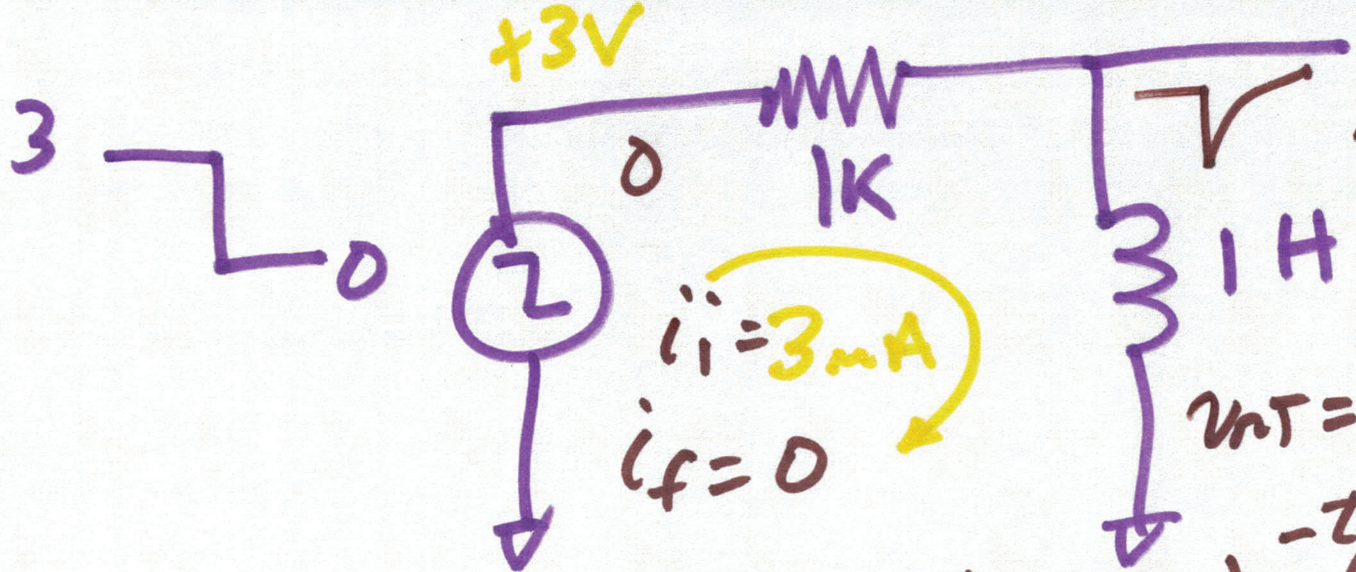
$$\text{let } = \tau = 750 \cdot 200\times10^{-12}$$

$$V_{OUT}(s) = \frac{1.5}{\cancel{s}} \cdot \frac{\cancel{s}}{s + \frac{1}{\tau}}$$

$$= \frac{1.5}{s + \frac{1}{\tau}} e^{-100 \cdot s}$$

$$v_{OUT}(t) = 1.5 e^{-t/\tau} \cdot u(t)$$

$$= 1.5 e^{-(t-100n)/\tau} \cdot u(t-100n)$$



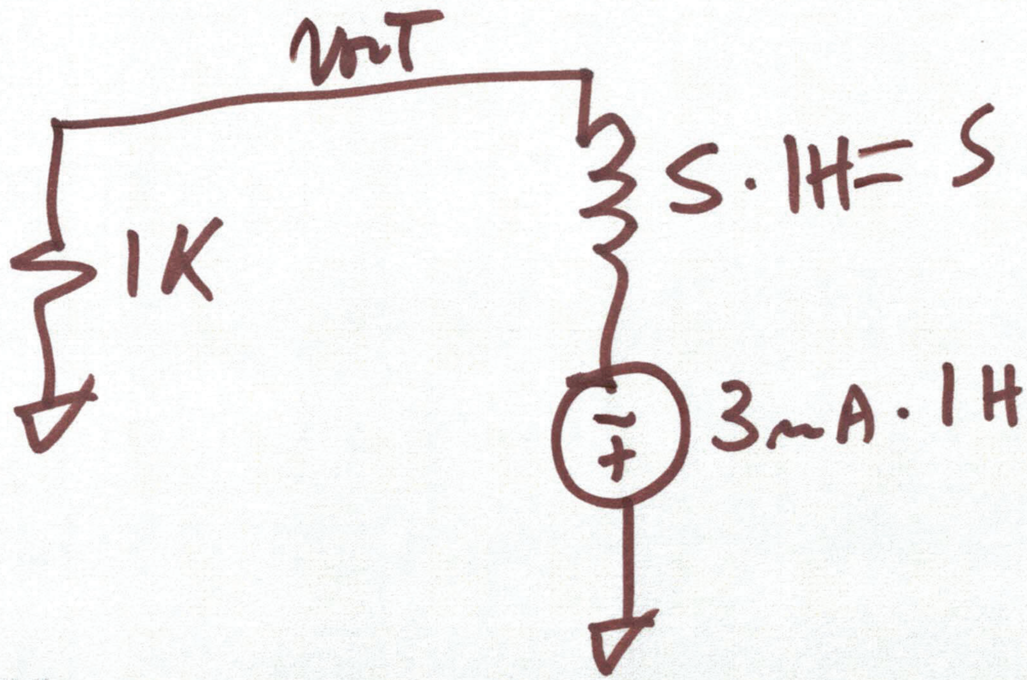
$v_i = -3V$

$v_f = 0$

$v_{OUT} = -3e^{-t/1ms}$

$v_{OUT} = v_f + (v_i - v_f)e^{-t/\tau}$

$\tau = \frac{L}{R} = 1ms$



$$-3mA \cdot 1 \cdot \frac{1K}{1K + s} = V_0(s)$$

$$V_0(s) = \frac{-3}{s + 1K} = -\frac{3}{s + \frac{1}{1ms}}$$

$$v_{OUT} = -3e^{-t/1ms}\, u(t)$$