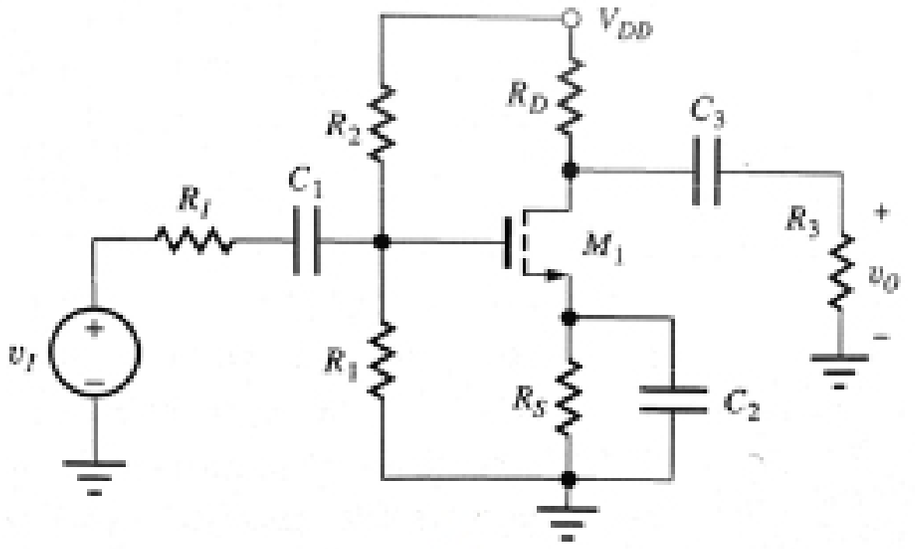
PROBLEM SET #2

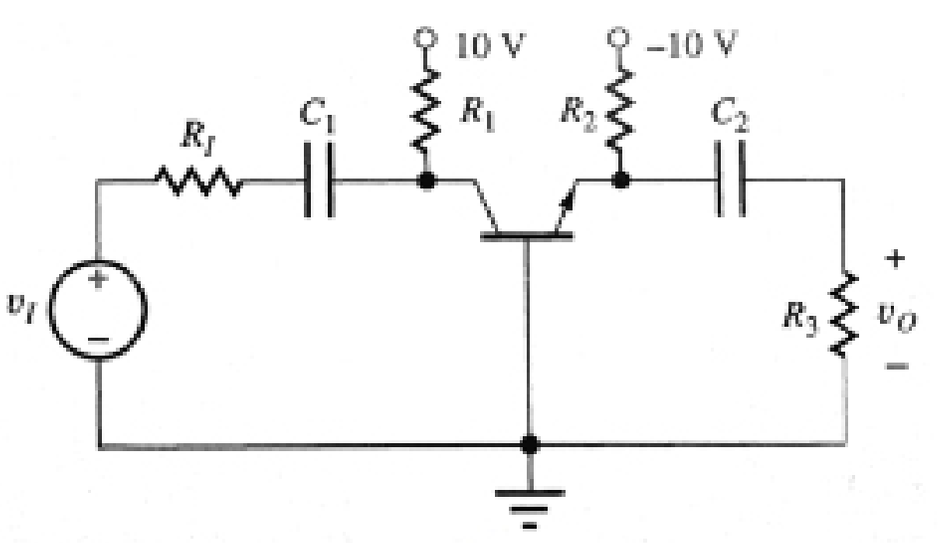
Issued: Tuesday, Feb.1, 2011

Due: Tuesday, Feb.8, 2011, 5:00 p.m. in the EE 140 homework box in 240 Cory

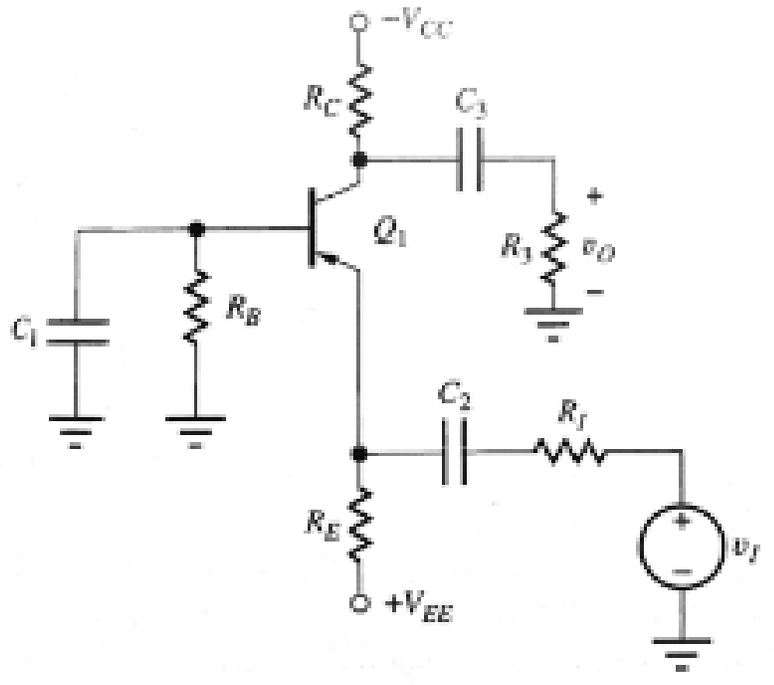
1. Use inspection analysis to write expressions for the input resistance R_i, output resistance R_o, and gain v_o/v_S for each of the amplifiers in Fig PS2.1. The expressions should be in terms of the given elements and parameters of the small-signal equivalent circuits (i.e., g_m, r_p, r_o, β, etc.) for the transistors used. For each circuit, assume that all capacitors shown have infinite values.



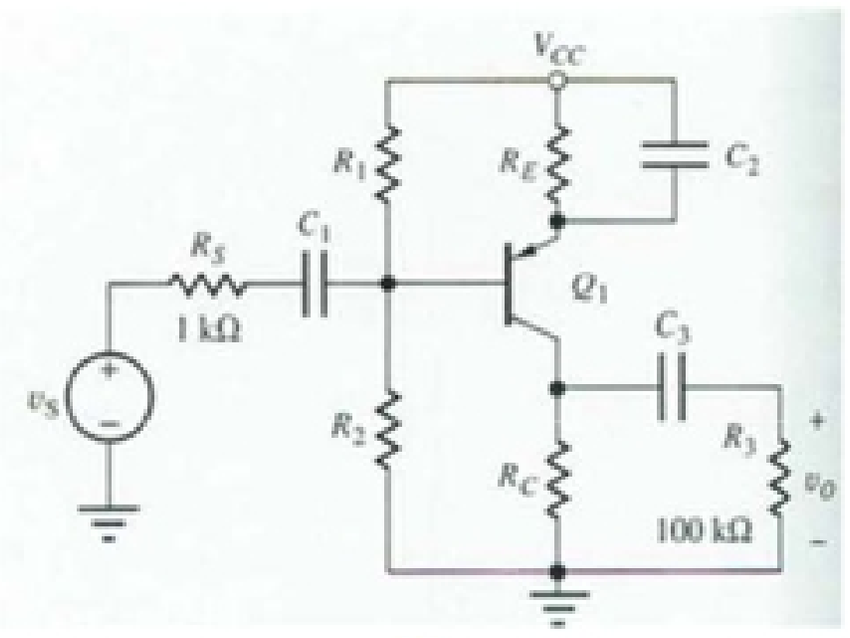
(a)



(c)



(b)



(d)

Fig. PS2.1

2. Find the input resistance R_i and the voltage gain v_o/v_s of the circuit in Fig. PS2.2 using inspection analysis. Explain the purpose of the 100 kΩ resistor.

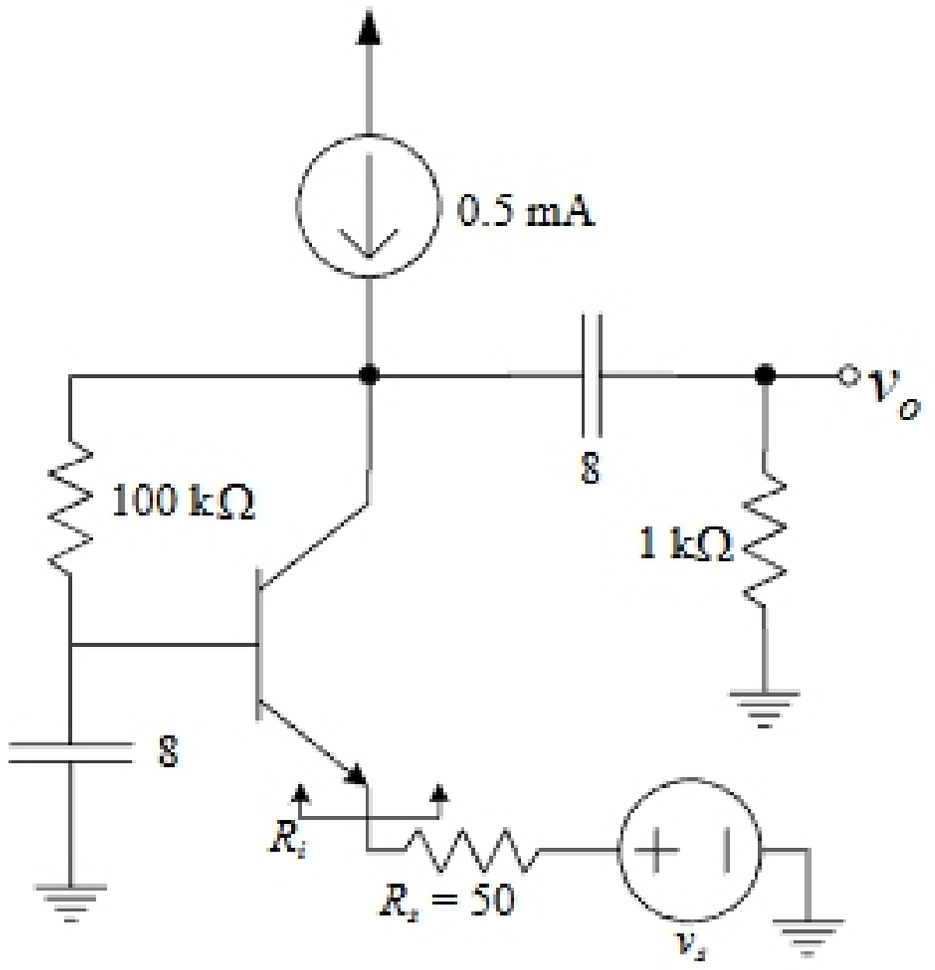


Fig. PS2.2

3. The BJT β values of the BJT in the emitter follower of Fig. PS2.3 may range from 20 to 200. For each extreme ($\beta = 20$ and $\beta = 200$), find:
   a. I_E, V_E, V_B
   b. R_i
   c. v_o/v_s

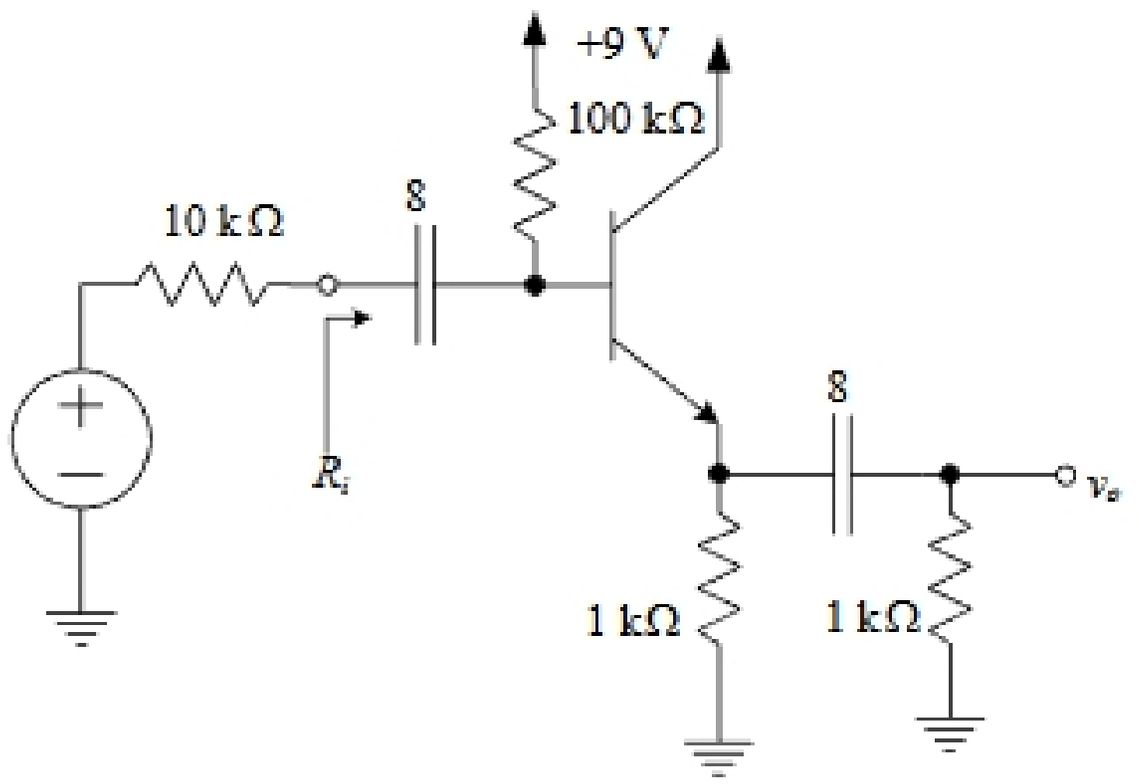


Fig. PS2.3

4. For the circuit in Fig. PS2.4, let transistor Q_1 have $\beta = 20$ and transistor Q_2 have $\beta = 200$, and neglect the effect of r_o. Use $V_{BE} = 0.7$ V.

a. Find the DC emitter current of Q_1 and Q_2. Also find the DC voltages V_{B1} and V_{B2}.
b. If a load resistance $R_L = 1$ kΩ is connected to the output terminal, find the voltage gain from the base to the emitter of Q_2, v_e/v_{b2}, and find the input resistance looking into the base of Q_2, R_{ib2}.
c. Replacing Q_2 with its input resistance R_{ib2} found in (b), analyze the circuit of emitter follower Q_1 to determine its input resistance R_i, and the gain from its base to its emitter, v_{e1}/v_{b1}.
d. If the circuit is fed with a source having a 100 kΩ resistance, find the transmission to the base of Q_1, v_{b1}/v_s.
e. Find the overall voltage gain v_o/v_s including the resistances added in parts b and d.

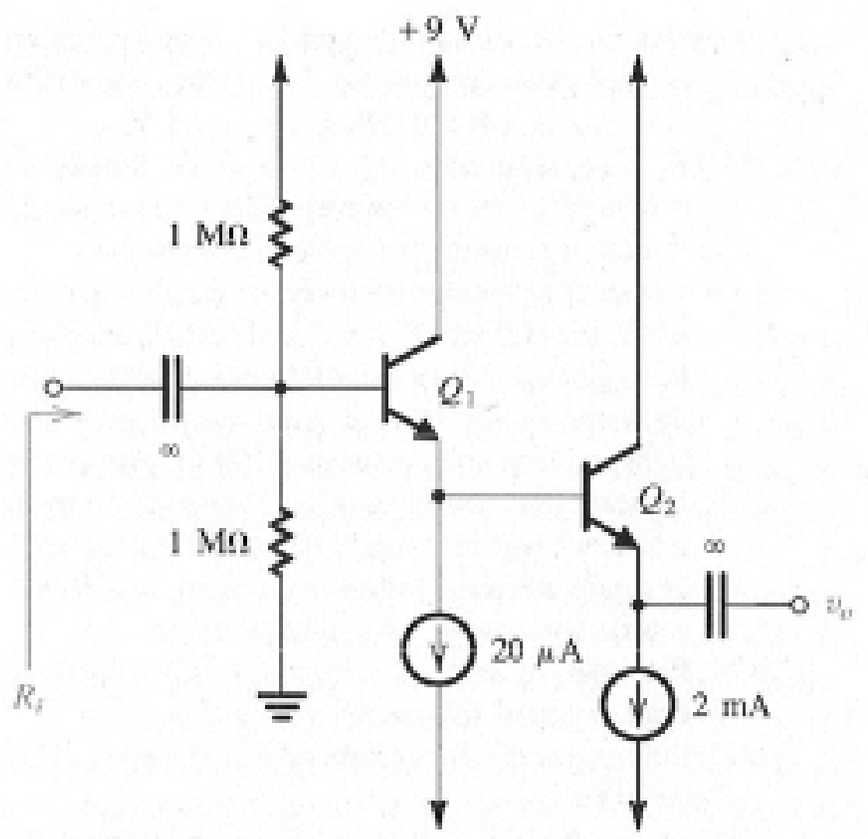


Fig. PS2.4

5. Calculate the output resistance r_o^c of the circuit in Fig. PS2.5 as a function of I_{BIAS}. Do not neglect r_{o1} or r_{o2} in this calculation, but you may neglect r_b and r_μ. If $I_{C2} = 1$ mA, what is r_o^c for $I_{BIAS} = 1$ mA? For $I_{BIAS} = 0$?

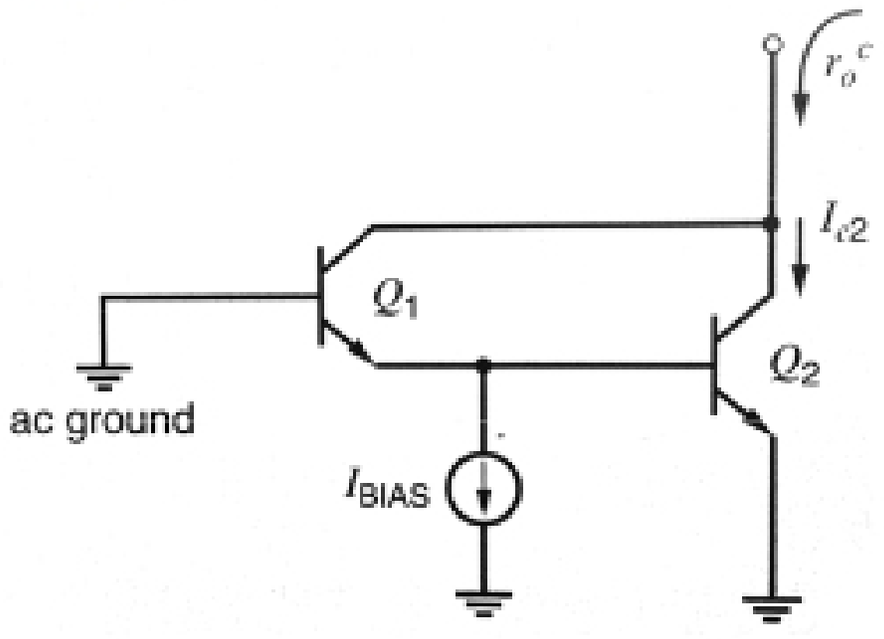


Fig. PS2.5