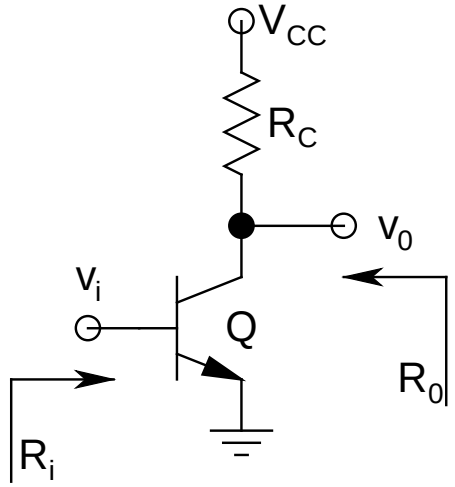
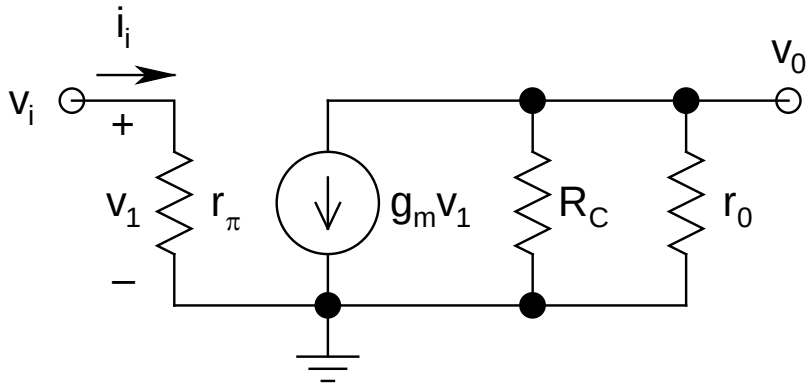
Single-Stage Amplifiers

- ***Common-Emitter*** (CE):





ac Schematic **ac Low-Frequency Equivalent**

➢ ***Biasing circuit not shown***

- By inspection, ***Voltage Gain***:

$$A_v = \frac{v_0}{v_i} = \frac{-g_m v_1 \left(R_C \parallel r_0 \right)}{v_i} = -g_m \left(R_C \parallel r_0 \right)$$

- The ***negative sign*** in front implies ***180° phase shift*** between v_i and v_0
  - ***v_i and v_0 are exactly out of phase***
- For ***discrete circuits***, in general, $R_C << r_0$

  $\Rightarrow A_v = - g_m R_C \approx - R_C / r_E$ (***moderate to large***)
- On the other hand, if $r_0 << R_C$:

  $A_v = - g_m r_0 = - 1/\eta = - V_A / V_T$ (***can be huge***!)
  - ***Theoretical maximum voltage gain of this circuit***

- ***Current Gain***:

  $A_i = i_c/i_b = \beta$ (***large***)

- Thus, ***Power Gain***:

  $PG = A_v \times A_i$ (***very large***)

- Therefore, this circuit is ***designers' favorite***!
- Has primary use as ***audio amplifiers***
- ***Input Resistance***:

  $R_i = v_i/i_i = r_\pi$ (***decent***)

- ***Output Resistance***:

  $R_0 = R_C \| r_0 \approx R_C$