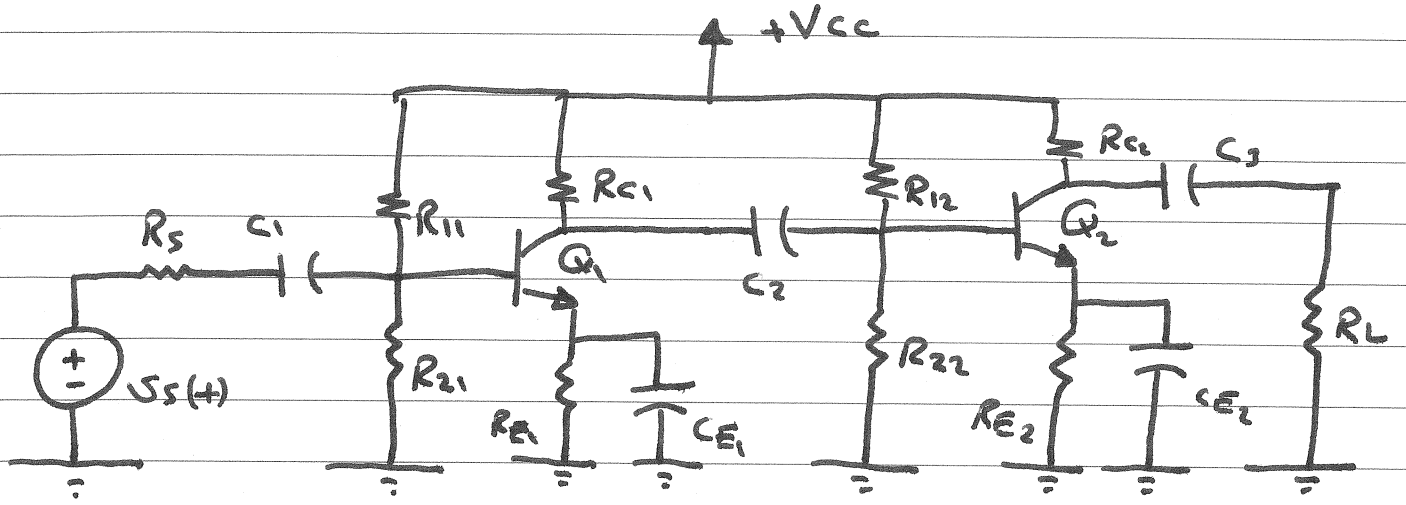
Multistage Amplifier Frequency Response



$R_S = 0.3K$ $R_{12} = 123K$

$R_{11} = 123K$ $R_{22} = 58K$

$R_{21} = 58K$ $R_{E2} = 5K$

$R_{E1} = 5K$ $R_{C2} = 8K$

$R_{C1} = 8K$ $R_L = 2K$

$C_{E1} = 250\,\mu F$ $C_1 = 10\,\mu F$ $C_3 = 7.5\,\mu F$

$C_{E2} = 1150\,\mu F$ $C_2 = 5\,\mu F$

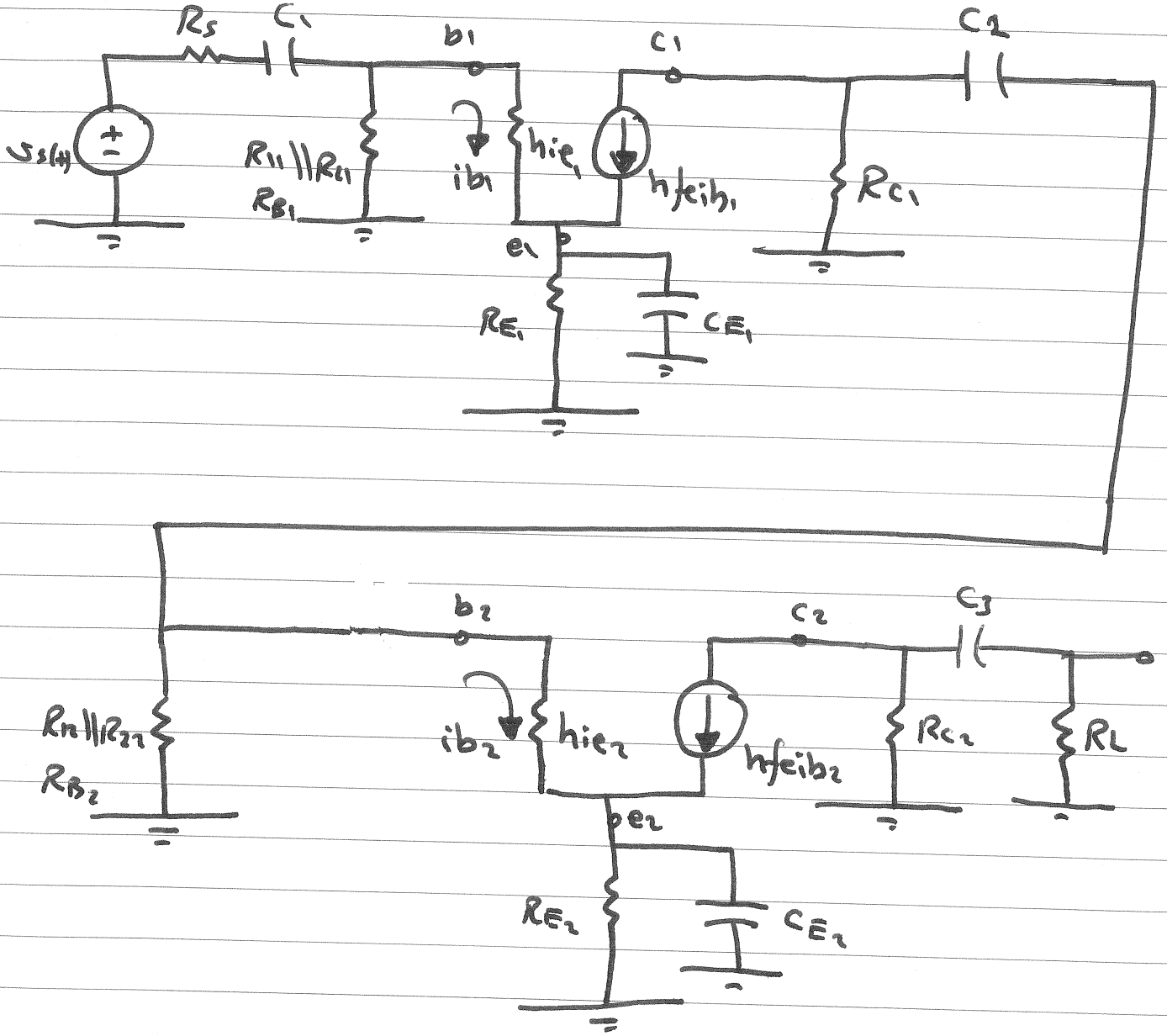
$h_{fe1} = h_{fe2} = 350$ $r_{x1} = r_{x2} = 50\,\Omega$

$h_{ie1} = h_{ie2} = 9K$

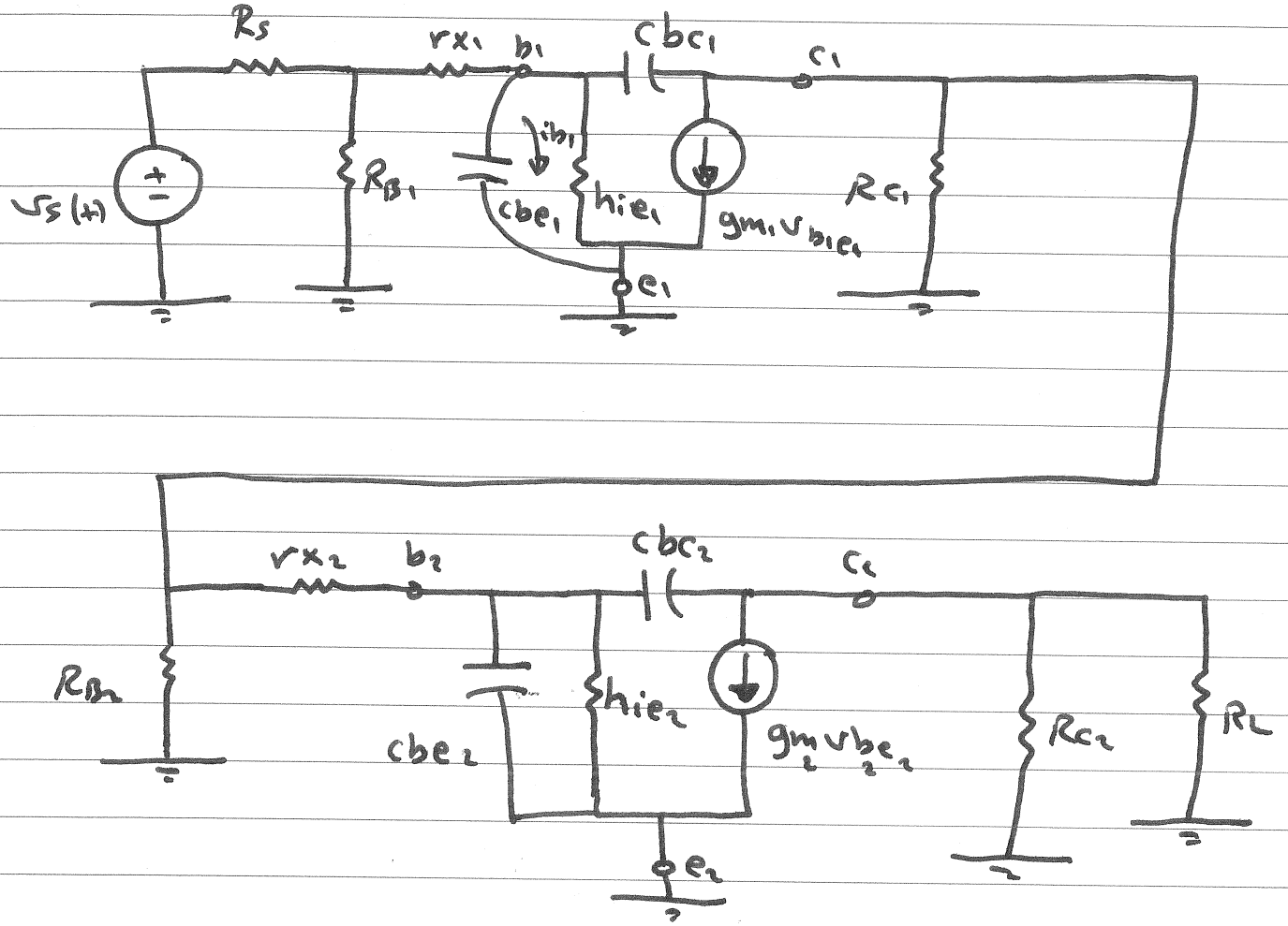
$c_{be1} = c_{be2} = 18.7\,pF$

$c_{bc1} = c_{bc2} = 2\,pF$

ac small Signal Low frequency equivalent ckt



ac small signal high-frequency equivalent ckt



An approximation For ω_L :

$$\omega_{C_1} = \frac{1}{C_1 (R_s + R_B \| h_{ie_1})} = 13.11 \text{ r/s} \quad ; R_{B_1} = 58\text{k} \| 123\text{k}$$

$$\omega_{C_2} = \frac{1}{C_2 (R_{c_1} + R_{B_1} \| h_{ie_2})} = 13.05 \text{ r/s} \qquad R_{B_1} \| R_{B_2}$$

$$\omega_{C_3} = \frac{1}{C_3 (R_{c_2} + R_L)} = 13.33 \text{ r/s}$$

$$\omega_{C_{E_1}} = \frac{1}{C_{E_1} \left(R_{E_1} \| \frac{h_{ie_1} + R_{B_1} \| R_s}{1 + h_{fe_1}}\right)} = 151. \text{ r/s}$$

$$\omega_{C_{E_2}} = \frac{1}{C_{E_2} \left(R_{E_2} \| \frac{h_{ie_2} + R_{B_2} \| R_{c_1}}{1 + h_{fe_2}}\right)} = 19.68 \text{ r/s}$$

$\therefore$ $211 \text{ r/s} > \omega_L > 151 \text{ r/s}$

$\omega_L \doteq 169 \text{ r/s}$

An approximation For ω_H :

1) $\tau_{bc_1} = C_{bc_1} \cdot R_{bc_1}$

$R_{bc_1} = R_{L_1}^- + (1 + g_{m_1} R_{L_1}^-) R_{S_1}^-$

$R_{L_1}^- = R_{c_1} \| R_{B_2} \| (r_{X_2} + h_{ie_2}) = 8\text{k} \| 39.4\text{k} \| (0.05\text{k} + 9\text{k})$
$= 3.83\text{ k}$

$R_{S_1}^- = h_{ie_1} \| (r_{X_1} + R_s \| R_{B_1}) = 9\text{k} \| (0.05\text{k} + 0.3\text{k} \| 39.4\text{k})$
$= 0.335\text{ k}$

$\tau_{bc_1} = 108.2 \text{ n s}$
$\omega_{bc_1} = 9.24 \text{ M r/s}$

2) $\tau_{be_1} = C_{be_1} R_{be_1}$

$R_{be_1} = R_{S_1}^{-} = 0.335\,K$

$\tau_{be_1} = 6.3\,ns$

$\omega_{be_1} = 158.7\,Mv/s$

3) $\tau_{bc_2} = C_{bc_2} R_{bc_2}$

$R_{bc_2} = R_{L_2}^{-} + R_{S_2}^{-} (1 + g_{m_2} R_{L_2}^{-})$

$R_{S_2}^{-} = h_{ie_2} \parallel (v_{X_2} + R_{C_1} \parallel R_{B_2}) = 9K \parallel (0.05K + 6K \parallel 39.4K)$

$= 3.84K$

$R_{L_2}^{-} = R_{C_2} \parallel R_L = 1.6K$

$\tau_{bc_2} = 489\,ns$

$\omega_{bc_2} = 2.044\,Mv/s$

4) $\tau_{be_2} = C_{be_2} R_{be_2}$

$R_{be_2} = R_{S_2}^{-} = 3.84K$

$\tau_{be_2} = 71.8\,ns$

$\omega_{be_2} = 13.929\,Mv/s$

$$\frac{1}{\tau_{be_1} + \tau_{be_2} + \tau_{bc_1} + \tau_{bc_2}} < \omega_H < 2.044\,Mv/s$$

$$1.481 < \omega_H < 2.044\,Mv/s$$

$$\omega_H \doteq 1.504\,Mv/s$$