3/6/2007

University of Portland
School of Engineering

EE 261-Electrical Circuits-3 cr. hrs.
Spring 2007

Midterm Exam # 1

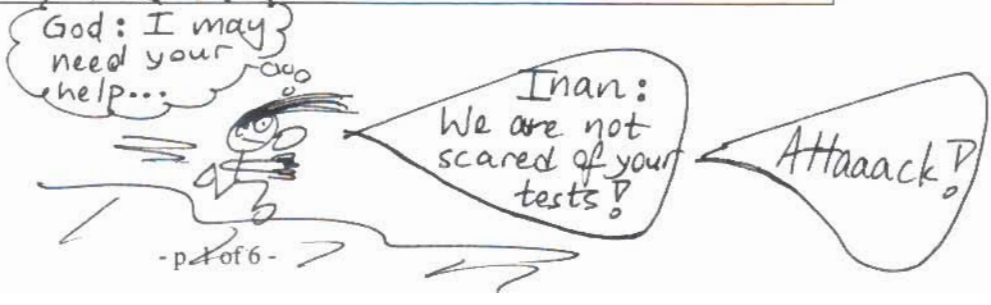
(Friday, February 16, 2007)
(Closed Book Exam, One Formula Sheet Allowed)
(Total Time: 55 minutes)

Name: SOLUTIONS! ☺

Signature: _____ ☺

"*An honest mind possesses a kingdom.*"
Lucius Annaeus Seneca (4B.C.–65A.D.)

"*Honest people are the true winners of the universe.*"
Anonymous



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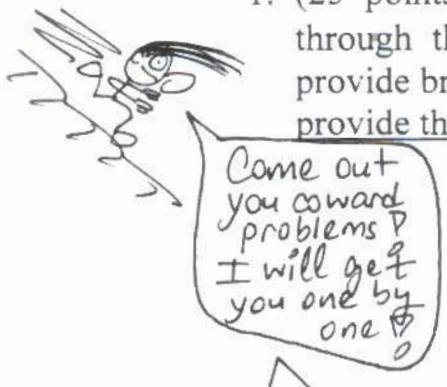
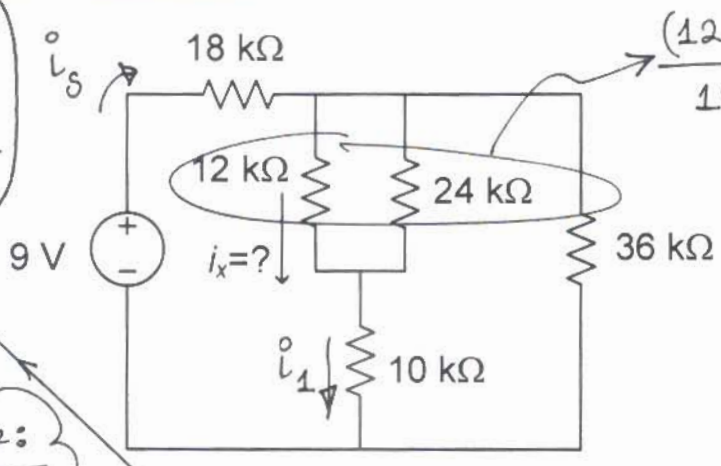
NOTE: On all the problems, please show your work clearly, and provide the appropriate units for your answers. Also mark on the schematic to show any current or voltage that you define in your solution.

1. (25 points) In the circuit shown, find the value of the current i_x through the 12 kΩ resistor. (Please show your work clearly and provide brief justifications for the steps you take. Also, don't forget to provide the correct units for your answers.)





$\frac{(12k)(24k)}{12k+24k} = 8k\Omega$

∴ Using CDP twice:

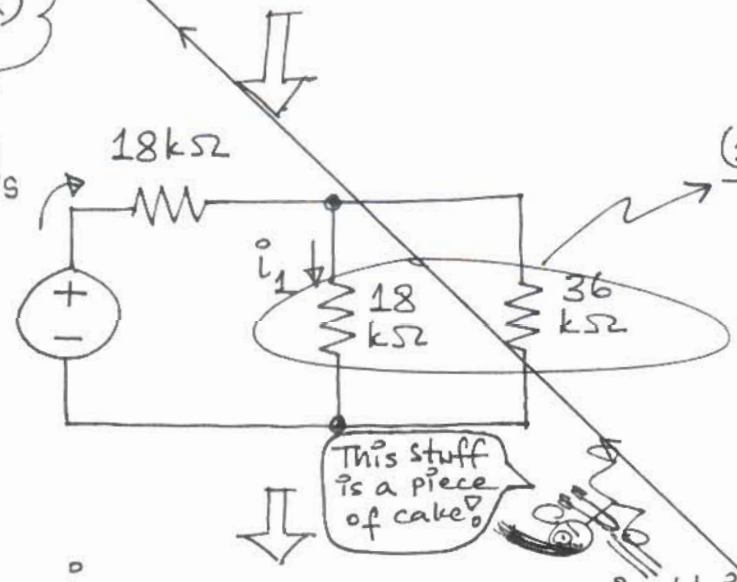
$i_1 = \frac{36k}{18k+36k}(0.3mA)$

$= 0.2mA$

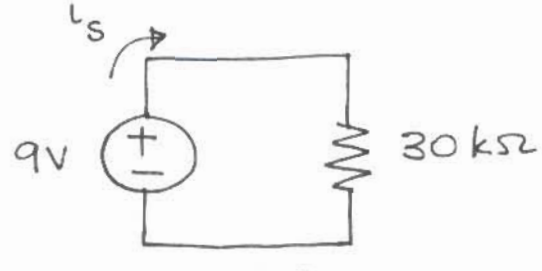
$i_x = \frac{24k}{12k+24k}(0.2mA)$

$= \frac{0.4}{3}mA$

$\simeq \boxed{0.1\bar{3}\ mA}$



$\frac{(18k)(36k)}{54k} = 12k\Omega$



∴ Using Ohm's law,

$i_s = \frac{9V}{30k\Omega}$

$= 0.3\ mA$ →

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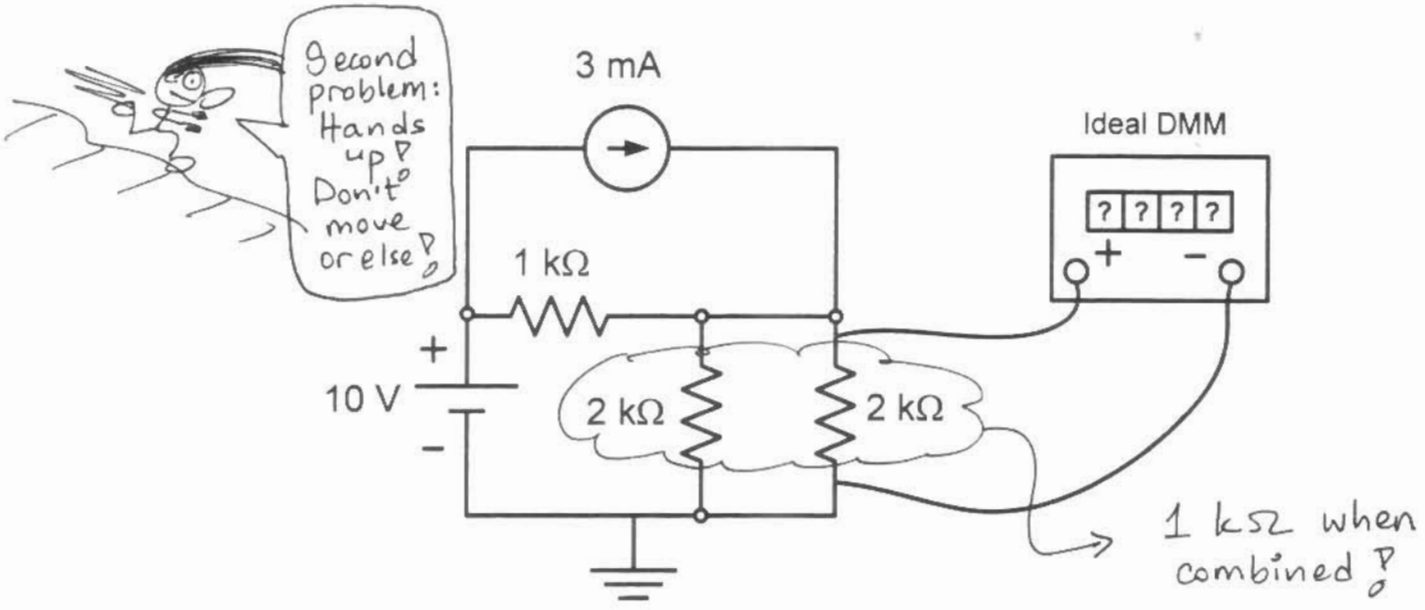
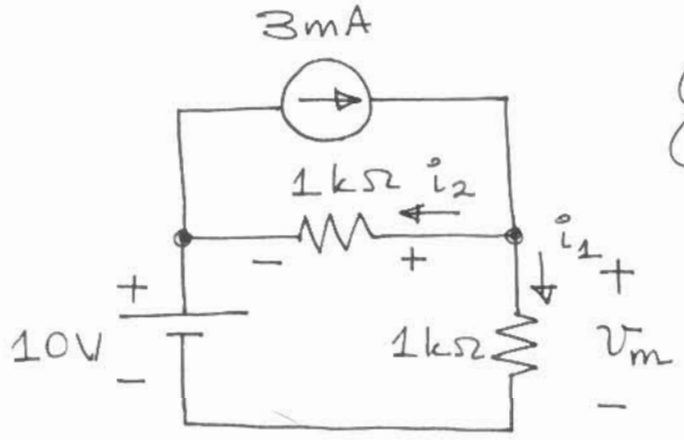
2. (Total: 25 Points) Consider the circuit with the ideal DMM connected as shown.



(a) (12.5 points) Find the DMM reading if it's set to measure voltage. Please indicate the appropriate units.



voltmeter which acts like an open circuit (or infinite resistance)!

Ohm's law → $i_1 = \dfrac{v_m}{1k\Omega}$

KCL → $i_2 = 3mA - i_1 = 3mA - \dfrac{v_m}{1k\Omega}$

KVL → $(1k\Omega)\left(3mA - \dfrac{v_m}{1k\Omega}\right) + 10 - v_m = 0$ (Ohm's law!)

$\rightarrow 3 - v_m + 10 - v_m = 0 \rightarrow v_m = \dfrac{13}{2} = \boxed{6.5V}$

I hope I'm right...

Third problem: You will never forget this moment!

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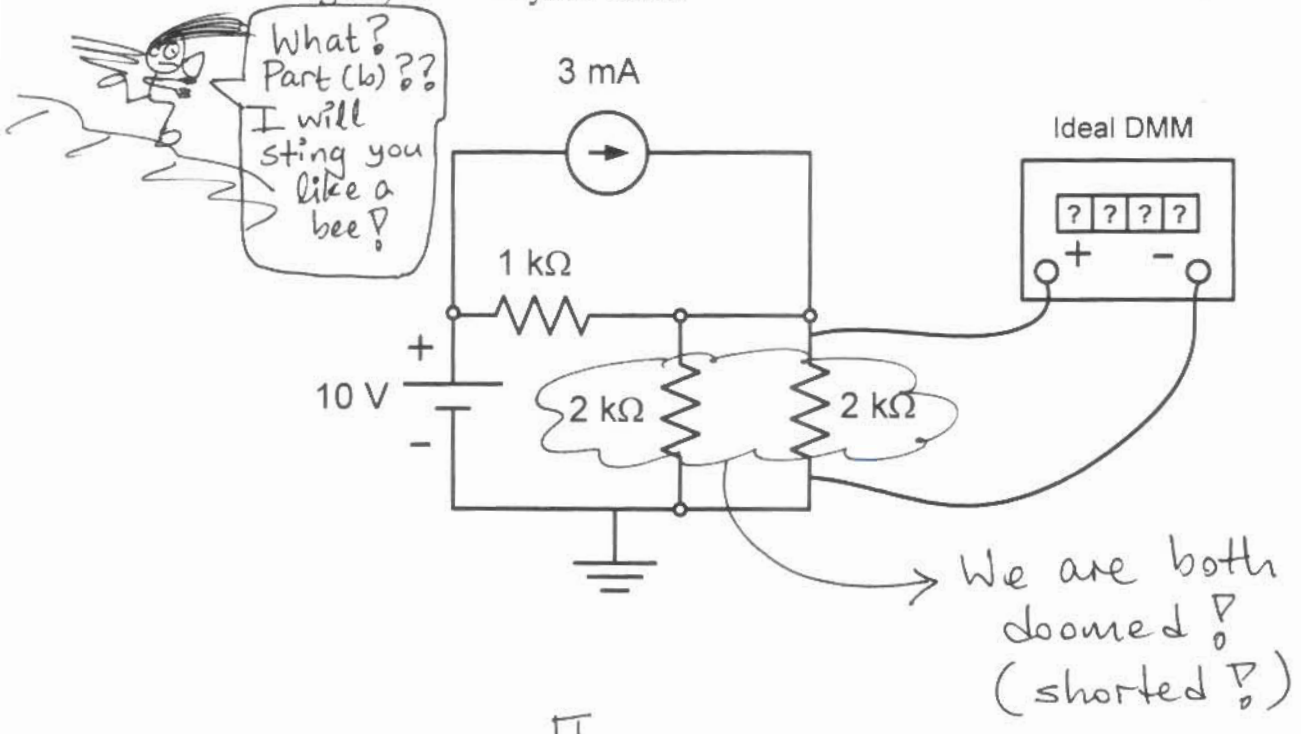
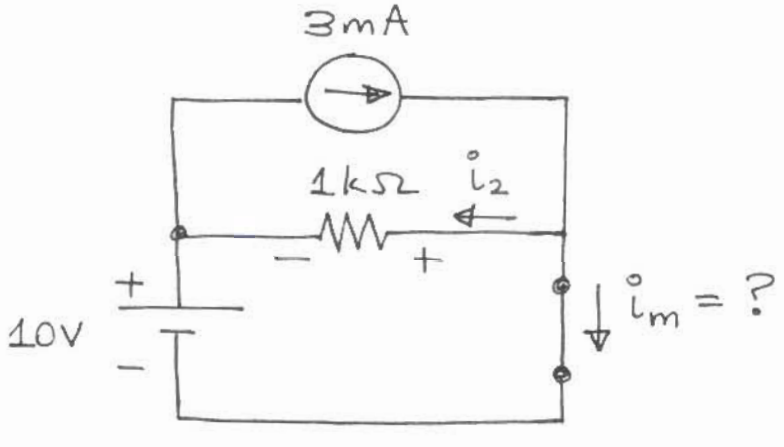
(b) (12.5 points) Find the DMM reading if it's set to measure current. Again, indicate your units.





KCL $\rightarrow$ $i_2 = 3\text{mA} - i_m$

KVL $\rightarrow$ $\underbrace{(1\text{k}\Omega)(3\text{mA} - i_m)}_{\text{Ohm's law!}} + 10 = 0$

$\rightarrow$ $i_m = \dfrac{13\text{ V}}{1\text{k}\Omega} = \boxed{13\text{ mA}}$

Dependent sources bother me a bit but I shouldn't cave in!

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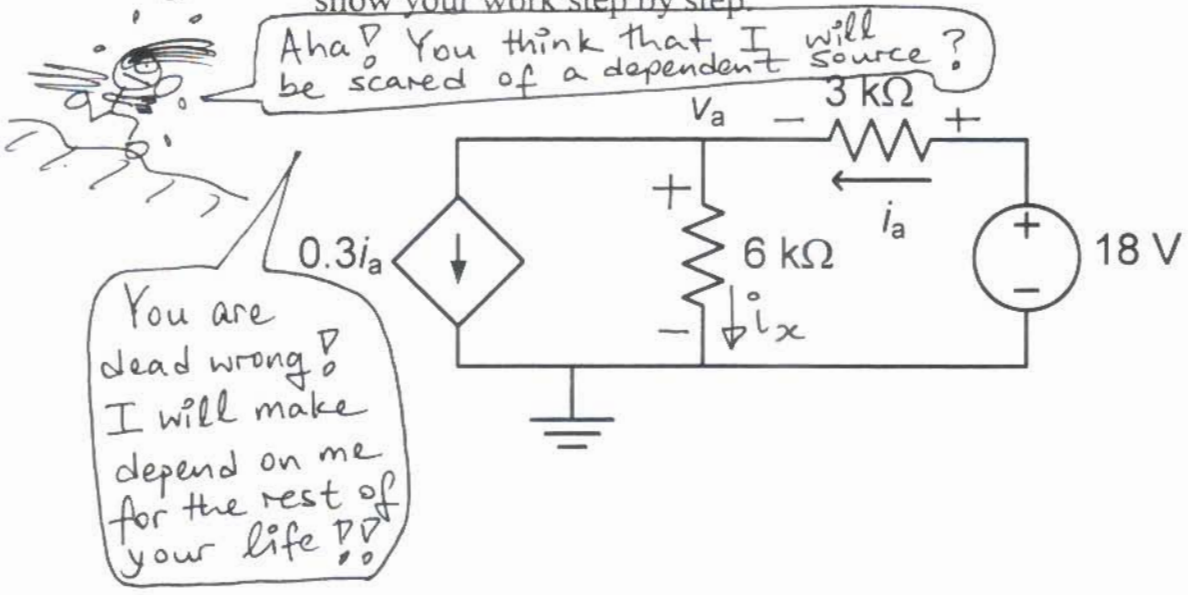
3. (25 Points) Consider the circuit shown. Determine the node voltage v_a. Also, determine the power delivered by the voltage source. Please show your work step by step.



KCL $\longrightarrow$ $i_x = i_a - 0.3i_a = 0.7i_a$

KVL $\longrightarrow$ $18 = \underbrace{(3\text{k}\Omega)i_a}_{\text{Ohm's law!}} + \underbrace{(6\text{k}\Omega)(0.7i_a)}_{\text{Ohm's law!}} = (7.2\text{k}\Omega)i_a$

$\therefore\ i_a = \dfrac{18\text{ V}}{7.2\text{k}\Omega} = 2.5\text{ mA}$

$\therefore\ v_a = (6\text{k}\Omega)(0.7i_a) = \boxed{10.5\text{ V}}$

Due to passive convention!

$\therefore\ P_{18\text{ V source}} = (18\text{ V})(-i_a)$

$= (18\text{ V})(-2.5\text{ mA})$

$= \boxed{-45\text{ mW}}$

I indicate supplied power!

Whew!

Where are you last problem? I will bust you in your cave!

God help?

How much time left?

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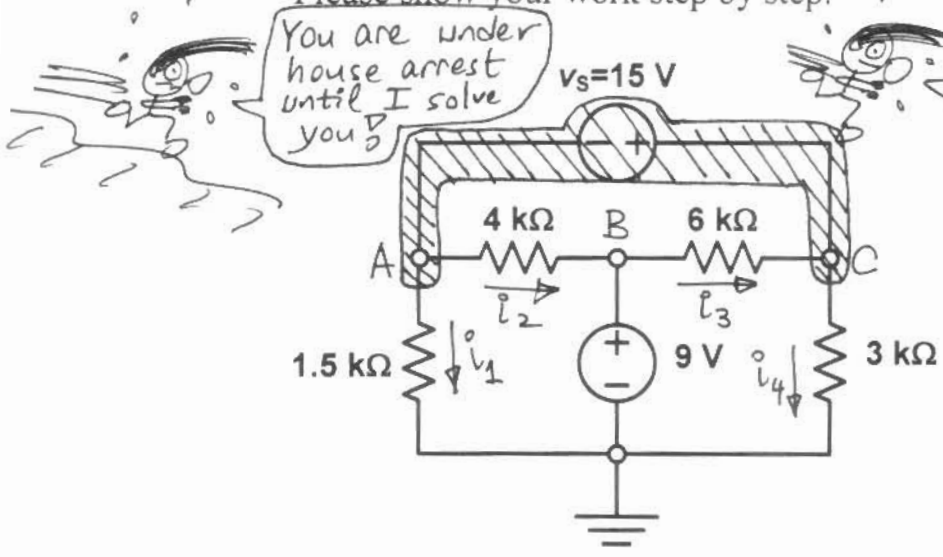
4. (25 Points) In the circuit shown, find the power of each voltage source. Indicate the type of each power (i.e., supplied or absorbed). Please show your work step by step.



Note that $v_c - v_A = 15\ V$!

KCL at supernode $\rightarrow i_1 + i_2 + i_4 = i_3$

$$\rightarrow \underbrace{\frac{v_A}{1.5k}}_{(8)} + \underbrace{\frac{v_A - 9}{4k\Omega}}_{(3)} + \underbrace{\frac{v_c}{3k\Omega}}_{(4)} = \underbrace{\frac{9 - v_c}{6k\Omega}}_{(2)} \rightarrow 11 v_A + 6 v_c = 45$$

$$\rightarrow 11 v_A + 6(15 + v_A) = 45 \rightarrow v_A = -\frac{45}{17}\ V \approx \boxed{-2.65\ V}$$

$$\rightarrow v_c = 15 + v_A = 15 - \frac{45}{17} = \frac{210}{17}\ V \approx \boxed{12.35\ V}$$

$$\therefore P_{9V\ source} = (9)(i_2 - i_3) = (9)\left[\frac{-2.65 - 9}{4k\Omega} - \frac{9 - 12.35}{6k\Omega}\right]$$

$$\simeq \boxed{-21.2\ mW}$$

$$P_{15\ V\ source} = (15)(i_3 - i_4) = (15)\left[\frac{9 - 12.35}{6k\Omega} - \frac{12.35}{3k\Omega}\right]$$

$$\simeq \boxed{-70.1\ mW}$$

Hurraaay!

Done, done, done!

Inan now knows that we are tougher than his tests!!