

9/30/2006

*University of Portland  
School of Engineering*

**EE 261-Electrical Circuits-3 cr. hrs.**

**Fall 2006**

SOLUTIONS TO

**Midterm Exam # 1**

(Friday, September 29, 2006)

(Closed Book Exam, One Formula Sheet Allowed)

(Total Time: 55 minutes)

Name: \_\_\_\_\_

SOLUTIONS! 😊

Signature: \_\_\_\_\_

*SOLUTIONS!* 😊

*"An honest mind possesses a kingdom."*

Lucius Annaeus Seneca (4B.C.-65A.D.)

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

Anonymous



Inan's students  
are vicious fighters...  
Attack the army  
of electric circuits!

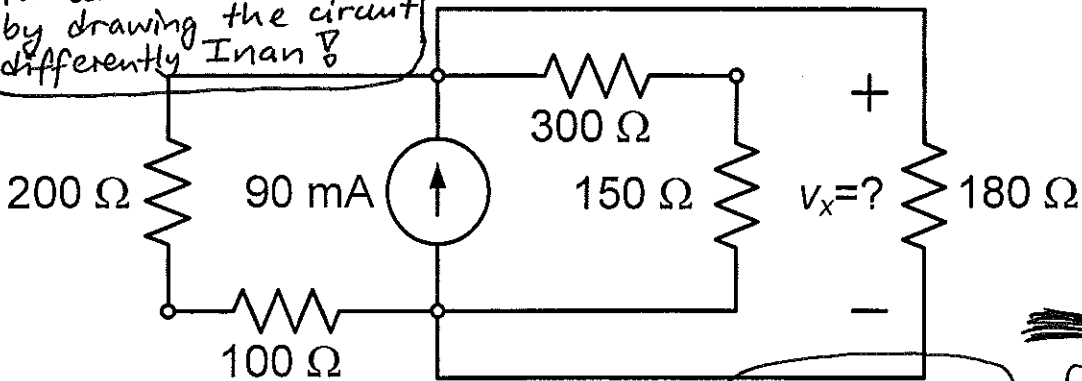
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**NOTE:** On all the problems, please show your work clearly, and provide the appropriate units for your answers. Also mark on the schematic to show any current or voltage that you define in your solution.

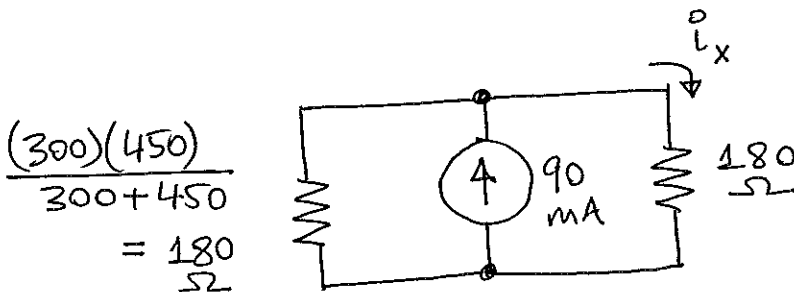
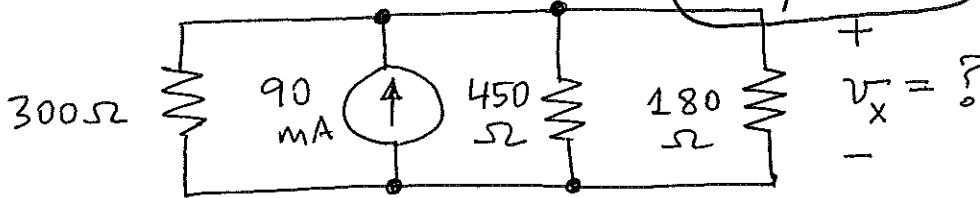
1. (25 points) In the circuit shown, find the value of the voltage  $v_x$  across the  $180 \Omega$  resistor. (Please show your work clearly and provide brief justifications for the steps you take. Also, don't forget to provide the correct units for your answers.)



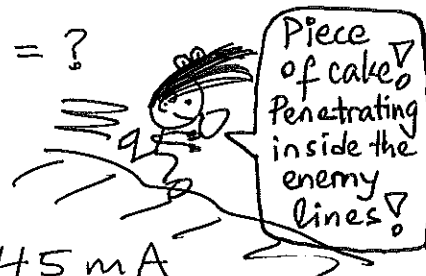
You can't trick us by drawing the circuit differently Inan



I recognize that all elements are connected in parallel



$v_x = ?$



Piece of cake Penetrating inside the enemy lines

∴ Based on CDP  $\rightarrow i_x = \frac{90}{2} = 45 \text{ mA}$

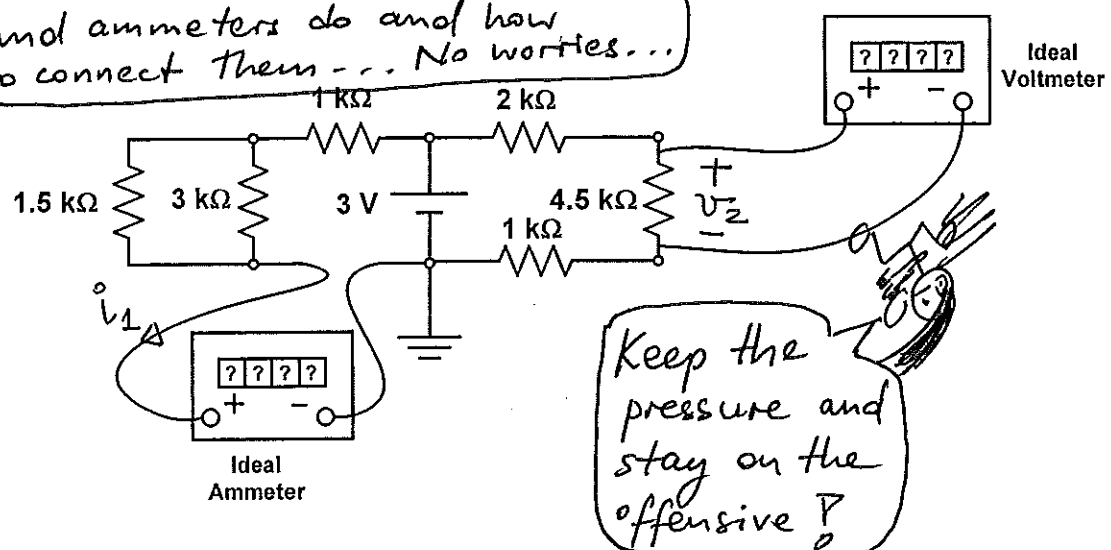
∴ Based on Ohm's law  $\rightarrow v_x = (180 \Omega)(45 \text{ mA}) = \boxed{8.1 \text{ V}}$

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Inan is trying to scare us with complicated looking circuits...

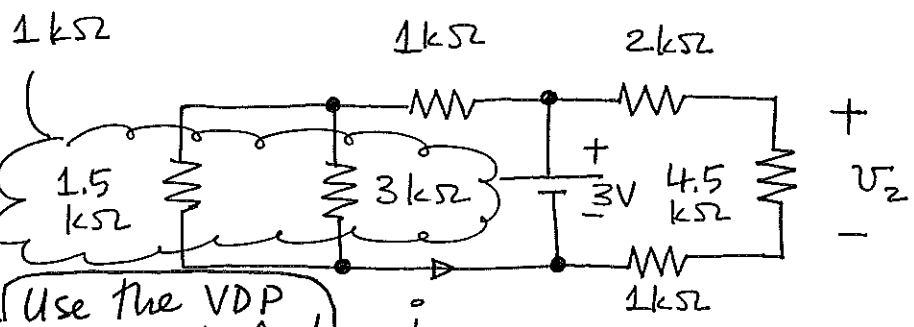
2. (Total: 25 Points) Consider the circuit with two digital multi-meters (DMM's) connected as shown.

We know what voltmeters and ammeters do and how to connect them... No worries...



Keep the pressure and stay on the offensive!

(a) (12.5 points) Find the two DMM readings. Please indicate the appropriate units. (Note: Pay attention to the polarities of each DMM!)



Use the VDP weapon to find voltage  $v_2$ !

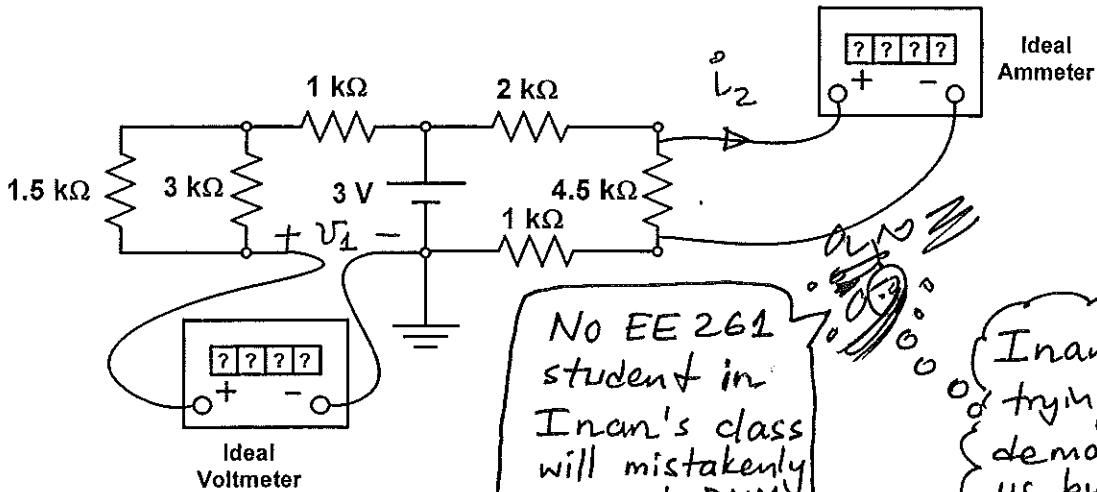
$$\therefore \text{VDP} \rightarrow v_2 = \frac{4.5 \text{ k}\Omega}{4.5 \text{ k}\Omega + 3 \text{ k}\Omega} (3 \text{ V}) = \boxed{1.8 \text{ V}}$$

$$\text{Ohm's law} \rightarrow i_1 = \frac{3 \text{ V}}{1 \text{ k}\Omega + 1 \text{ k}\Omega} = \boxed{1.5 \text{ mA}}$$

Thanks Mr. Ohm for discovering Ohm's law in 1827! Where are you nowadays?

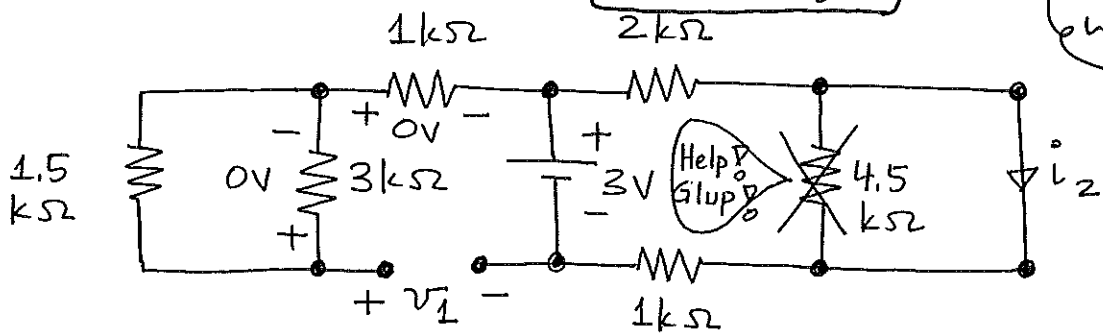
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(b) (12.5 points) Repeat part (a) if both DMMs are mistakenly set as shown below. Again, indicate your units.



No EE 261 student in Inan's class will mistakenly connect DMMs like this!

Inan is trying to demoralize us, but his tactics won't work!



∴ Using KVL  $\rightarrow v_1 = 0 + 0 + 3 = \boxed{3V}$

Using Ohm's law  $\rightarrow i_2 = \frac{3V}{2k\Omega + 1k\Omega} = \boxed{1mA}$

I bet it is Inan who purposely connected the DMMs wrong to confuse us...

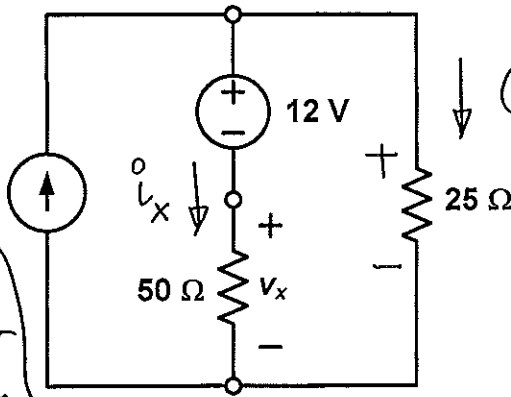
Next problem: Inan's students will find your solution no matter what!

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3. (25 Points) Consider the circuit shown. Determine the voltage  $v_x$  across the  $50 \Omega$  resistor. Please show your work step by step.



Electric circuits:  
You either surrender or you will be destroyed by Inan's students one by one.



$(0.3 - \dot{i}_x)$  (Based on KCL)

Using KVL in the right-hand-side loop:

$$-50\dot{i}_x - 12 + 25(0.3 - \dot{i}_x) = 0$$

$$\rightarrow 75\dot{i}_x = -4.5 \text{ V} \rightarrow \dot{i}_x = -0.06 \text{ A} = -60 \text{ mA}$$

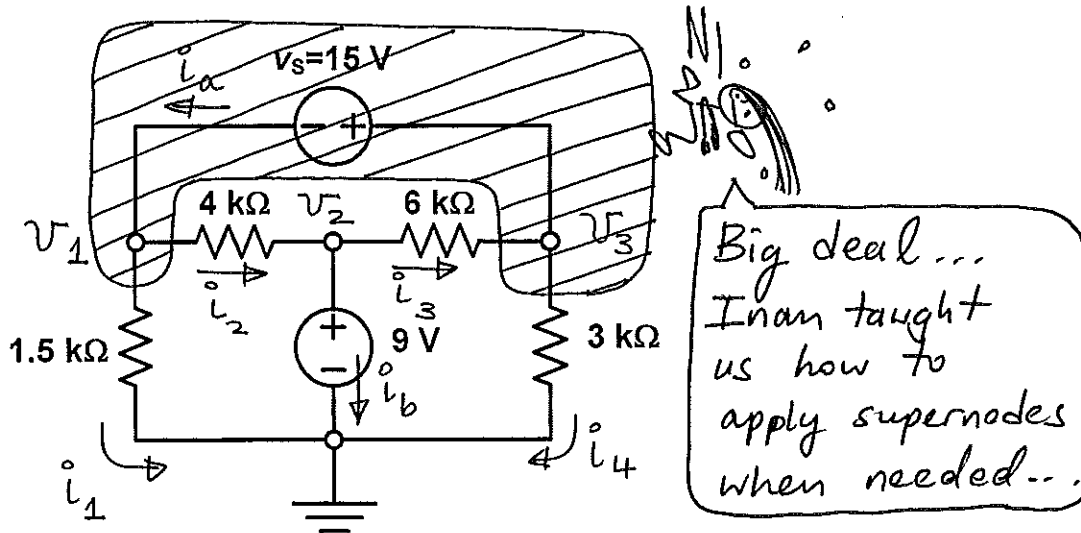
$$\therefore \text{Ohm's law} \rightarrow v_x = 50\dot{i}_x = 50(-0.06) = \boxed{-3 \text{ V}}$$



Words such as "loose" or "surrender" does not exist in Inan's students' own dictionary.

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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.



$$v_2 = 9V \quad \& \quad v_3 - v_1 = 15V$$

Applying KCL to the supernode yields:

$$i_1 + i_2 - i_3 + i_4 = 0$$

$$\frac{v_1}{1.5k} + \frac{v_1 - 9}{4k} - \frac{9 - v_3}{6k} + \frac{v_3}{3k} = 0$$

(8)      (3)      (2)      (4)

$$\rightarrow 11v_1 + 6v_3 = 45 \rightarrow 11v_1 + 6(15 + v_1) = 45$$

$$\rightarrow v_1 = -\frac{45}{17} V \approx -2.65V \quad \& \quad v_3 = \frac{210}{17} V \approx 12.35V$$

Next, using KCL:

$$i_a = i_1 + i_2 \approx -1.765mA - 2.912mA \approx -4.676mA$$

$$i_b = i_2 - i_3 \approx -2.912mA + 0.559mA \approx -2.353mA$$

$$P_{9V \text{ source}} = 9i_b \approx (9V)(-2.353mA) \approx -21.2mW$$

$$\& P_{15V \text{ source}} = 15i_a \approx (15V)(-4.676mA) \approx -70.2mW$$

Hurray!

Electric Circuit army is defeated and the war is over!