# Analog and Digital Electronics

Spring 2018

Take Home Final Exam:

You may use your text and class notes and lab notes. Do not consult other texts or persons about this exam. If you have Questions, you may come in and see me. **Due Wednesday May 23 at 9:00 am. This Exam is worth 80 points.**

Assume all op amps are ideal (zero offset voltage, infinite open loop gain and zero input or bias current) unless stated otherwise. Also assume the output voltages go from –10V to + 10V unless stated otherwise. SHOW YOUR WORK! BE NEAT!

Problems: DO FOUR of the FIVE problems (and of course the extra credit).

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1. If the potential difference, $V_A - V_B$, in the circuit at the right is + 6V, what is the EMF of the second battery, V_2?   I have used a box to indicate the battery's position because I want you to determine its orientation in the circuit. Draw the circuit indicating the value of the battery and its orientation in the circuit.
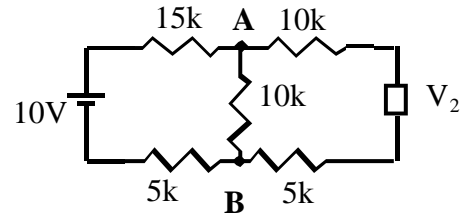

2. Find the truth table for the circuit below. It consists of an AND gate a NOR gate and a NAND Gate. I am not interested in the values Y1 and Y2, but you may find it helpful to fill them in. (**Make your truth table as shown below**!)
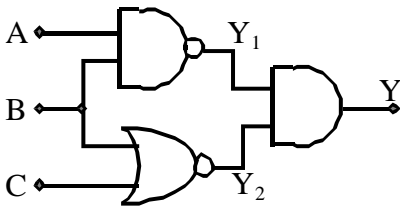

| A	B	C	Y_1	Y_2	Y
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

3. Find the output voltage for the circuit at the right. Note that there are three voltages applied to the circuit, + 3V, + 3V and – 1V.
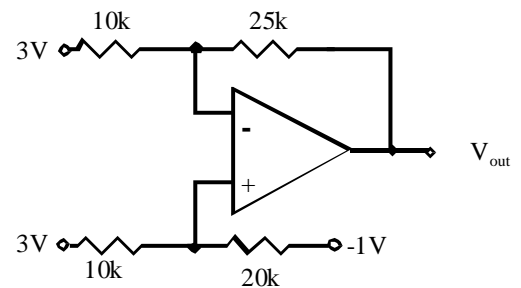
4. Given the positive edge triggered D flip-flops, find the three outputs Q_A, Q_B and Q_C for the given clock input. Assume the clears and presets are inactive (High) and all three Q's are initially low. (Note that the gate is a NOR gate.)
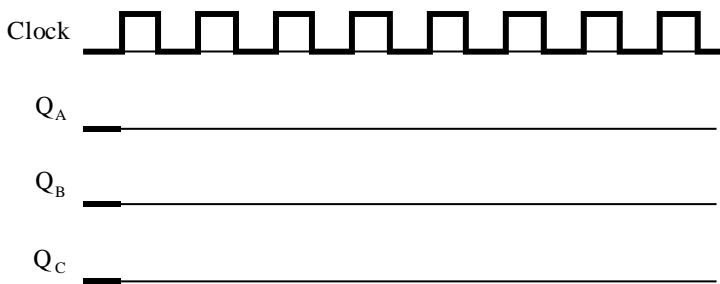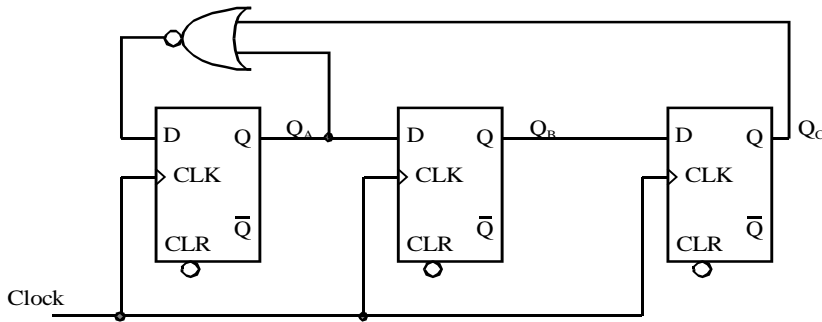

5. Sketch V_{out} for the V_{in} given in the graph below for the circuit below, i.e. a triangle wave going from $-4V$ to $+4V$. Assume the outputs can swing to $\pm 10V$. (Sketch V_{out} on the same graph.) At what values of V_{in} does the output go from low to high and high to low? (Hint: how do the + and – inputs to the op amp compare when transitions occur?)
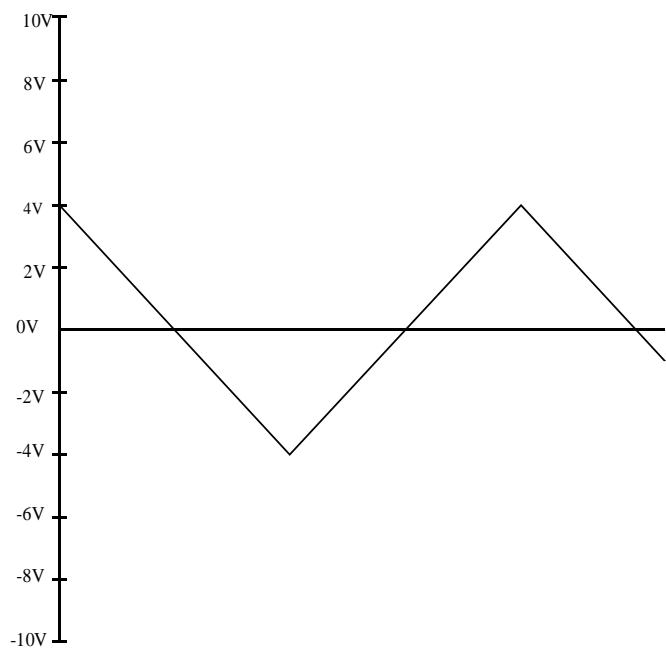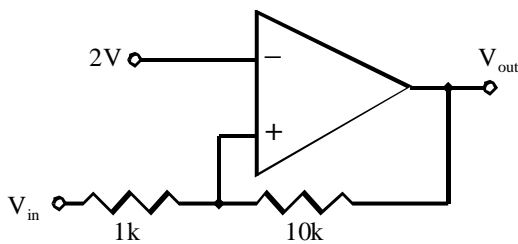
Given the two op amps at the right, find
   a) V_A and V_B as a function of V_1 and V_2 and the R's.
   b)   The difference between V_A & V_B, i.e. $V_A - V_B$.
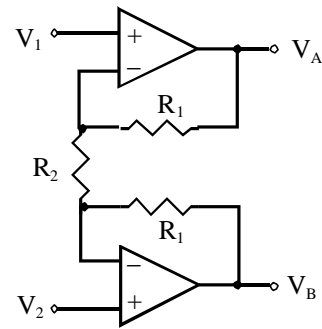
For the in class final you may bring and use the class notes I've handed out! The primary emphasis will be on digital to analog and analog to digital conversions, binary numbers, filtering, and Kirchoff's Rules.