Name: _____ (please print)

Signature: _____

ECE 3455
Quiz #6
November 29, 2007

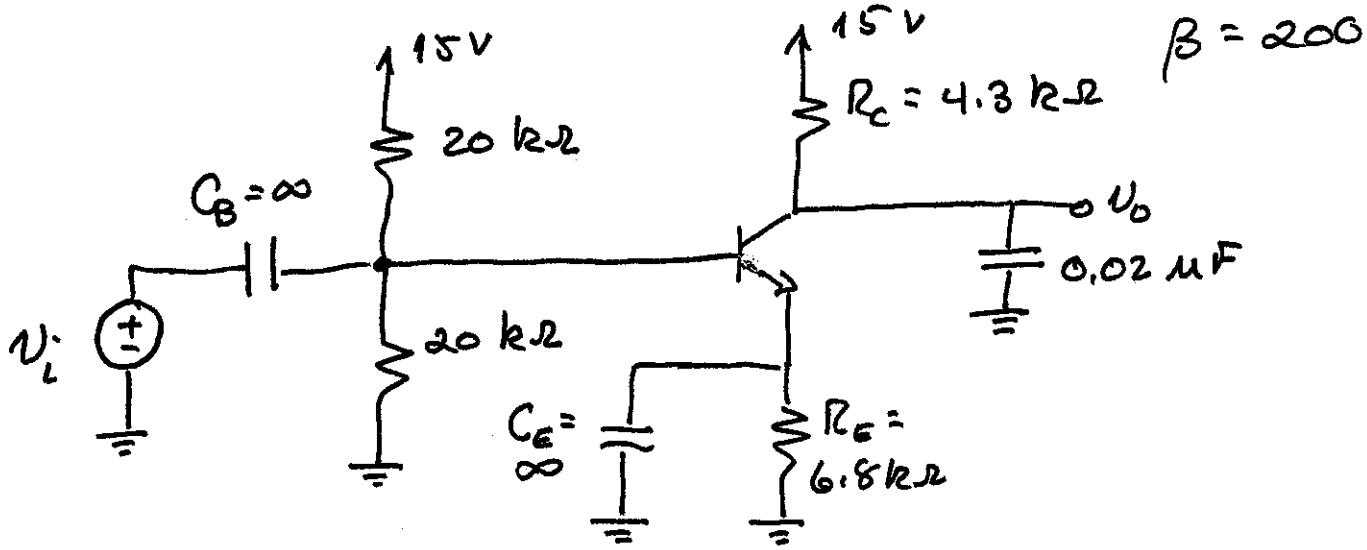
Quiz duration: 30 minutes

1. You may have one 8 ½ x 11 in. "crib" sheet, written on both sides, during the quiz. You may have any calculator you choose, but no computers. No other notes or materials will be allowed.
2. Show all work necessary to complete the problem on these pages. A solution without the work shown will receive no credit.
3. Show units in intermediate and final results, and in figures.
4. If your work is sloppy or difficult to follow, points will be subtracted.

_____/20

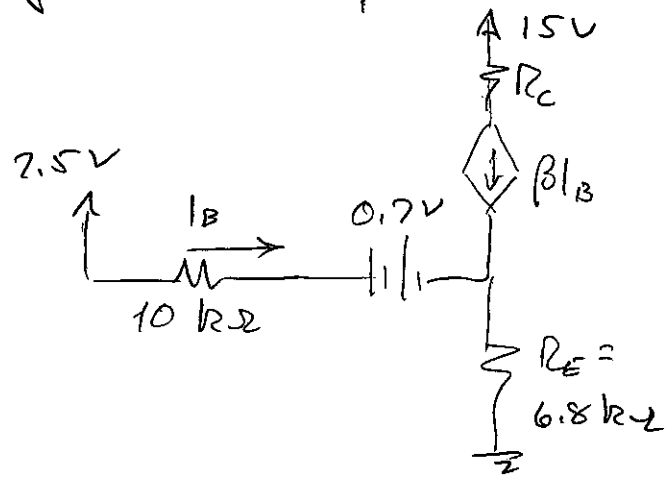
The BJT in the circuit shown is biased in the linear region. There is no need to prove this assertion. The capacitances C_E and C_B are very large. Do the following.

a) Find the gain v_o/v_i in the pass band.
b) Describe the frequency response of this circuit: is it a low-pass, high-pass, or band-pass response? How do you know?
c) Find the breakpoint frequency(ies), that is, find the zeros and poles.



DC analysis: all capacitors → open ckt

Then...

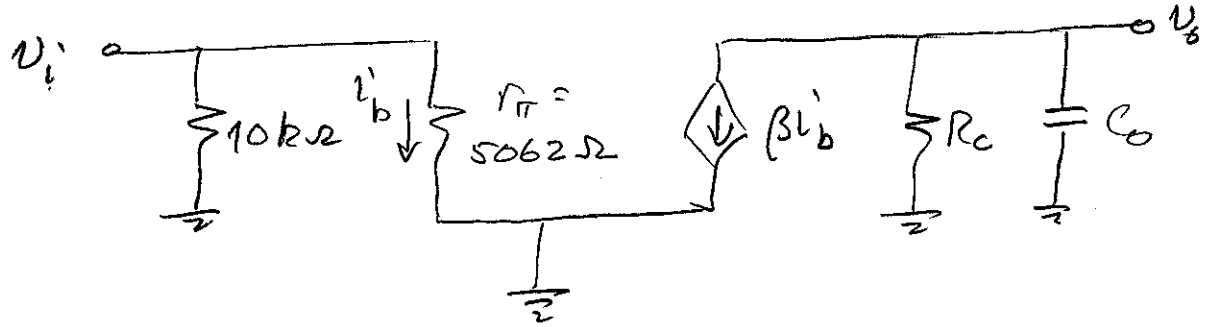


$$I_B = \frac{2.5 - 0.7}{10\text{k} + (201)6800} = 4.94\,\mu A$$

At any $\omega > 0$, C_B and C_E → short ckt. So the ac model is...

$$r_\pi = \frac{V_T}{I_B} = \frac{0.025}{4.94 \times 10^{-6}} = 5062\ \Omega$$

Room for Extra Work



with $C_0 = 0.02\,\mu F$.

PASS BAND: $C_0 \rightarrow$ open ckt and

$$v_o = -\beta i_b \cdot R_c \qquad i_b = v_i / r_\pi$$

$$\boxed{\frac{v_o}{v_i} = -\beta \frac{R_c}{r_\pi} = 170.}$$

The frequency response is low-pass: for $\omega \rightarrow \infty$, $v_o \rightarrow 0$ because $C_0 \rightarrow$ short.

$$\bar{V}_o = -\beta \bar{I}_B \cdot \frac{R_c}{1 + j\omega R_c C_0}$$

so we have a pole at

$$\boxed{\omega = 1/R_c C_0 \simeq 11.6\ \text{k rad/s}}$$