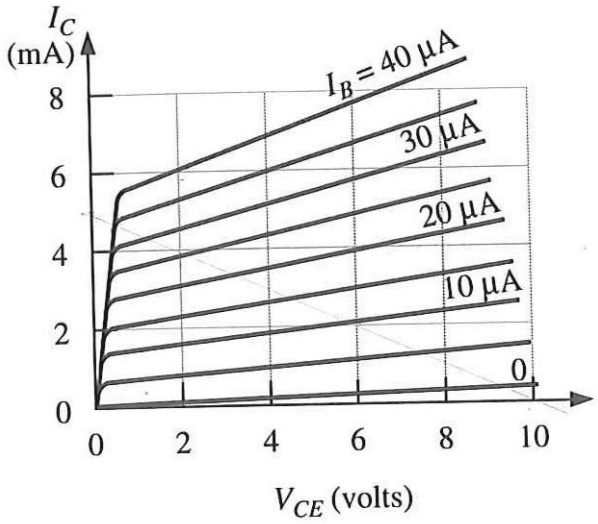
Physics 313 assignment 5 for Tuesday, September 27:

Topics: transistors

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.



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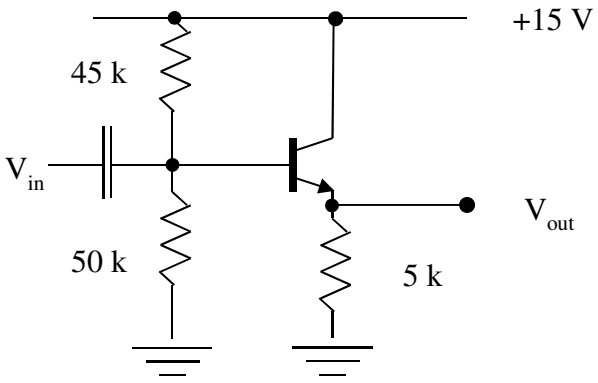
e) Would you need the 45k and 50k resistors if you had a –15V power supply as well as a +15V supply available? Why?



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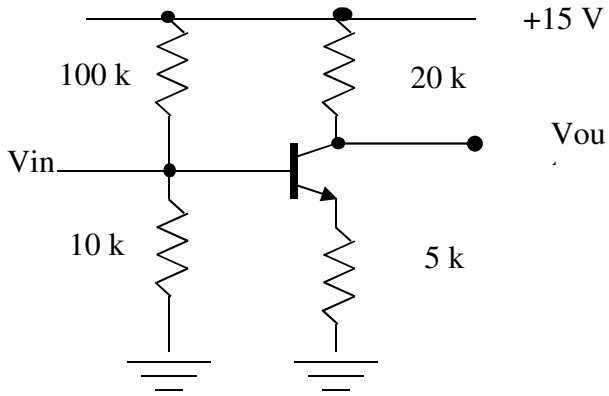

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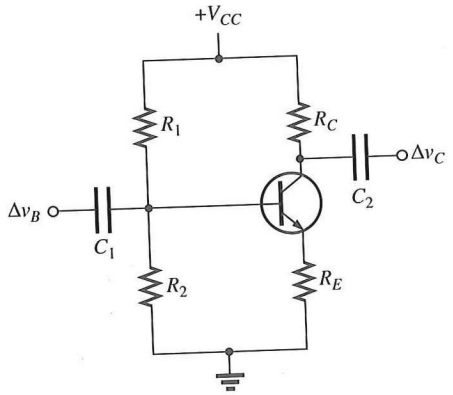

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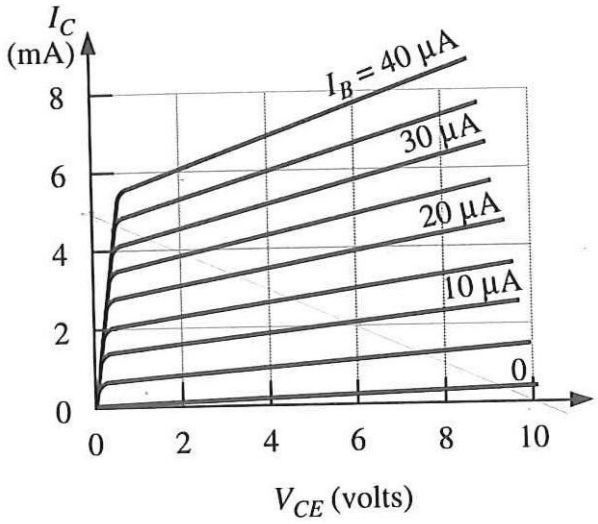

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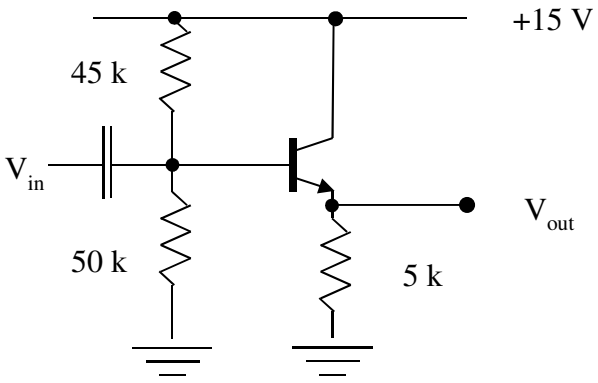

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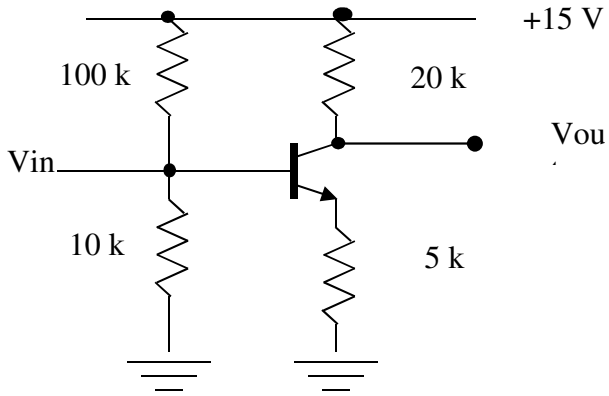

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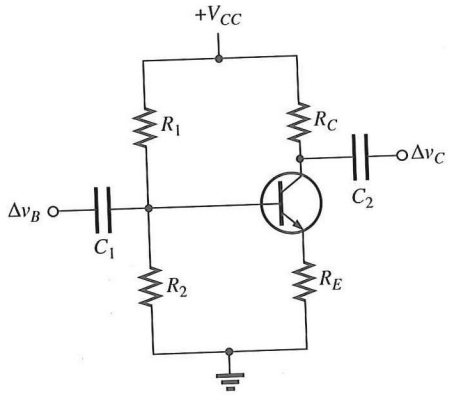

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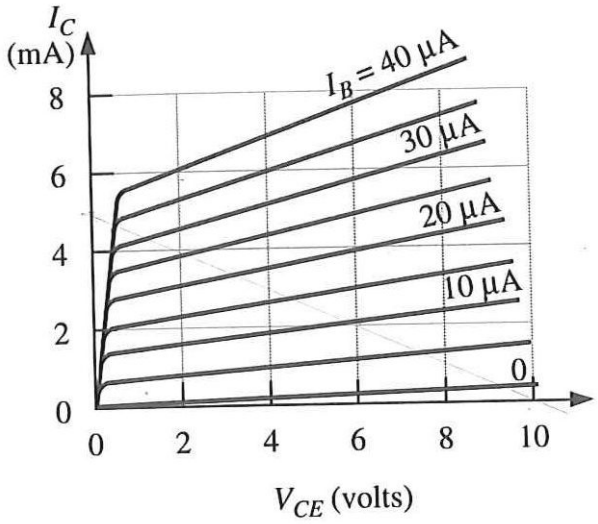

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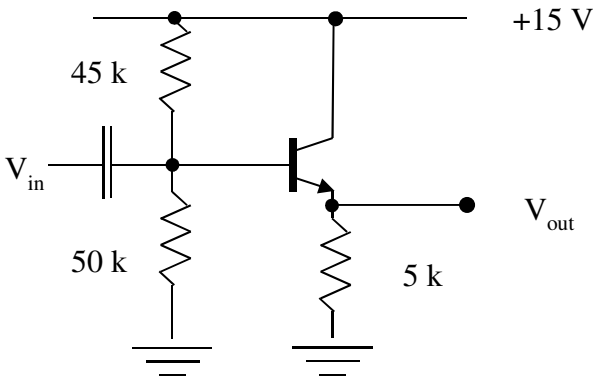

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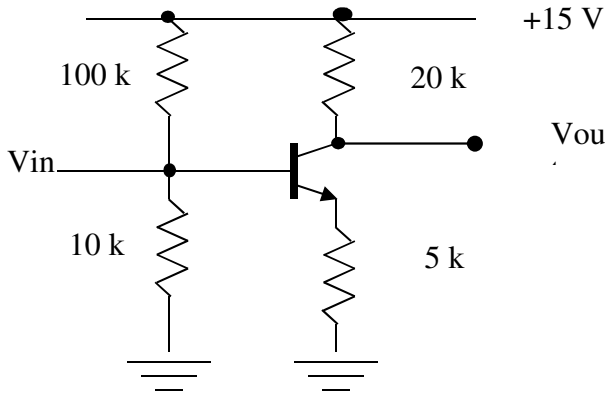

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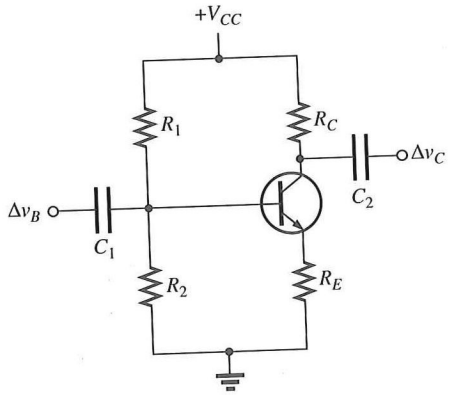

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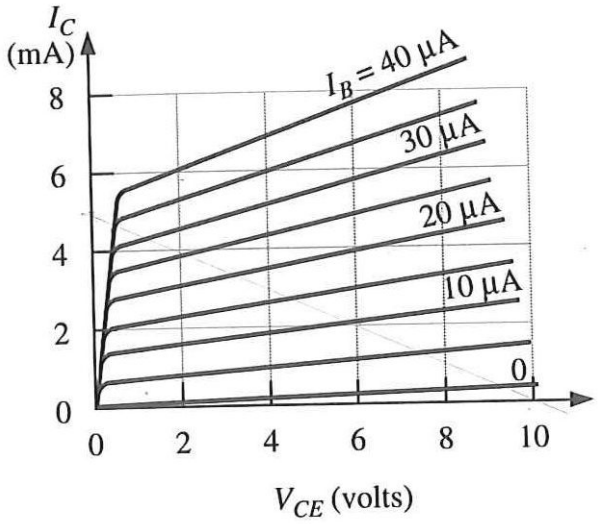

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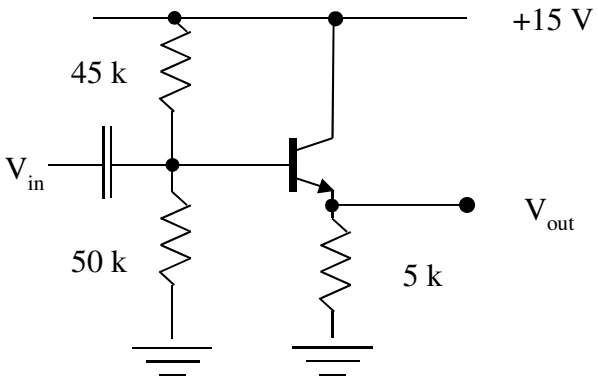

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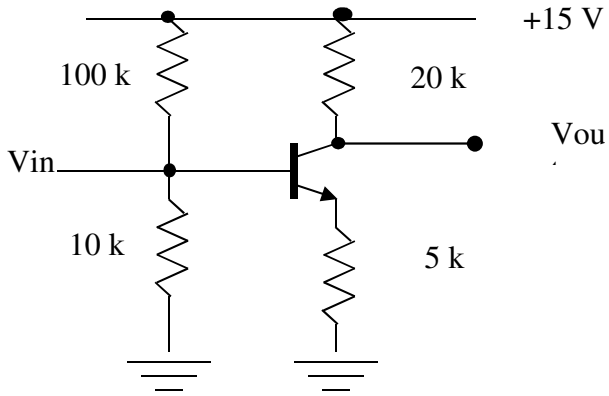

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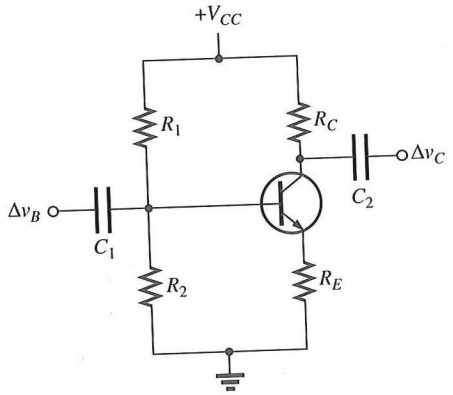

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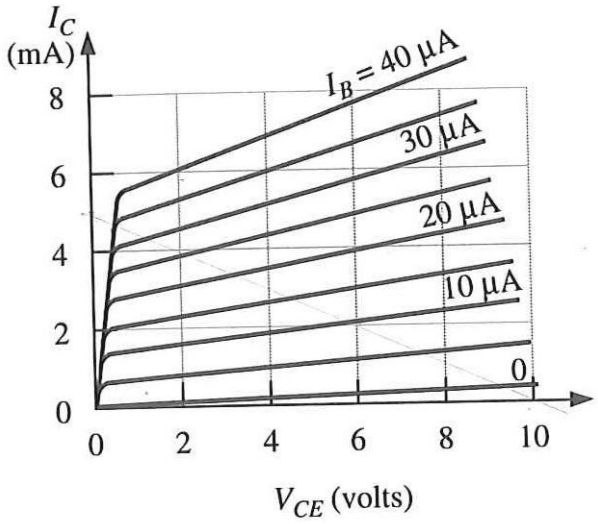

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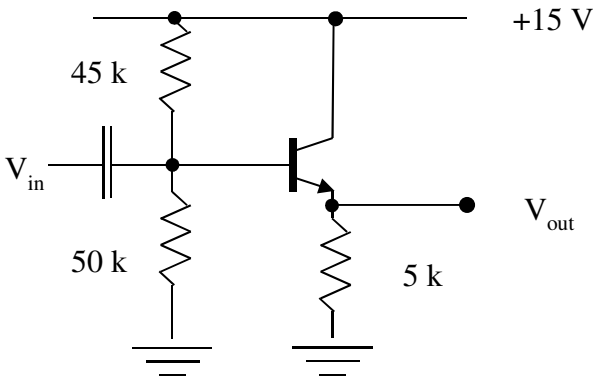

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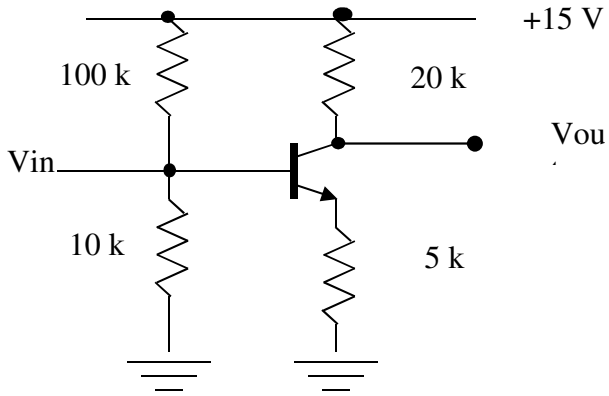

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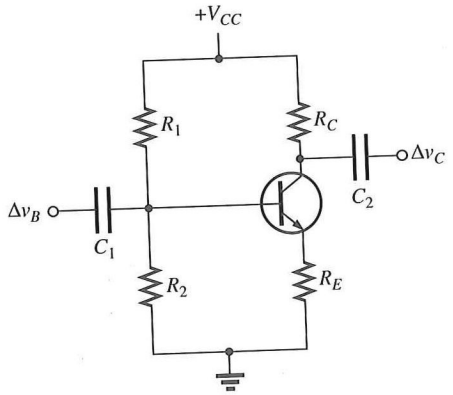


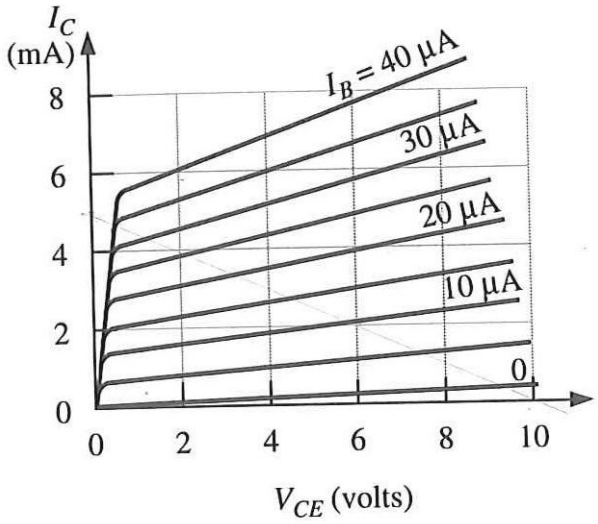
c) For a 0.5 V amplitude input sine wave at 10 kHz, give the expected amplitude and frequency of the output signal. Explain briefly. Is the output signal inverted? Is the output signal offset from ground, and if so, by how much?
d) What happens if the input signal is a 1.0 V amplitude input sine wave at 10 kHz? Explain your reasoning.

Physics 313 assignment 5 for Tuesday, September 27:

Topics: transistors

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.



2. Setting a voltage at the base of a transistor that's high enough that the base current will be greater than zero for all expected signals is called setting the quiescent point (or "operating point"). What does the word quiescent mean? Give your source. (If you find several definitions, give the one that seems most closely related to its use in this context.)

3. What do the small v's and i's used in the textbook mean as distinct from the capital V's and I's? (Hint: go back to the first chapter on AC circuits).

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?
iv) What is the expression for the input impedance?
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5. For the emitter follower (a.k.a. common collector),
i) Is there voltage gain (that is, is v_{out}/v_{in} different from 1)? If so, what does the gain depend on?
ii) What is the expression for the input impedance? Is this typically a big or a small number?
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6. Why is it usually useful for a circuit to have a high input impedance and a low output impedance?

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.
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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?
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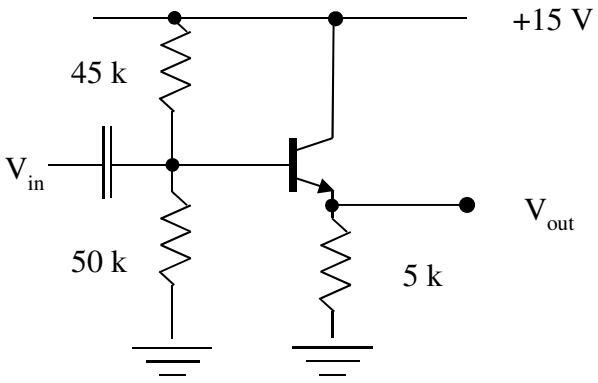
e) Would you need the 45k and 50k resistors if you had a –15V power supply as well as a +15V supply available? Why?



2) a) For the common-emitter amplifier at right, what do you expect the quiescent values of V_B, V_E, V_C, I_B, I_E, and I_C to be?
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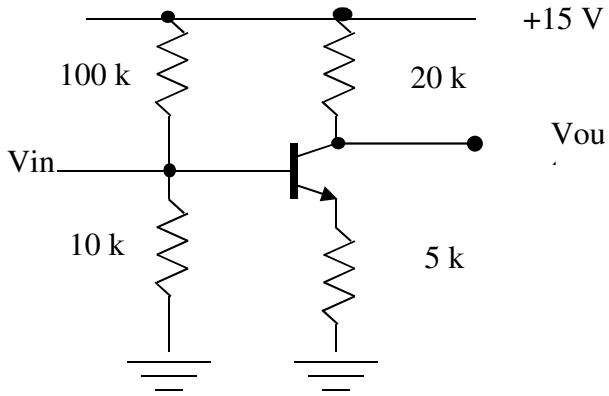

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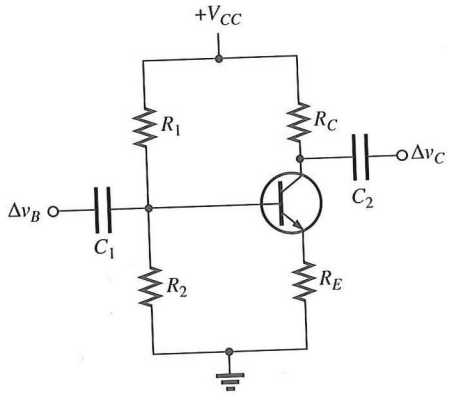

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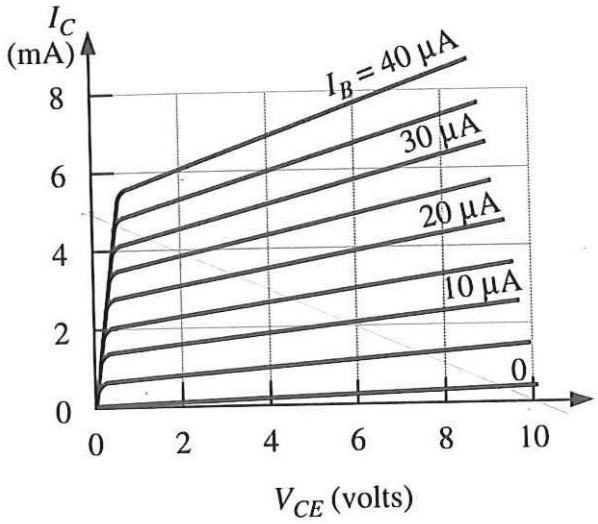

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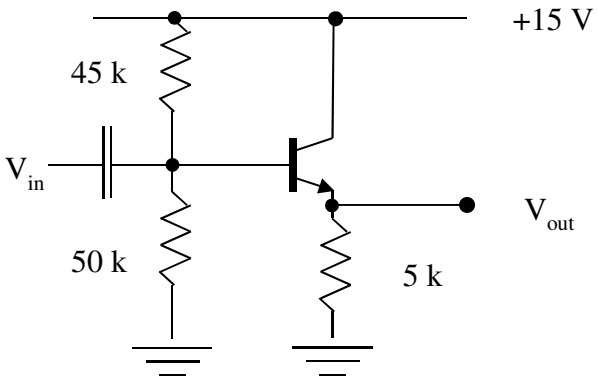

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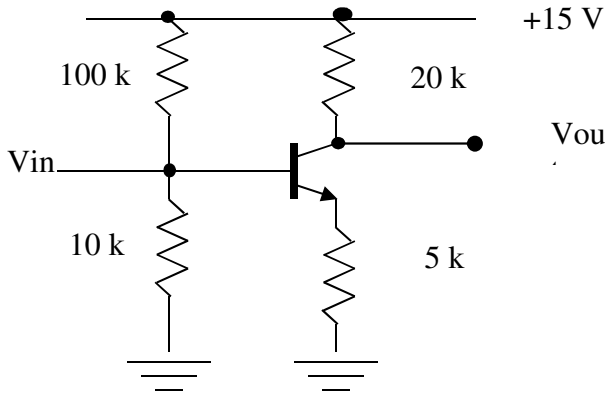

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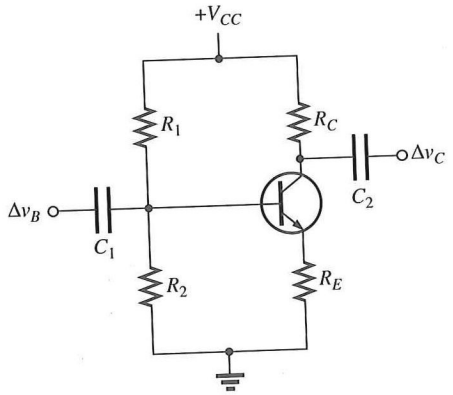

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