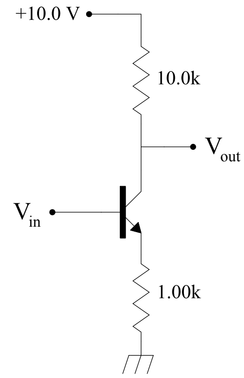
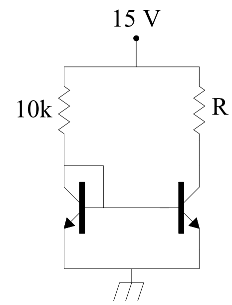
Phys 3150/5190 — Homework Assignment 4

Due Wednesday, September 26

1. The circuit shows a 10× common emitter amplifier, similar to the one used in Lab 4. Assuming that the transistor has a V_{BE} diode drop of exactly 0.6 V, a V_{CES} saturation voltage of 0.2 V, and a current gain $\beta = 100$, calculate the ouput voltage V_{out} as a function of the input voltage V_{in}. What are the largest and smallest output voltages that can be obtained, and what input voltage limits correspond to this range?

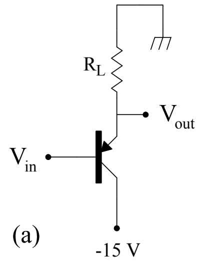


2. The circuit shown is known as a current mirror. Assume that both transistors are perfectly identical, and take them to be 2N3904's if it matters.
(a) Approximately how much current will flow through the 10 kΩ resistor?
(b) Determine the current through the unspecified resistor R in terms of R and the other circuit parameters. You can assume that $R \lesssim 10$ kΩ.
Can you see why this is called a current mirror?

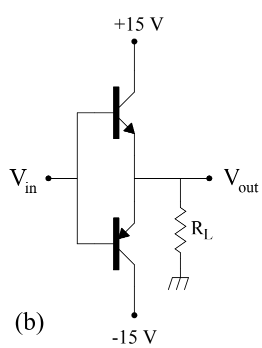


3. (i) Recall that pnp transistors work like npn transistors with the current directions reversed. Circuit (a) shows a pnp transistor being used as an emitter follower; compare to Fig. 4.4(b) in your lab manual. If V_{in} is a 10 V_{pp} sine wave with no dc offset, sketch $V_{\text{out}}(t)$ on a reasonably accurate vertical scale.

(ii) An npn transistor and a pnp transistor can be combined as shown in (b). Sketch the output of this circuit for the same input as part (i). (This circuit is called a push-pull follower, and shows one way to deal with the base-biasing problem.)



(a)



(b)