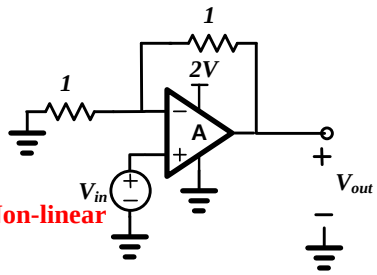
Quiz #1 [50pts] Solution

1. Which of the below system(s) is(are) linear? [5pts] **ANS: (a , b , c)**

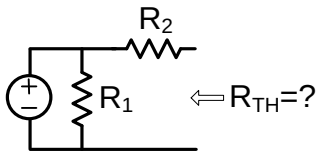


(a) $i(t) = \frac{d^3 v(t)}{dt^3}$: input = $v(t)$, output = $i(t)$ **:Linear**

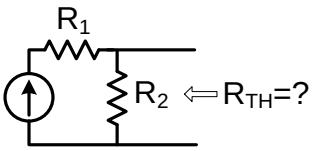
(b) $v(t) = 4i(t) + 3$: input = $i(t)$, output = $v(t) - v(0)$ **:Linear**

(c) Circuit shown in right with a practical opamp where input: $V_{in}(t)$, output: $V_{out}(t)$ **:Non-linear**

2. What is the resistance (R_{TH}) seen in the below circuits? (i.e. find the Thevinin resistance) [8pts]

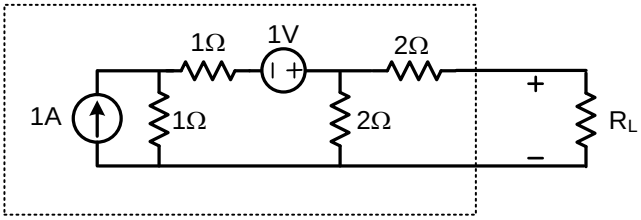


$R_{TH}=R_2$

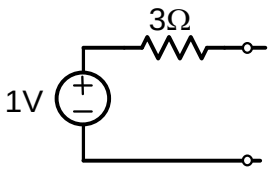


$R_{TH}=R_2$

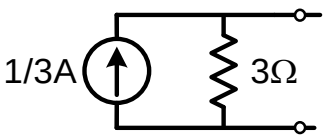
3. Consider the circuit shown below. [10pts]



(a) Draw the Thevenin equivalent of the circuit in the dotted box. [4pts]



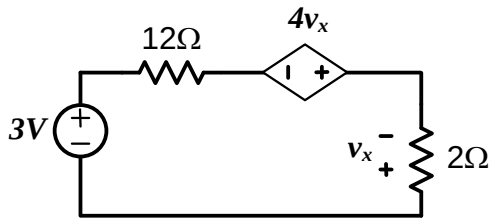
(b) Draw the Norton equivalent of the circuit in the dotted box. [2pts]



(c) What value of load resistance would result in the maximum power delivered to the load? [4pts]

$R_L=3\Omega$

4. What is the power absorbed by the 2 Ω resistor in the circuit shown below? [8pts]



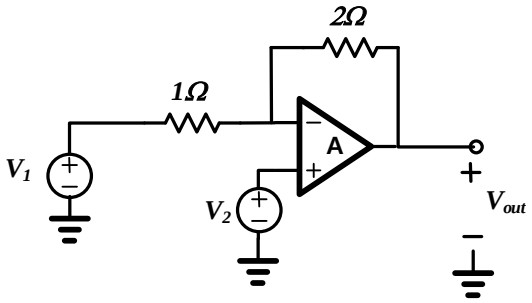
Eq1. $3-12i+4v_x-3i=0$

Eq2. $v_x=-2i$

$\therefore \ i=3/22$ A,

Power=$I^2R=9/242 \fallingdotseq 0.0372$ W

5. Express V_{out} as a function of V_1 and V_2. Assume that the opamp is ideal. [8pts]



$$\frac{(V_1-V_2)}{1}=\frac{(V_2-V_{out})}{2}$$

$$V_{out}=-2V_1+3V_2$$

6. In order for KCL to hold, length of wire must be sufficiently (short, long). Moreover, the speed of electrons must be (equal to speed of light, close to speed of light, slower than speed of light, depends on the condition). [5pts]

7. How would you compare the magnitude of A and β to 1 in a feedback system? [6pts] (e.g. 100 >> 1, β > 1)

A (>> > ≅ < <<) 1

β (>> > ≅ < <<) 1