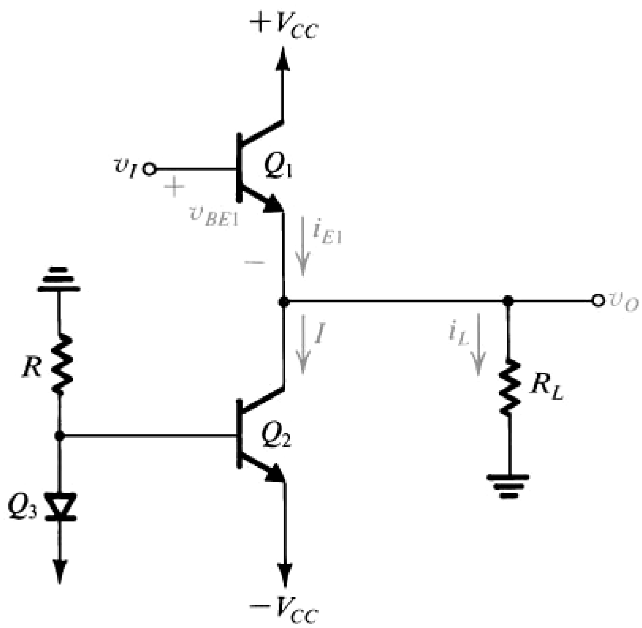
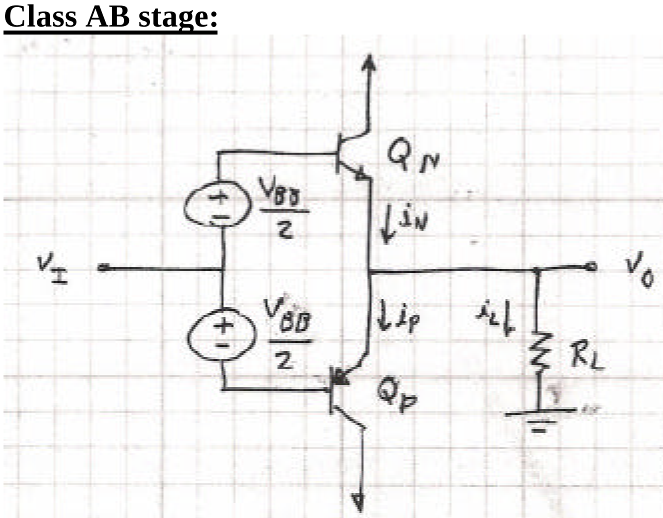
OUTPUT STAGES

Example:
(P14.3)
Design the circuit below using a +-9V supply to provide a design capable of +-7V outputs with a 1kohm load. Use the smallest possible total supply current.



Example #2:
(D14.14)
A class B output stage is required to deliver an average power of 100W into a 16ohm load. The power supply should be 4V greater than the corresponding peak sine-wave output voltage. Determine the power-supply voltage required (to the nearest volt), the peak current from each supply, the total supply power, and the power-conversion efficiency.

Class AB stage:



- This type of stage uses both the "A" and the "B" to produce a "push-pull" operation without the deadband.

OUTPUT STAGES

- The voltage offset at the input crossover distortion

$$I_Q = I_S e^{\frac{V_{BB}}{2V_T}} \Rightarrow V_{BB} = 2V_T \ln \frac{I_Q}{I_S}$$

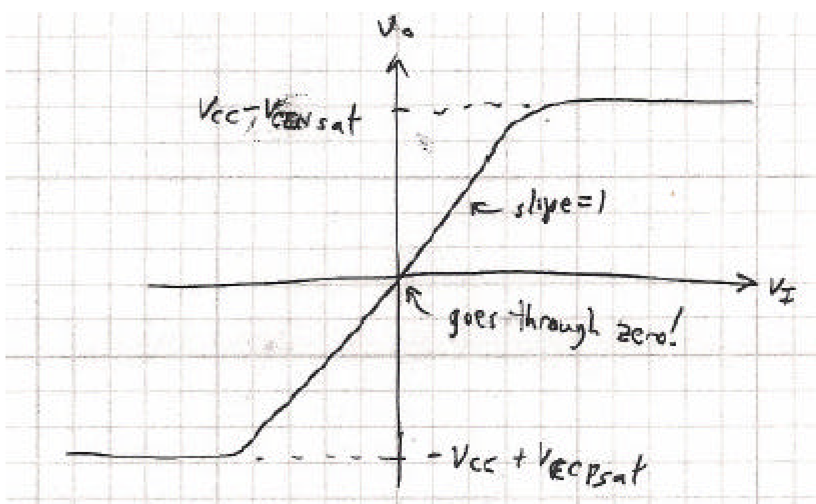
$$i_N = I_S e^{\frac{v_{BEN}}{V_T}} \Rightarrow v_{BEN} = V_T \ln \frac{i_N}{I_S}$$

$$i_P = I_S e^{\frac{v_{EBP}}{V_T}} \Rightarrow v_{EB} = V_T \ln \frac{i_P}{I_S}$$

$$v_{BEN} + v_{EBP} = V_{BB}$$

$$\Rightarrow V_T \ln\left(\frac{i_N}{I_S}\right) + V_T \ln\left(\frac{i_P}{I_S}\right) = 2V_T \ln \frac{I_Q}{I_S}$$

$$\Rightarrow i_N i_P = I_Q^2$$ ← smooth transition at $v_o = 0$ from Q_N to Q_P conducting



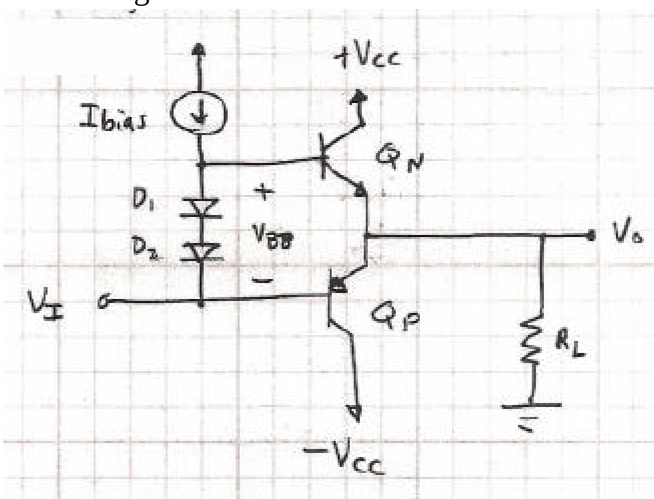
<u>Output resistance</u>:

- This will change as Vo changes => Therefore, only find for a <u>*fixed value*</u> of Vo.

OUTPUT STAGES

Biasing Class AB stage:

- Biasing with diodes:



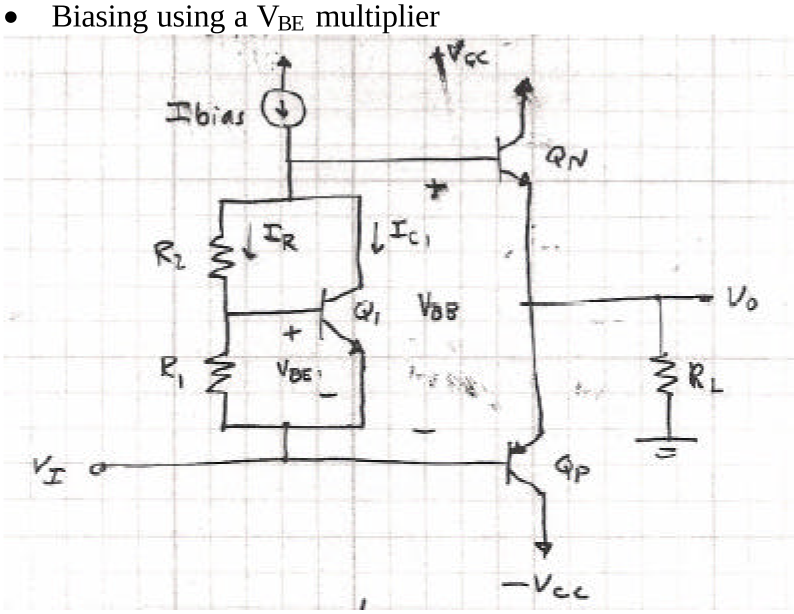
- If output transistor emitter area is n times larger than diode junction area, then

$$i_N = I_S e^{\frac{V_{BEN}}{V_T}} \qquad i_P = I_S e^{\frac{V_{EBP}}{V_T}}$$

$$i_{Diode} = \frac{I_S}{n} e^{\frac{V_{Diode}}{V_T}}$$

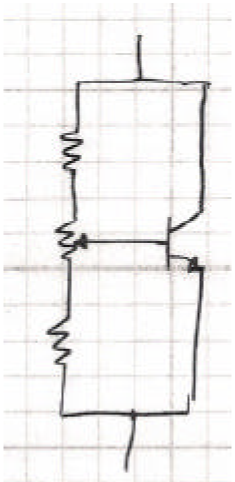
$$I_Q = n I_{bias}$$

- Biasing using a V_{BE} multiplier



OUTPUT STAGES

V_{BB} can be set using resistors adjusted to get the right I_Q:



<u>Thermal Runaway in BJT's:</u>

- As Temperature ↑ by 1°C:
  - If collector current is fixed, V_{BE} drops by 2mV {VBE dependence => -2mV/°C}
  - If V_{BE} is fixed, collector current increases 8%

- As collector current ↑, BJT Temp ↑ which causes collector current ↑, …
  THERMAL RUNAWAY
- Solution is to :
  - Place D1, D2 or Q1 in ________________________________
    - IC Design => place them ______________________
    - In discrete design => mount D1, D2, or Q1 on the _____________