3/30/2007

University of Portland
School of Engineering

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

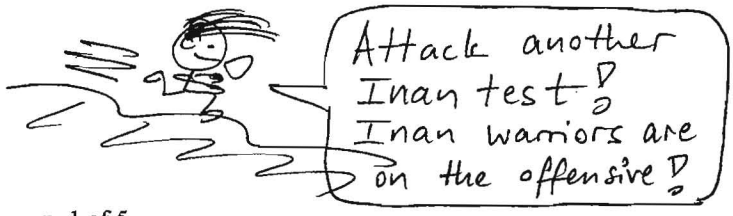
Midterm Exam # 2

(Monday, March 26, 2007)
(Closed Book Exam, Two Formula Sheets Allowed)
(Total Time: 55 minutes)

Name: SOLUTIONS :D ☺

Signature: Sally Jean ☺

> ***"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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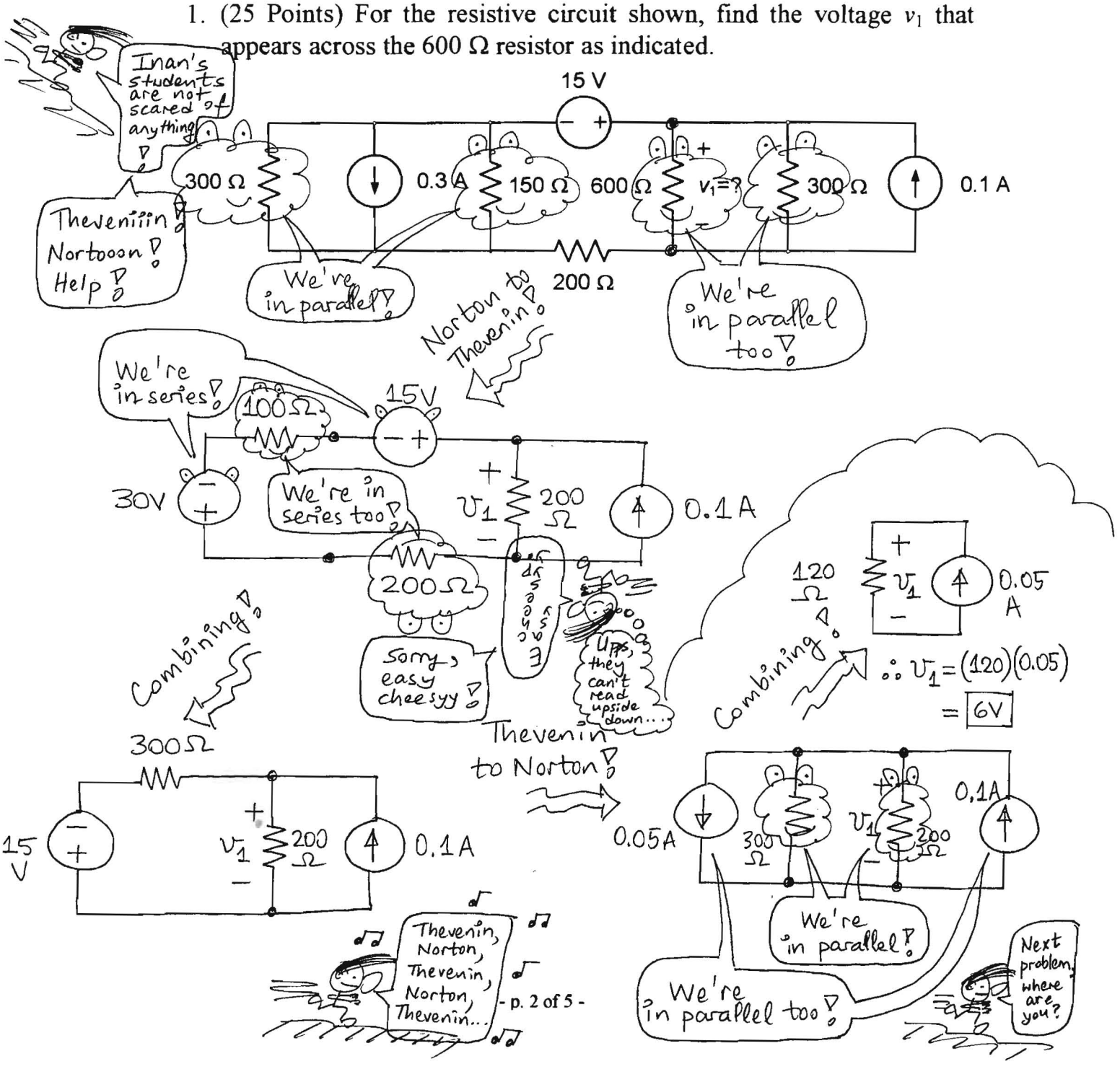
This table will be used by Inan for recording the grades!

Problem	Points gained
#1	
#2	
#3	
#4	
Total	

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

1. (25 Points) For the resistive circuit shown, find the voltage v_1 that appears across the 600 Ω resistor as indicated.



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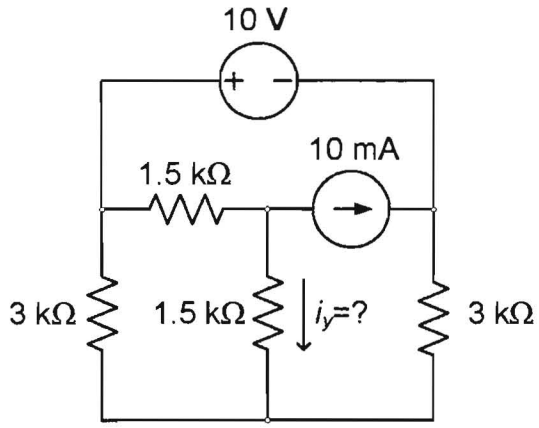
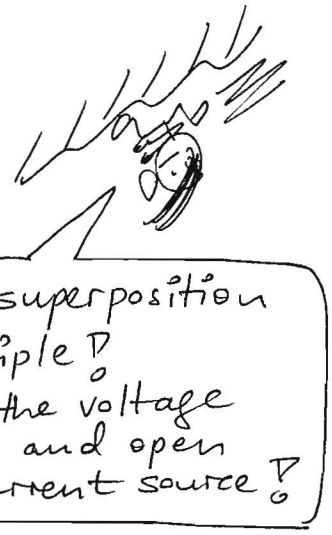
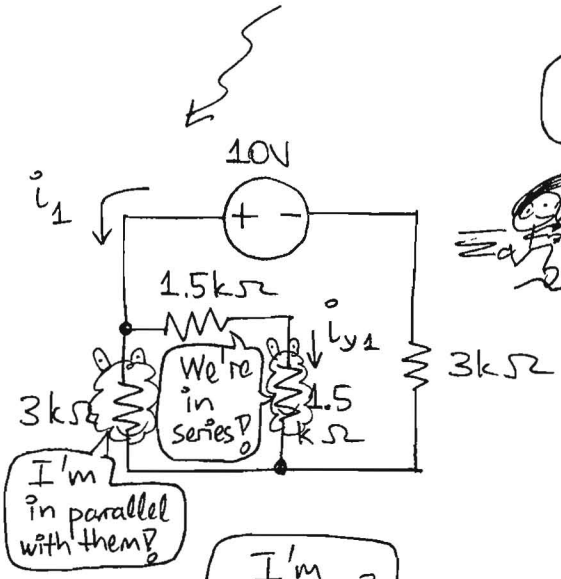
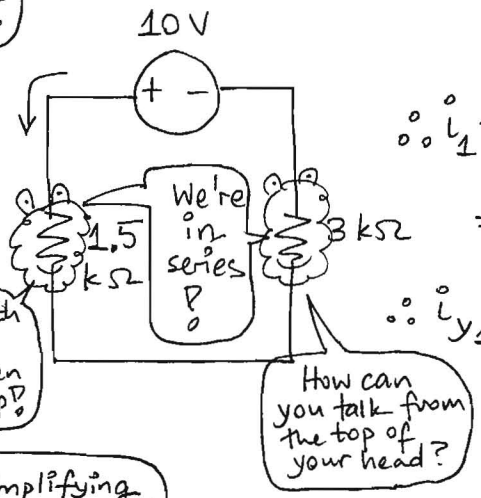
2. (25 points) In the circuit shown, find the current i_y through the 1.5 kΩ resistor. Please show your work step by step.



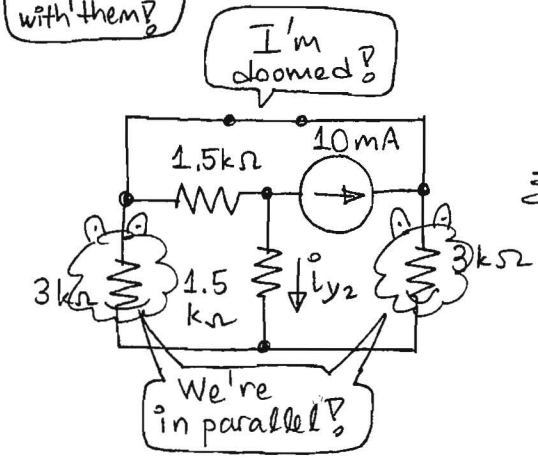


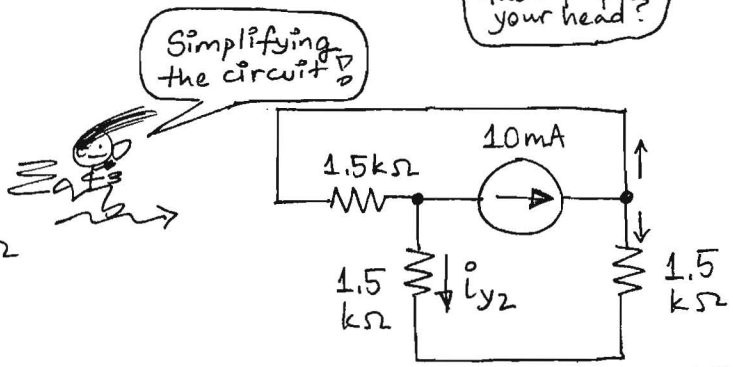




$$\therefore i_1 = \frac{10\text{V}}{4.5\text{k}\Omega} = \frac{20}{9}\text{ mA}$$

$$\therefore i_{y_1} = \frac{i_1}{2} = \boxed{\frac{10}{9}\text{ mA}}$$





Applying CDP $\rightarrow$ $i_{y_2} = -\frac{1.5\text{k}\Omega}{4.5\text{k}\Omega}(10\text{mA})$

$$= \boxed{-\frac{10}{3}\text{ mA}}$$

$$\therefore i_y = i_{y_1} + i_{y_2} = \frac{10}{9} - \frac{10}{3} = -\frac{20}{9}\text{ mA} \approx \boxed{-2.22\text{ mA}}$$

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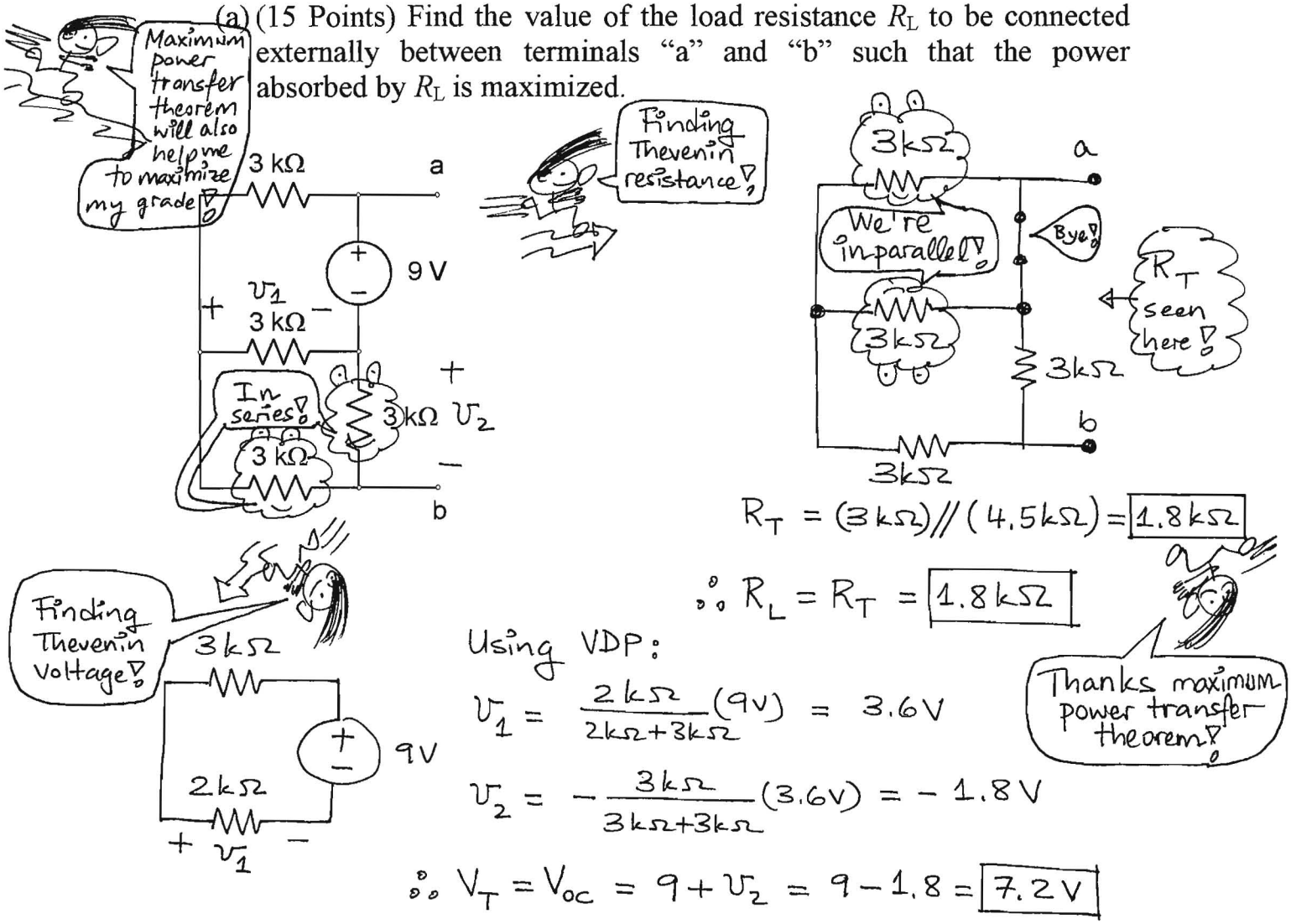
3. (Total: 25 points) Consider the circuit shown below.

(a) (15 Points) Find the value of the load resistance R_L to be connected externally between terminals "a" and "b" such that the power absorbed by R_L is maximized.



$$R_T = (3\,k\Omega)\,//\,(4.5\,k\Omega) = \boxed{1.8\,k\Omega}$$

$$\therefore R_L = R_T = \boxed{1.8\,k\Omega}$$

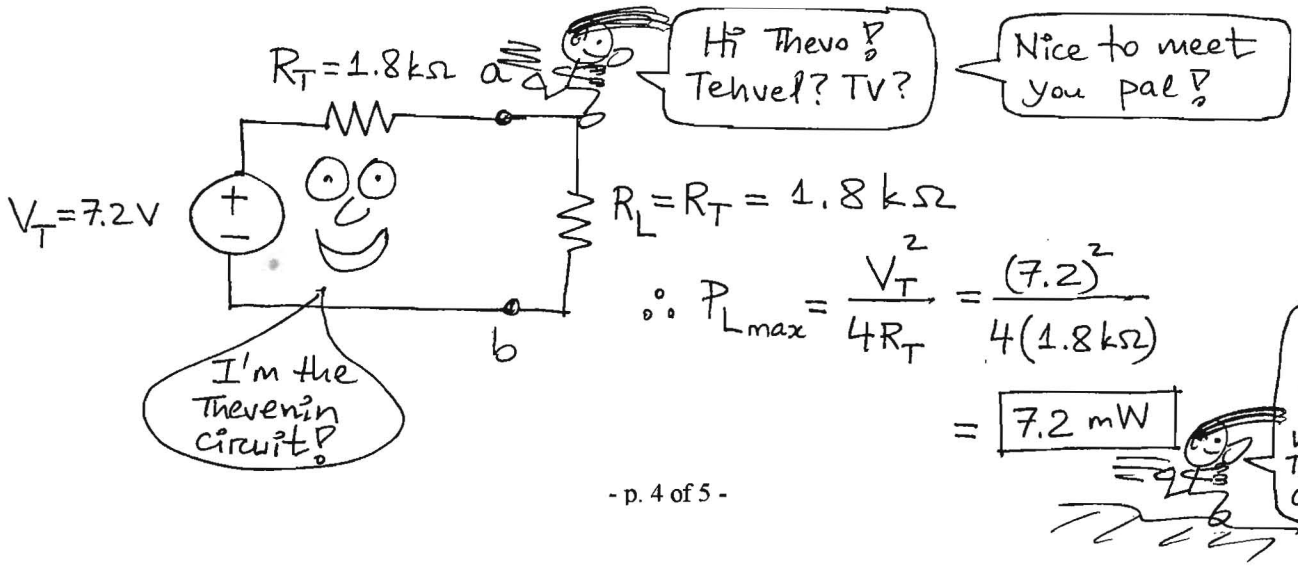
Using VDP:

$$v_1 = \frac{2\,k\Omega}{2\,k\Omega + 3\,k\Omega}(9V) = 3.6V$$

$$v_2 = -\frac{3\,k\Omega}{3\,k\Omega + 3\,k\Omega}(3.6V) = -1.8V$$

$$\therefore V_T = V_{oc} = 9 + v_2 = 9 - 1.8 = \boxed{7.2V}$$

(b) (10 Points) Find the maximum value of the power absorbed by R_L.



$$\therefore P_{L\max} = \frac{V_T^2}{4R_T} = \frac{(7.2)^2}{4(1.8\,k\Omega)}$$

$$= \boxed{7.2\,mW}$$

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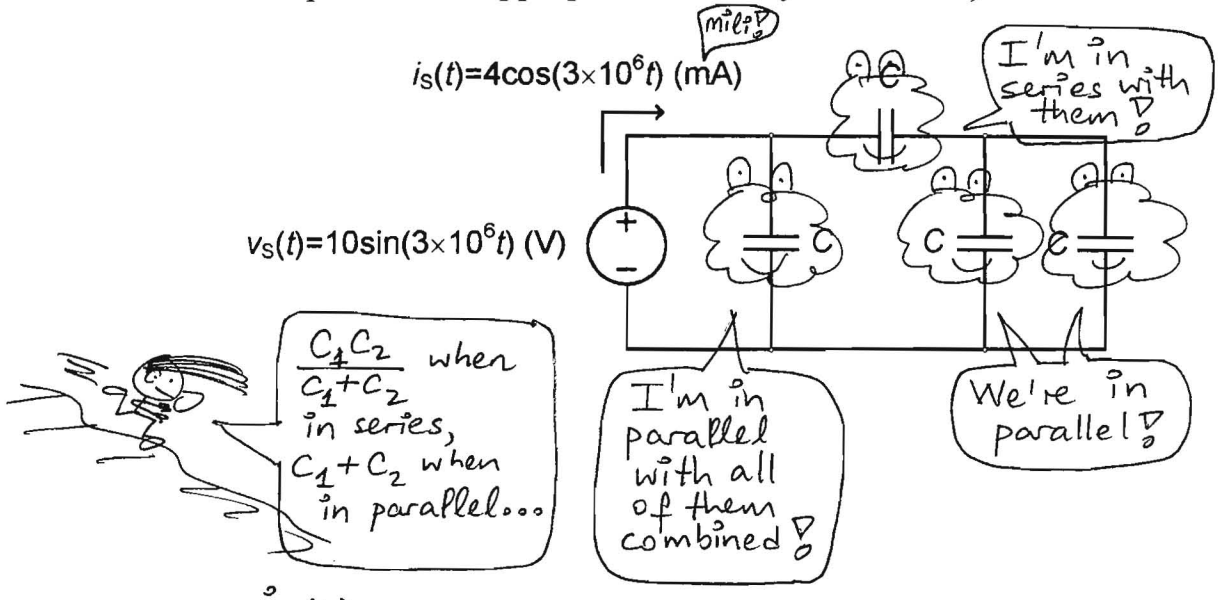
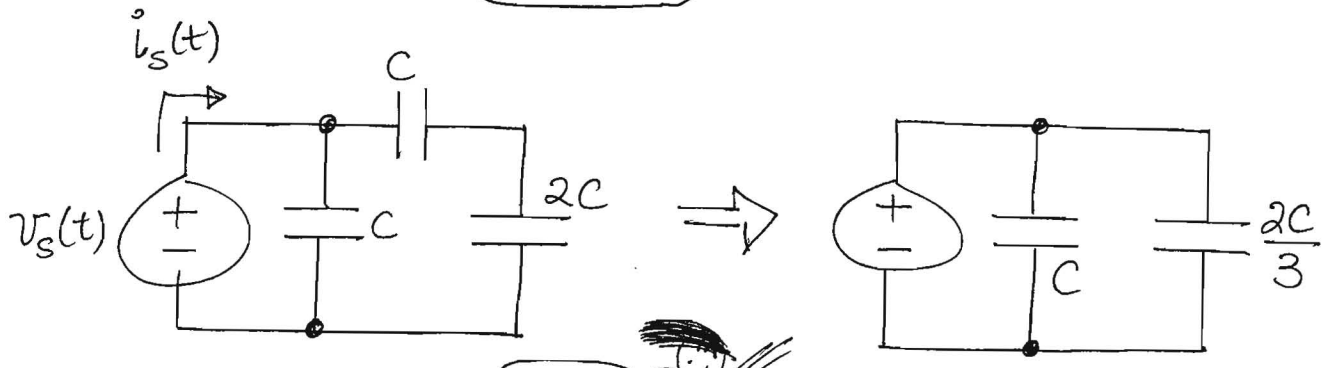
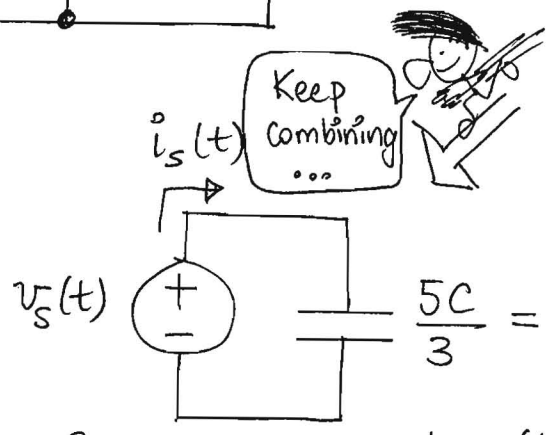
4. (25 points) In the circuit shown, both the source voltage and the source current are given. Assuming all capacitors to have the same value, what is C? (Note: Show all the steps in your solution and please provide the appropriate unit for your answer.)







Since $i_s(t) = C_{eq}\dfrac{dv_s(t)}{dt}$, we have

$$4\cos(3\times10^6 t)\,(10^{-3}) = \frac{5C}{3}(3\times10^6)(10\cos(3\times10^6 t))$$

(mili?)

$$\rightarrow C = 0.8\times10^{-10}\ \text{F} = \boxed{80\text{pF}}$$