 ID number_____

Unified Quiz 3S
November 5, 2004

Two 8 1/2" x 11" sheets (both sides) of notes allowed.

Calculators are not needed, and may not be used.

No books allowed.

- **Put the last 4 digits of your ID on each page of the exam.**
- **Read all questions carefully.**
- **Do all work for each problem on the two pages provided.**
- **Show intermediate results.**
- **Explain your work --- don't just write equations. Any problem (except multiple choice) without an explanation can receive no better than a "B" grade.**
- **Partial credit will be given, but only when the intermediate results and explanations are clear.**
- **Please be neat. It will be easier to identify correct or partially correct responses when the response is neat.**
- **Show appropriate units with your final answers.**
- **Box your final answers.**

Exam Scoring

#1 (12.5%)	
#2 (12.5%)	
#3 (25%)	
#4 (25%)	
#5 (25%)	
Total	

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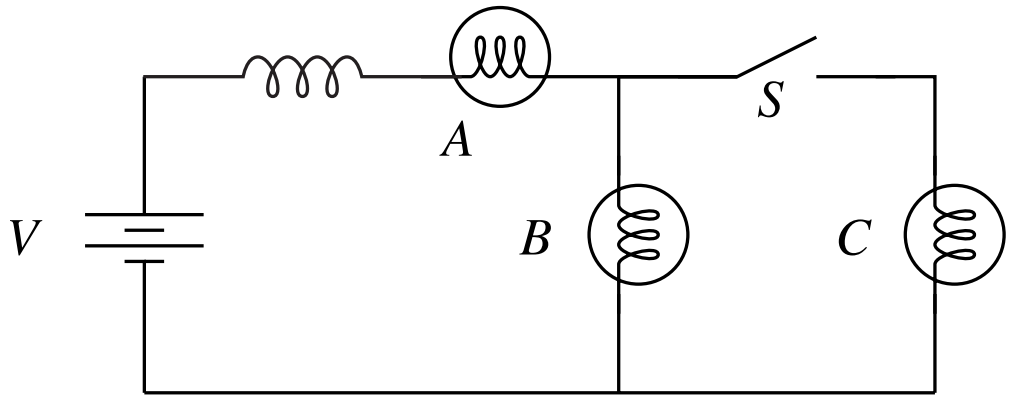
PROBLEM #1 (12.5%)



Consider the circuit above with three identical light bulbs, an inductor, and a switch. Initially, the switch is open, and has been open for a long time. When the switch is closed, what happens to the intensity of each bulb?

1. Immediately after the switch is closed, the intensity of bulb *A*

   increases decreases stays the same

2. Immediately after the switch is closed, the intensity of bulb *B*

   increases decreases stays the same

3. After the switch has been closed for a long time, the intensity of bulb *A* is

   greater than less than the same as

   the intensity of bulb *A* before the switch is closed.

4. After the switch has been closed for a long time, the intensity of bulb *B* is

   greater than less than the same as

   the intensity of bulb *B* before the switch is closed.

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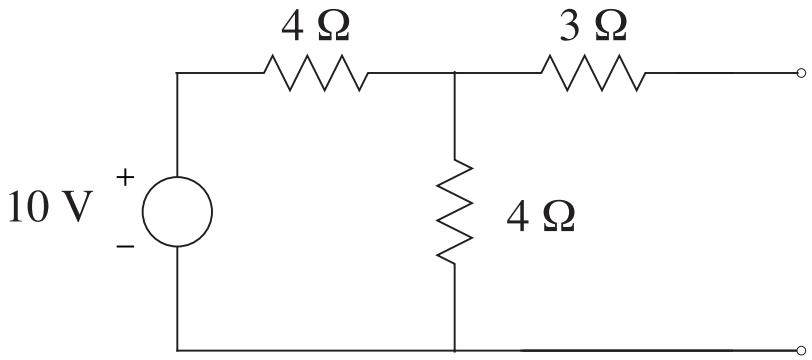
PROBLEM #2 (12.5%)

Find the Thevinin equivalent for the circuit below:



PROBLEM #2 (continued)

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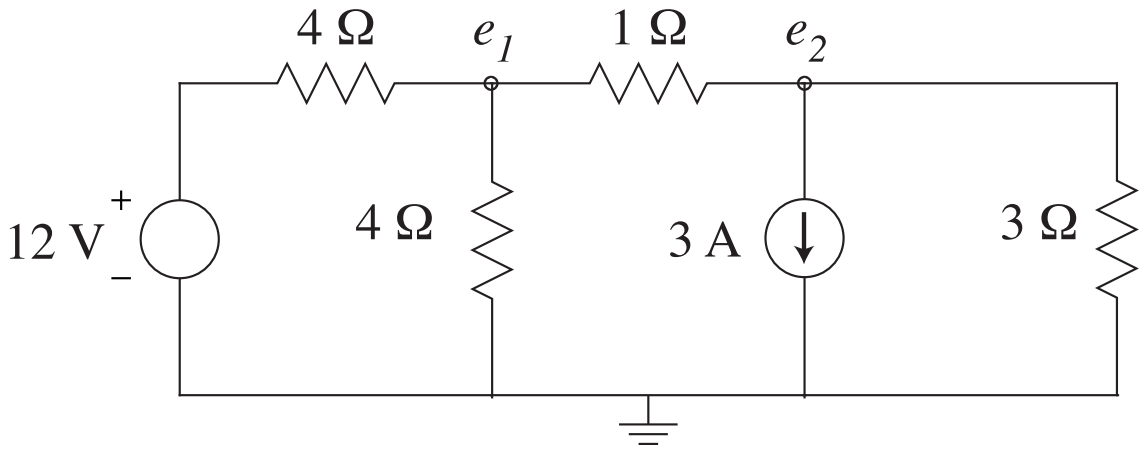
PROBLEM #3 (25%)



For the circuit above, calculate:

(a) The node potentials e_1 and e_2.

(b) The current in the 3 Ω resistor. Make sure that you specify the direction of the current.

PROBLEM #3 (continued)

PROBLEM #4 (continued)

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PROBLEM #4 (25%)

A circuit has dynamics described by the state-space equation

$$\frac{d}{dt}\begin{bmatrix} v_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} -3 & -1 \\ 2 & 0 \end{bmatrix}\begin{bmatrix} v_1 \\ i_2 \end{bmatrix}$$

Find $v_1(t)$ and $i_2(t)$ for the initial conditions

$$v_1(0) = 1 \text{ V}$$
$$i_2(0) = 4 \text{ A}$$

PROBLEM #4 (continued)

PROBLEM #4 (continued)

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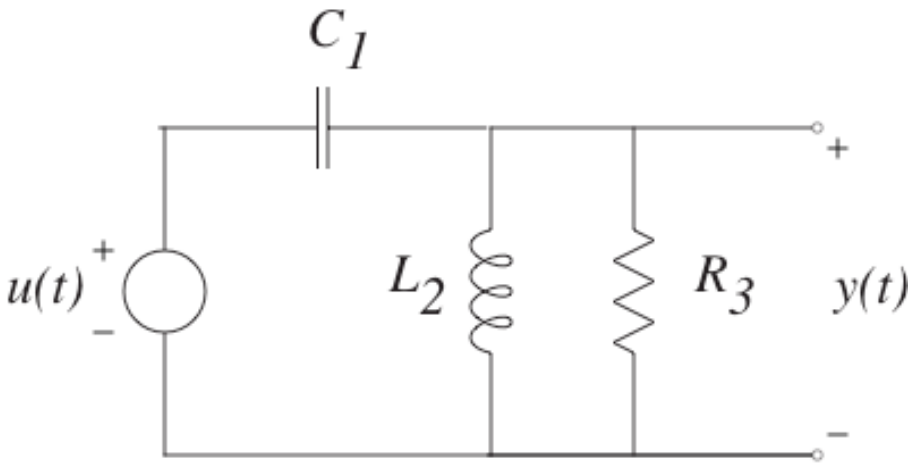
PROBLEM #5 (25%)



Find the differential equations that describe the input-output behavior of the circuit above, in state-space form,

$$\dot{\underline{x}}(t) = A\underline{x}(t) + Bu(t)$$
$$y(t) = C\underline{x}(t) + Du(t)$$

That is, you must define the state vector $\underline{x}$, and then derive the matrices A, B, C, and D. The component values are not given, so your answer should be in symbolic form.

PROBLEM #5 (continued)

PROBLEM #5 (continued)