PHYS 235 — Exam #2 Thursday, March 5, 2009

Name:

(18 pts) Consider the illustrated circuit containing an ideal op-amp (powered from ±15 V supplies) and resistors. Determine the numerical value of output voltage v_{out}. Be sure to include all reasoning and/or derivations.



3. (10 pts) Why is an amplifier with a voltage gain of 1, i.e., with $v_{\text{out}} = v_{\text{in}}$, of any use to anyone? (Specific examples may help your explanation.)

5. (18 pts) Consider the illustrated circuit with a transistor and two resistors. You may use the "simplest" model of transistor behavior in this problem, i.e., $I_B \simeq 0$.



- (a) Determine the output when $v_{\rm in} = 2$ V.
- (b) Determine the output when $v_{\rm in} = 4$ V.

3. Ideal op-amps are assumed to have open-loop gains A_0 that are infinite, and for an ideal op-amp the following circuit is a voltage follower with $v_{out} = v_{in}$. If the op-amp is **not** ideal, and A_0 is finite, determine v_{out} in terms of v_{in} and A_0 . (You may still assume that the inputs do not draw any current.)



4. Consider the illustrated circuit containing a battery, a silicon diode and a resistor.



- (a) Sketch a graph of the the voltage output waveform for the illustrated input.
- (b) Sketch a graph of the current through the resistor vs. time.



5. Sketch the output $v_{\rm out}$ of the illustrated circuit for the input shown in the graph.





- 5. (10 pts) You go into lab and find:
 - a supply of 1.5 V D-Cell batteries,
 - a large selection of resistors, and
 - some green Light Emitting Diodes with a turn-on voltage of 2.2 V that emit the desired amount of light when a current of 20 mA flows through them.

Design a circuit that will power one of the LEDs.

6. (10 pts) In lab you built a full-wave bridge rectifier:



What is the purpose of the $100 \,\mu\text{F}$ capacitor in this circuit? (What would the voltage across the load be without the capacitor compared to the voltage with the capacitor? How does the value of the capacitance affect the output?)