Duke University
Edmund T. Pratt, Jr. School of Engineering

EGR 119 Spring 2011

# Test I

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Name (please print)_____

In keeping with the Community Standard, I have neither provided nor received any assistance on this test. I understand if it is later determined that I gave or received assistance, I will be brought before the Undergraduate Conduct Board and, if found responsible for academic dishonesty or academic contempt, fail the class. I also understand that I am not allowed to speak to anyone except the instructor about any aspect of this test until the instructor announces it is allowed. I understand if it is later determined that I did speak to another person about the test before the instructor said it was allowed, I will be brought before the Undergraduate Conduct Board and, if found responsible for academic dishonesty or academic contempt, fail the class.

Signature:_____

## Instructions

First - please turn **off** any cell phones or other annoyance-producing devices. Vibrate mode is not enough - your device needs to be in a mode where it will make no sounds during the course of the test, including the vibrate buzz or those acknowledging receipt of a text or voicemail.

Please be sure to put each problem on its own page or pages - do *not* write answers to more than one problem on any piece of paper and do not use the back of a problem for work on a *different* problem. You will be turning in each of the problems independently. This cover page should be stapled to the front of Problem 1.

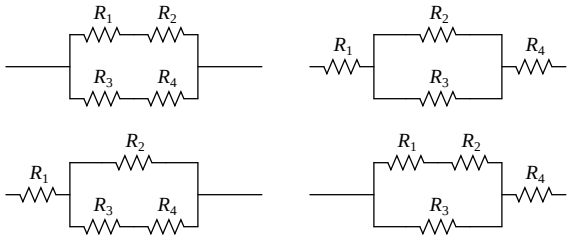
Make sure that your name *and* NET ID are *clearly* written at the top of *every* page, just in case problem parts come loose in the shuffle. Make sure that the work you are submitting for an answer is clearly marked as such. Finally, when turning in the test, individually staple all the work for each problem and place each problem's work in the appropriate folder.

Note that there may be people taking the test after you, so you are not allowed to talk about the test - even to people outside of this class - until I send along the OK. This includes talking about the specific problem types, how long it took you, how hard you thought it was - really anything. Please maintain the integrity of this test.

You may use the $\|$ symbol for resistances in parallel and do not need to expand that construction. Be clear with your use of parentheses, however; simply writing something like

$$R_{\text{eq}} = R_1 + R_2 \parallel R_3 + R_4$$

is too vague since it could refer to any of the four combinations below:



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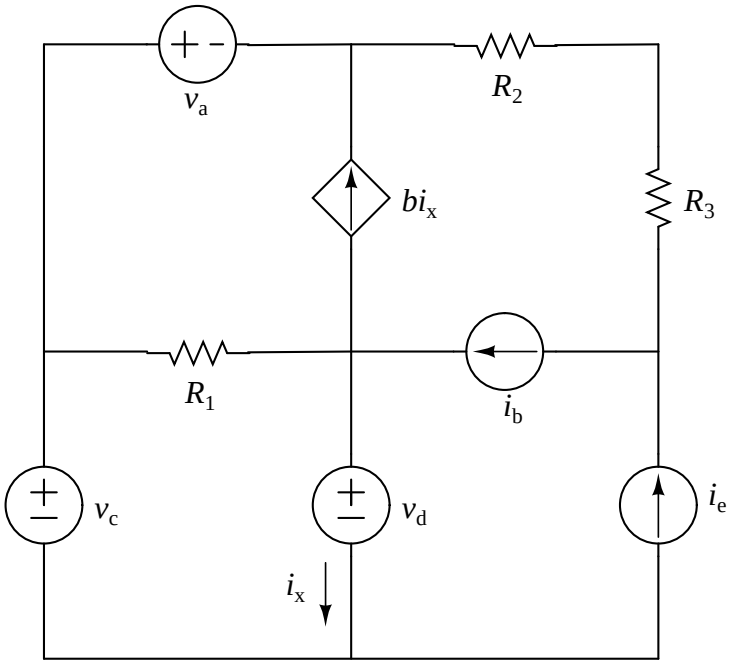
## Problem I: [20 pts.] The Basics

Given the following circuit:




and assuming that gain $b$, the values for the passive elements ($R_1$, $R_2$, $R_3$), and the values for the independent sources ($v_a$, $i_b$, $v_c$, $v_d$, $i_e$) are known, determine expressions for the following values in terms of known values. Note - if you solve for an unknown in terms of known quantities and clearly indicate that expression, you may use it in later calculations without substitution. Put your expressions next to the appropriate bullet below:

- $i_x$

- $p_{abs,R_1} =$

- $p_{abs,R_2} =$

- $p_{del,v_c} =$

- $p_{del,CCCS} =$

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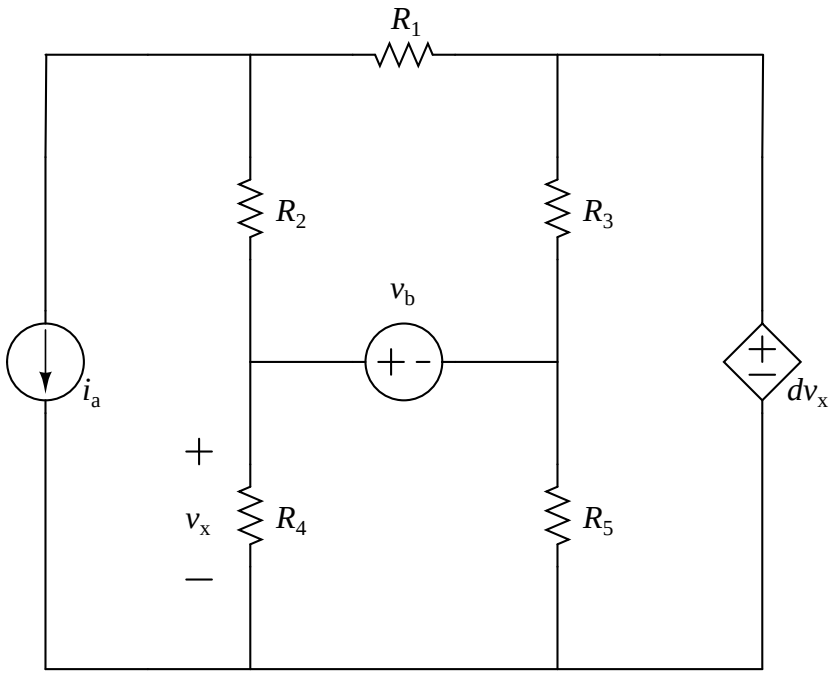
## Problem II: [20 pts.] Node Voltage Method

Given the following circuit:




and assuming that gain $d$, the values for the passive elements ($R_1$, $R_2$, $R_3$, $R_4$, $R_5$), and the values for the independent sources ($i_a$, $v_b$) are known,

*(a)* *Clearly* demonstrate the use of the Node Voltage Method in labeling unknowns for the circuit and in determining a complete set of linearly independent equations that could be used to solve for these unknowns. List the set of unknowns you believe your equations will find.

*(b)* Assuming you are able to solve for those unknowns, write expressions for

- $p_{\text{abs},R_2} =$

- $p_{\text{del},v_b} =$

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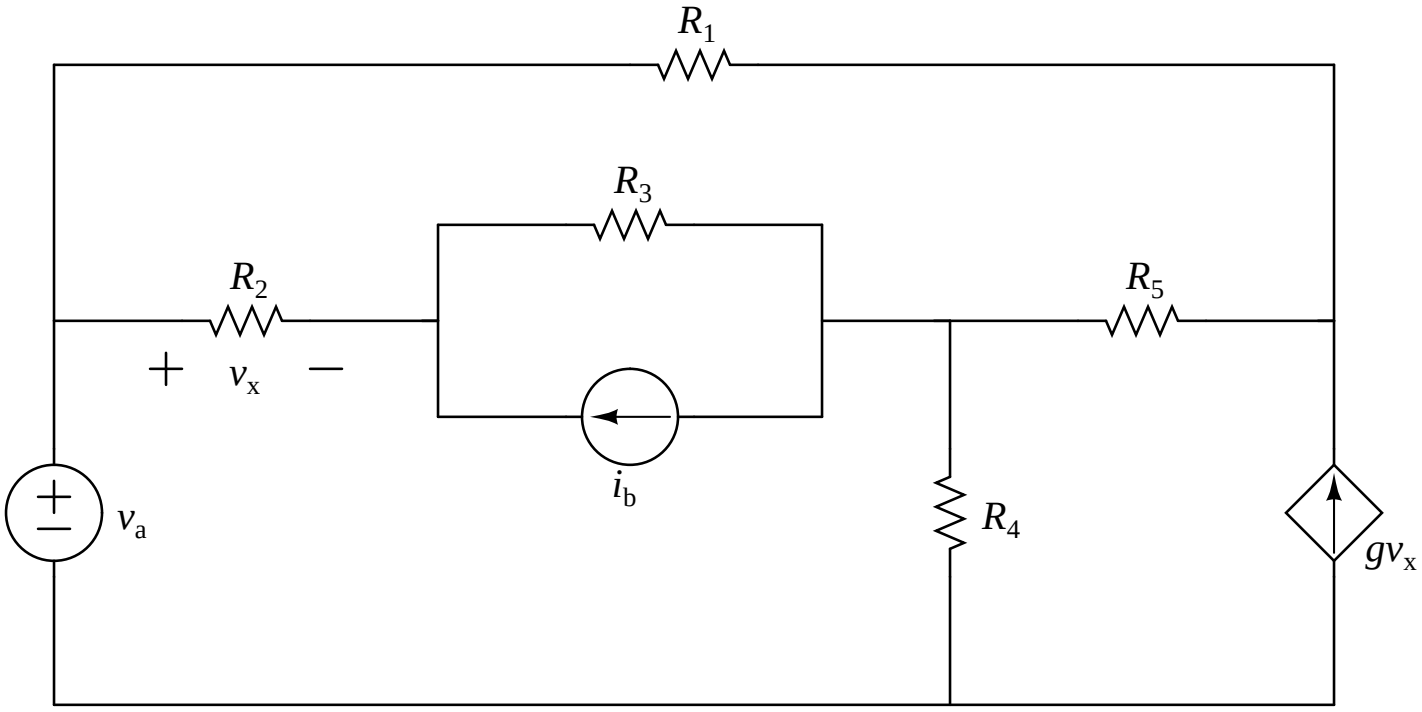
## Problem III: [20 pts.] Mesh Current Method

Given the following circuit:




and assuming that gain $g$, the values for the passive elements ($R_1$, $R_2$, $R_3$, $R_4$, $R_5$), and the values for the independent sources ($v_a$, $i_b$) are known,

*(a)* *Clearly* demonstrate the use of the Mesh Current Method in labeling unknowns for the circuit and in determining a complete set of linearly independent equations that could be used to solve for these unknowns. List the set of unknowns you believe your equations will find.

*(b)* Assuming you are able to solve for those unknowns, write an expression for:

- $p_{\text{abs},R_4} =$

- $p_{\text{del},i_b} =$

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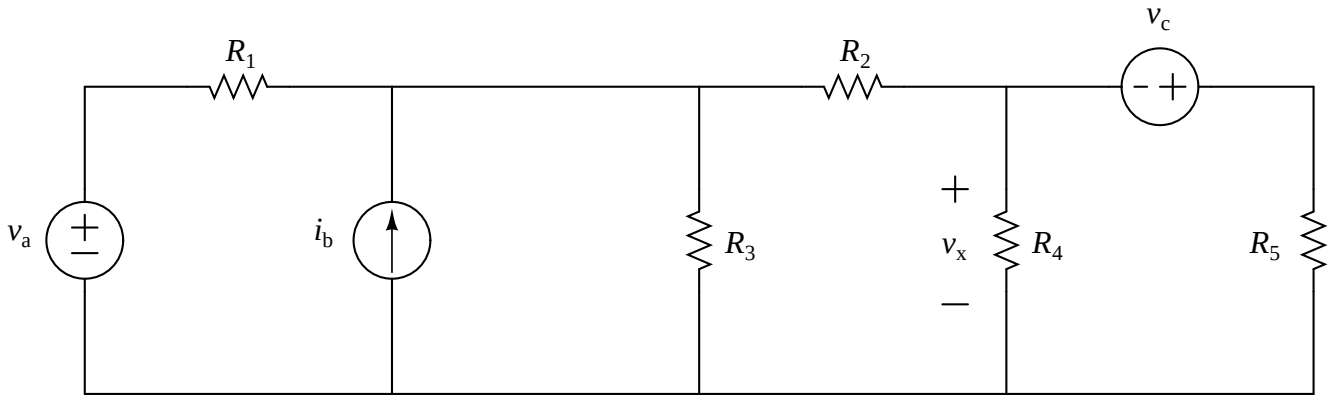
## Problem IV: [20 pts.] Superposition

Given the following circuit:




and assuming that the values for the passive elements ($R_1$, $R_2$, $R_3$, $R_4$, $R_5$), and the values for the independent sources ($v_a$, $i_b$, $v_c$) are known, *clearly* demonstrate the use of superposition and find an expression for the unknown voltage $v_x$ in terms of the passive element values and the sources.

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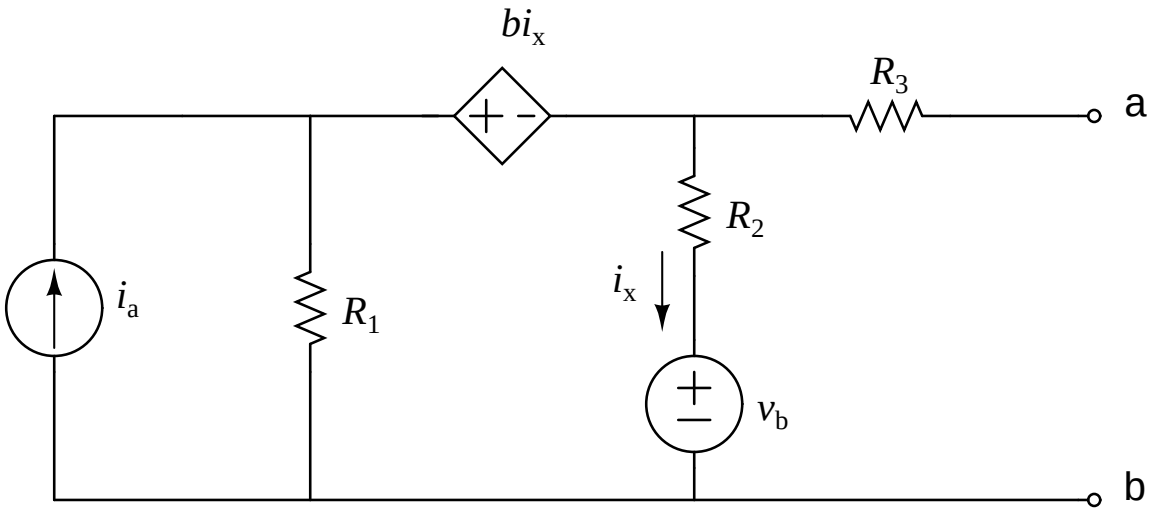
## Problem V: [20 pts.] Thévenin/Norton Equivalent Circuits

Given the following circuit:




and assuming that gain $b$, the values for the passive elements ($R_1$, $R_2$, $R_3$), and the values for the independent sources ($i_a$, $v_b$) are known, draw both the Thévenin and Norton equivalent circuits with respect to terminals $a$ and $b$ in terms of the known values.