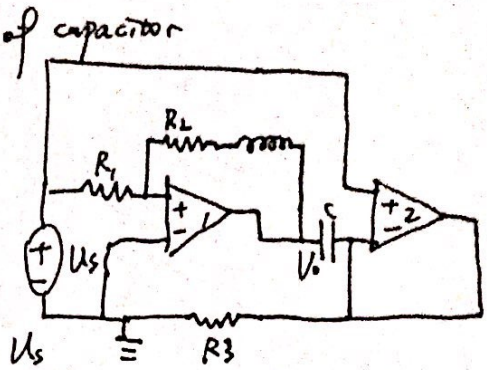
Quiz 2:

Problem 1: 2'

(1) ① Isolate two stages

② Reduce the influence between two circuits } 1'

(2) By the property V_0 is the voltage of leftside of capacitor



$$\frac{U_s - V_1}{R_1} = \frac{V_1 - V_0}{R_2} \Rightarrow V_0 = V_1 - \frac{R_2}{R_1}\cdot(U_s - V_1)$$

Since ~~V_1~~ $V_1 = 0$. (gnd) $\Rightarrow V_0 = -\frac{R_2}{R_1}\cdot U_s$

Since + (positive) side of op-amp 2 is connected to U_s

So the right side of capacitor is U_s.

$$V_C = U_s - (-U_s \cdot \frac{R_2}{R_1}) = \frac{R_1+R_2}{R_1} U_s .$$

So the energy stored in capacitor C is

$$\frac{1}{2} C \cdot \left(\frac{R_1+R_2}{R_1} U_s\right)^2 \cdot \quad 1'$$

Problem 2: 1.5'

$$V_0 = -RC\frac{dV_i}{dt} = -20000\,\Omega \times 0.01\times10^{-6}\,F \cdot \frac{dV_i}{dt}$$

I. $\frac{dV_i}{dt} = 10\times10^3\ V/s$ $0<t<1$ ms

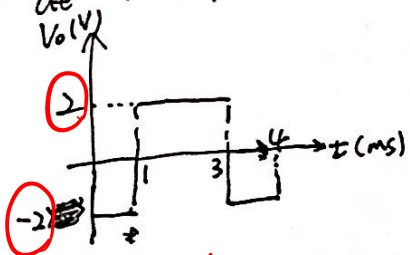
II. $\frac{dV_i}{dt} = -10\times10^3\ V/s$ $1<t<3$ ms

III. $\frac{dV_i}{dt} = 10\times10^3\ V/s$ $3<t<4$ ms

So $V_0 = -2$ V. $0<t<1$ ms

$V_0 = 2$ V $1<t<3$ ms

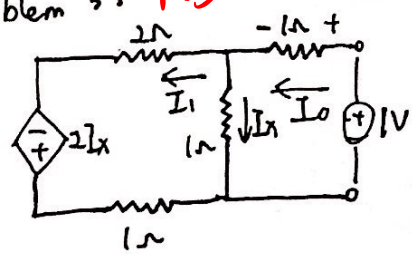
$V_0 = -2$ V $3<t<4$ ms



1' for shape

0.5' for 2 values.

Problem 3. 1.5'



Assume input voltage 1V. and input current I_o

By KVL:

$$\begin{cases} -2I_1 + I_x - I_1 + 2I_x = 0 \\ I_o + I_x - 1 = 0 \end{cases} \Rightarrow \begin{cases} I_x - I_1 = 0 \\ I_o + I_x = 1 \end{cases} \Rightarrow$$

$I_o = I_x + I_1$ $\Rightarrow I_o = \frac{2}{3}A$ $I_x = \frac{1}{3}A$.

Since there is no independent source, to calculate V_{TH}. 0.5'

$I_x\cdot1 + I_x\cdot1 + I_x\cdot2 + 2I_x = 0 \Rightarrow V_{TH} = 0$ For norton $I_N = 0$.

And $R_N = \frac{1V}{I_o} = \frac{1V}{\frac{2}{3}A} = \frac{3}{2}\,\Omega$ 0.5'

So equivalent circuit: 0.5'