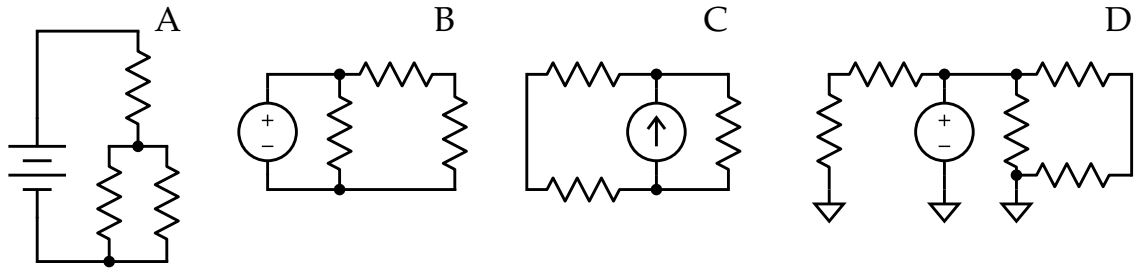
Name: _____ Lab section/TA: _____

Problem Set 2

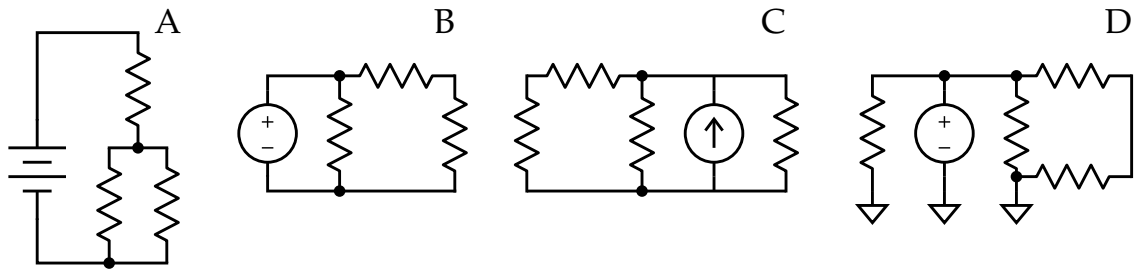
The following problems will give you some practice working with series and parallel resistances. You will use these concepts to explore what happens when you connect a multimeter to your circuit and how it can cause measurement errors.

Problem 1: Series and parallel

On the circuit diagrams below, circle the pairs of resistors which are in series. For the purposes of this problem, don't include larger combinations that will be in series after some simplification. *Hint: There are a total of 4 pairs. Some circuits might not have any, and some might have more than one pair.*

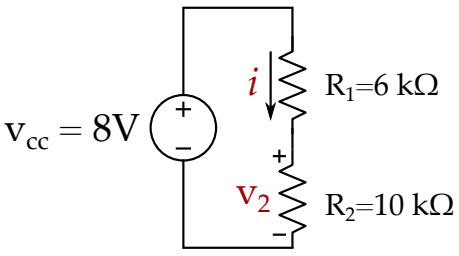


On the diagrams below, circle the pairs of resistors which are in parallel. Again, don't circle larger combinations.

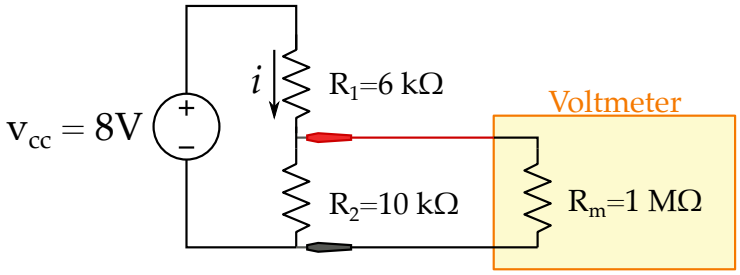


Problem 2: Voltage measurements

For the circuit below, find i and v_2.



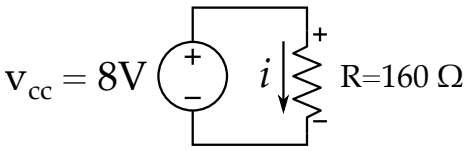
Now we add a multimeter to measure v_2, and put the meter into voltage-measuring mode. If the meter has an internal resistance of 1 MΩ in voltage mode, what voltage will it measure (i.e., what is the voltage across R_m)?



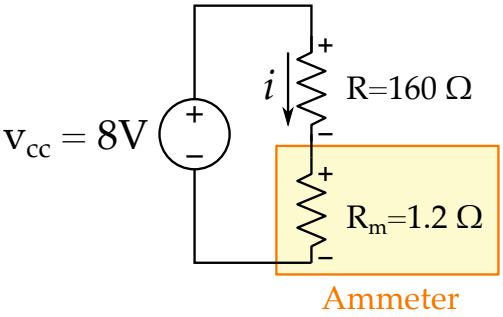
We carelessly try to measure i by leaving the probes connected the same way and switching the meter into current-measuring mode. The meter has a resistance of 100 Ω in 2000 µA current mode. What current does the meter measure? How close is this to the true i?

Problem 3: Current measurements

For the circuit below, find the current i.



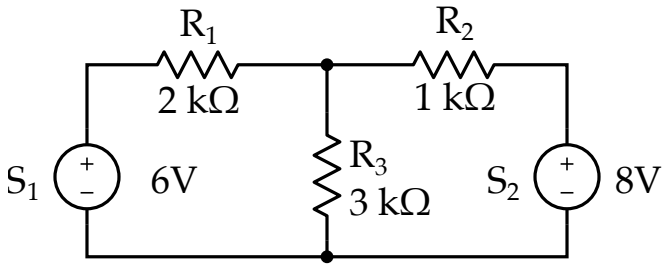
Now we use a multimeter to measure the current. Assume that the meter has a $1.2\,\Omega$ resistance on the $200\,\text{mA}$ setting. What current will the meter actually measure?



We switch the meter into voltage-measurement mode, which has $R_m = 1\,\text{M}\Omega$. What voltage will the meter measure?

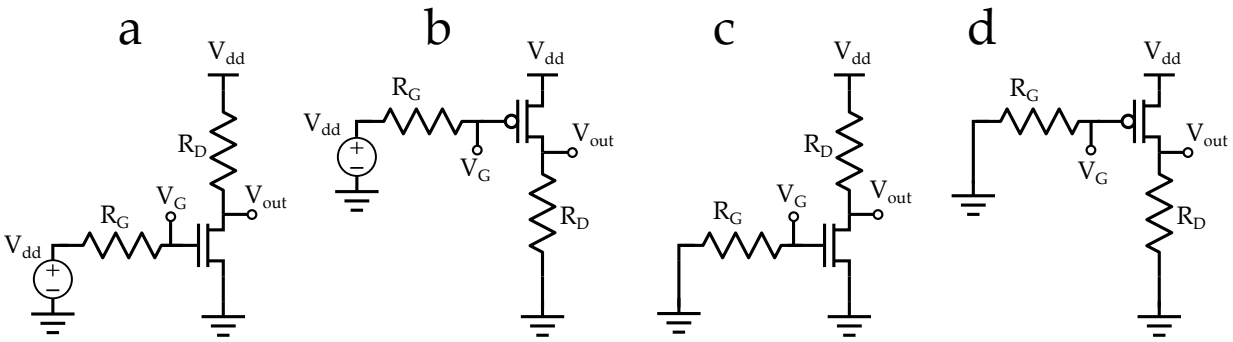
Problem 4: Nodal Analysis

Use nodal analysis find the current through each of the resistors.



Problem 5: NMOS and PMOS Transistors

(12 Points) For each of the circuits below, find V_G and V_{out} (relative to ground). $V_{dd} = 5\,\text{V}$, $R_G = 1\,\text{k}\Omega$, $R_D = 10\,\text{k}\Omega$. The transistors have a resistance of $50\,\Omega$ between the source and drain when they are on (connected), and a resistance of $500\,\text{M}\Omega$ when off (disconnected).



Problem 6: Reflection

How long did it take you to complete this assignment?

Which problem was the most difficult?