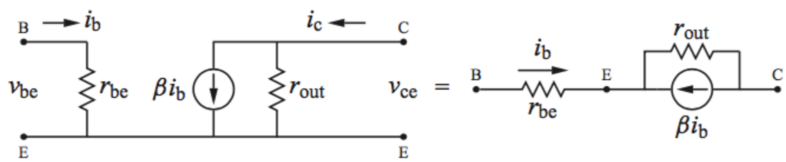
How To Analyze Transistor Amplifiers with AC Equivalent Circuits

1. Treat coupling capacitors as shorts (assuming they are large enough).

2. Short the supply to ground.

3. Insert the AC transistor model,



   To do this, snip out the transistor and attach the idealized transistor circuit in the diagram, matching up base, collector and emitter.

4. Simplify the circuit where possible (look for Thevenin-type equivalents). Often r_{out} can be considered infinite and removed from the approximate diagram.

5. Draw the following quantities on the circuit: v_{in}, v_{out}, i_{in}, i_{out}, i_b.

6. Draw B, E, C at the locations of the base, emitter and collector.

7. Compute a, g, Z_{in} and Z_{out} by writing v_{in}, v_{out}, i_{in}, i_{out} in terms of i_b.

   - The gain is $a = \frac{v_{\text{out}}}{v_{\text{in}}}$. The "open loop" gain (open circuit at output) is $a_{OL} = \frac{v_{\text{out}}(R_L=\infty)}{v_{\text{in}}}$.
   - The current gain is $g = i_{\text{out}}/i_{\text{in}}$.
   - The input impedance is $Z_{\text{in}} = v_{\text{in}}/i_{\text{in}}$.
   - The output impedance is $Z_{\text{out}} = \frac{v_{\text{out}}(R_L=\infty)}{i_{\text{out}}(R_L=0)}$.

You will then have a full characterization of the amplifier behavior.