ID:
NAME:

EE201 Circuit Theory
KAIST, Fall 2013

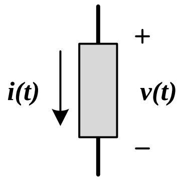
Oct. 16, 2013

Quiz #1 [50pts]

Problem Sets

1. If the input and output is current and voltage, is the following element linear? [5pts]

   Ans: (Yes, No, Depends on situation) (3 points deducted if incorrect. No need to provide proof.)



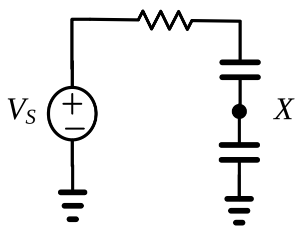
$$v(t) = K\frac{d^2 i(t)}{dt^2}$$

Sol)

Yes.

2. Is it possible for the net charge on node X to change if you can provide ANY voltage source at the input Vs?

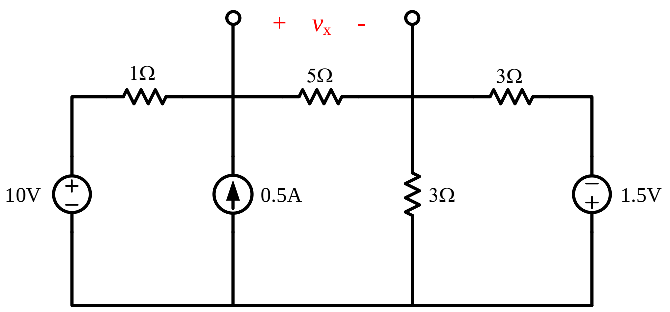
   Ans: (Yes, No, Depends on the input) (3 points deducted if incorrect, No need to provide any explanation.) [5pts]



Sol)

No.

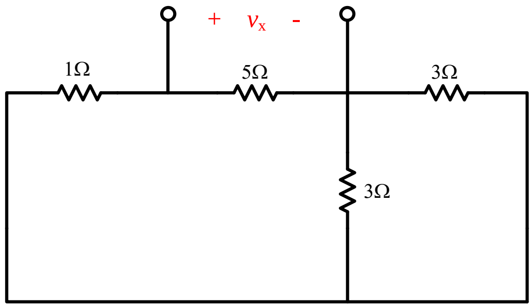
3. Determine the Thévenin equivalent of the network shown as below as seen looking into v_x. [10pts]



ID:
NAME:

Sol)

$$R_{th} = 5 \parallel (1 + 3 \parallel 3) = \frac{5}{3}\Omega$$

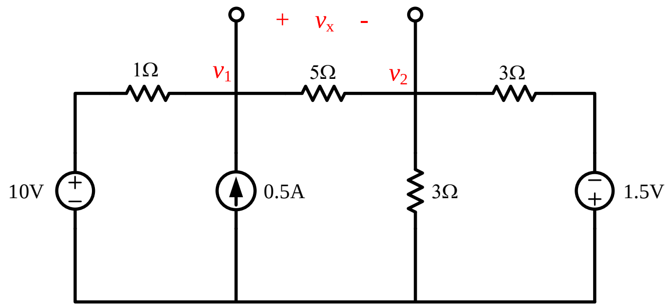


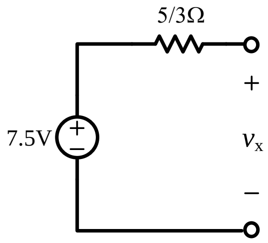
Use KCL

$$\frac{v_1 - 10}{1} - 0.5 + \frac{v_1 - v_2}{5} = 0$$

$$\frac{v_2 - v_1}{5} + \frac{v_2}{3} + \frac{v_2 - (-1.5)}{3} = 0$$

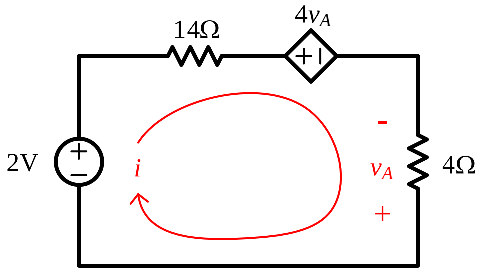
$$v_1 = 9V,\ v_2 = 1.5V,\ v_x = 7.5V$$





ID:
NAME:

4. What is the power absorbed by the 4 ohm resistor in the circuit shown below? [10pts]



Sol)

Use KVL

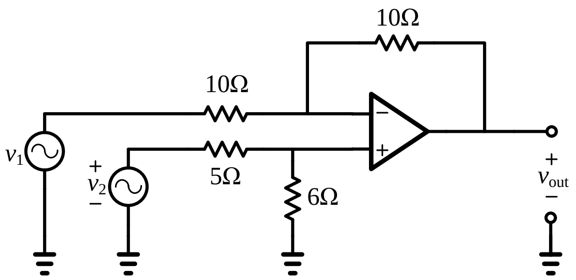
$$-2+14i+4v_A+4i=0,\ \ i=\frac{-v_A}{4}$$

$$-2+14i+4\times(-4i)+4i=-2+14i-16i+4i=2+2i=0$$

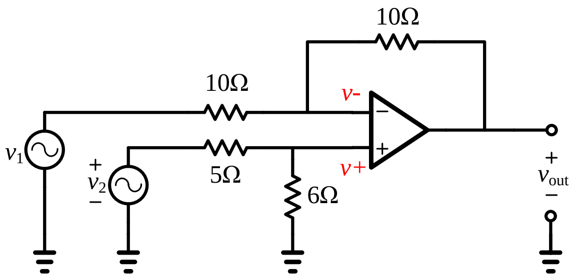
$$i=1A$$

$$P=I^2R=1^2\times 4=4W$$

5. Derive an expression for v_{out} as a function of v_1 and v_2 for the circuit represented as below. [10pts]



Sol)



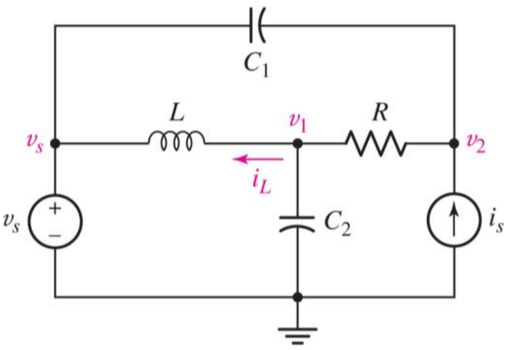
$$v_+=v_-=\frac{6}{5+6}v_2=\frac{6}{11}v_2$$

$$\frac{v_--v_1}{10}+\frac{v_--v_{out}}{10}=0,\ \ 2v_--v_1-v_{out}=0$$

$$v_{out}=2v_--v_1=\frac{12}{11}v_2-v_1$$

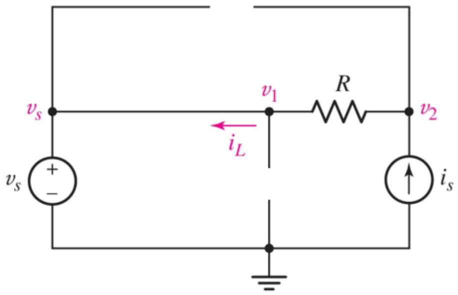
ID:
NAME:

6. Find the final steady-state output voltage of v_1 and v_2 in the below circuit. Assume v_s = 2V, i_s=2A, R = 2Ω, L=1nH, C_1=1uF, C_2 = 5uF. Assume initial conditions of all elements are zero. [10pts]



Sol)

At final steady-state, capacitor acts as a open circuit. Inductor acts as a short circuit.



$$v_s = v_1 = 2V$$
$$v_2 - v_1 = R \times i_s = 2 \times 2 = 4V$$
$$v_1 = 2V\,,\ \ v_2 = 6V$$