1 of 2. (a) Solve for $v_o$ with $i_o = 0$.
(b) Solve for $i_o$ with $v_o = 0$.
(c) What is the output resistance $r_{out}$?
(d) Draw the Thévenin and Norton equivalents at the circuit output.

2 of 2. (a) Draw and label the hybrid-π model of the BJT. On the drawings, include labels for the currents $i_b$, $i_e$, $i'_e$, $i_c$, and $i'_c$ and labels for the resistors $r_\pi$ and $r_0$. Answer: See class notes.
(b) How is the hybrid-π model converted into the T model? Explain any condition that must hold for the models to be equivalent and and draw the T model. Answer: Replace $r_\pi$ in the $i_b$ branch with $r_e$ in the $i'_e$ branch such that $i_b r_\pi = i'_e r_e$. 

\[
\begin{align*}
v_c &= 4 \times 5 \| 20 - 5v_c \frac{5}{5 + 20} = 16 - v_c \implies v_c = 8\text{ V} \\
v_{o(oc)} &= 4 \times 5 \| 20 + 5v_c \frac{20}{5 + 20} = 16 + 4v_c = 48\text{ V} \\\nv_c &= 4 \times 0 + \frac{5v_c}{5} \implies v_c = 0 \\
i_{(sc)} &= 4 + \frac{5v_c}{5} = 4\text{ A} \\
r_{out} &= \frac{v_{o(oc)}}{i_{o(sc)}} = \frac{48}{4} = 12\Omega
\end{align*}
\]