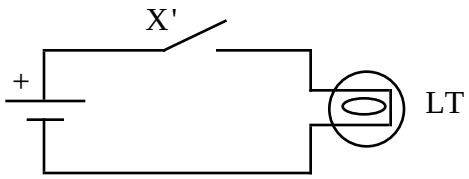
ECE 204 - THE VERY BASICS - INVESTIGATION 3
INTRODUCTION TO SWITCHING CIRCUITS - PART III

FALL 2003 **A.P. FELZER**

To do "well" on this investigation you must not only get the right answers but must also do neat, complete and concise writeups that make obvious what each problem is, how you're solving the problem and what your answer is. You also need to include drawings of all circuits as well as appropriate graphs and tables.

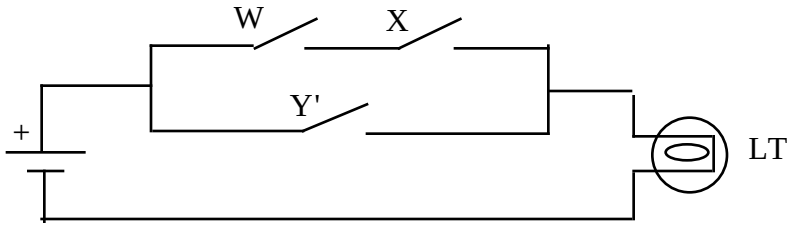
In Investigation 2 we showed how we could write equations for combinational switching circuits including those containing complements like X' and Y'. The main objective of this Investigation is to get practice writing logic equations from logic circuits and truth tables.

1. We begin with some review problems. Given the following logic circuit



   a. Write the logic equation for LT
   b. Write the Truth Table for LT

2. Given the following logic circuit



   a. Write the logic equation for LT
   b. Write out the Truth Table for LT

3. Draw a logic circuit for LT = W' and (X or Y)

4. When we write logic equations in the world of digital circuits we use

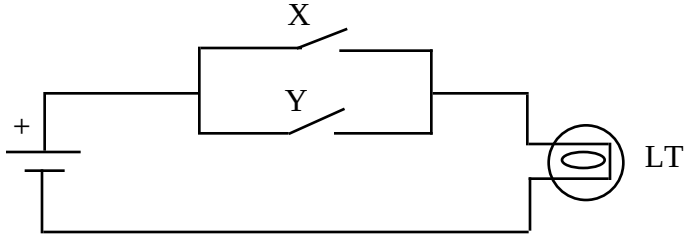
   pluses in place of *or's*: **or** → **+**

   dots in place of *and's:* **and** → **·**

   So an equation like the following

   LT = X and Y becomes LT = X·Y

   Use this new notation to write the logic equation for the following circuit



5. Note that when we write a logic equation like the following

$$LT = W \cdot X + Y'$$

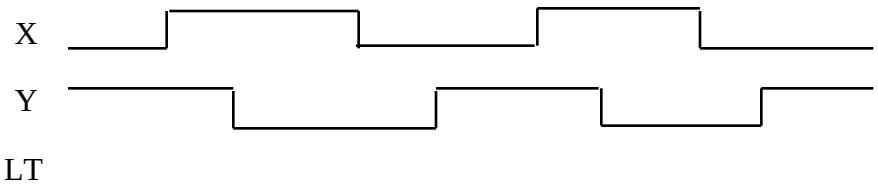
it's always understood that the AND'ing is done first and then the OR'ing. Make use of this convention to obtain a
   a. Truth Table for LT
   b. Switching circuit for LT

6. Draw a switching circuit for the logic equation $LT = V \cdot W + X' \cdot Y$

7. Given the following Truth Table

X	**Y**	**LT**
L	L	L
L	H	L
H	L	H
H	H	L

   a. Find the logic equation for LT
   b. Draw a logic circuit for LT
   c. Complete the following timing diagram



8. Up to now all the truth tables we've been writing equations for have only had one row with LT=H. But more generally our truth table will have two or more such rows as follows

X	**Y**	**LT**
L	L	L
L	H	H
H	L	H
H	H	L

What this truth table tell us is that the light will be ON when X=L and Y=H as well as when X=H and Y=L. Therefore we can write an equation for LT as follows

$$LT = X' \cdot Y + X \cdot Y'$$

with one term for each row of the truth table where LT=H. Note in particular that each of the terms $X' \cdot Y$ and $X \cdot Y'$ contains each of the variables. We call these products **minterms**. **Memorize** this definition and then write the equation for LT with the following truth table

X	**Y**	**LT**
L	L	H
L	H	H
H	L	L
H	H	H

as a sum of minterms. Note that a given signal can control more than one switch.