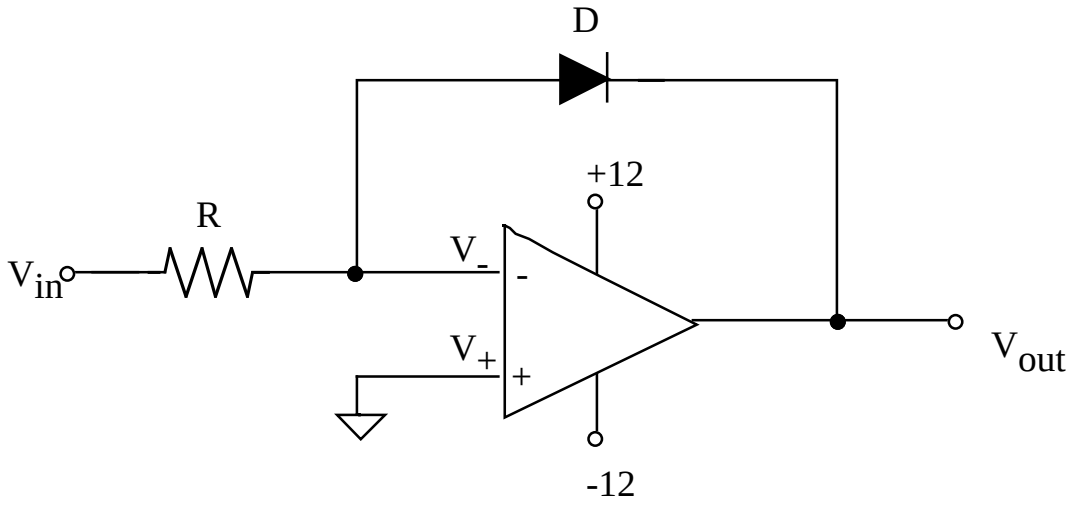
Homework #4:

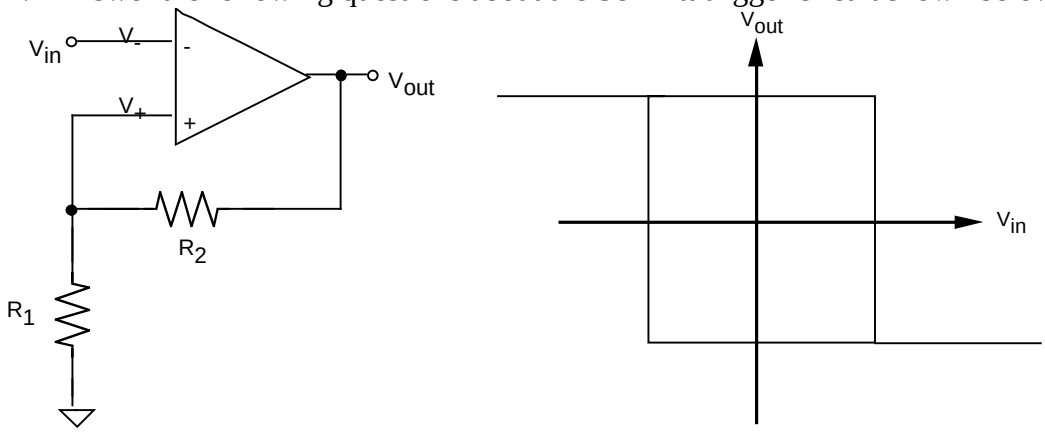
# LOGARITHMIC AMPLIFIER

1. (50 points) The operational amplifier shown in the circuit below is ideal. The diode is at room temperature. Determine $V_{out}$ as a function of $V_{in}$. Use R=1kW and $I_S$ (the saturation current in the Shockley equation, see page 172 in your text) = 1μA in your solution.

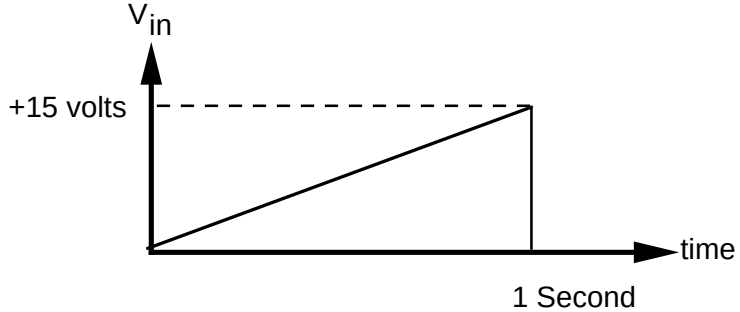



# SCHMITT TRIGGER

2. Answer the following questions about the Schmitt trigger circuit shown below.




(a) If Vin=0 volts and Vout=+15 volts describe what happens to Vout if Vin(t) is:




(b) Using the input/output diagram at the above right, explain hysteresis, the difference between the upper and lower trip points, as it applies to a Schmitt trigger. How can you change it in the given circuit.

(c) How could you modify the above circuit so that the circuit operation is no longer centered about zero.

3. A student built the circuit shown in Figure 1 below in order to create a Schmitt trigger, but it was tested and the output voltage versus the input voltage behaved as shown in the right-hand figure.

(a) You are to examine the student's circuit and show where s/he made the error since it clearly doesn't work like it was supposed to.
(b) Explain why the circuit behaved as shown.
(c) Correct the circuit so that it will operate as a Schmitt trigger.
(d) Now that the error has been corrected, assume $R_2$=10k$\Omega$ and $R_3$=100k$\Omega$ and find the value of $R_1$ which will cause the output to switch from +10 volts to -10 volts at approximately $V_s$=3.5 volts. Show all work.

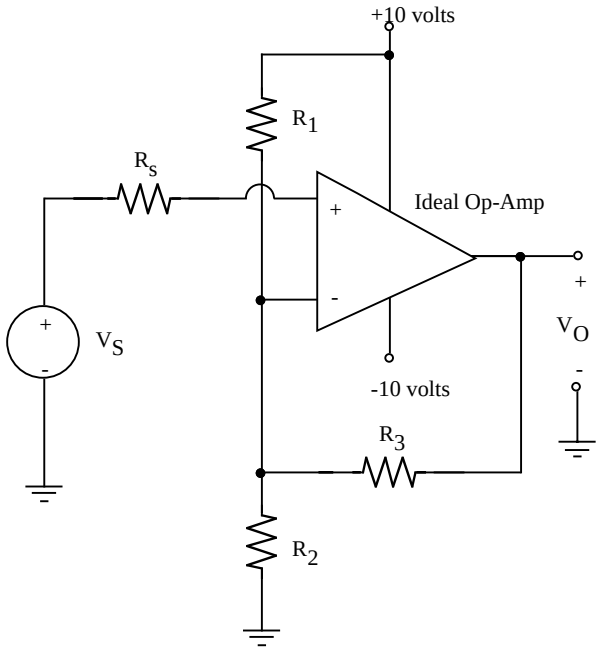



Figure 1. Circuit for problem 3.

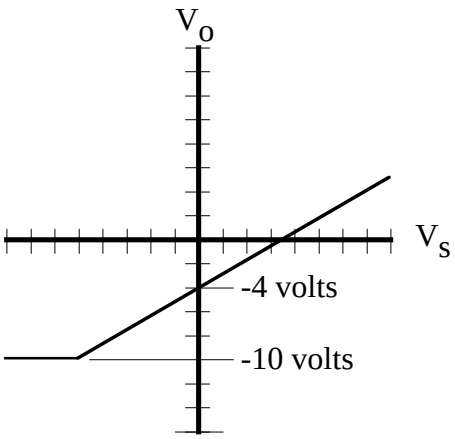



Figure 2. Graph of experimentally measured output.

# BJT Problems (from Hambley)

4.12
4.17 (This is a PSpice problem)
4.22
4.33
4.34
4.37 (Note: the resistor color code and 1%, 5%, 10% and 20% tolerance values are given in Appendix A, pages 865-866 of Hambley).