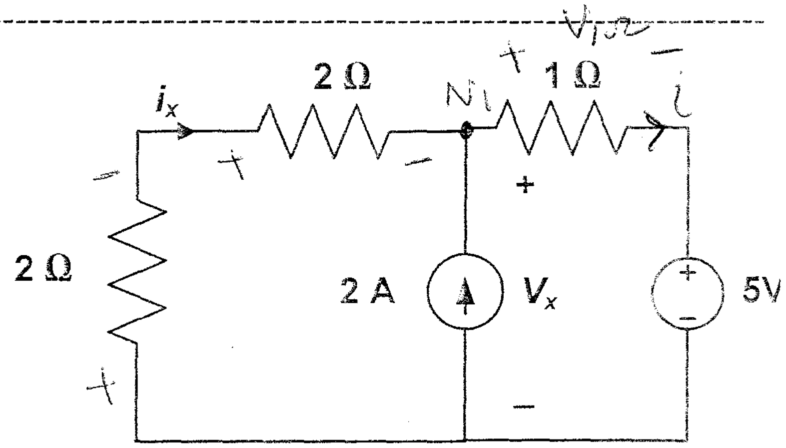
King Fahd University Of Petroleum & Minerals
Department of Electrical Engineering
2009-2010 First Semester (091)

EE204 – HW # 1

Ser	Name	ID#	SEC#

Determine V_x and i_x in the given circuit.

1. Using the direct method.
2. Verify your result in 1 using source transformation.
3. Verify your result in 1 using superposition.
4. Using the result in 1, 2, or 3 determine the power absorbed by the 1Ω resistor, the power absorbed by the voltage source and the power absorbed by the current source.



Show the steps of your work and results.

(1) Using direct method

- assume a current passing in the 1-Ω resistor as shown:
- Apply KCL at N_1:

$$i = 2 + i_x$$

- Lable the voltage polarity for every resistor according to the passive sign convention as shown.
- apply KVL for the outer loop in clock wise direction

$$2 i_x + 2 i_x + 1(i) + 5 = 0$$

$$4 i_x + (2 + i_x) + 5 = 0$$

$$5 i_x + 7 = 0 \Rightarrow \boxed{i_x = -\frac{7}{5} \text{ A}}$$

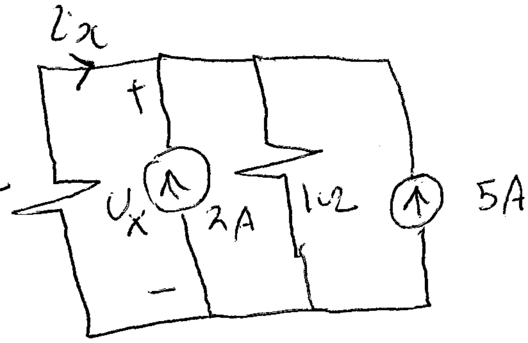
- apply KVL for the right loop in clock wise direction

$$-V_x + 1(i) + 5 = 0$$

$$-V_x + \left(2 - \frac{7}{5}\right) + 5 = 0 \Rightarrow V_x = \frac{3}{5} + 5 \Rightarrow \boxed{V_x = \frac{28}{5} \text{ V}}$$

(2) Using source transformation

Transform the 5-V in series with 1-Ω into a current source in Parallel with 1-Ω resistor as shown.



2Ω in series with 2Ω = 4Ω.

Note: I did not lose i_x

I did not lose V_x

The resultant circuit is a single node-pair circuit

$$V_x = \frac{2+5}{\frac{1}{1}+\frac{1}{4}} = \frac{7}{\frac{4+1}{4}} = \frac{28}{5}\ V$$

Use ohm's law for the 4-Ω resistor:

$$V_x = -4 i_x \Rightarrow i_x = -\frac{V_x}{4} = -\frac{28}{5}\frac{1}{4} = -\frac{7}{5}\ A$$

(4) Power calculations:

$$P_{1\Omega} = \frac{(V_{1\Omega})^2}{1} = (V_{1\Omega})^2 = (V_x - 5)^2 = \left(\frac{3}{5}\right)^2 = \frac{9}{25}\ W$$

$$P_{2A} = -V_x(2) = -\frac{28}{5}(2) = -\frac{56}{5}\ W.$$

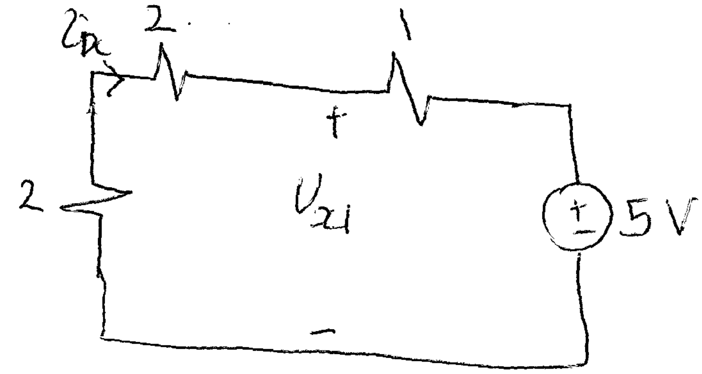
$$P_{5V} = 5(I_{1\Omega}) = 5\left(\frac{V_{1\Omega}}{1}\right) = 5(V_x - 5) = 5\left(\frac{3}{5}\right)$$
$$= 3\ W$$

$$P_{(2+2)\Omega} = 4 i_x^2 = 4\left(-\frac{7}{5}\right)^2 = \frac{49}{25}(4) = \frac{196}{25}\ W$$

$$\Sigma P_i = \frac{9}{25} - \frac{56}{5} + 3 + \frac{196}{25} = \frac{9}{25} - \frac{280}{25} + \frac{75}{25} + \frac{196}{25}$$
$$= 0\ W.$$

(3) Using superposition

- The 5-V source alone
deactivate the current source

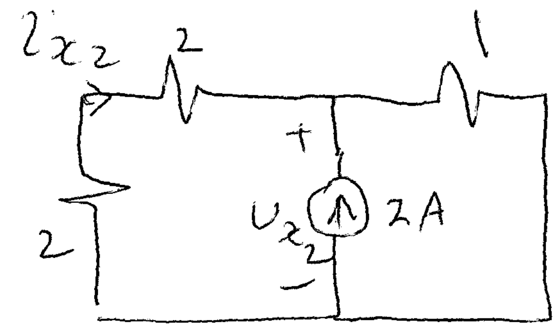


It is a single loop circuit

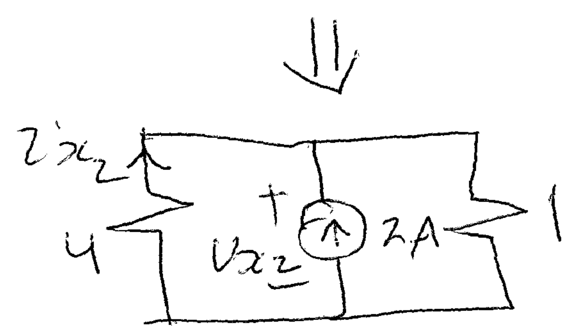
$$i_{x1} = \frac{-5}{1+2+2} = \frac{-5}{5} = -1\ A$$

$$V_{x1} = -4(i_x) = -4(-1) = 4\ V$$

- The 2-A source alone
deactivate the voltage source



Single-node pair circuit



$$V_{x2} = \frac{2}{\frac{1}{1}+\frac{1}{4}} = \frac{2}{\frac{4+1}{4}} = \frac{8}{5}$$

apply ohm's law for the 4-Ω resistor.

$$i_{x2} = -\frac{V_{x2}}{4} = -\frac{8}{(5)(4)} = -\frac{2}{5}$$

$\therefore$ $i_x = i_{x1} + i_{x2} = -1 - \frac{2}{5} = -\frac{7}{5}\ A$

$V_x = V_{x1} + V_{x2} = 4 + \frac{8}{5} = \frac{20+8}{5} = \frac{28}{5}\ V$