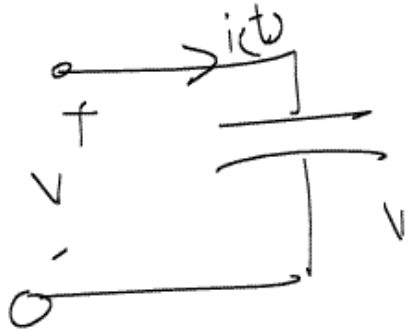
EE100 Wednesday June 29th 2005 (office hour notes)

p3.11) (similar to p3.10)



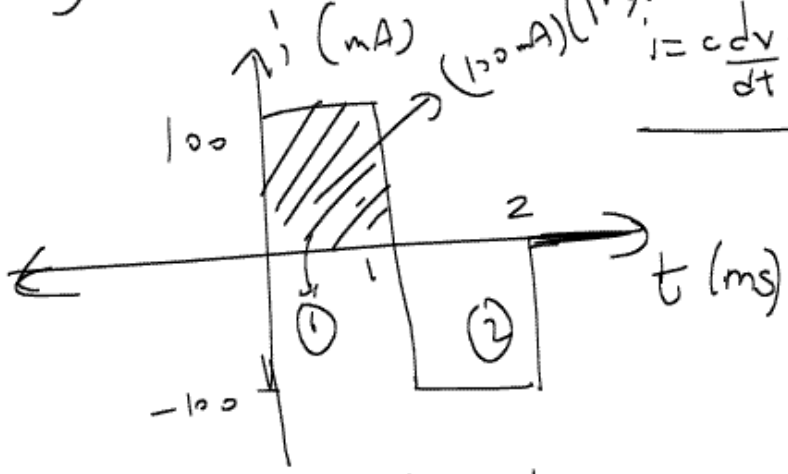
$C = 3\mu F$

$v(0) = 10V$

(a) Sketch voltage, power & stored energy vs time.

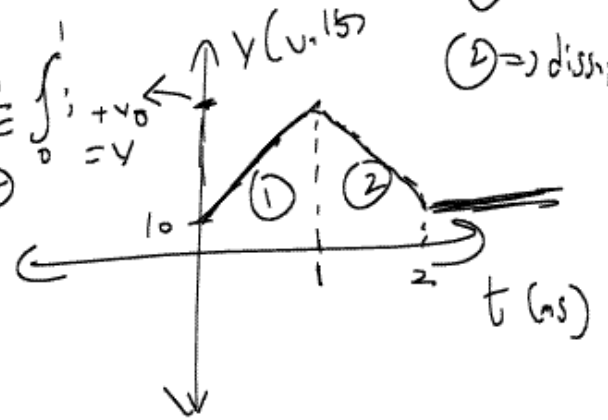
(1) ⇒ absorbing

(2) ⇒ dissipating



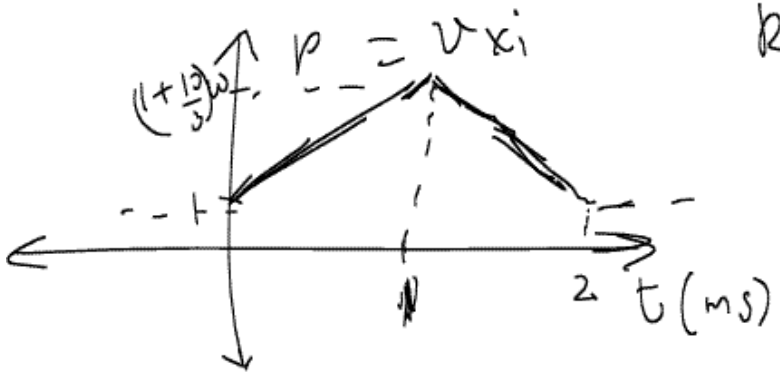
$(100\,mA)(1\,ms) = Q$

$i = C\frac{dv}{dt} \Rightarrow \frac{1}{C}\int_0^t i + v_0 = v$



$\therefore\ v(t = 1ms) = \frac{1}{C}\int_0^1 i\,dt + V_0 \Rightarrow \frac{1}{3\mu F}(100\mu A)(1\mu s) + 10$

$\Rightarrow \boxed{10 + \frac{100}{3} = v(t = 1ms)}$



Region ①: $i_{①}(t) = 100\ mA$

$v(t) = ?$

$$\frac{\Delta v}{\Delta t}_{①} = \frac{\left(\frac{100}{3}+10\right) - 10}{1-0} = \frac{100}{3}$$

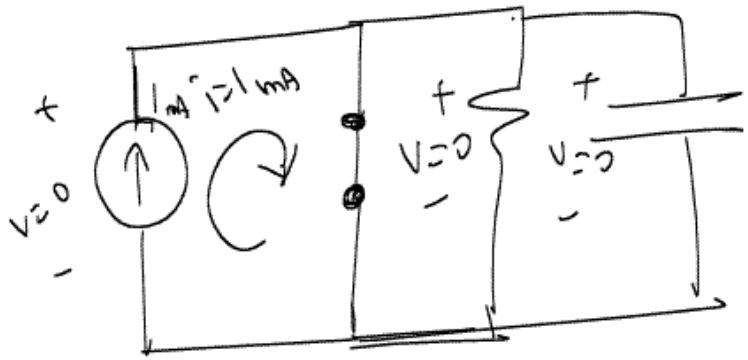
$$\therefore v(t)_{①} = \frac{100}{3}t + 10 \text{ volts}$$

$$\therefore P_{①}(t) = v(t)_{①} \cdot i_{①}(t) = \frac{10000\ mW}{3}t + 1000\ mW$$

$$\boxed{P(t) = \frac{10}{3}t + 1\ W}$$

$\longrightarrow$ Easy from now!

p4-2) $t \le 0$



Note: Check EE40 online exams on http://bkn.eecs.berkeley.edu for good practice problems.

EXAMPLE: Fall 2000 midterm 1; problem 3:

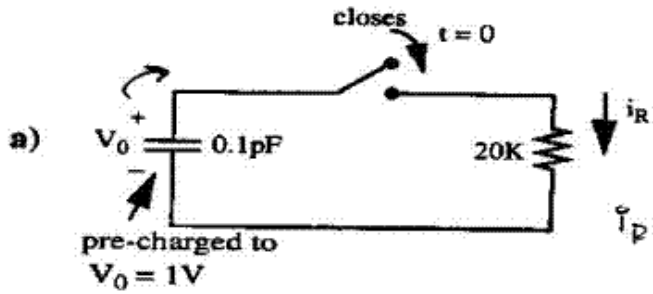
(a)

Problem #3

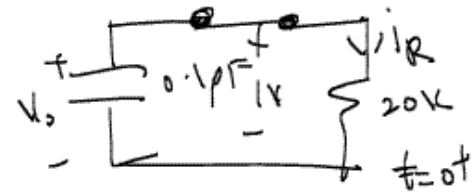
Initial Conditions

In each of the problems below, find the value of the current or voltage just after the switch moves (i = 0+). (What is requested is just a numerical value, Not an equation or function of time.

a.



$i_R = ?$



$V_0 = 1V = V(t=0^+)$
$(t=0^-)$

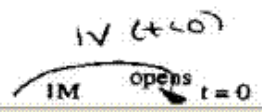
(Voltage across a capacitor cannot change instantaneously)

$i_R(t=0^+) = \frac{1}{20K}$

$= \frac{100}{200K}$ M $\Rightarrow$ $\boxed{i_R = 50\ \mu A}$

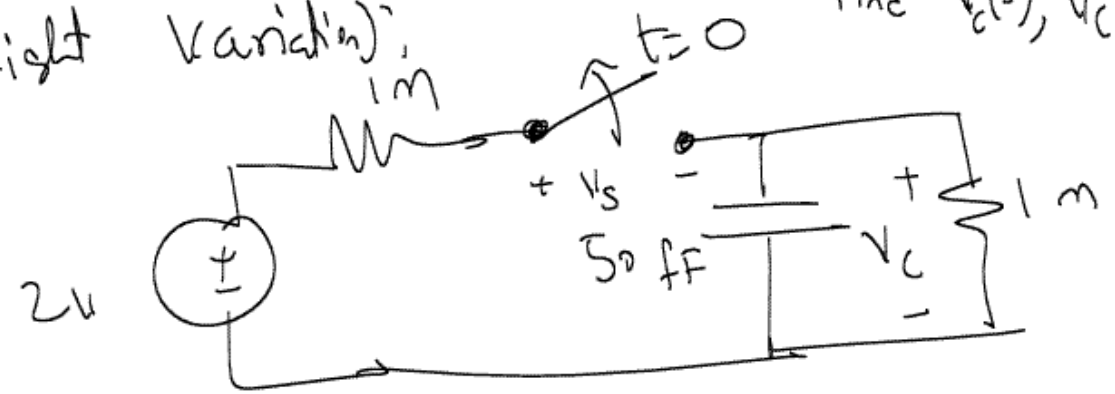
iR= ___ microAmps

b.

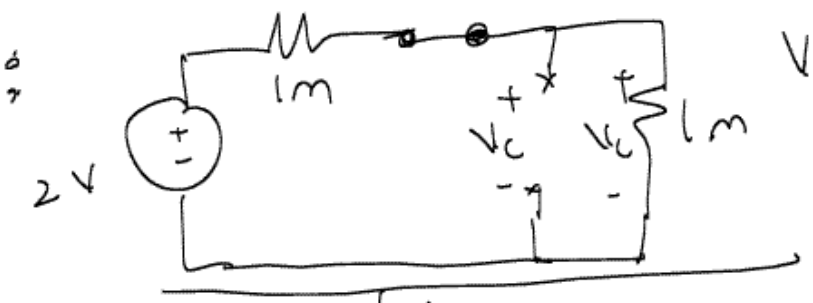


(b) (slight variation):

Find $V_c(0^-)$, $V_c(0^+)$, $V_s(0^+)$



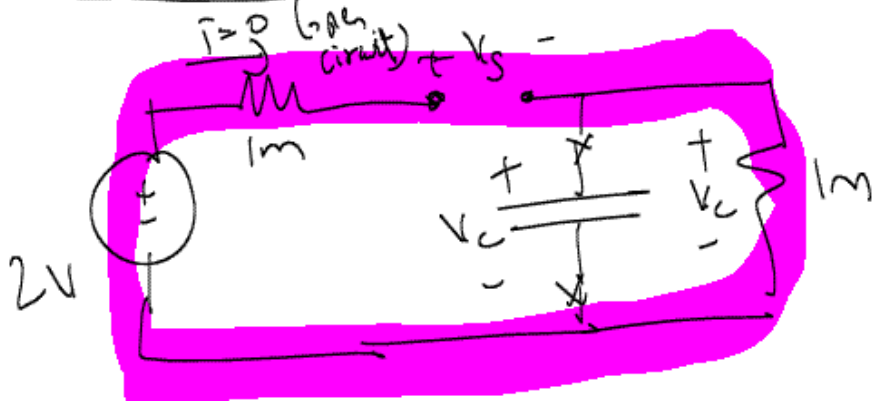
$\underline{\underline{t=0^-}}$:



$V_c(0^-) = 1\ V$

(voltage divider)

$\underline{\underline{t=0^+}}$:



$V_c(0^+) = 1\ V$

$V_s(0^+) = 1\ V$

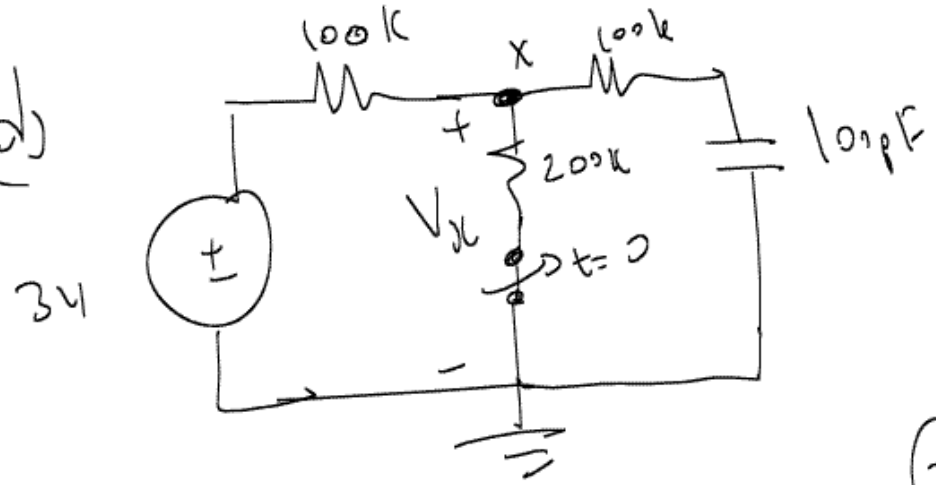
(KVL)

KVL,

$$2 - (0)(1m) - V_S - V_C = 0$$

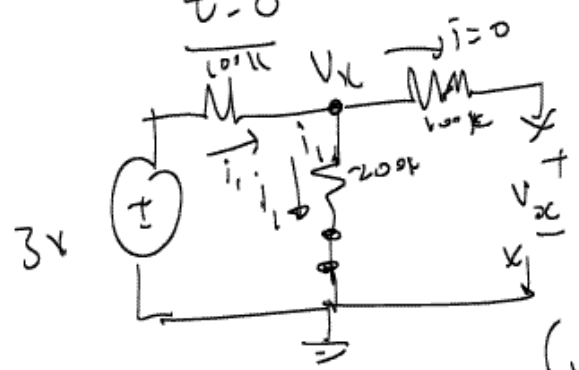
$$\Rightarrow \boxed{V_S = 2 - 1 = 1\ V}$$

d)



$V_x(0^+)$

$t = 0^-$

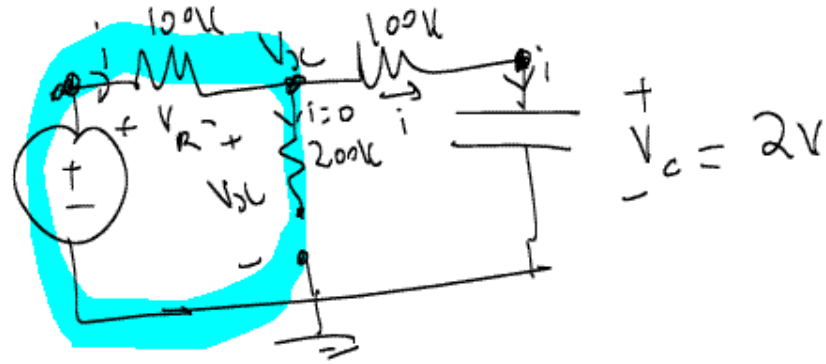


(voltage divider)

$$V_x(0^-) = \frac{200k}{300k} \cdot 3 = 2\ V$$

$t = 0^+$

Note: $V_{x} \neq V_C$ at $t = 0^+$, because $i \neq 0$



KVL: $3 - V_R - V_x = 0 \Rightarrow V_x = 3 - V_R$

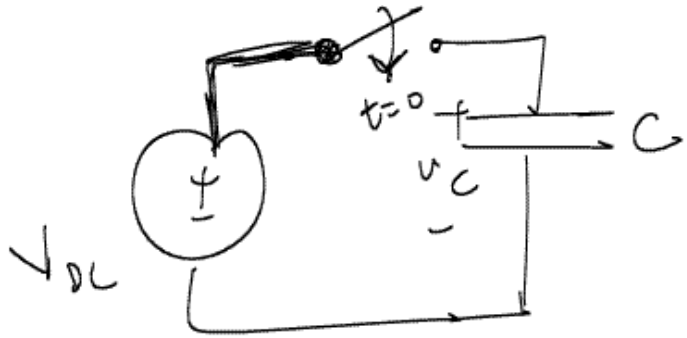
$= 3 - i(100k)$

$= 3 - \left(\frac{3-2}{200k}\right) \cdot 100k$

$= 3 - 0.5 = 2.5\,V$

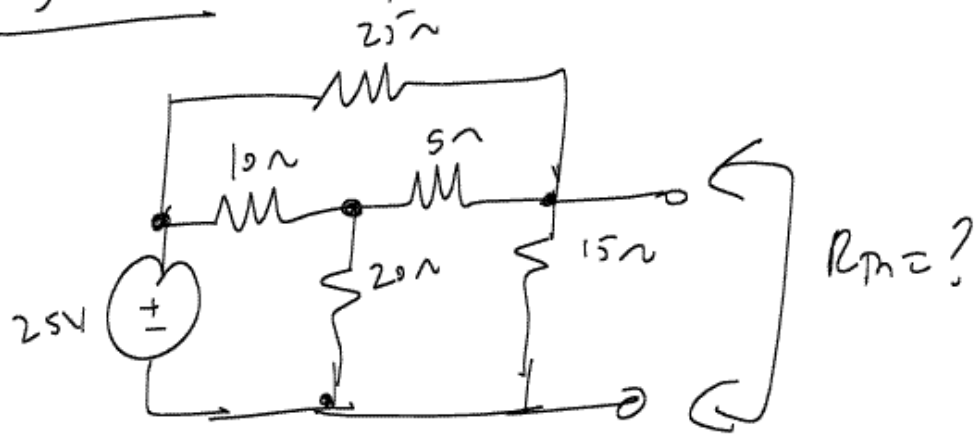
$\therefore \boxed{V_x(0^+) = 2.5\,V}$

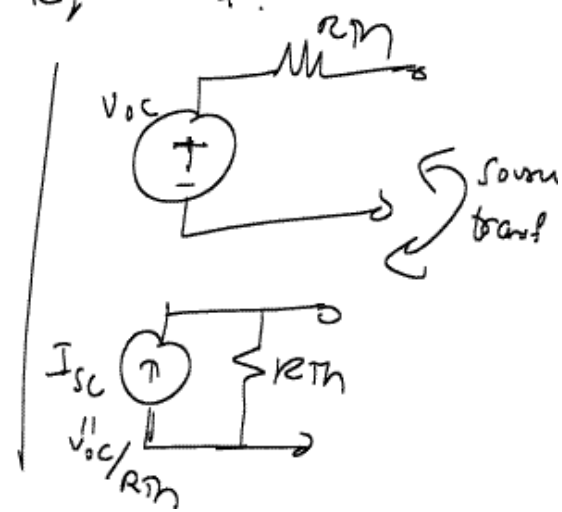
(Q:) What happens:



Ideally: Bad! v_C cannot change instantaneously!!!

(Q:) 2.66 Find Thevenin & Norton equivalent:





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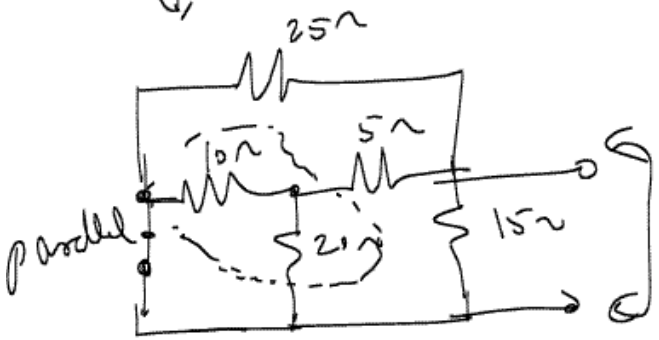
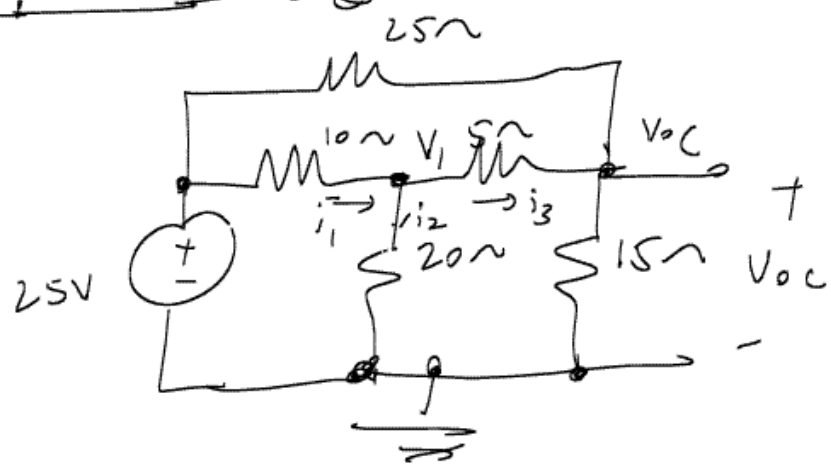


$R_{th} = ?$ ⟶ Solve!

$V_{oc} = ?$

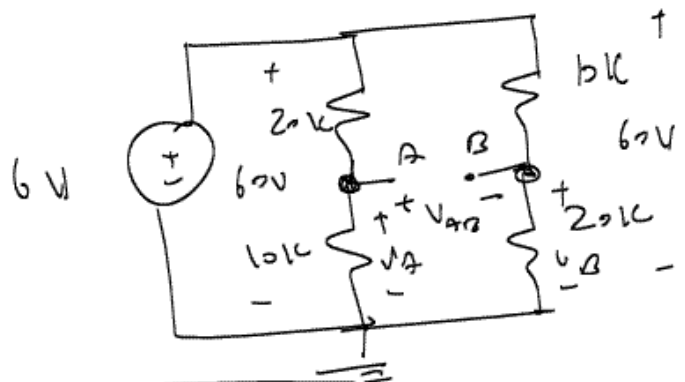


KCL @ V_1: $i_1 = i_2 + i_3 \Rightarrow \frac{25 - V_1}{10} = \frac{V_1}{20} + \frac{V_1 - V_{oc}}{5}$

Setup KCL at V_{oc} & then solve!

More example problems: refer to old exams & review problems from EE100 website (eg: Click on "EE100 Spring 2005 website" on EE100 homepage & click on Exams).

Eg:



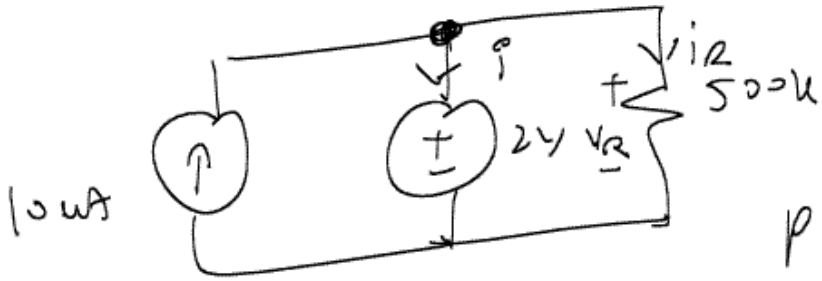
$V_A = \frac{10k}{10+20k} \cdot 60V$ (voltage divider)

$= 2V$

Similarly, $V_B = \frac{20k}{30k} \cdot 60V = 4V$

$\therefore \boxed{V_{AB} = V_A - V_B = -2V}$

eg:



(Q:) Find $P_{2V} = ?$

$$P = \underbrace{(2V)}_{V}\, i$$

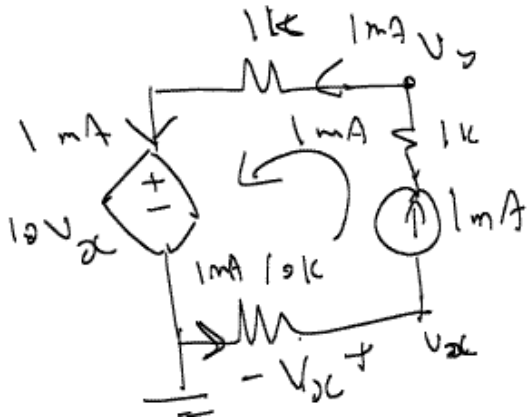
$$10\,uA = i + i_R \quad (KCL)$$

$$= i + \frac{2 = v_R}{500k} \Rightarrow 10u = i + 4uA$$

$$\Rightarrow i = 6\,uA$$

$$\therefore P = (2V)(6\,uA) = \boxed{+12\,uW = P}$$

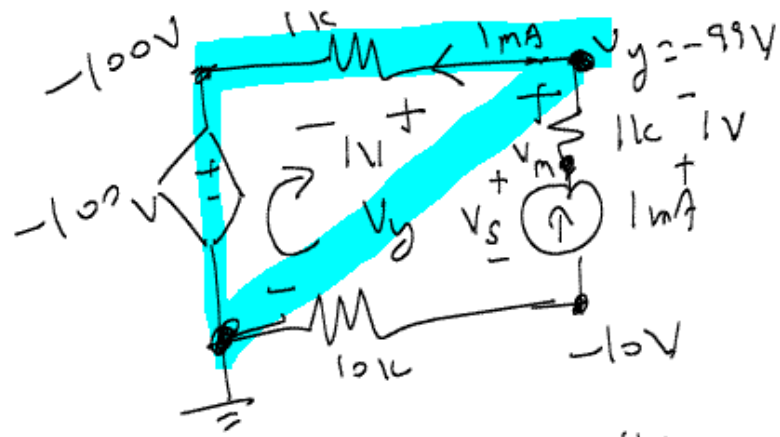
eg:



$$V_x = -\underbrace{(1mA)(10k)}$$

[convention, current enters negative terminal of V_x across 10k]

$$\Rightarrow \boxed{V_x = -10V}$$



$\therefore v_y = -100 + 1V$

$$\boxed{v_y = -99V}$$

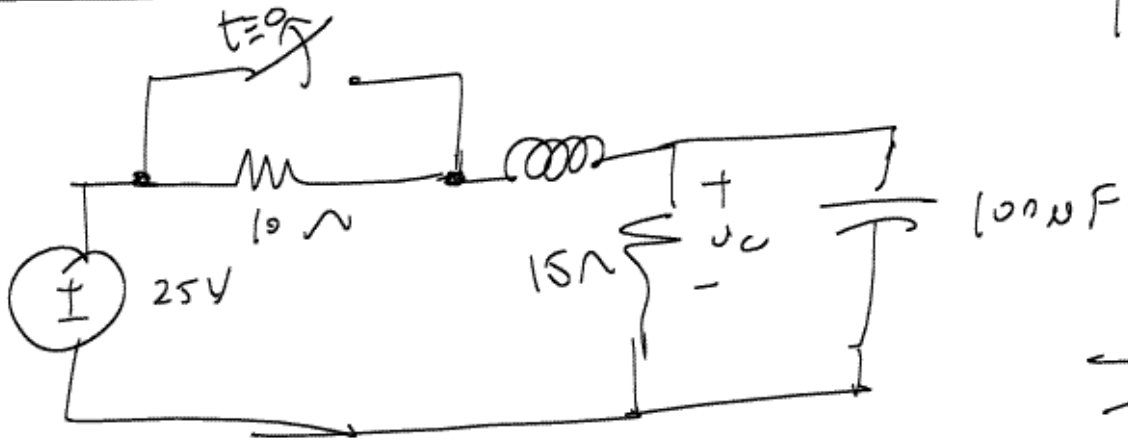
Note: KVL around "loop" marked by

Extra: Find V_s? Now, $V_s = V_m - (-10\,V)$

$= (-99 + 1\,V) + 10$

$= -98 + 10 \Rightarrow \boxed{v_s = -88\,V}$

(Q:) Chap. 4 material: p. 4.16



Hint: for $t<0$ & $t\to\infty$

Steady state!