10/3/2005

University of Portland
School of Engineering

EE 261-Electrical Circuits-3 cr. hrs.
Fall 2005

Midterm Exam # 1

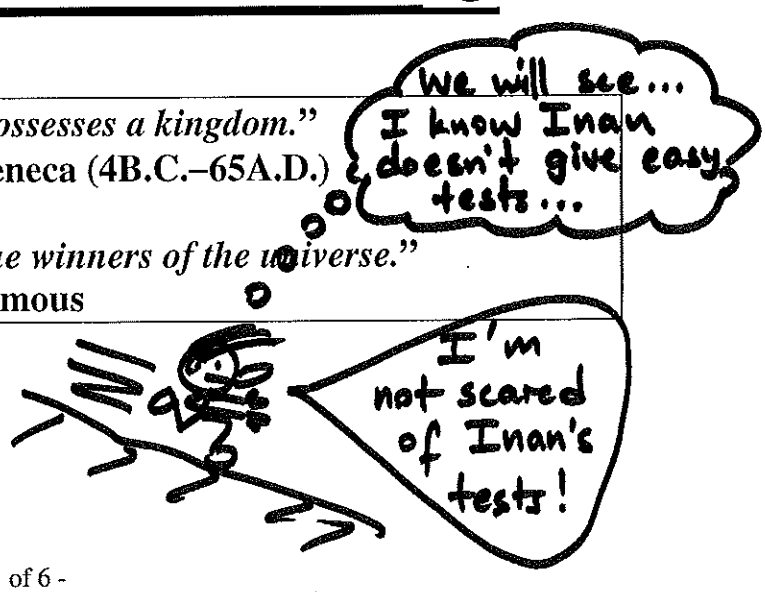
(Friday, September 30, 2005)
(Closed Book Exam, One Formula Sheet Allowed)
(Total Time: 55 minutes)

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



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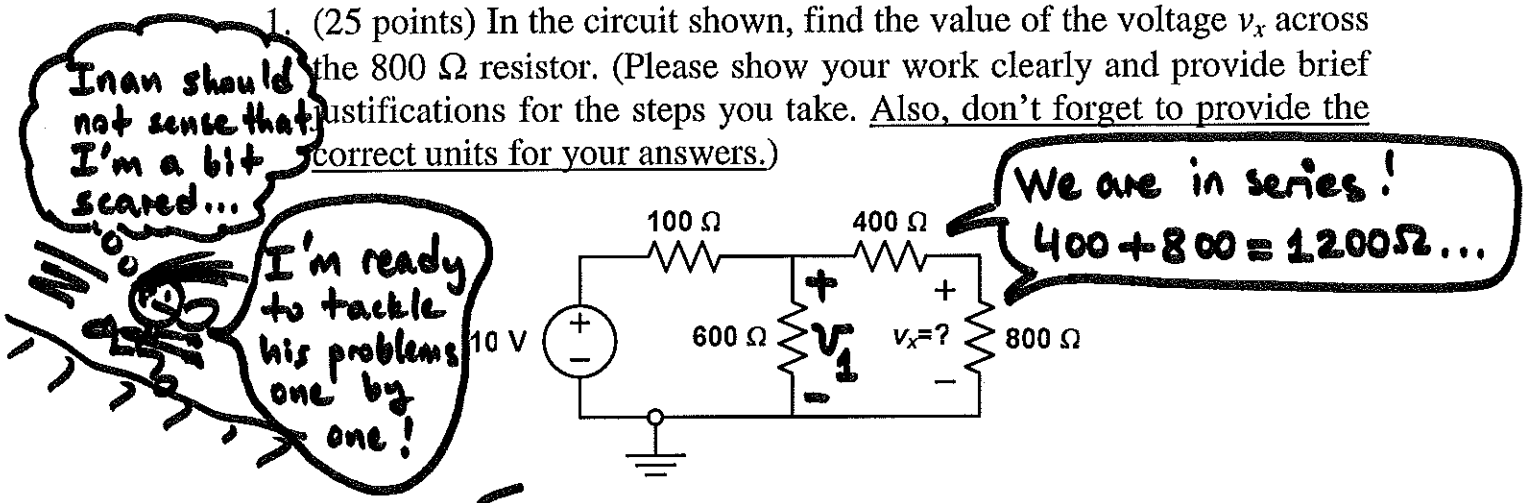
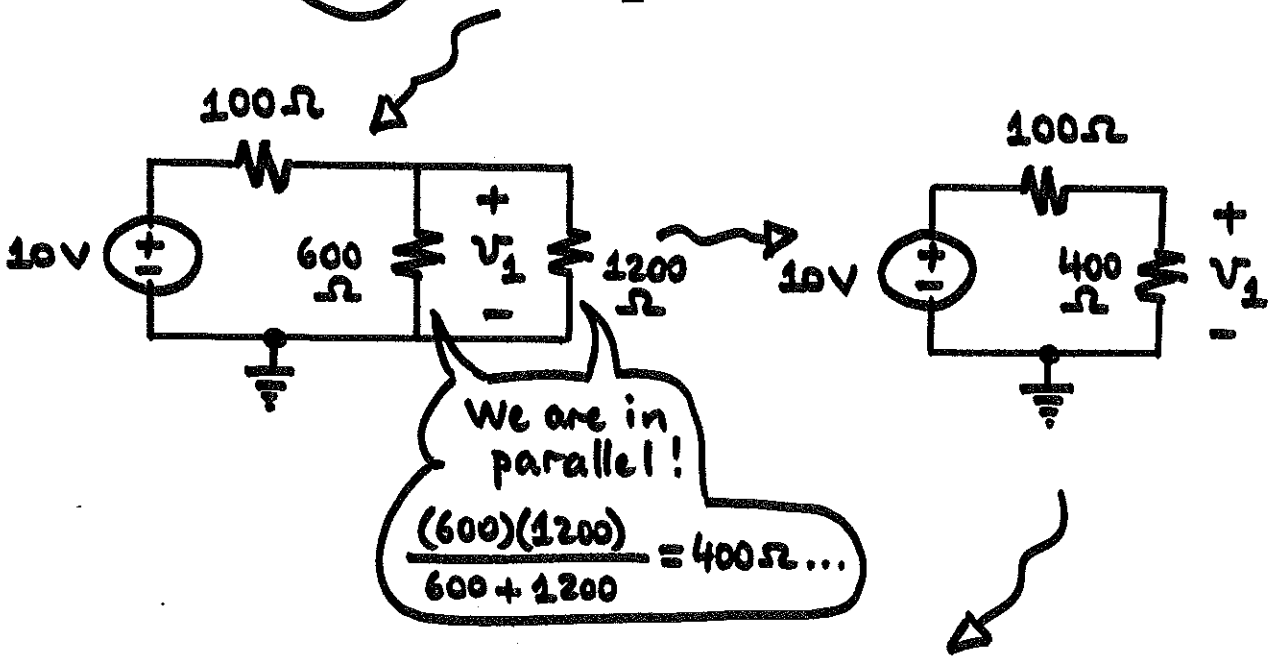
NOTE: On all the problems, please show your work clearly, and provide the appropriate units for your answers. Also mark on the schematic to show any current or voltage that you define in your solution.

1. (25 points) In the circuit shown, find the value of the voltage v_x across the 800 Ω 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.)

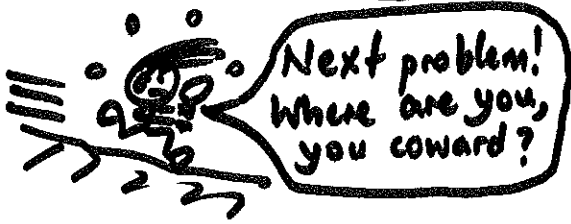




Using voltage divider principle twice:

$$v_1 = \frac{400}{100+400}(10V) = 8\,V$$

$$v_x = \frac{800}{400+800} v_1 = \frac{800}{400+800}(8V) \cong \boxed{5.33\,V}$$



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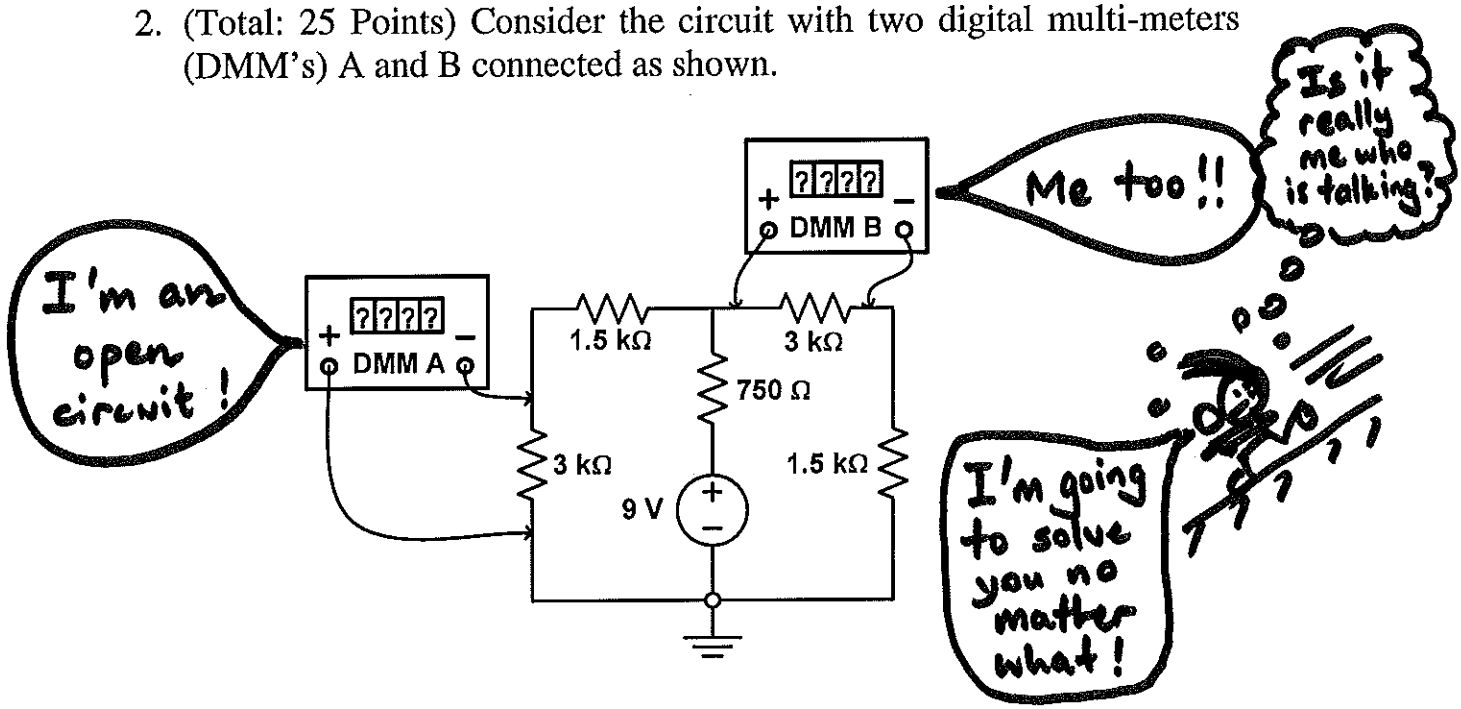
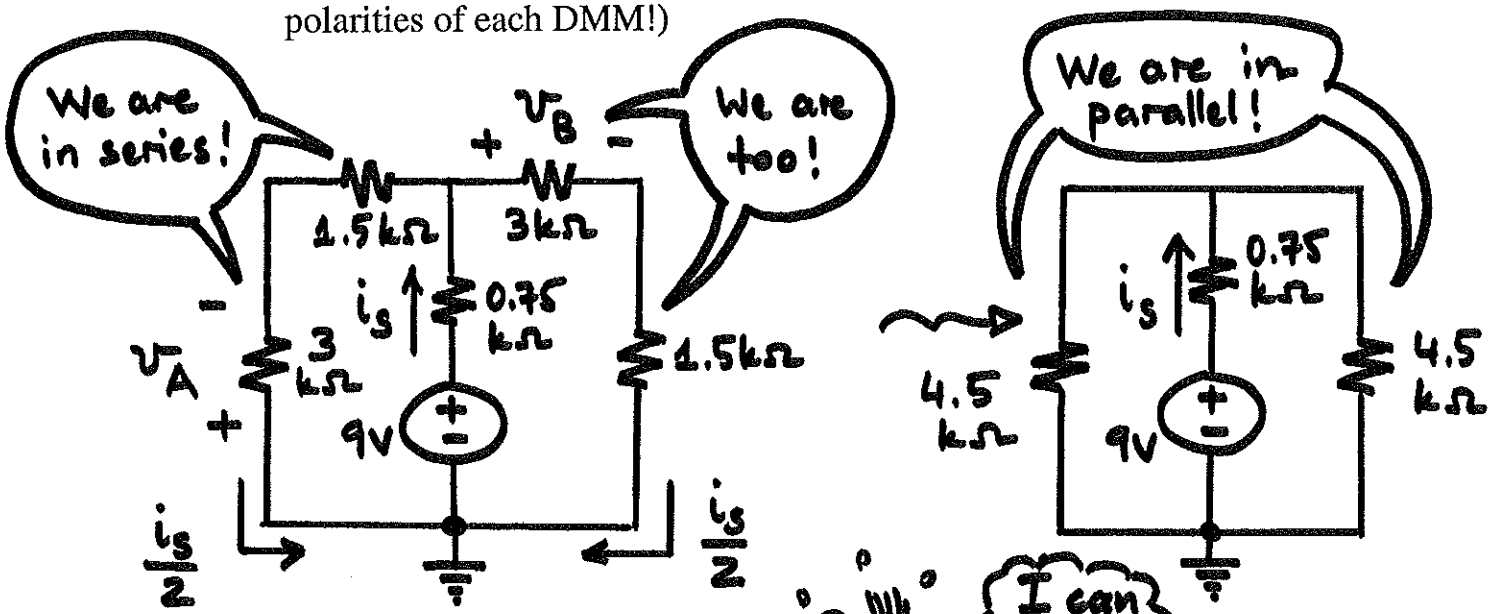
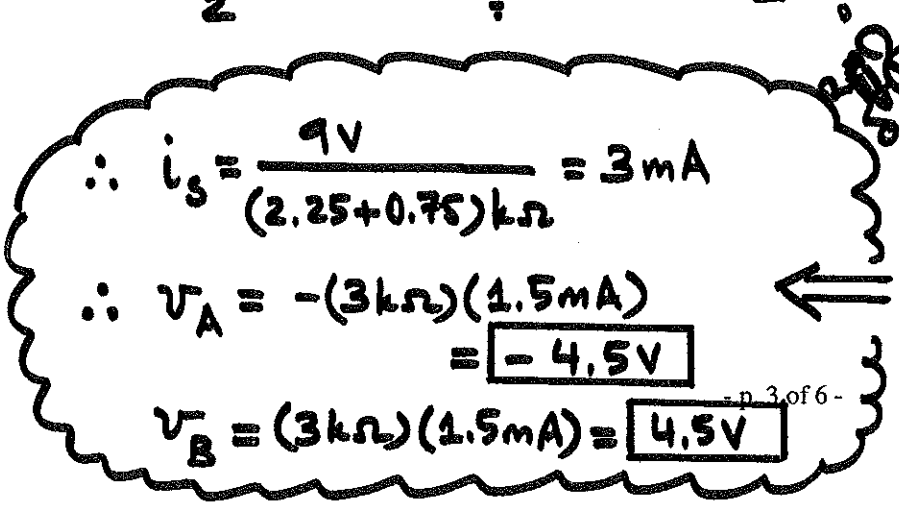
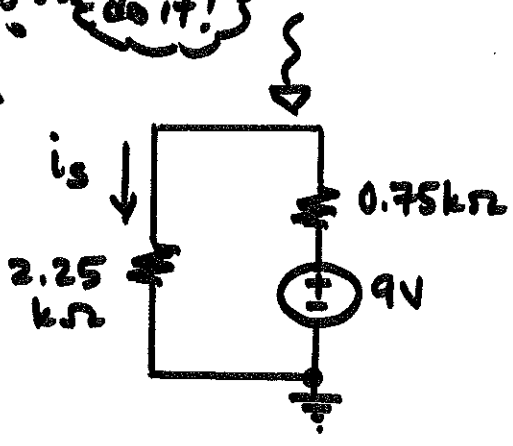
2. (Total: 25 Points) Consider the circuit with two digital multi-meters (DMM's) A and B connected as shown.



(a) (12.5 points) Find the DMM readings if both of them are set to measure voltage, and indicate the units. (Note: Pay attention to the polarities of each DMM!)







Inan must be impressed! I can't put him down!

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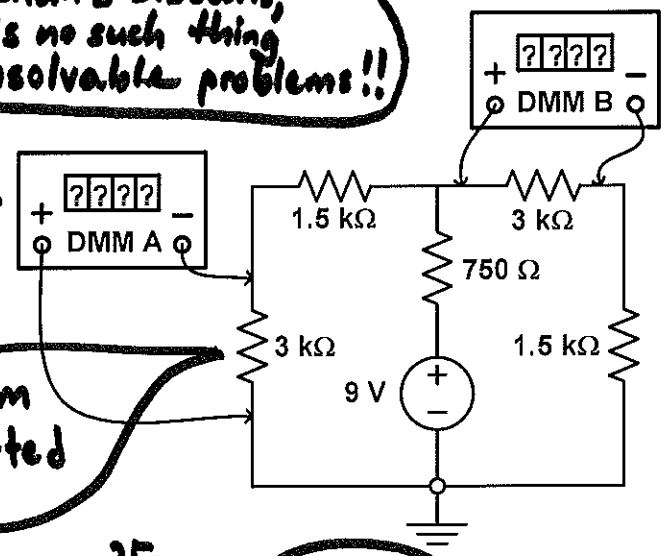
(b) (12.5 points) Repeat part (a) if DMM A by mistake is set to measure current. Again, indicate your units.

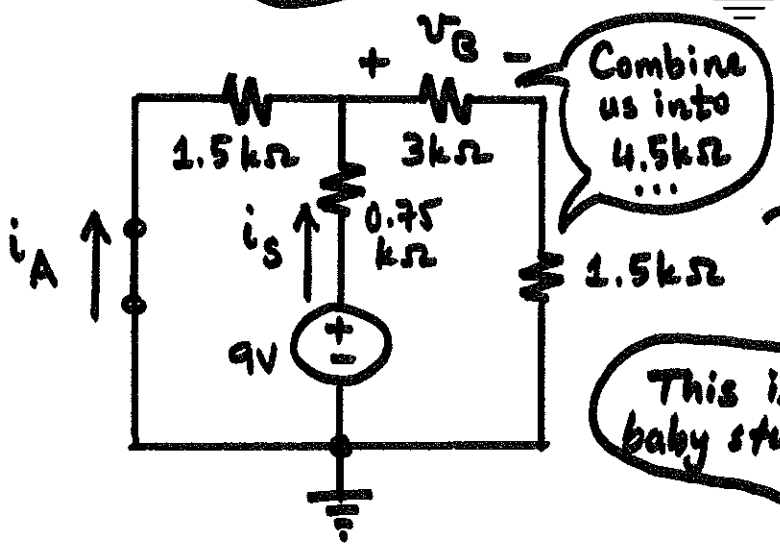
For Inan's students, there is no such thing as unsolvable problems!!

I'm a short circuit!

I'm still an open circuit!

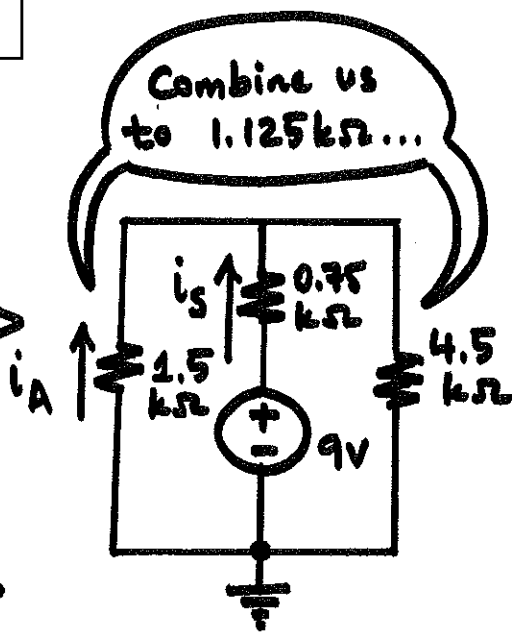
I'm shorted!!





Combine us into 4.5kΩ...

Combine us to 1.125kΩ...



This is baby stuff!

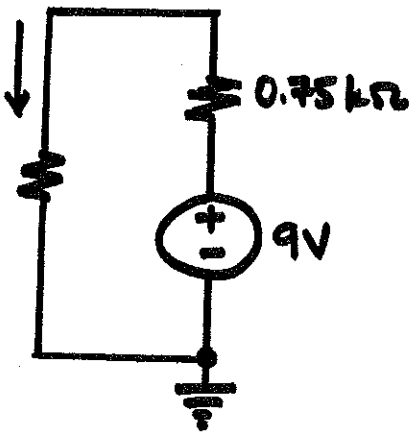
$$\therefore i_S = \frac{9\text{V}}{(1.125+0.75)\text{k}\Omega} = 4.8\text{mA}$$

$$\therefore i_A = -\frac{4.5\text{k}\Omega}{(1.5+4.5)\text{k}\Omega}(4.8\text{mA})$$

$$= \boxed{-3.6\text{mA}}$$

$$\therefore v_B = (3\text{k}\Omega)(i_S + i_A)$$

$$= (3\text{k}\Omega)(4.8-3.6)\text{mA} = \boxed{3.6\text{V}}$$



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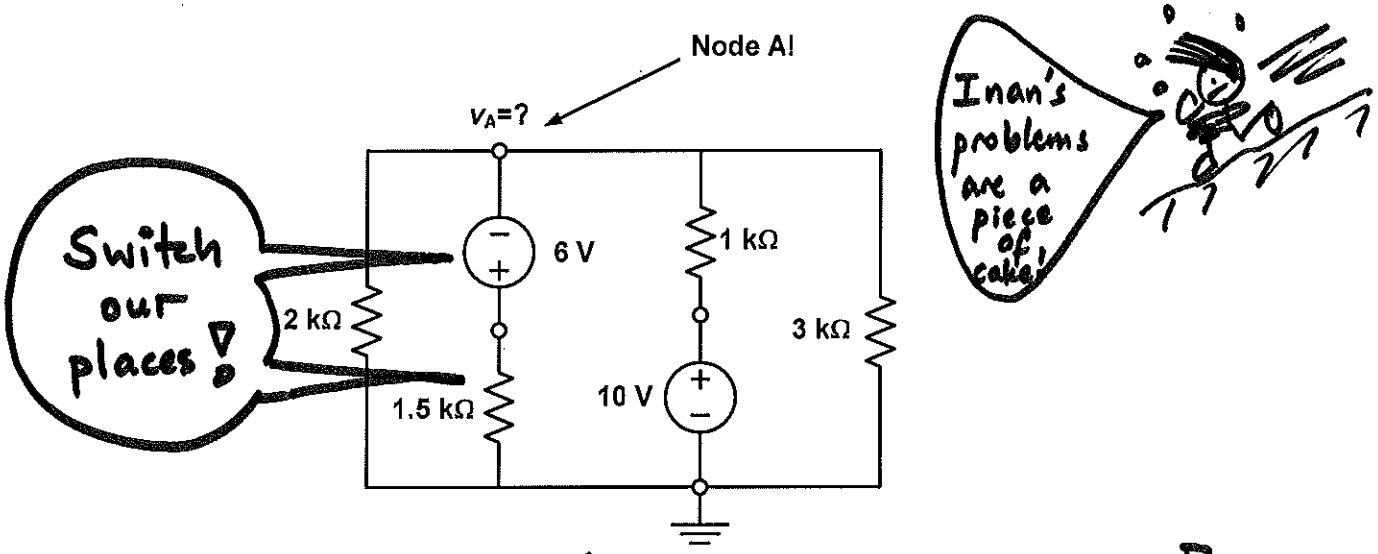
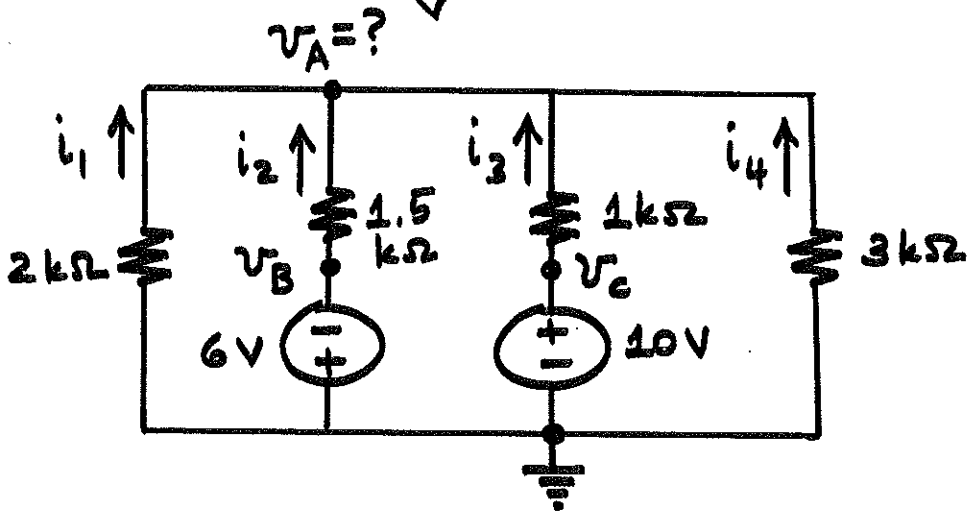
3. (25 Points) Consider the circuit shown. Determine the node voltage v_A at node A. Please show your work step by step.



Redraw the circuit !



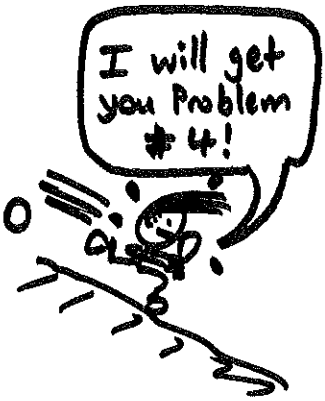
$v_B = -6\,V$ & $v_C = 10\,V$.

KCL at A yields $i_1 + i_2 + i_3 + i_4 = 0$

or $-\frac{v_A}{2k} + \frac{-6-v_A}{1.5k} + \frac{10-v_A}{1k} - \frac{v_A}{3k} = 0$

or $-3v_A - 24 - 4v_A + 60 - 6v_A - 2v_A = 0$

or $15\,v_A = 36 \rightarrow \boxed{v_A = 2.4\,V}$



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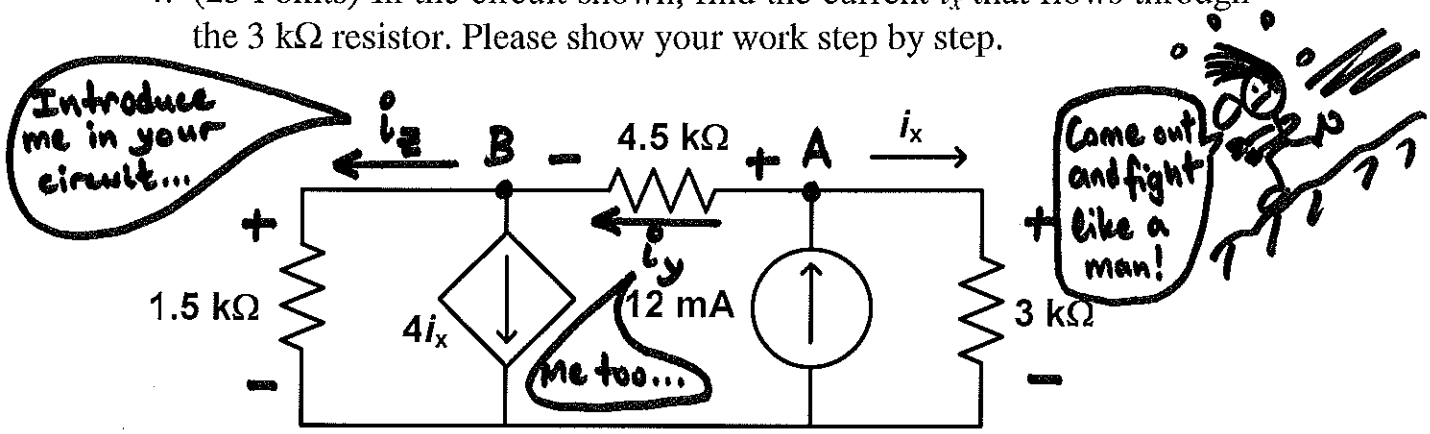
4. (25 Points) In the circuit shown, find the current i_x that flows through the 3 kΩ resistor. Please show your work step by step.



KCL at node A yields $\rightsquigarrow i_y = 12\,\text{mA} - i_x$

KCL at node B yields $\rightsquigarrow i_z = 12\,\text{mA} - 5i_x$

KVL around the outermost loop yields

$$\rightsquigarrow (1.5\,\text{k}\Omega)\,i_z - (3\,\text{k}\Omega)\,i_x + (4.5\,\text{k}\Omega)\,i_y = 0$$

$$\rightsquigarrow 18 - (7.5\text{k})\,i_x - (3\text{k})\,i_x + 54 - (4.5\text{k})\,i_x = 0$$

$$\rightsquigarrow i_x = \frac{72\ \text{V}}{15\,\text{k}\Omega} = \boxed{4.8\ \text{mA}}$$