

**EE331****Electrical Engineering I****EXAM 1****Monday February 13<sup>th</sup>, 2012**

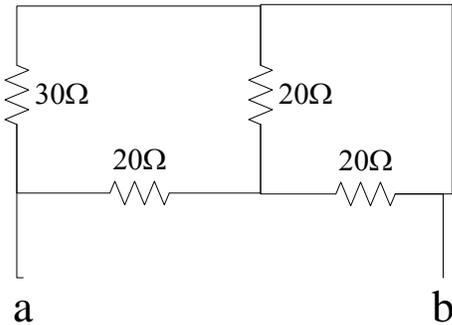
This is a 50 minute exam. Please work quickly and quietly. Place your name below before beginning. There are 6 pages including this cover sheet. Please ensure that you have all 6 pages. Show as much work as practical to maximize partial credit. Eyes should remain on your own work. There is no sharing of calculators. **Do not discuss this exam until it is returned to you.** Please commence when advised.

<b>Page</b>	<b>Points</b>	<b>Score</b>
1		
2	<b>18</b>	
3	<b>16</b>	
4	<b>14</b>	
5	<b>14</b>	
6	<b>18</b>	
Total	<b>80</b>	

**NAME:** \_\_\_\_\_

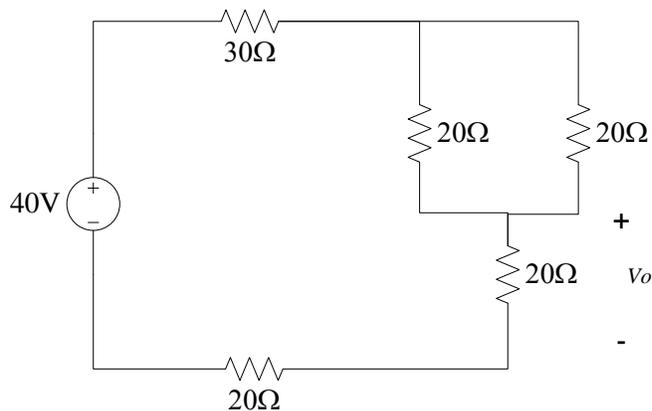
**Problem 1: (2 pts) Warm up!** A lightning Bolt with 8 kA strikes an object for 15  $\mu$ s, how much charge is deposited on the object?

**Problem 2: (4 pts)** Find  $R_{eq}$  between points a and b.



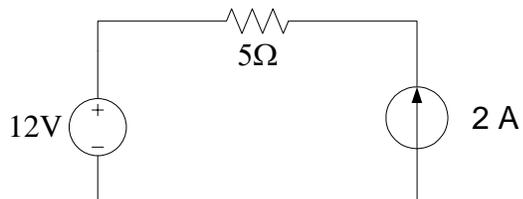
$$R_{eq} = \underline{\hspace{2cm}}$$

**Problem 3: (6 pts)** Find  $V_o$  using the voltage divider rule.



$$V_o = \underline{\hspace{2cm}}$$

**Problem 4: (6 pts)** Compute the power of each element in the circuit below.

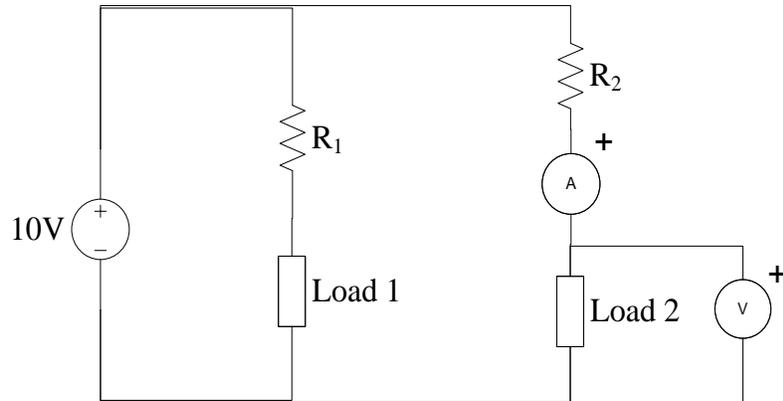


$$P_{5\Omega} = \underline{\hspace{2cm}}$$

$$P_{12V} = \underline{\hspace{2cm}}$$

$$P_{2A} = \underline{\hspace{2cm}}$$

**Problem 4: (8 pts)** Load 1 requires 5V and draws 20 mA. Load 2 requires 3V and draws 25 mA. Compute the requested values.



$$R_1 = \underline{\hspace{2cm}}$$

$$R_2 = \underline{\hspace{2cm}}$$

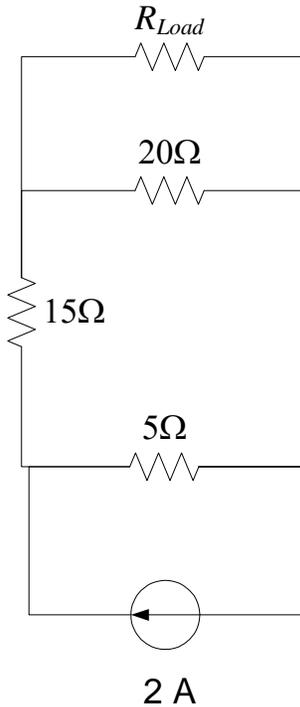
$$\eta \text{ (circuit efficiency)} = \underline{\hspace{2cm}}$$

**Question 1: (4 pts)** What will the Ideal Ammeter and Ideal Voltmeter read in the above circuit?

**Question 2: (4 pts)** If the ideal Ammeter is replaced with a real Ammeter with an internal resistance of  $10 \Omega$ , how does this change your values for Problem 4 (a detailed qualitative discussion is fine)?

**Bonus question 1: (2 pts)** The 10V battery in the above circuit has a 0.8 A-hr capacity, how long will the battery last?

**Problem 5: (10 pts)** Find and **draw** the Thevenin equivalent circuit. (Show your work!)



**Draw Thevenin Circuit**

$$R_{th} = \underline{\hspace{2cm}}$$

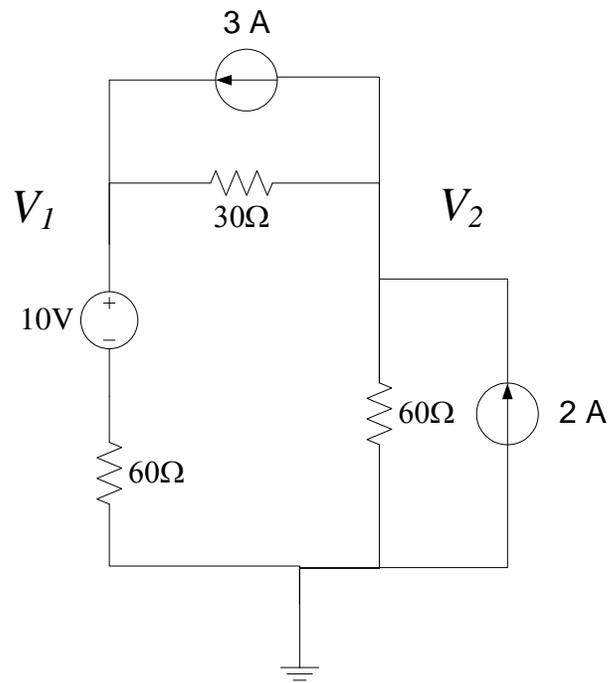
$$V_{th} = \underline{\hspace{2cm}}$$

**Question 3: (4 pts):** The load,  $R_{load}$ , connected to the above circuit draws a current,  $I_{load} = 250$  mA. What is the power to the load and is the load drawing maximum power?

$$P_{load} = \underline{\hspace{2cm}}$$

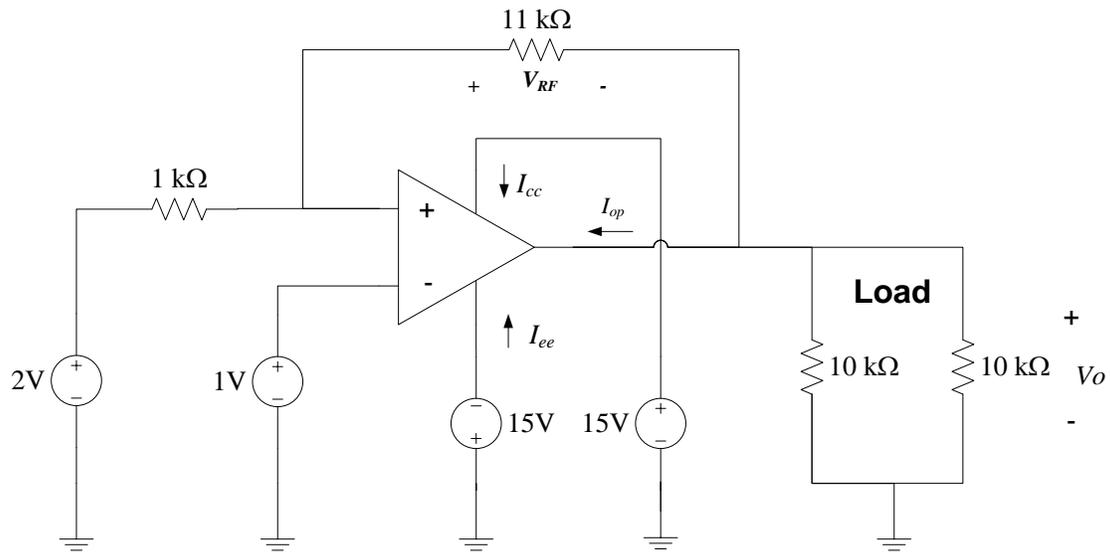
**Maximum power is delivered to load: Yes / No (circle one, and please explain)**

**Problem 6: (10 pts)** Establish the nodal equations required to solve for  $V_1$ , and  $V_2$   
**(DO NOT solve the equations)**



**Question: (4 pts)** If  $V_1 = 20\text{ V}$ ,  $V_2 = 10\text{ V}$  (note, this may or may not be the case), compute the power absorbed by  $R_{30\Omega}$ ?

**Problem 7: (18 pts)** Given the following operational amplifier circuit, calculate the following quantities: *Show your work!*



- a. (6 pts) Calculate the load voltage,  $V_o$  and  $V_{RF}$

$$V_o = \underline{\hspace{2cm}}$$

$$V_{RF} = \underline{\hspace{2cm}}$$

- b. (4 pts) Find the op amp current,  $I_{op}$

$$I_{op} = \underline{\hspace{2cm}}$$

- c. (4 pts) If  $I_{cc} = 1$  mA, find  $I_{ee}$ .

$$I_{ee} = \underline{\hspace{2cm}}$$

- d. (4 pts) Find the power of each 15V power supply

$$P_{cc} = \underline{\hspace{2cm}}$$

$$P_{ee} = \underline{\hspace{2cm}}$$

**Bonus question 2: (2 pts)** Compute the overall amplifier efficiency (*hint: the **Load** is the circuit output*).