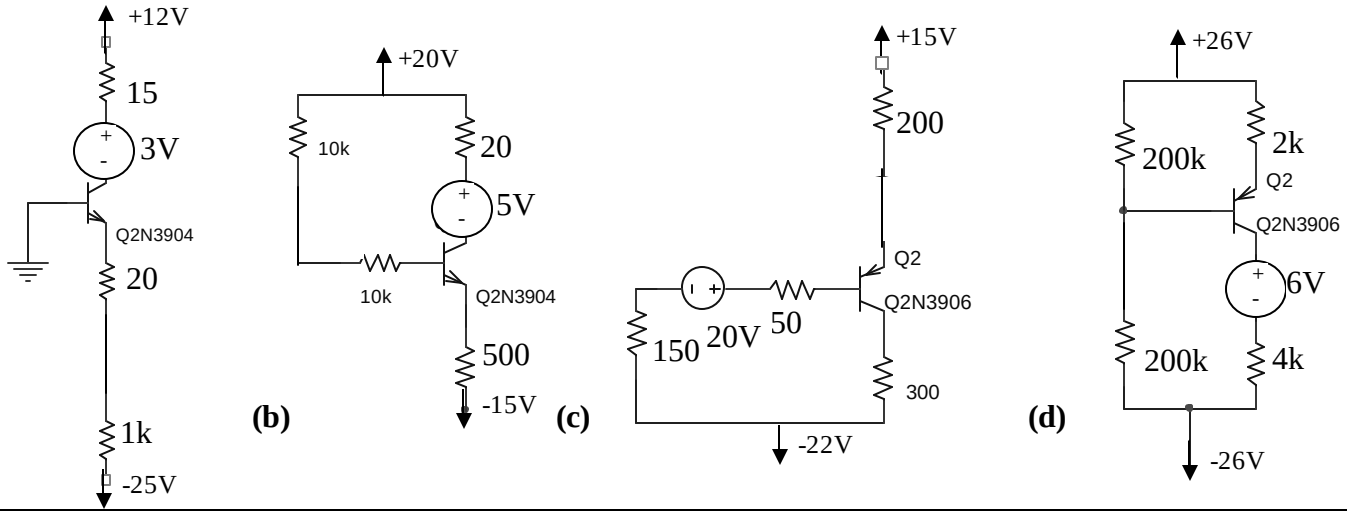
ECE2280 **Homework #6** **Spring 2008**

1. a) Draw the cross section of a BJT.
   b) Explain in your own words and drawings as needed how, when(under what conditions), and in what direction the current flows in the BJT for the 3 regions of operation.

2. Voltages are measured at the emitter, E, base, B, and collector, C, as shown below for an **npn** transistor. Determine what mode or operation the transistor is in.

Case	E	B	C	Mode
1	0	0.7	0.3	
2	-0.2	4	5	
3	1.2	1.2	15	
4	-1.4	-0.7	3	
5	0.7	0.7	0	
6	-0.7	0	-0.2	
7	5	5.7	5.7	
8	4	3	0	

3. Use $|V_{BE}|$=0.7, β=100. Find voltages at all nodes and currents through all branches. *(worth 4 problems)*

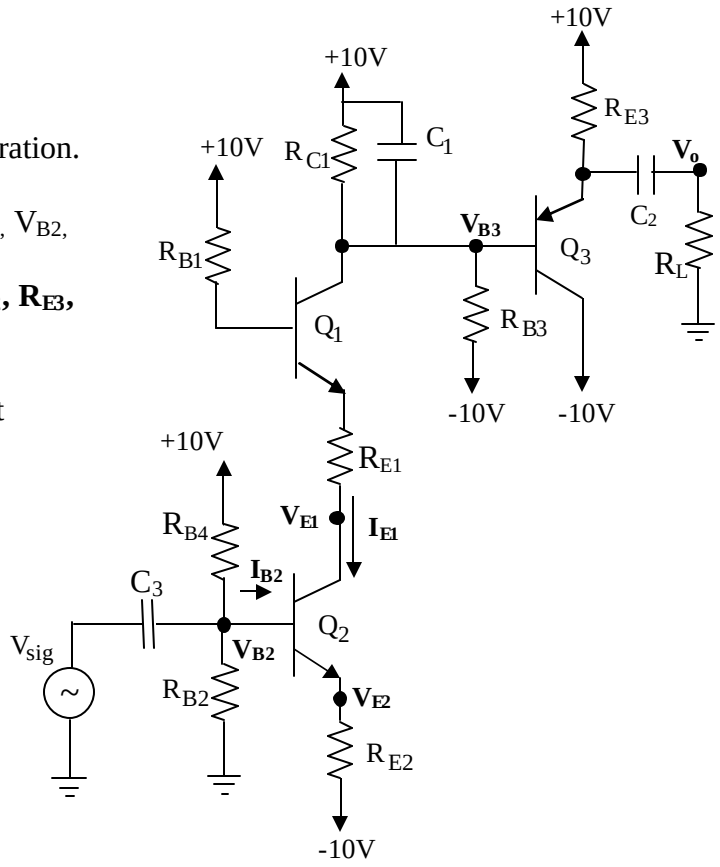


- Use the circuit at the right for Problems 2 and 3

4. Assume active operation for all transistors.
(Vsig is an ac source)
Assume that the capacitors act as an open for DC operation.

Find the symbolic equations for the DC values for $I_{E1,}$ $V_{B2,}$ $I_{B2,}$ $V_{E2,}$ $V_{B3,}$ V_o
You may use only R_{B1}, R_{B2}, R_{B3}, R_{B4}, R_{C1}, R_{E1}, R_{E2}, R_{E3}, R_L, +10, -10, V_{BE}, $V_{EB,}$ and b **or** a **.**

5. Draw the hybrid-π or model-T small signal circuit



6. Use $|V_{BE}|$=0.7, β=20, V_T=25mV (Vsig is an ac source), ignore r_o.

This small-signal model circuit is shown below. It was found through a DC analysis that **I_{C1}=1mA and I_{C2}=2mA**. The subscripts represent the 1st transistor by a subscript 1 and the 2nd transistor by a 1 subscript.

(a) Find the ac parameters, $r_{\pi 1}$ and gm_2

(b) Find a symbolic equation for the input resistance, R_{in}. (Ignore the AC input source and Rsig, include R1)

(c) Find a symbolic expression for the overall gain, $\frac{Vo}{Vsig}$.