9/30/2006

University of Portland
School of Engineering

EE 261-Electrical Circuits-3 cr. hrs.
Fall 2006

SOLUTIONS TO

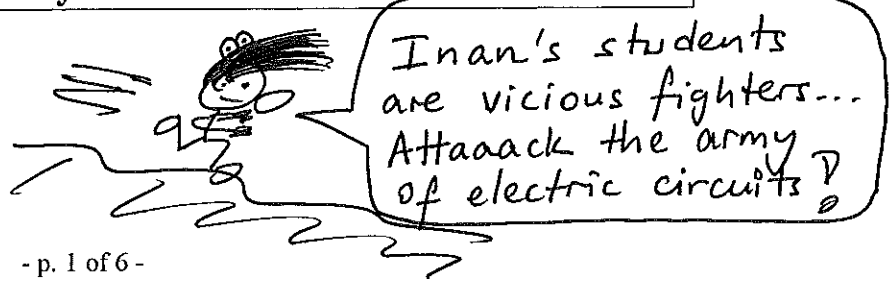
Midterm Exam # 1

(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**



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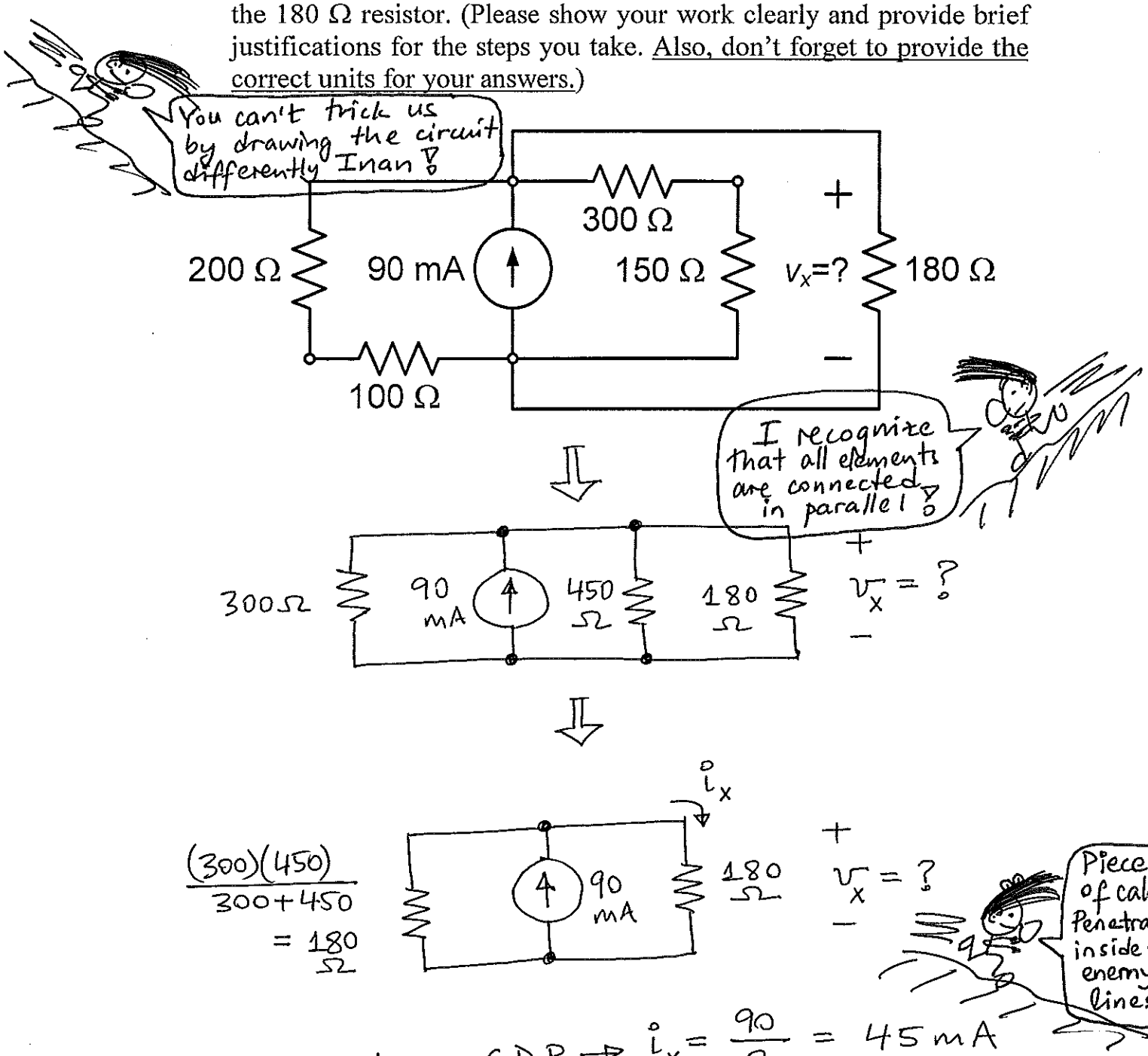
NOTE: On all the problems, please show your work clearly, and provide the appropriate units for your answers. Also mark on the schematic to show any current or voltage that you define in your solution.

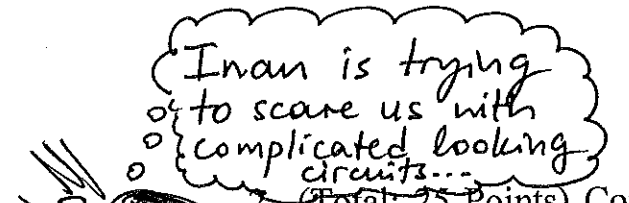
1. (25 points) In the circuit shown, find the value of the voltage v_x across the 180 Ω resistor. (Please show your work clearly and provide brief justifications for the steps you take. Also, don't forget to provide the correct units for your answers.)



$\therefore$ Based on CDP $\rightarrow$ $i_x = \frac{90}{2} = 45\,mA$

$\therefore$ Based on Ohm's law $\rightarrow$ $v_x = (180\Omega)(45mA)$

$= \boxed{8.1\,V}$



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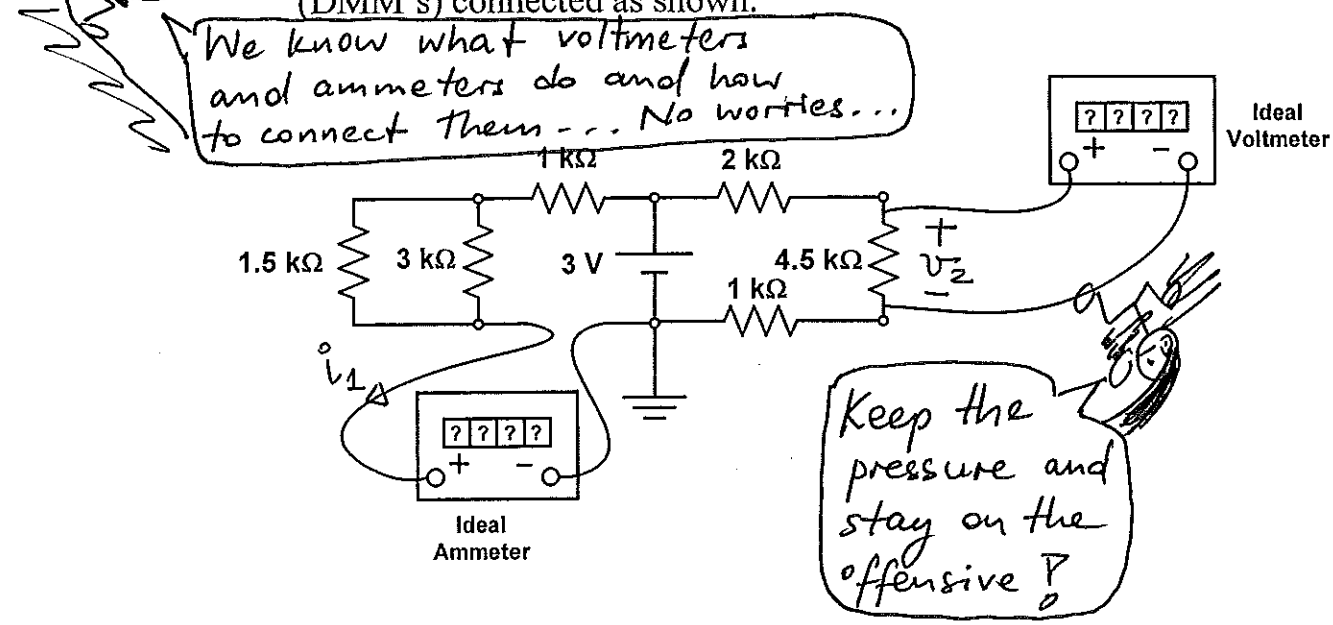
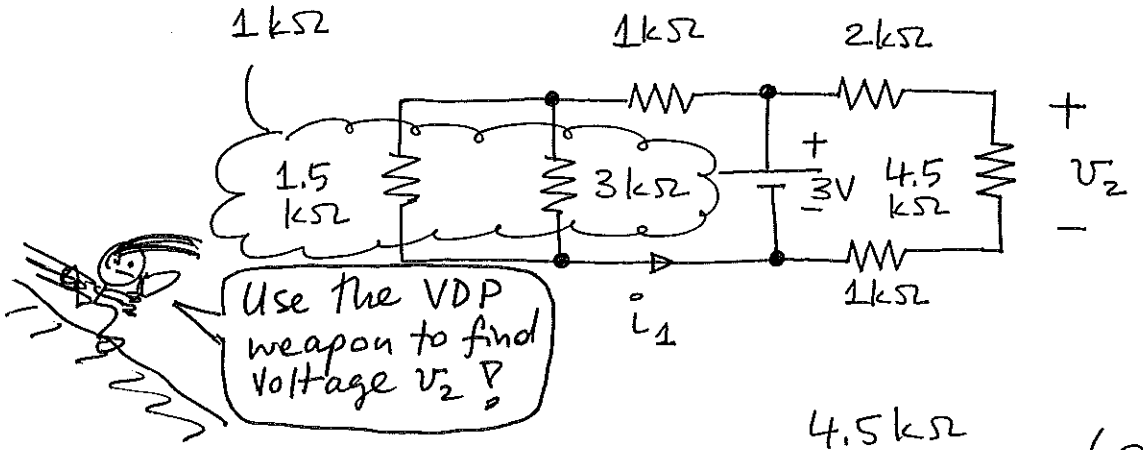
2. (Total: 25 Points) Consider the circuit with two digital multi-meters (DMM's) connected as shown.

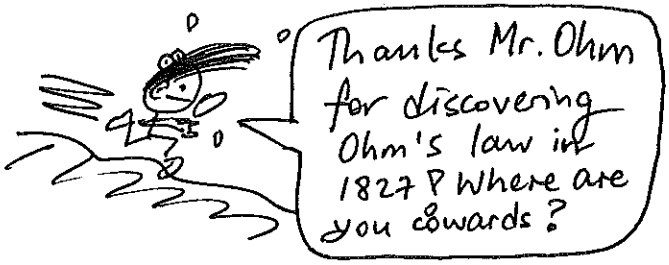


(a) (12.5 points) Find the two DMM readings. Please indicate the appropriate units. (*Note:* Pay attention to the polarities of each DMM!)



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

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



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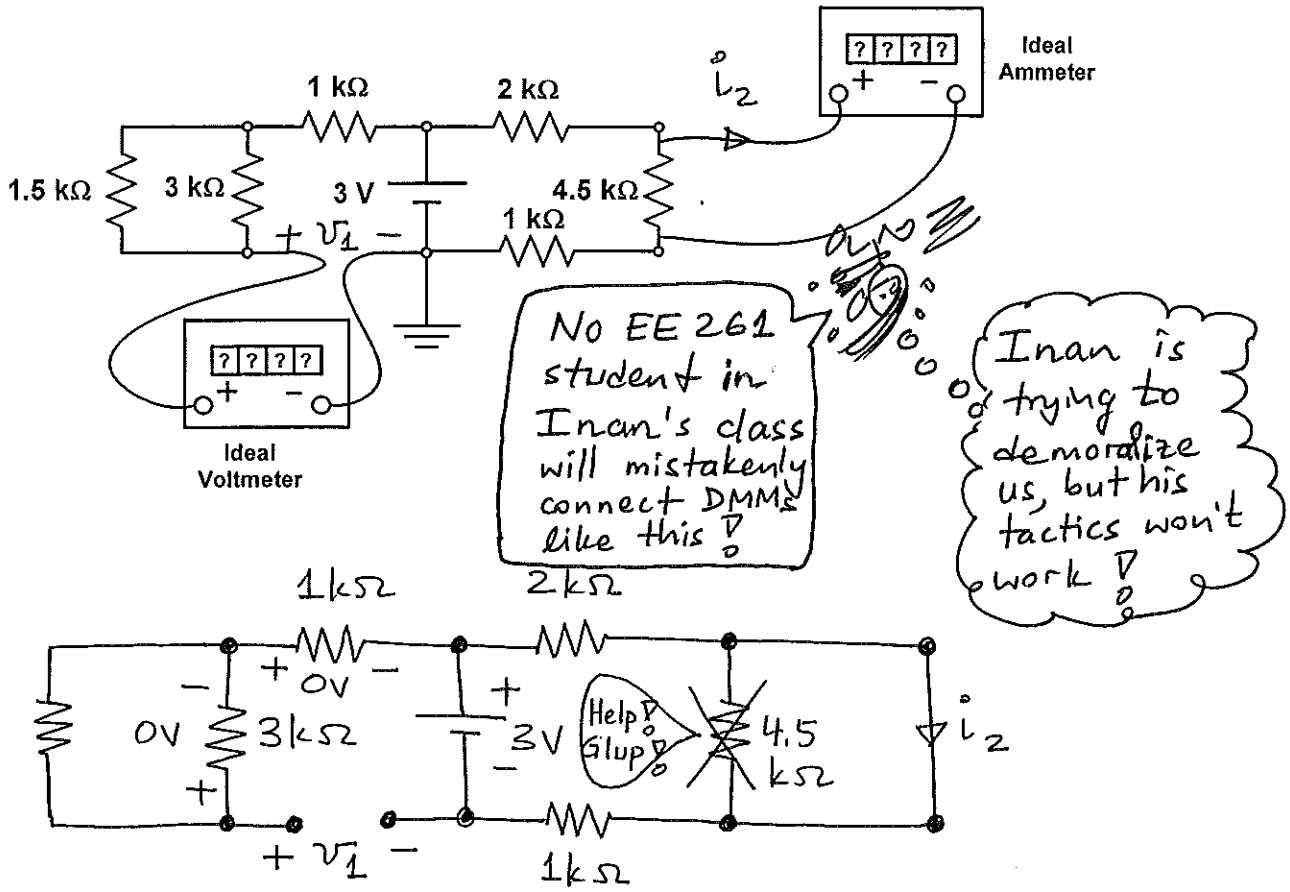
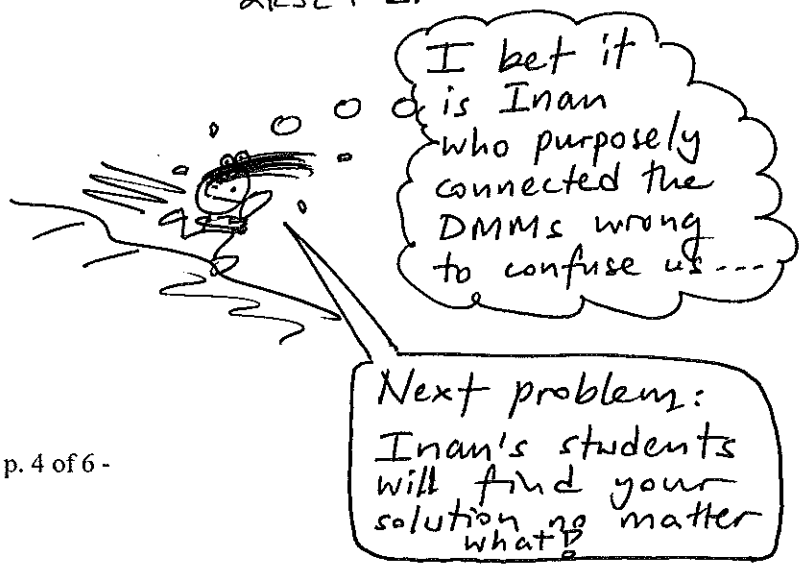
(b) (12.5 points) Repeat part (a) if both DMMs are mistakenly set as shown below. Again, indicate your units.



$\therefore$ Using KVL $\rightarrow v_1 = 0 + 0 + 3 =$ **3V**

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



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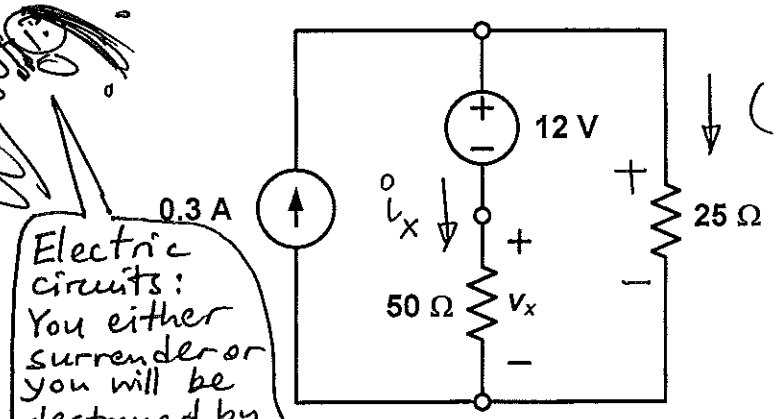
3. (25 Points) Consider the circuit shown. Determine the voltage v_x across the 50 Ω resistor. Please show your work step by step.



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

$\downarrow (0.3 - i_x)$ (Based on KCL)

Using KVL in the right-hand-side loop:

$$-50 i_x - 12 + 25(0.3 - i_x) = 0$$

$$75 i_x = -4.5\ \text{V} \rightarrow i_x = -0.06\ \text{A} = -60\ \text{mA}$$

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

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

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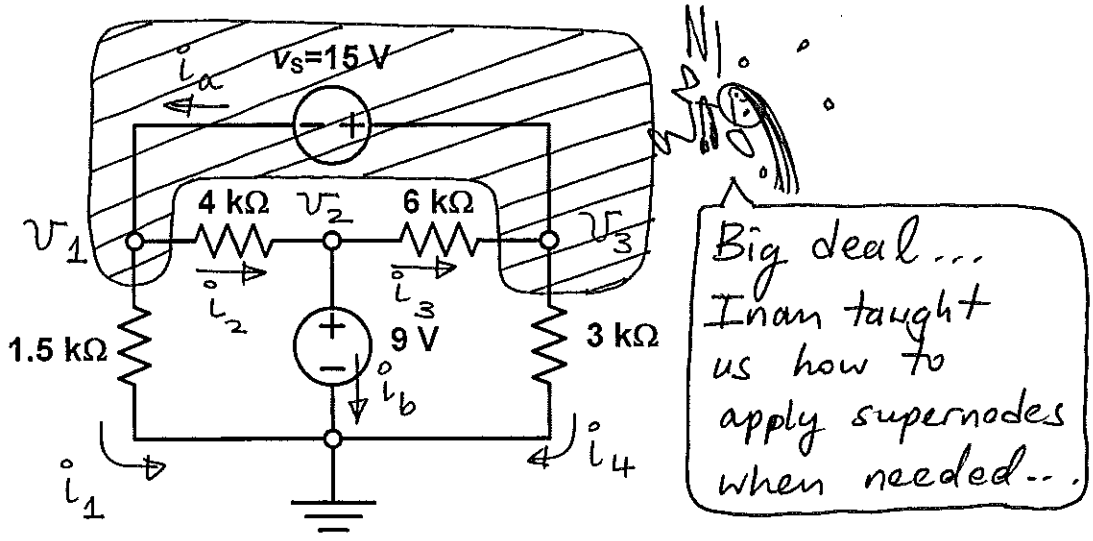
4. (25 Points) In the circuit shown, find the power of each voltage source. Indicate the type of each power (i.e., supplied or absorbed). Please show your work step by step.



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

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)

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

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

Next, using KCL:

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

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

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

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