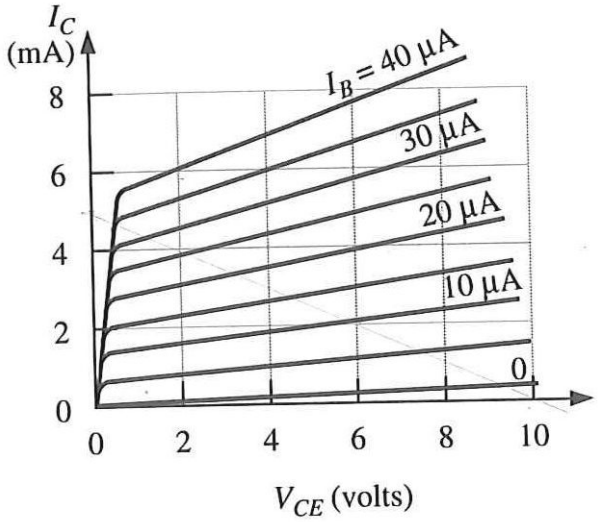
Physics 313 assignment 5 for Tuesday, October 10, 2017:

Topics: transistors, op-amps

Reading: my notes, supplementary info on transistors (see website)

Reading questions:

1. For the transistor whose characteristic curves are shown at right,
a) Roughly what is the value of β (or h_{FE}) at V_{CE} of 4 volts, say.
b) If the power rating of the transistor P_{max} is 0.05 W, is there any region of the curves shown for which P_{max} would be exceeded? (Power dissipated by a BJT ~ $V_{CE}I_C$.) Explain. Also, shade in roughly the region where P_{max} is exceeded.



4. For the common-emitter amplifier,
i) Is there voltage gain (that is, is v_{out}/v_{in} much different from 1)? If so, what does the gain depend on?
ii) If the voltage at the base rises by 0.1 V, what does the voltage at the emitter rise by?
iii) Is the output signal inverted with respect to the input signal?

5. For the emitter follower (a.k.a. common collector),
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Problems: (assume that all transistors are npn silicon, like the 2N3904)

1) This is an emitter follower with the base biased quiescently above ground so that a single supply can be used without clipping negative input signals.
a) Find the expected quiescent values of V_B, V_E, and V_C.
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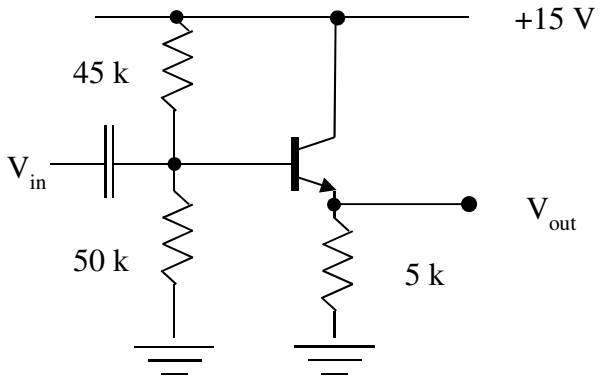
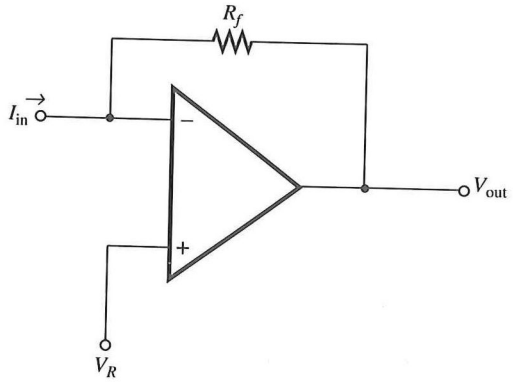
c) Check to make sure that the quiescent I_B is small compared to the quiescent current through the 50k resistor. Why is it important to design the circuit so that this is the case?
d) For roughly what range of V_{in} (+ and -) is the output free from clipping?
e) Would you need the 45k and 50k resistors if you had a –15V power supply as well as a +15V supply available? Why?



2) Design an opamp-based inverting amplifier with a gain of 50 and an input impedance of 10k-Ohm

3. a) What does the circuit at right do (Assume V_R=0)? Explain using the golden rules of op-amps.

b) What is the maximum current that can be measured (without saturating the op amp) in the figure at right if R_f is 10 M? Assume ±15 V supplies are being used to power the op amp.



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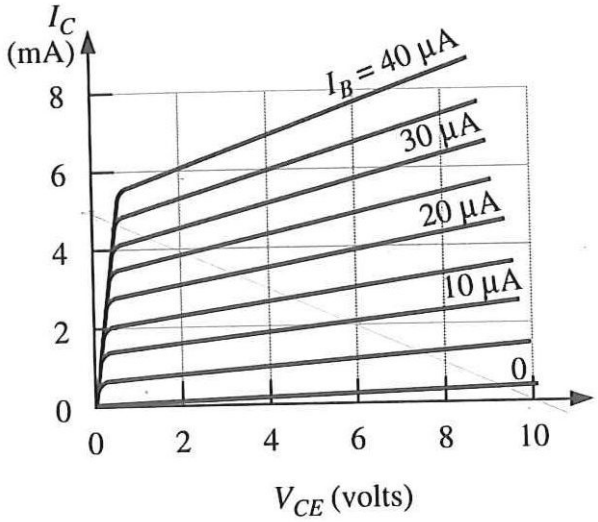

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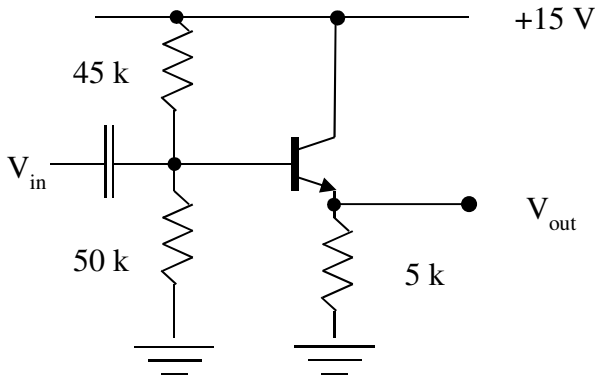

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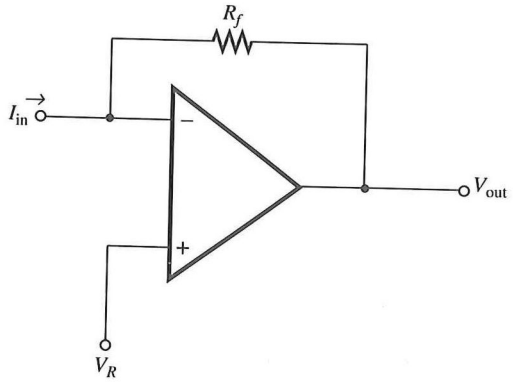

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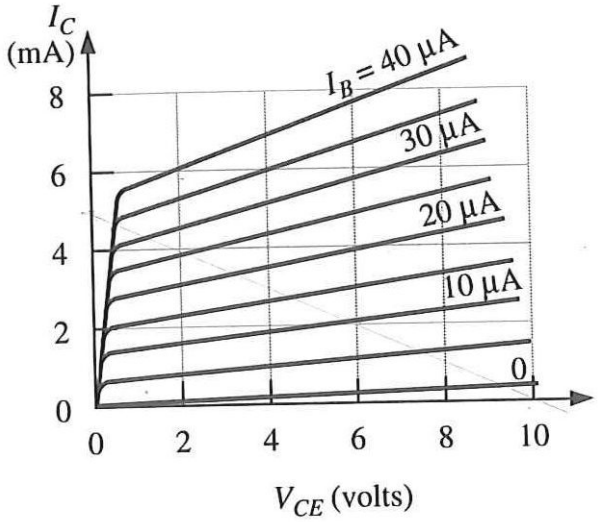

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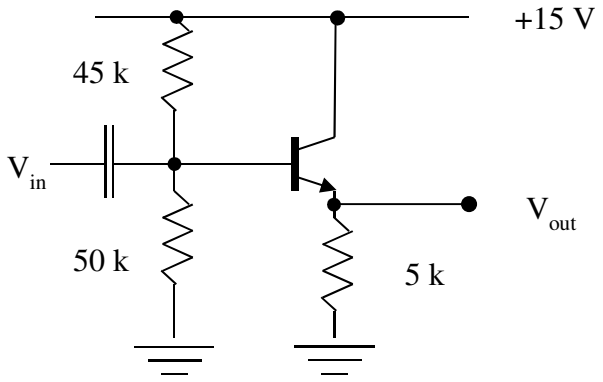

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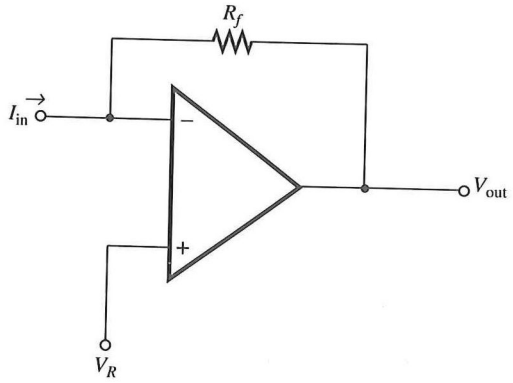

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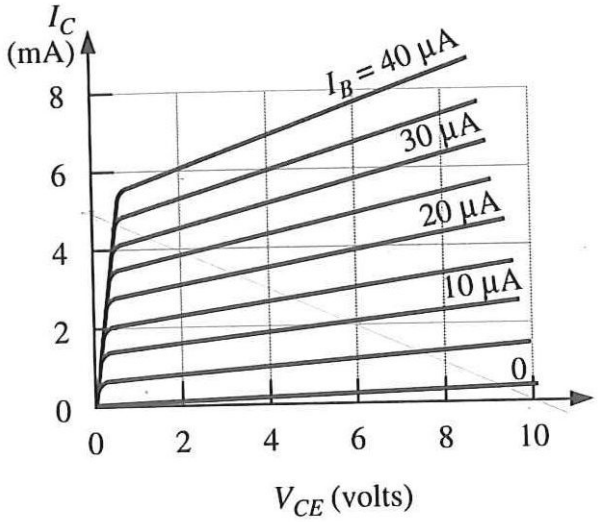

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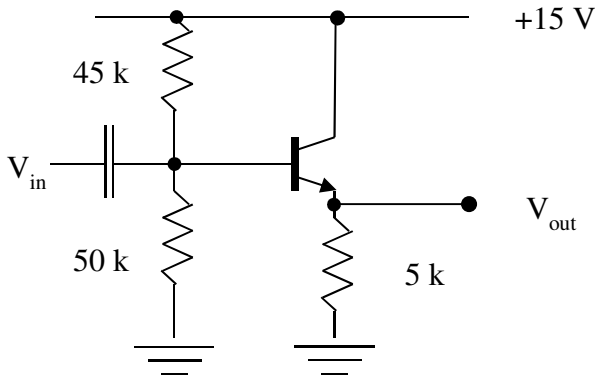

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