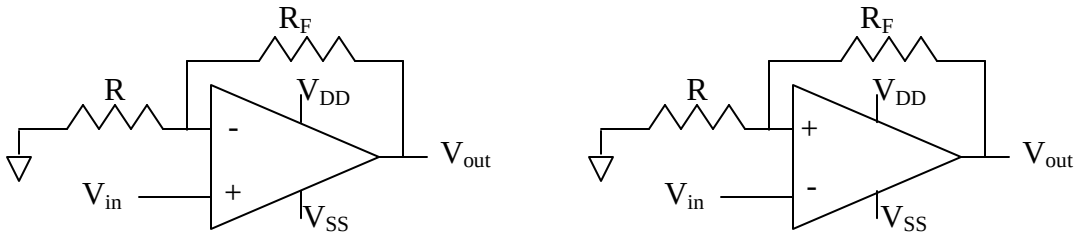
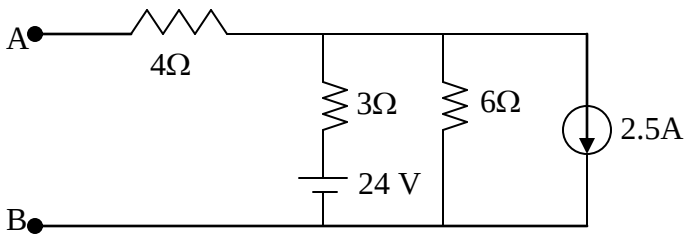
Ph.D. Qualifying Examination in Electronics (Fall, 2008)
Department of Electrical and Biomedical Engineering

Do 6 of 7 problems.

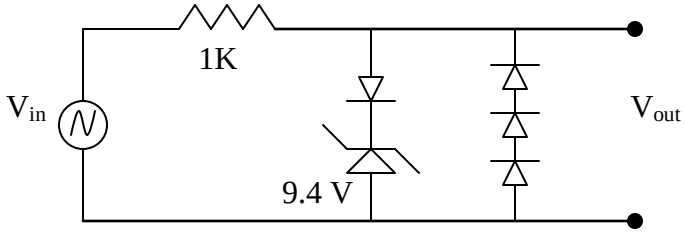
1. For the operational amplifier circuits below, give an expression for the output voltage V_{out} in terms of the input voltage V_{in} when the feedback resistor R_F has a value of 2R.



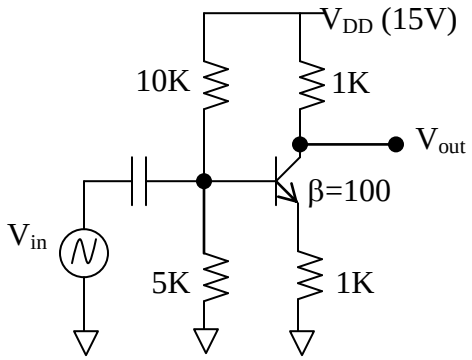
2. For the circuit below, find the Thevenin equivalent circuit across AB.



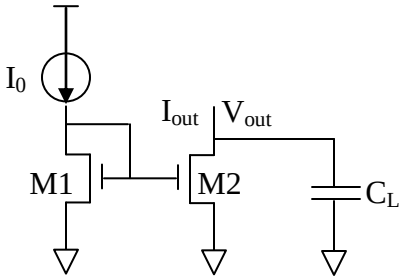
3. For the diode circuit below, sketch the output waveform for an input sinusoid of magnitude 12 volts when (a) the diodes are idea; and (b) the diodes have a drop of 0.6 volts.



4. For the circuit below, find the quiescent collector current and collector-emitter voltage. Drive an expression for the voltage gain. If an emitter bypass capacitor is added, derive the new expression for the voltage gain. (Vbe=0.7V)



5. For the simple current source below, find an expression for the M2 drain current I_{out} in terms of the M2 drain voltage V_{out}. Assume M1 is always in saturation, and both M1 and M2 are NMOS transistors.



6. Sketch a three input CMOS NAND gate with a capacitive load. If a minimum geometry (W/L=1) device is used, would you expect the rise or the fall time to be faster? Explain.

7. Compare ideal operational amplifiers to real operational amplifiers. Discuss the limits of real operational amplifiers relative to the 741.