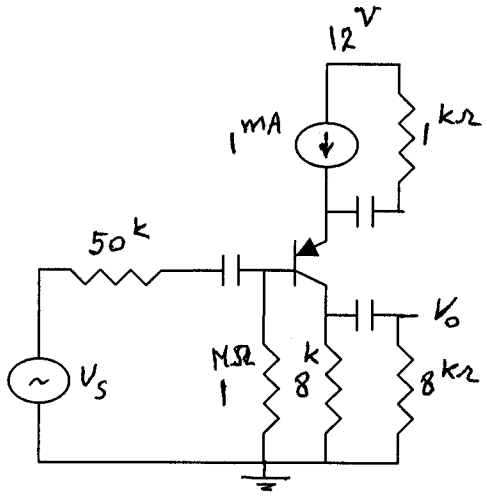
(ECE3455, Q6) In the circuit shown, VEB(on)=0.7[V], VEC(sat)=0.2[V] and beta=100.

a) Find Av, Ri and Ro.

b) Find the maximum output and input amplitudes.

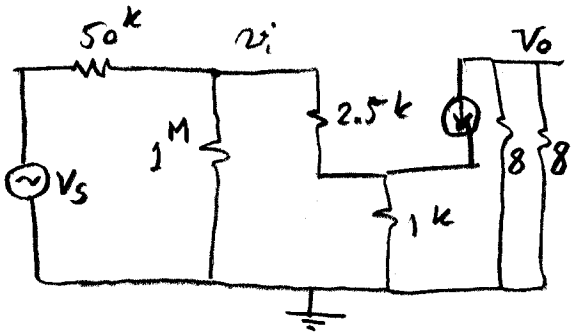


Solution:

a) $I_C = 1\ mA \qquad r_\pi = \frac{100 \times 25}{1} = 2.5\ k\Omega$

$R_i = 1^M \| [2.5 + 101 \times 1] = \boxed{93.8\ k\Omega}$

$R_o = \boxed{8^k}$



$A_v = \frac{v_i}{v_s} \times \frac{i_b}{v_i} \times \frac{v_o}{i_b}$

$\frac{v_i}{v_s} = \frac{R_i}{R_i + R_s} = \frac{93.8}{93.8 + 50} = 0.65$

$\frac{i_b}{v_i} = [r_\pi + (1+\beta) R_E]^{-1} = [2.5 + 101 \times 1]^{-1} = [103.5\ k]^{-1} = \frac{1}{103.5\ k}$

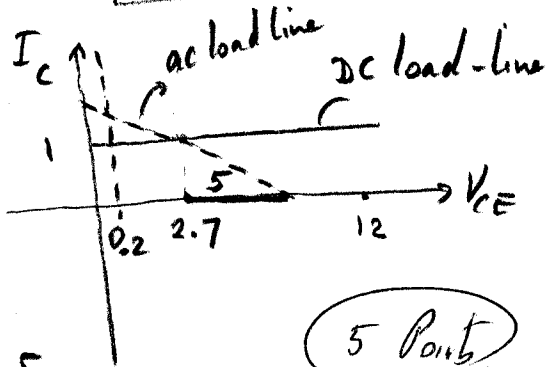
15 Points

$\frac{v_o}{i_b} = -100 \times 8 \| 8 = -400\ k\Omega$

$A_v = \frac{v_o}{v_s} = 0.65 \times \frac{1}{103.5} \times (-400) = \boxed{-2.5}$

b) $V_{EC} = R_B \times \frac{I_C}{\beta} + 0.7 - 8 \times 1 = 2.7\ [V]$

ac load line: $v_{ce} = -5\, i_c$



Distance to Cut-off $= 5 \times 1 = 5\ V$

" " Saturation $= 2.7 - 0.2 = 2.5$

5 Points

$v_o(max) = v_{ce}(max) = 2.5 \qquad v_s(max) = \frac{2.5}{2.5} = 1\ V$