ECSE-200 Electric Circuit 1—Quiz #5 (Feb 15, 2019)

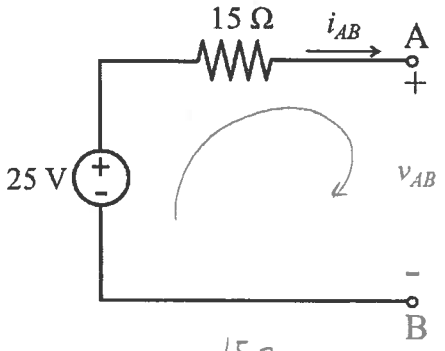
LAST NAME SOLUTION **MCGILL ID#** _____

FIRST NAME _____ **SIGNATURE** _____

- ***Carefully read the questions***
- ***Show all your work***
- ***Clearly indicate your final answer***
- ***Plagiarism will have important consequences***
- ***Provide symbol for both the multiplier and SI unit in your final answer where applicable***
- ***Only standard calculator is accepted***
- ***You have 45 minutes to complete this quiz***

Question 1: Consider the Thévenin circuit below showing the voltage variable v_{AB} at the output of the two terminals (A and B) and the current variable i_{AB}. Answer the following questions.

a) Derive the equation relating the current variable i_{AB} to the voltage variable v_{AB}. [1 pt]
b) Draw the i_{AB}-v_{AB} diagram corresponding to the circuit shown. Have the voltage v_{AB} on the x-axis and the current i_{AB} on the y-axis. Clearly indicate the value of the voltage v_{AB} when i_{AB} = 0A, and the value of the current i_{AB} when v_{AB} = 0V. [2 pt]
c) What is the power delivered by the independent voltage source when a load resistor of 20 Ω is connected between the two terminals A and B? [2 pt]
d) Indicate on your diagram in part b), the i_{AB}-v_{AB} point corresponding to the circuit in part c) (i.e., when a load resistor of 20 Ω is connected). [1 pt]

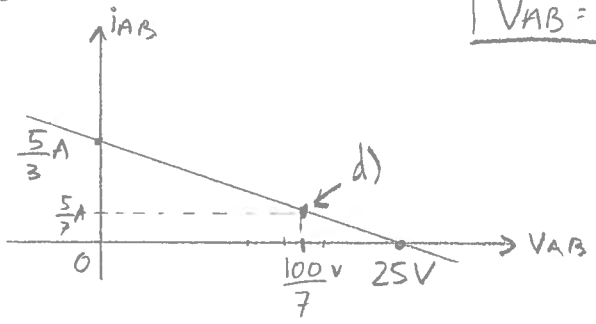


a) Using KVL & ohm's law $-25V + 15\Omega\, i_{AB} + V_{AB} = 0$

$$V_{AB} = 25\,V - 15\Omega\, i_{AB}$$

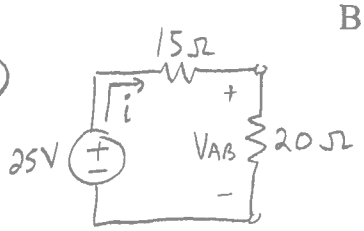
$V_{AB} = 25$ V when $i_{AB} = 0$A

b)



$i_{AB} = \frac{25V}{15\Omega} = \frac{5}{3}$ A when $V_{AB} = 0V$

c)



$$P = I \cdot V = i \cdot 25\,V = \frac{25\,V}{35\Omega} \cdot 25\,V = \frac{125\,V^2}{7\Omega} = \frac{125}{7}\,W = \boxed{17.86\,W}$$

d) $V_{AB} = 25V \cdot \frac{20\Omega}{15\Omega + 20\Omega} = 25V \cdot \frac{4\Omega}{7\Omega} = \boxed{\frac{100}{7}\,V = V_{AB} \quad 14.29V}$

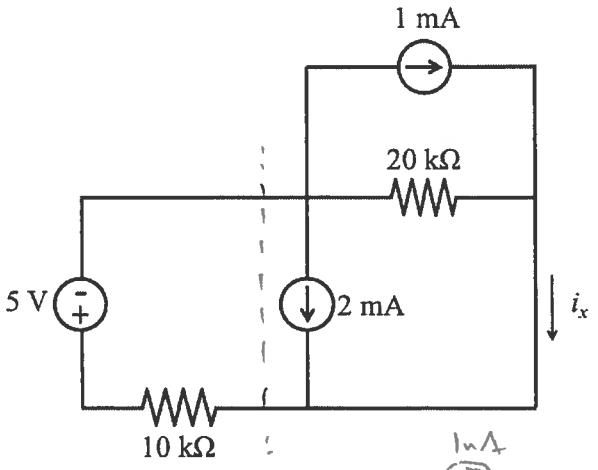
$i_{AB} = \frac{25V}{15\Omega} - \frac{V_{AB}}{15\Omega}$ (from a)

$i_{AB} = \frac{5}{3}\,A - \frac{100}{7}\,V \cdot \frac{1}{15\Omega} = \frac{5A}{3} - \frac{20V}{21\Omega} = \frac{35-20}{21}\,A = \frac{15}{21}\,A = \boxed{\frac{5}{7}\,A = i_{AB} \quad 0.714}$

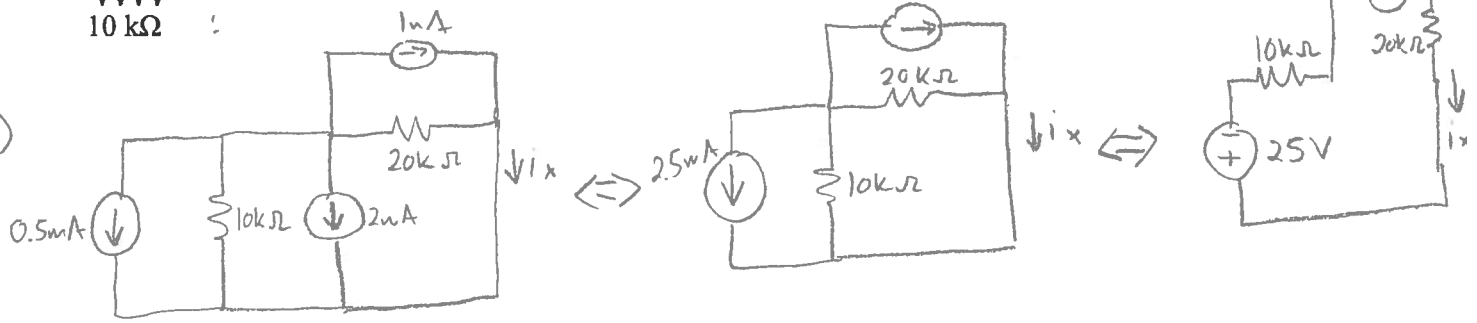
Question 2: Considering the circuit below. Answer the following questions.

a) Use source transformation to find the value of the current i_x. [3 pt]

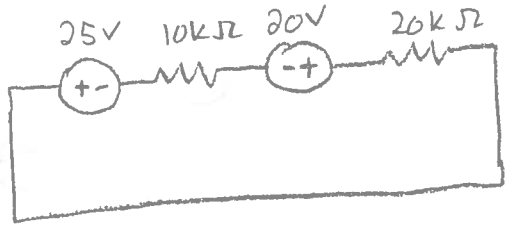
b) Use the principle of superposition to find the value of the power delivered by the independent voltage source. [3 pt]



a)



redraw.

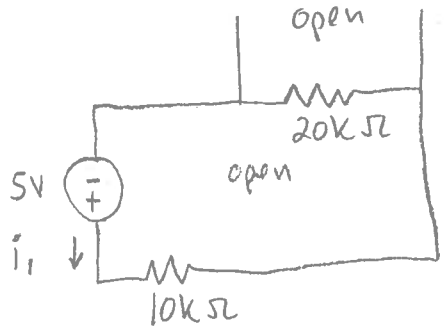


$i_x = \frac{-5V}{30k\Omega}$

$i_x = -167\,\mu A$

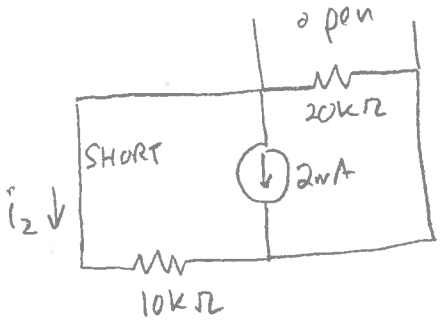
b) all src off, 5V on

for b) you need to find the current out of the 5V supply to find power



$i_1 = \frac{5V}{30k\Omega} = \frac{1}{6}\,mA$

all src off, 2mA on

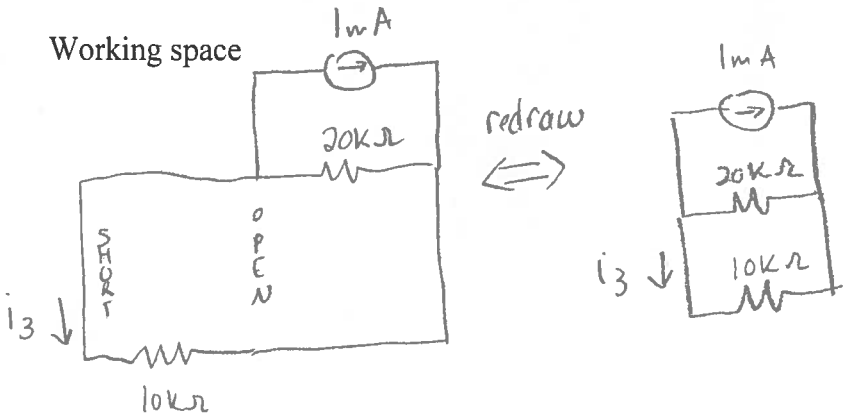


$i_2 = -2mA \cdot \frac{20k\Omega}{10k\Omega + 20k\Omega}$

$i_2 = -2 \cdot \frac{2mA}{3} = \frac{-4}{3}\,mA$

Working space

c) all src off, 1mA ON



$$i_3 = -1mA \cdot \frac{20K\Omega}{10K\Omega + 20K\Omega}$$

$$i_3 = -\frac{2}{3}mA$$

$$\therefore i = i_1 + i_2 + i_3 = \left(\frac{1}{6} - \frac{4}{3} - \frac{2}{3}\right)mA = \left(\frac{1}{6} - \frac{6}{3}\right)mA$$

$$i = -\frac{11}{6}mA$$

$$Pwr = 5V \cdot \left(-\frac{11}{6}mA\right) = -\frac{55}{6}mW$$

power delivered
$-9.167mW$