Name: ______________________________ (please print)

Signature: ___________________________

ECE 3455
Quiz #6
April 28, 2008

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.

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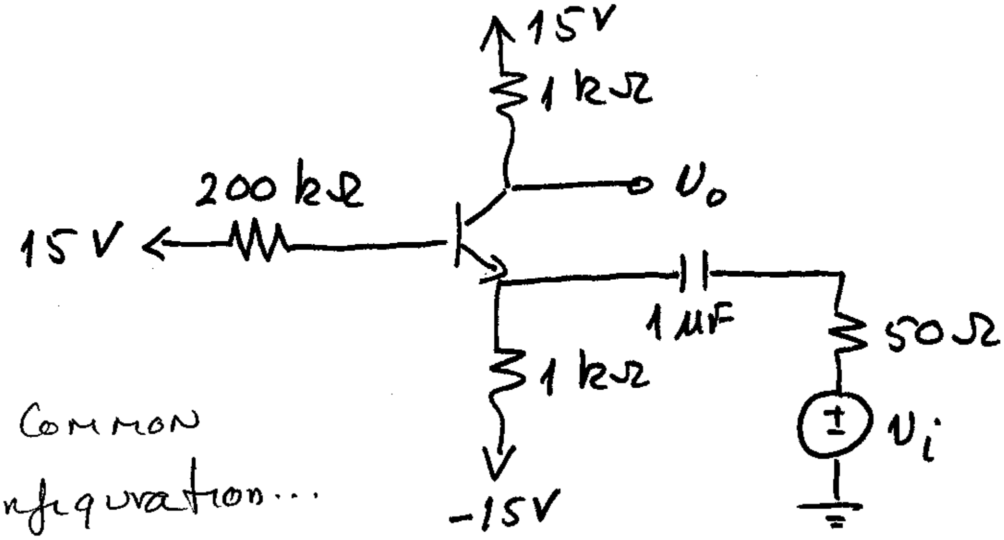
The BJT in the circuit below has $\beta = 100$ and $V_{CE,SAT} = 0.3$ V. It is biased in the linear region; you may assume this without proof. Find the gain v_o/v_i in the pass band.

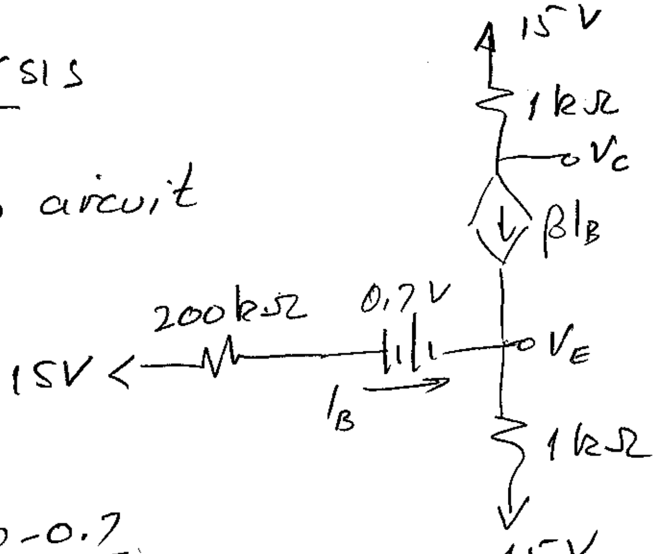


This is a COMMON BASE configuration...

We were not asked for proof that the BJT is in the linear region but let's do it anyway. We need I_B or I_C for our ac model anyway...

DC ANALYSIS

C → open circuit



$$I_B = \frac{30 - 0.7}{200k + (\beta+1)1k}$$

$$= 98.7\ \mu A$$

$$\Rightarrow \quad V_{CE} = (15 - 1000\beta I_B) - (1000(\beta+1)I_B - 15)$$

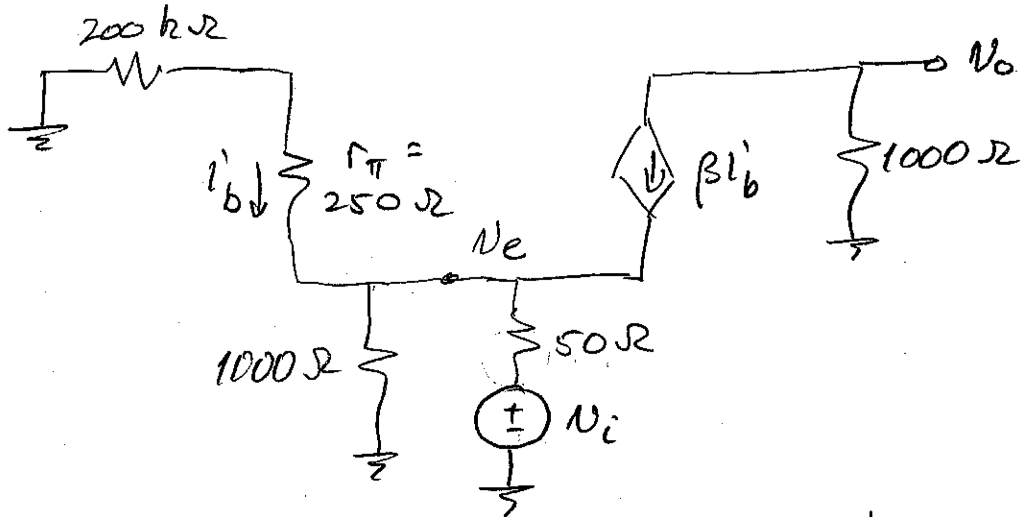
$$= 5.13 - (-5.03)$$

$$= 10.33\ V$$

✓

Room for Extra Work

So $r_\pi = V_T/I_B \cong 250\,\Omega$ so the small signal model is ...



We were asked for V_o/V_i in the pass band so we have shorted the capacitor (otherwise the gain is 0 - actually, there is no input).

r_π is negligible in comparison with 200 kΩ, so...

$$\frac{V_e}{200k} + \frac{V_e}{1k} + \frac{V_e - V_i}{50} - \beta\left(\frac{-V_e}{200k}\right) = 0$$

$$V_e\left(\frac{1}{200k} + \frac{1}{1k} + \frac{1}{50} + \frac{100}{200k}\right) = \frac{V_i}{50} \Rightarrow \underline{V_e = 0.93\,V_i}$$

$$V_o = -\beta i_b' \cdot 1k = \frac{\beta V_e}{200k} 1k = \frac{\beta(0.93 V_i)}{200k} 1k$$

$$\boxed{\frac{V_o}{V_i} = \frac{\beta(0.93)}{200000} 1000 \cong 0.46}$$