Test 2

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Electronic Circuits 1
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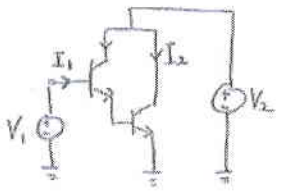
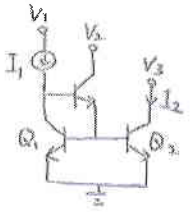
Prob. 1 (20)

Determine the ratio of I_1 and I_2 (I_2 / I_1) in each of following circuits. Assume all BJT transistors in the forward active region and have the same value of β. Ignore the Early effect.

(a)(10)



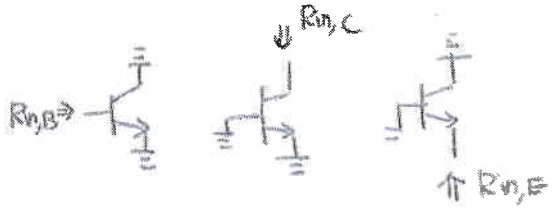
(b)(10)



Prob. 2(20)

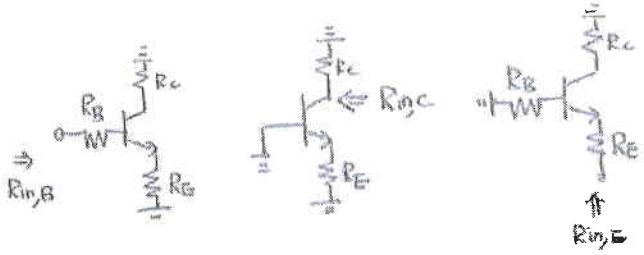
We want to determine input resistances of an NPN transistor in the forward active region in various conditions. Express your answers in terms of small-signal parameters and β.

(a)(5) Determine $R_{in,B}$, $R_{in,C}$, $R_{in,E}$ in the following circuits without the Early effect.



(b)(5) Do the same as in (a) with the Early effect using r_O.

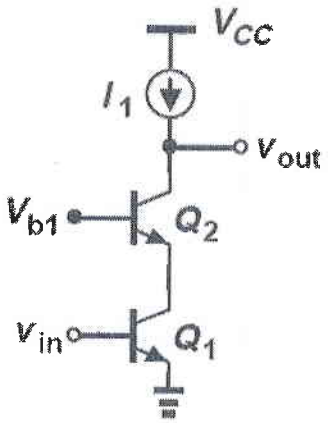
(c)(5) Determine $R_{in,B}$, $R_{in,C}$, $R_{in,E}$ when some resistors are added as shown below. Do not consider the Early effect.



(d)(5) Determine $R_{in,C}$ in Prob. 1(c) with the Early effect using r_O.

Prob. 3(30)

Consider the following amplifier in which CE stage is cascaded with CB stage. Assume the bias is achieved with an ideal current (I_1) and a voltage source (V_{b1}) so that both transistors are in the forward active region and have the identical bias condition. The Early effect for both transistors can be modeled with the same resistance r_O. Determine the small-signal voltage gain (v_{out}/v_{in}) in the following steps.



(a)(5) Determine the input resistance of the CB stage in the above circuit.

(b)(5) Determine the voltage gain of the CE stage (v_X/v_{in}), where v_X is the voltage of Q_1 emitter.

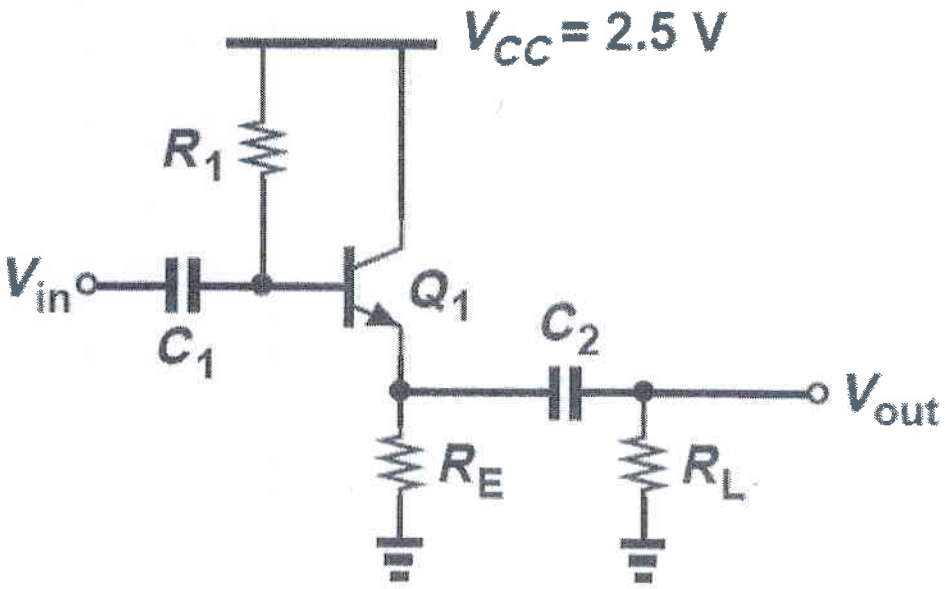
(c)(5) Determine the voltage gain of the CB stage (v_{out}/v_X).

(d)(5) Determine the total voltage gain v_{out}/v_{in}.

(e)(10) Determine output resistance of the above amplifier.

Prob. 4(30)

We want to design the bias circuit for the following EF circuit so that it can deliver voltage gain of 0.8 to a load having R_L = 50 Ω. The transistor has $I_s = 6x10^{-16}A$, β = 100, and a large Early voltage so that the Early effect can be ignored. Assume V_T=25mV and the capacitors are selected so that they are open for bias and short for small signals.



(a)(10) Assuming R_E is much larger than R_L, determine the collect current that provides the desired gain.

(b)(10) What is required value for R_1? Assume R_E = 250 Ω.

(c)(10) Estimate the minimum value of C_1 that allows delivery of input signals into the amplifier. Assume the lowest frequency for input signals is 100MHz. Use R_E = 250 Ω.