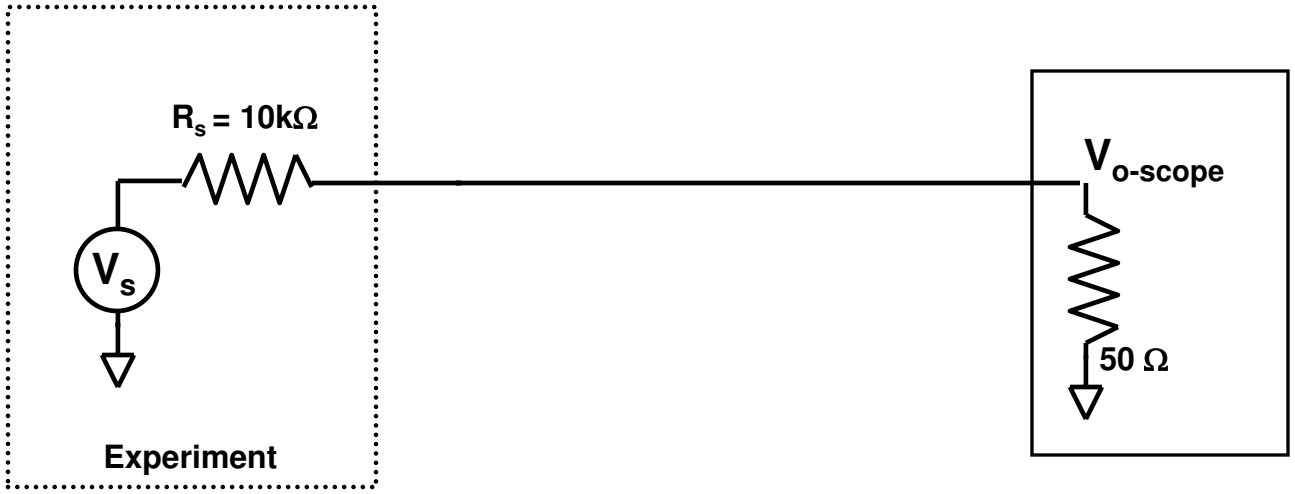
Name: _____ Perm #: _____ TA: _____

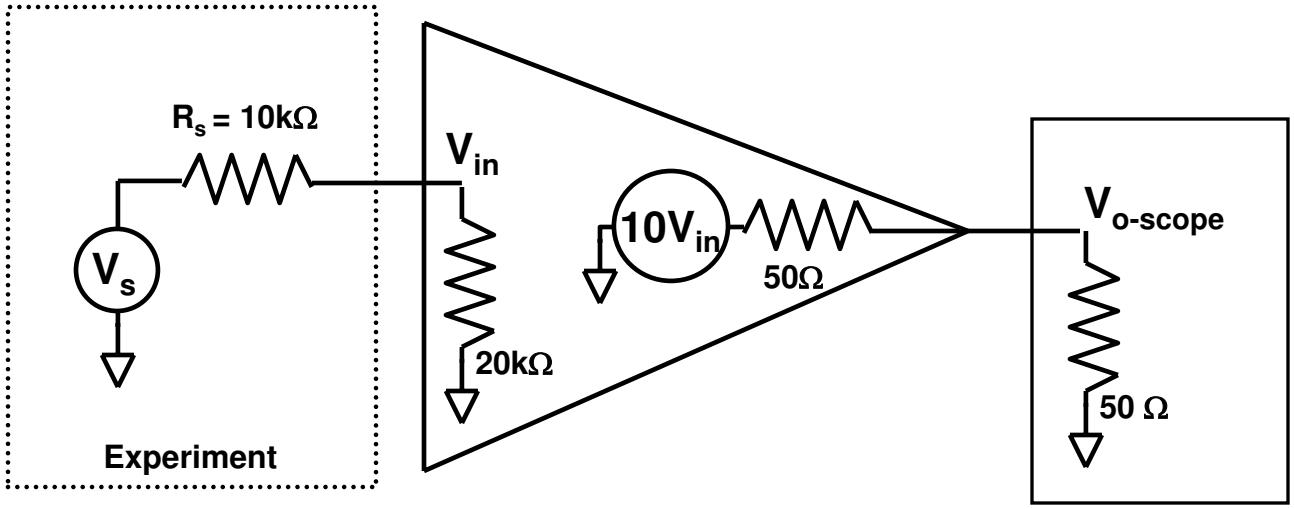
HW6, PHYSICS 127A

1. (a) You are measuring with a high-speed oscilloscope (with 50 Ω input resistance) an experiment with a Vs = 1 mV voltage source and a 10 kΩ source impedance. What is the voltage measured by the o-scope? Why is the voltage so small?
(b) You now connect an amplifier between the experiment and o-scope. The amplifier has a gain of 10 , Rin = 20 kΩ, and Rout = 50Ω. What is the voltage then measured by the o-scope?

(a)

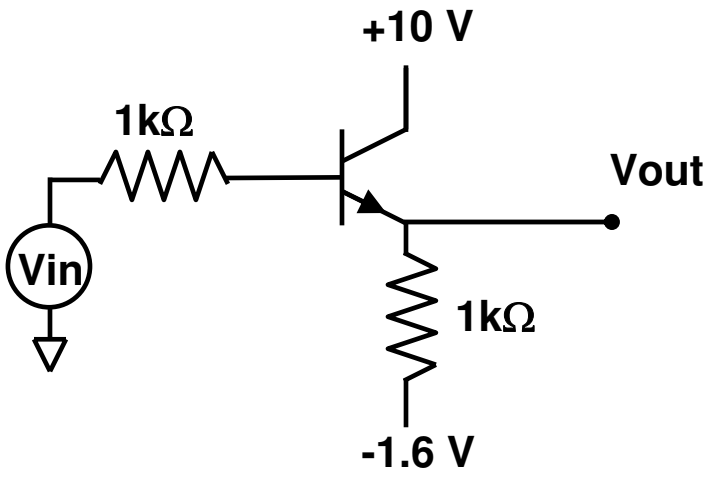


(b)



2. Explain what is incorrect with the 4 bad circuits in A and D on page 108 (Figure 2.81) in HH.

3. Emitter followers are supposed to have a gain of 1. In this problem, let's calculate how close to 1 the gain really is.
(a) Show that the gain of the following circuit is 0.99, assuming $\beta = 100$.
(b) Now show the gain drops to 0.966 when you include the effect of the emitter resistor r_e (in series with the base-emitter diode in the transistor).
(c) What happens to the gain if you drop the lower voltage to -2.6 V?
(d) What happens to the gain if you change the 1k resistor to 2k?



4. (a) For the following circuit, compute the quiescent (Vin=0) voltages and currents in the following circuit. (b) Compute the small-signal gain, input and output resistance for a high-frequency sine wave.
The sequence to analyze the circuit is:
(I) Compute the Thevenin equivalent circuit for the two resistors biasing the transistor base.
(II) Check that the transformed resistance of the emitter is much larger than this Thevenin equivalent resistor. The base voltage is the Thevenin voltage, minus a small voltage computed from the resistor divider formed by the Thevenin resistance and the transformed emitter resistance.
(III) Compute the emitter voltage knowing the diode voltage drop.
(IV) Compute emitter current.
(V) Knowing the collector current, compute the drop in voltage across the collector resistor.
(VI) Knowing this voltage drop, compute the collector voltage.
(VII) Compute the voltage gain
(VIII) Rin is given by the Thevenin resistance in parallel with the transformed emitter resistor
(IX) Rout is the collector resistance in parallel with the infinite resistance of the collector current bias.