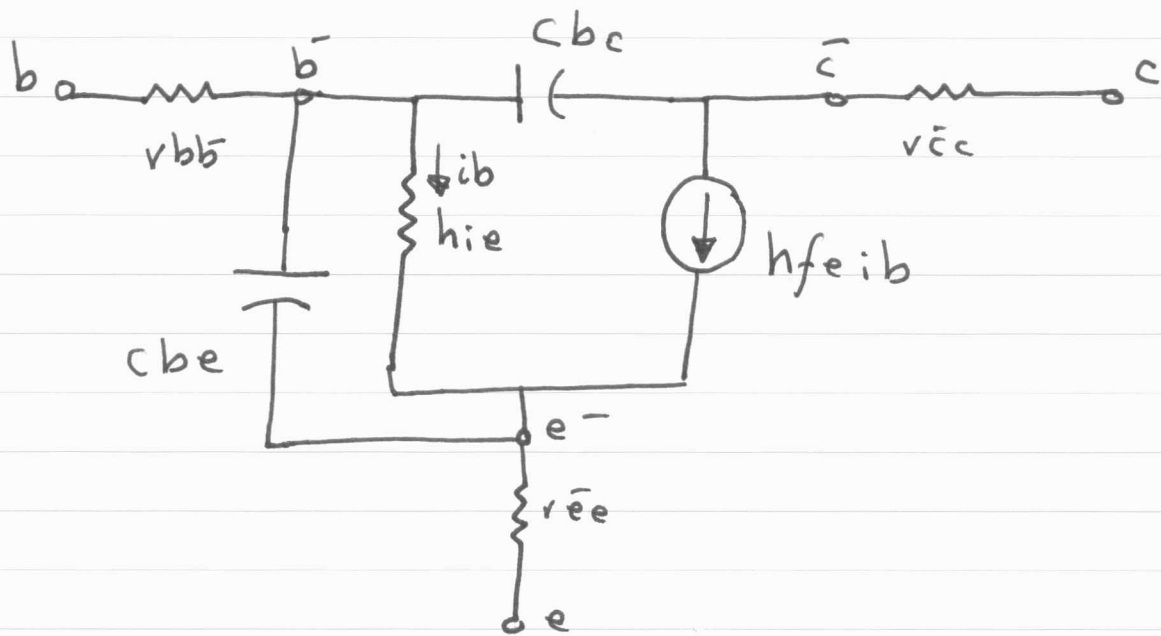
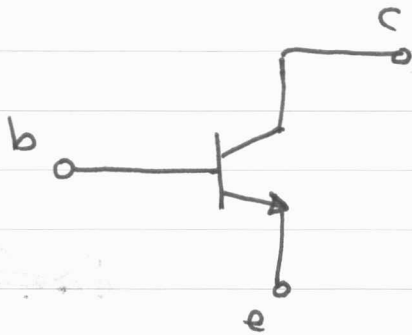


BJT small signal high-frequency equivalent CRT

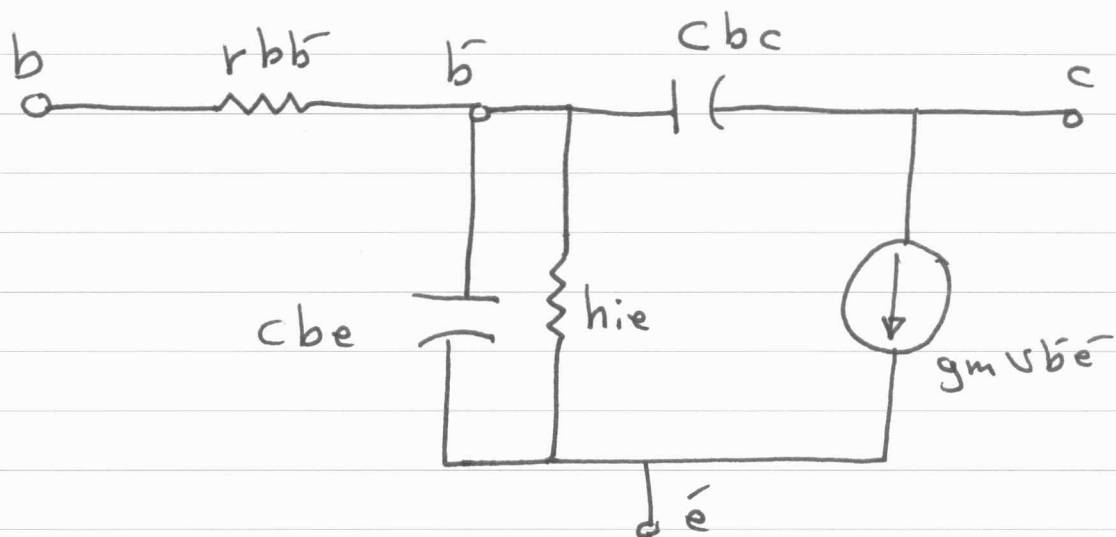
1) CE and CC



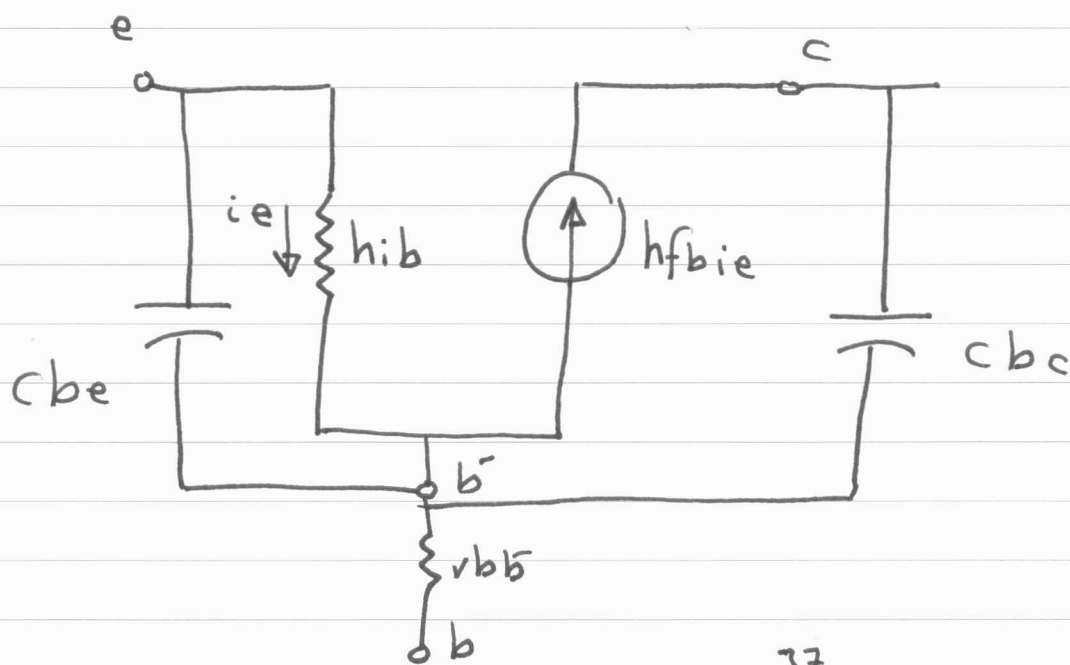
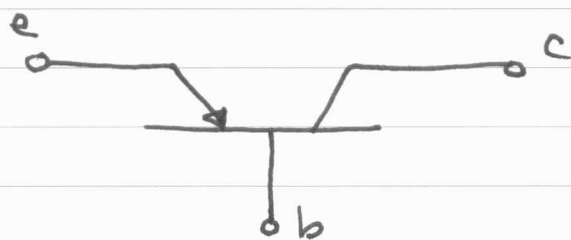
$$r_{bb\bar{}} = (20\Omega - 200\Omega)$$

$$r_{cc\bar{}} = r_{ee\bar{}} = (1\Omega - 2\Omega) \rightarrow 0\Omega$$

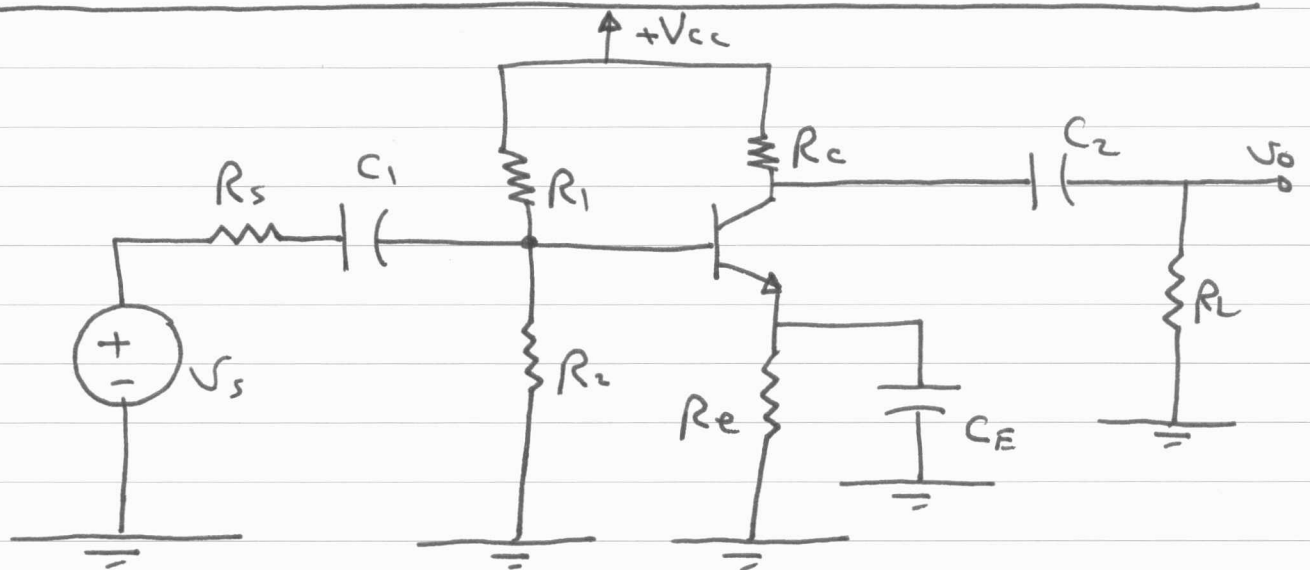
$$h_{feib} = h_{fe} \frac{v_{b\bar{e}}}{h_{ie}} = \frac{h_{fe}}{h_{ie}} v_{b\bar{e}} = g_m v_{b\bar{e}}$$



2) CB



Common Emitter Amplifier High-Frequency Analysis



$$g_m = 33.5 \text{ mS}, \quad h_{ie} = 8.78 \text{ k}\Omega$$

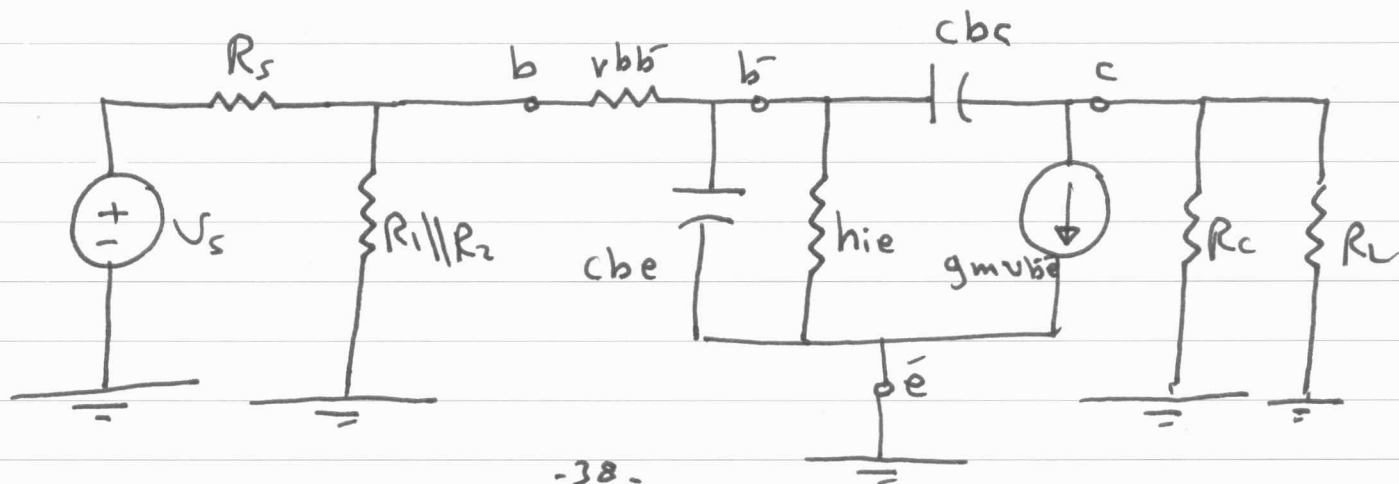
$$R_1 \parallel R_2 = 16.67 \text{ k}\Omega, \quad R_s = 1 \text{ k}\Omega, \quad R_C = 5 \text{ k}\Omega$$

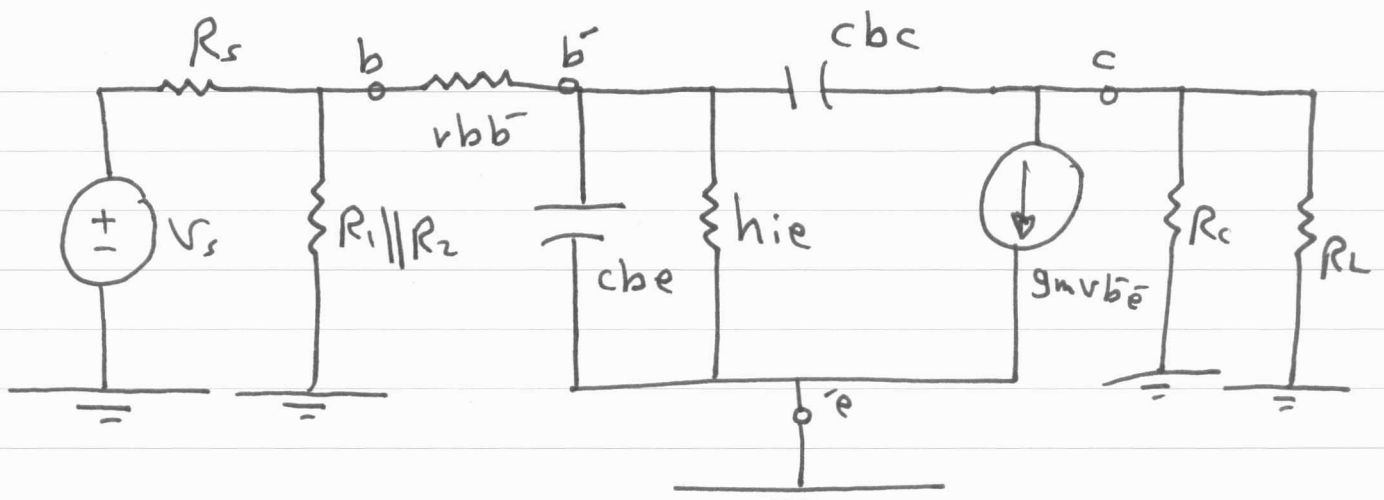
$$R_L = 2 \text{ k}\Omega, \quad R_E = 1 \text{ k}\Omega, \quad r_{bb} = 50 \Omega$$

$$C_{be} = 17.25 \text{ pF}, \quad \text{and} \quad C_{bc} = 1.8 \text{ pF}$$

Estimate ω_H

ac small signal high-frequency equivalent ckt





1) To find T_{be} , set c_{bc} open circuit

$$T_{be} = C_{be} R_{be}$$

$$R_{be} = (R_s \parallel R_1 \parallel R_2 + r_{bb}) \parallel h_{ie}$$

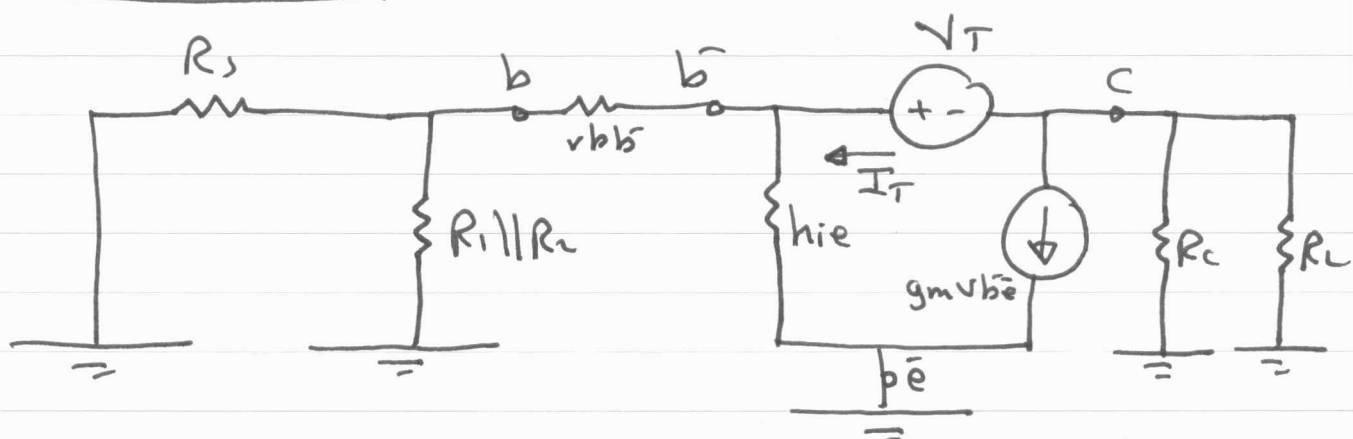
$$T_{be} = 14.98 \text{ ns}$$

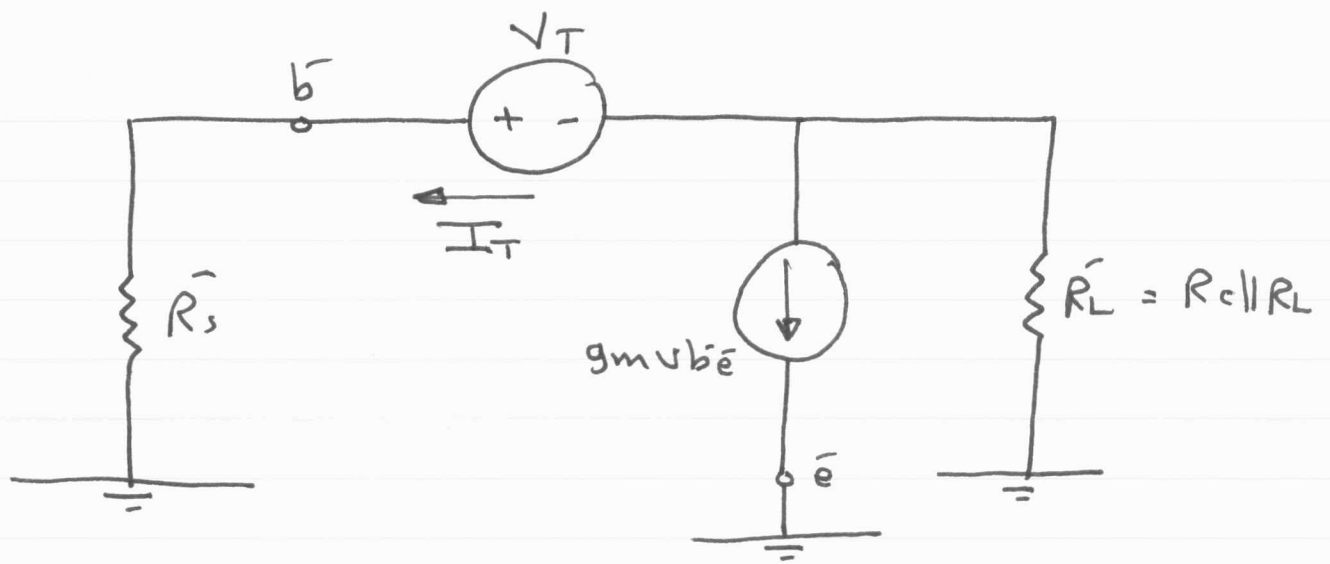
$$\therefore W_{be} = 66.76 \text{ mV/s}$$

2) To find T_{bc} , set C_{be} open circuit

$$T_{bc} = C_{bc} R_{bc}$$

to find R_{bc}





$$R_s^- = [R_s \parallel R_1 \parallel R_2 + r_{bb}] \parallel h_{ie}$$

$$R_L^- (I_T + g_m v_{be}) + R_s^- I_T = V_T$$

$$v_{be} = R_s^- I_T$$

$$\therefore \frac{V_T}{I_T} = R_{bc} = R_s^- + R_L^- + g_m R_L^- R_s^-$$

$$\therefore \tau_{bc} = 78.9 \text{ ns}$$

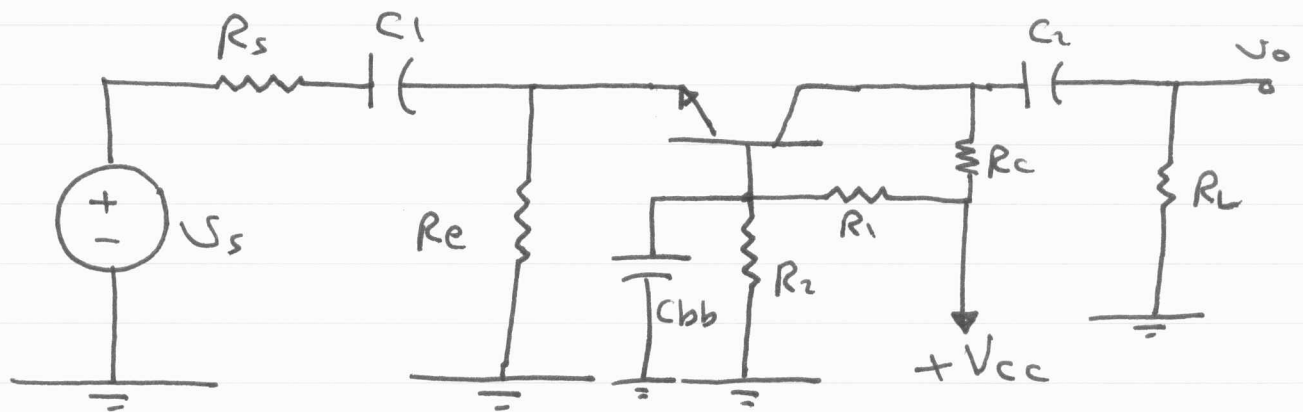
$$\therefore \omega_{bc} = 12.67 \text{ Mrad/s}$$

$$\frac{1}{\tau_{be} + \tau_{bc}} < \omega_H < 12.67 \text{ Mrad/s}$$

$$10.65 \text{ Mrad/s} < \omega_H < 12.67 \text{ Mrad/s}$$

$$\omega_H \approx 10.7 \text{ Mrad/s}$$

Common base amplifier

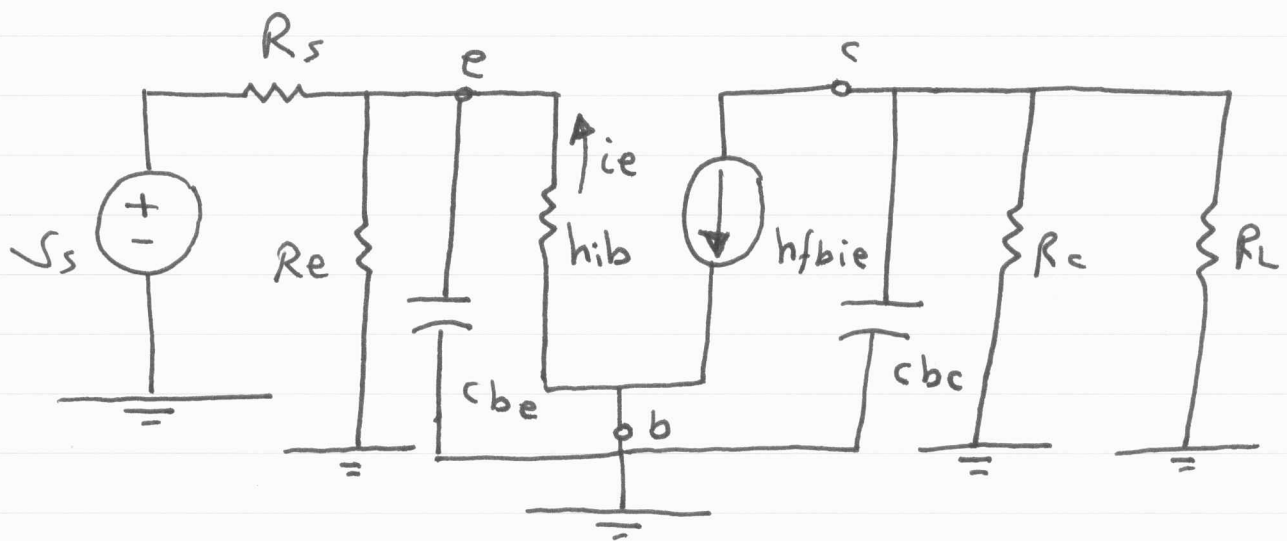


$$R_s = 0.1k, R_e = 1k, R_c = 10k, R_L = 10k$$

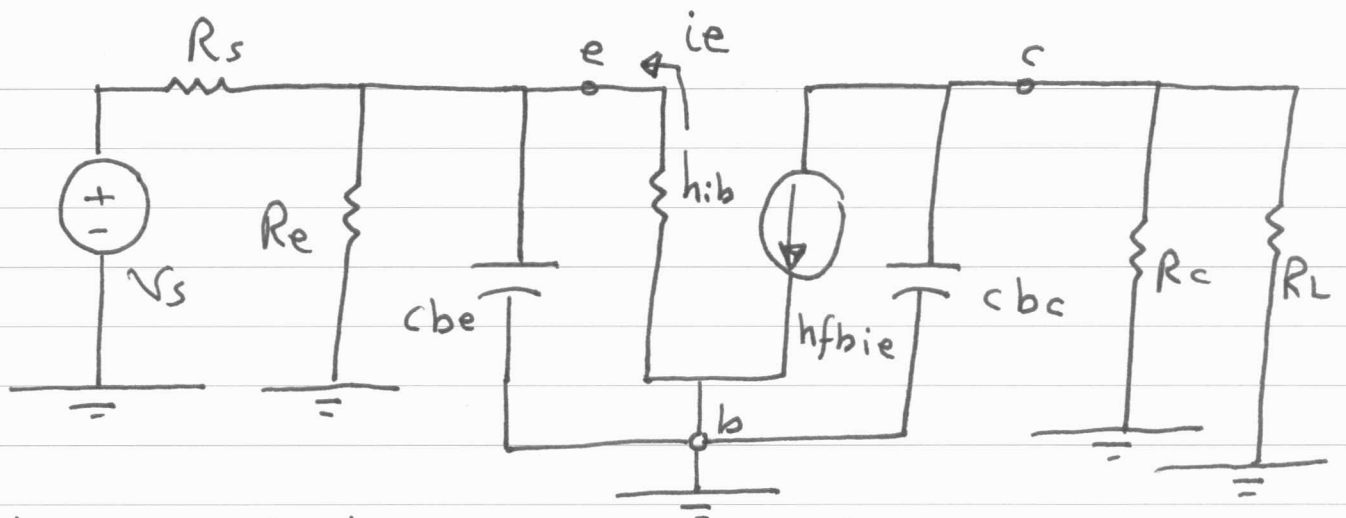
$$R_1 \parallel R_2 = 16.67k, h_{ib} = 0.026k, v_{bb} = 0$$

$$C_{be} = 20pF, \text{ and } C_{bc} = 2pF$$

Estimate ω_H



ac small signal high-frequency equivalent ckt



1) To find τ_{be} , set C_{bc} open circuit

$$\tau_{be} = C_{be} R_{be}$$

$$R_{be} = R_s \parallel R_1 \parallel R_2 \parallel h_{ib}$$

$$\therefore \tau_{be} = 0.40797 \text{ ns}$$

$$\therefore W_{be} = 2451 \text{ Mv/s}$$

2) To find τ_{bc} , set C_{be} open circuit

$$\tau_{bc} = C_{bc} R_{bc}$$

$$R_{bc} = R_c \parallel R_L$$

$$\therefore \tau_{bc} = 10 \text{ ns}$$

$$\therefore W_{bc} = 100 \text{ Mv/s}$$

$$96.1 \text{ Mv/s} < W_H < 100 \text{ Mv/s}$$

$$W_H \approx 99.8 \text{ Mv/s}$$