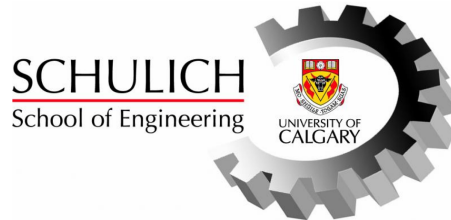


Name:	ID#:
--------------	-------------

(Please PRINT your name)



Electrical and Computer Engineering Department
ENGG225 (Fundamentals of Electric Circuits and Machines) – Summer 2011

Midterm Exam

Tuesday, July 31, 2012

Room: ENE241

Time: 8:00 AM – 9:30 AM; Total marks: 30

Instructor: Dr. Anis Haque

Instructions:

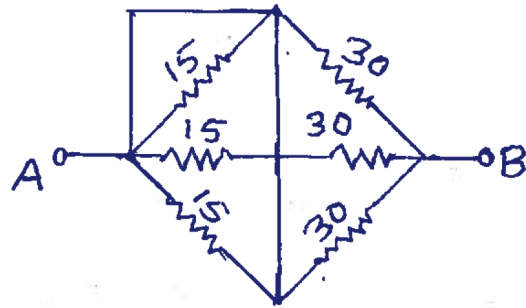
- The examination is closed-book
- The maximum number of marks is 30. Attempt all questions.
- Use a pen or heavy pencil to ensure legibility
- If required students must use the sanctioned Schulich School of Engineering calculator. No other calculators will be allowed.
- No other electronic devices (including all wireless devices) are allowed
- Any simplification and/or assumption should be written clearly with appropriate reasoning
- For full marks show your work
- No formula sheet is allowed

1. [Total 15] In the following questions no part marks will be given.

a) [3] Determine the equivalent resistance looking at terminals A-B (R_{AB}) of the following circuit.

The three 15 Ω resistors are short!

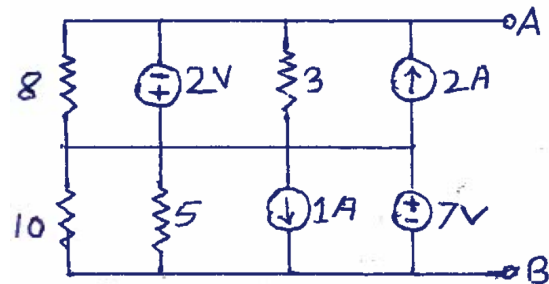
Thus, $R_{AB} = 30\Omega // 30\Omega // 30\Omega = 10\Omega$



Ans: $R_{AB} = 10\Omega$

b) [3] Determine the voltage V_{AB} of the given circuit. You are not allowed to do nodal or mesh analysis.

$V_{AB} = -2 + 7 = 5V$

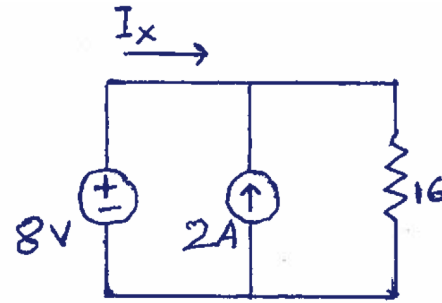


Ans: $V_{AB} = 5V$

c) [3] Consider the following circuit. Determine the current I_x as indicated in the circuit.

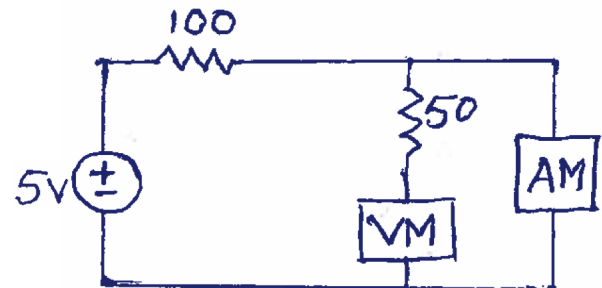
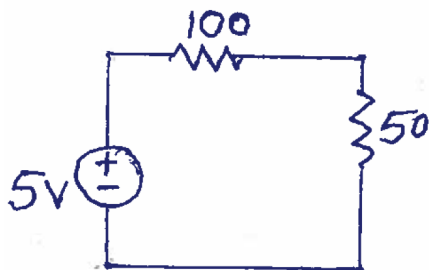
The voltage across the 16Ω resistor is 8 V .
 Thus, the current in the 16Ω resistor is
 $= 8/16 = 0.5 \text{ A}$

By KCL,
 $-I_x - 2 + 0.5 = 0$
 $I_x = -1.5 \text{ A}$



Ans: $I_x = -1.5 \text{ A}$

d) [3] A student in ENGG225 wants to measure voltage across and current through the 50Ω resistor of the following circuit (left). She has connected a voltmeter in series and an ammeter in parallel as shown in the 2nd circuit at the right side. As you know this is a wrong way of connecting the meters. However, with this wrong connection what will be her voltmeter and ammeter reading, i.e. the voltage displayed by the voltmeter and the current displayed by the ammeter. Assume both meters are ideal.



Here, the ammeter will short the voltmeter and the 50Ω resistor. Thus, the circuit has only the 100Ω resistor and the 5 V source in series.

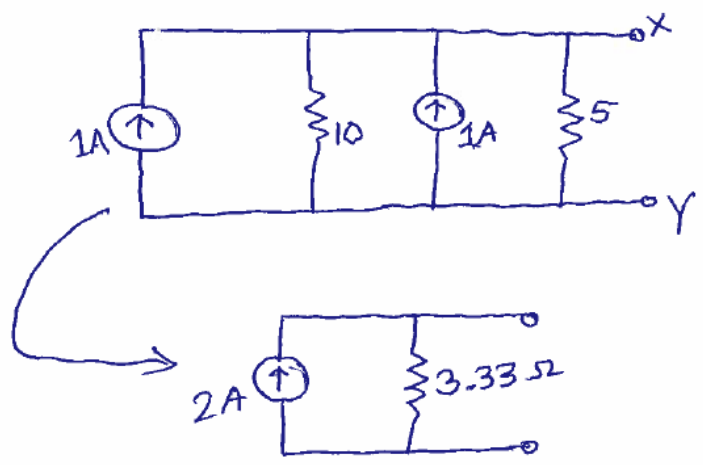
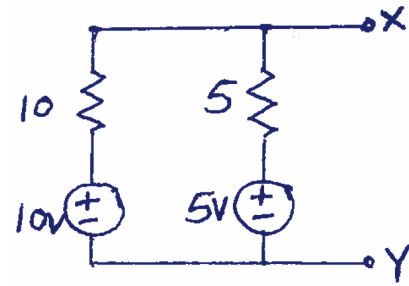
The current in the ammeter $= 5/100 = 0.05 \text{ A} = 50 \text{ mA}$.

Since the voltmeter is short, there is no voltage across it.

Ammeter: $I = 50 \text{ mA}$

Voltmeter: $V = 0$

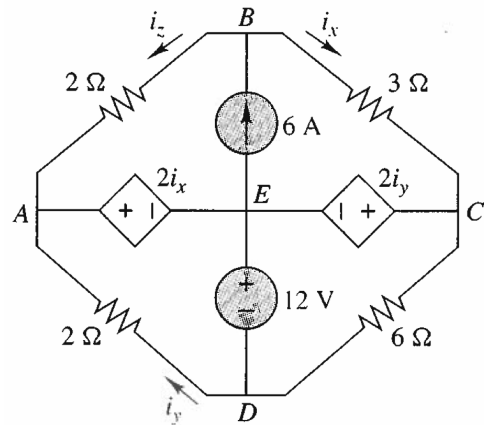
- e) [3] Applying source transformation in the following circuit find an equivalent circuit of it where the equivalent circuit will contain only one current source and one resistor.



2. [4] Students in ENGG225 course were asked to determine node voltages of the following circuit by using nodal analysis method. A student in this course chose node E as reference and determined the following node voltages: $V_A = 48 \text{ V}$, $V_B = 12 \text{ V}$, $V_C = -60 \text{ V}$ and $V_D = -12 \text{ V}$. Another student in the course chose node D as reference. Assuming the first student's answer was correct, what will be the correct values of V_A , V_B , V_C , V_D , and V_E for the second student who has chosen node D as reference. You are not allowed to do another nodal analysis to answer this question.

The voltage difference between node E and node D is 12V. If node D is chosen as reference instead of node E, all node voltages will differ by 12 V. Thus with D being considered as reference the node voltages will be as follows:

$$\begin{aligned}
 V_A &= 48 + 12 = 60 \text{ V} \\
 V_B &= 12 + 12 = 24 \text{ V} \\
 V_C &= -60 + 12 = -48 \text{ V} \\
 V_D &= -12 + 12 = 0 \text{ V} \\
 V_E &= 0 + 12 = 12 \text{ V}
 \end{aligned}$$



$V_A = 60\text{V}$
$V_B = 24 \text{ V}$
$V_C = -48 \text{ V}$
$V_D = 0 \text{ V}$
$V_E = 12 \text{ V}$

3. [5] Using nodal analysis find the node voltages **V1** and **V2** of the following circuit. Calculate the power absorbed or delivered by the dependent current source of the given circuit.

KCL at supernode 1 and 2:

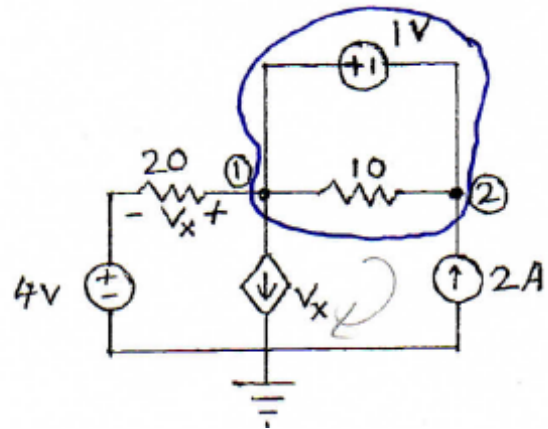
$$\begin{aligned} & (V_1 - 4)/20 + V_x - 2 = 0 \\ \text{or, } & (V_1 - 4)/20 + (V_1 - 4) - 2 = 0 \quad [\text{since } V_x = V_1 - 4] \\ \text{or, } & \mathbf{V_1 = 5.9 V} \end{aligned}$$

$$\begin{aligned} \text{By inspection, } & V_1 = V_2 + 1 \\ \text{or, } & \mathbf{V_2 = 5.9 - 1 = 4.9 V} \end{aligned}$$

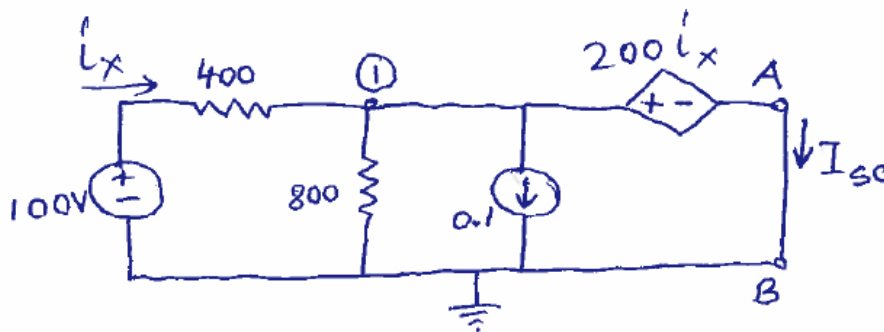
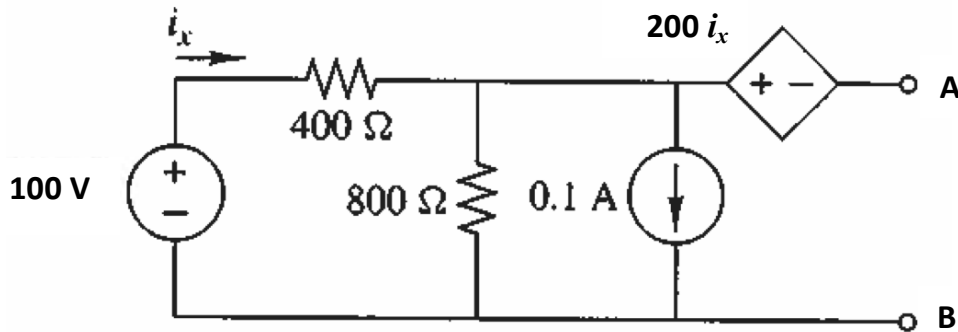
$$P_{(V_x)} = V_1 * V_x \quad (\text{Notice } V_1 \text{ is voltage across the dependent source and } V_x \text{ the current the the dependent source.})$$

$$P_{(V_x)} = V_1 * V_x = V_1 * (V_1 - 4) = 5.9 * (5.9 - 4) = 11.21 \text{ W}$$

Thus, the current source V_x source absorbs **11.21 W** of power.



4. [6] Given that the voltage between terminals A and B, when open, is 10 V. Find the Thevenin equivalent circuit of the following circuit.



$$V_1 = 200 i_x$$

$$V_1 = 200 \times \frac{100 - V_1}{400}$$

$$3V_1 = 100$$

$$\boxed{V_1 = 33.3 \text{ V}}$$

KCL at node 1:

$$\frac{V_1 - 100}{400} + \frac{V_1}{800} + 0.1 + I_{sc} = 0$$

$$\text{or, } 2(33.3 - 100) + V_1 + 80 + 800 I_{sc} = 0$$

$$\boxed{I_{sc} = 0.025 \text{ A}}$$

$$R_{TH} = \frac{V_{TH}}{I_{SC}} = \frac{10}{0.025} = 400$$

$$R_{TH} = 400 \Omega$$



