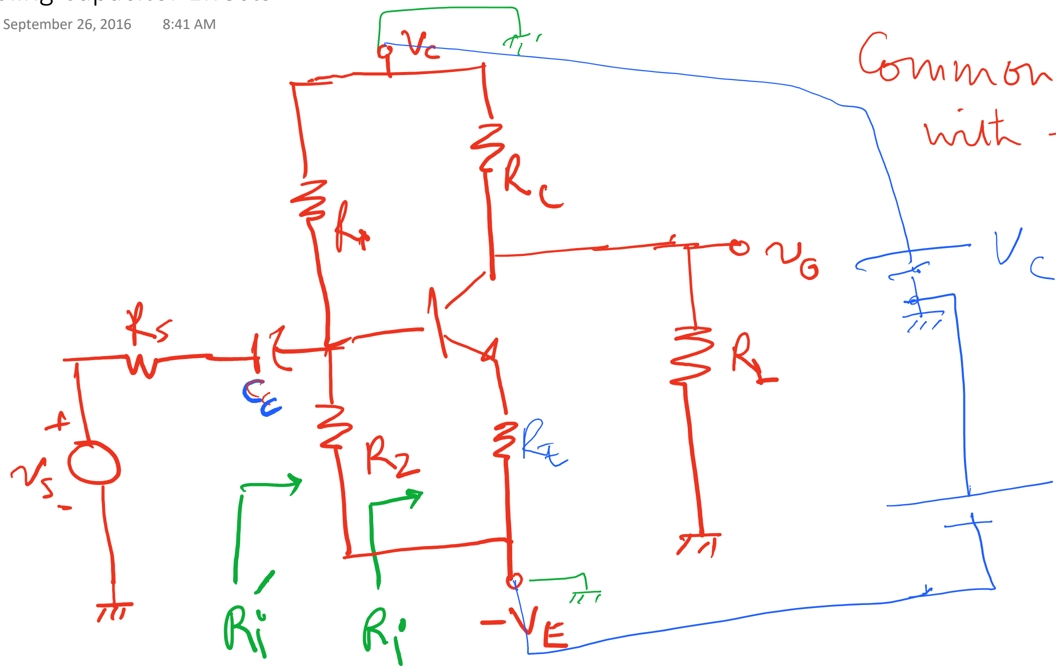
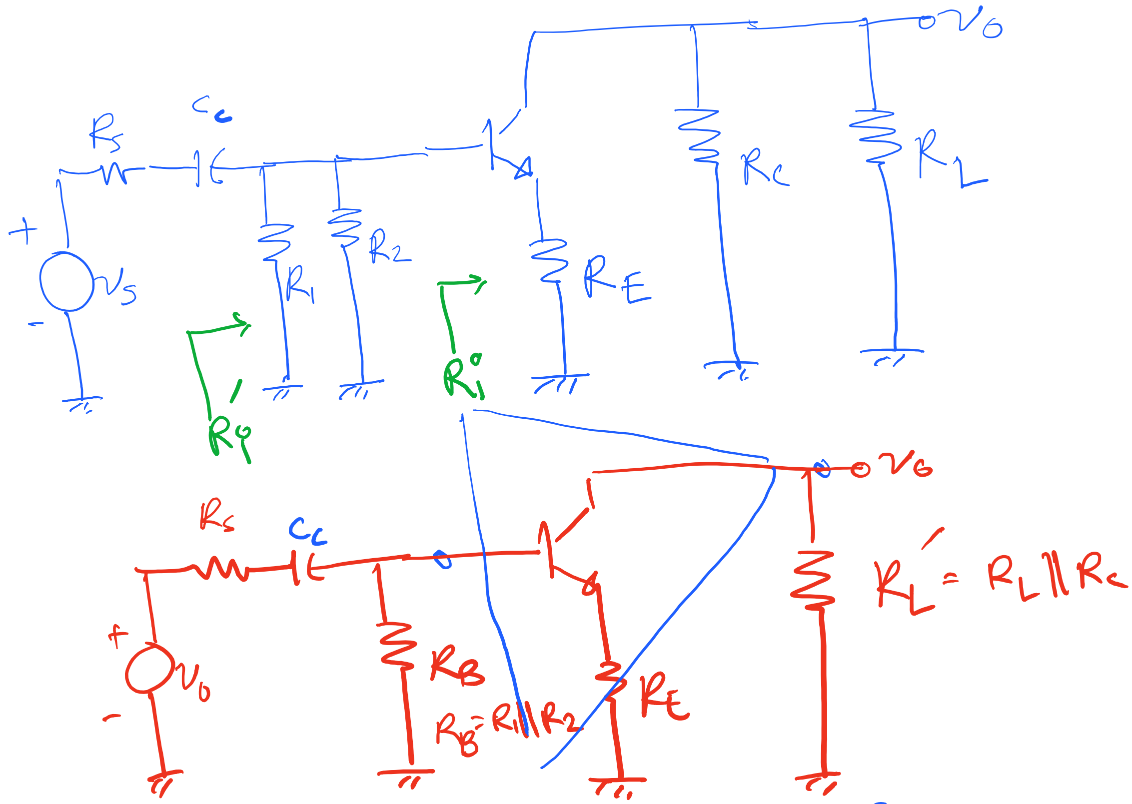
Coupling Capacitor Effects

Monday, September 26, 2016 8:41 AM

Common Emitter with emitter resistor



Ac equivalent circuit

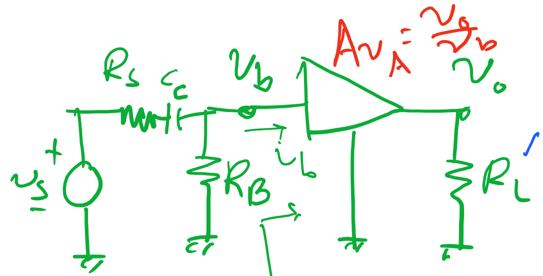


① Find the gain at low frequency

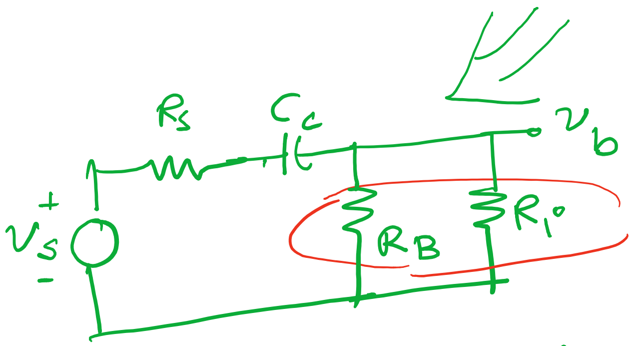
at midband frequency

② Find the gain

Find the maximum gain.



$$R_i' = \frac{v_b}{i_b}$$



R_i'

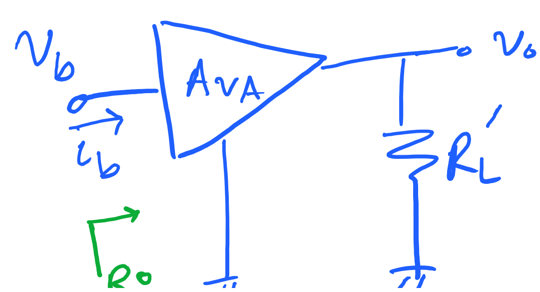
$$\tau = (R_s + R_i')C_c$$

$$f_L = \frac{1}{2\pi\tau}$$

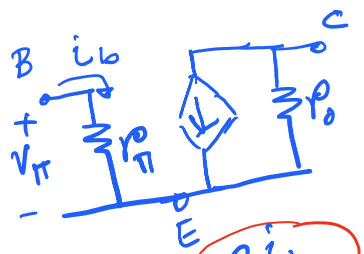
$$A_v = \frac{v_o}{v_s} = \frac{v_o}{v_b} \cdot \frac{v_b}{v_s} = A_{v_A} \times \frac{v_b}{v_s}$$

$$\frac{v_b}{v_s} = \frac{R_i'}{R_s + R_i' - j\frac{1}{\omega C_c}} = \frac{R_i'}{R_s + R_i' + \frac{1}{sC_c}}$$

$$\left.\frac{v_b}{v_s}\right|_{\text{midband}} = \frac{R_i'}{R_s + R_i'}$$

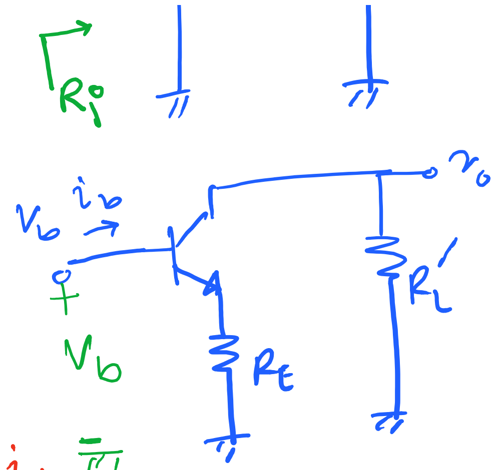


$$A_{v_A} = \frac{v_o}{v_b}$$

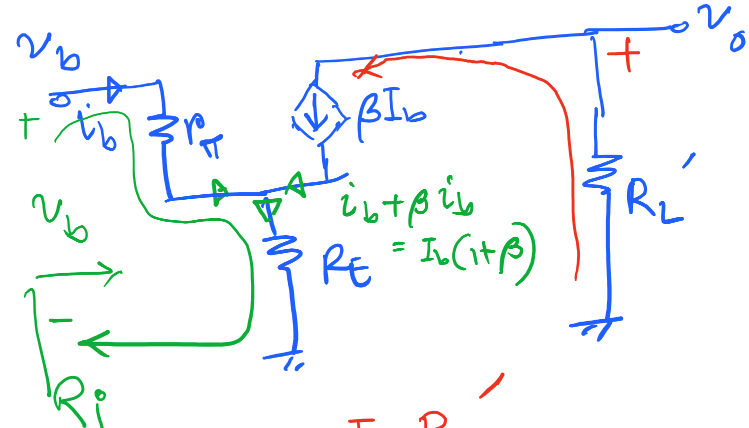


βi_b $\qquad$ β

$g_m v_\pi = (g_m r_\pi) i_b$



$r_o = \infty$



$$A_{v_A} = \frac{v_o}{v_b}$$

$$v_o = -\beta I_b R_L'$$

$$= \frac{-\beta I_b R_L'}{[r_\pi + (1+\beta) R_E] I_b}$$

$$V_b = I_b r_\pi + (1+\beta) I_b R_E$$

$$= \left(r_\pi + (1+\beta) R_E\right) I_b$$

$$= \frac{-\beta R_L'}{r_\pi + (1+\beta) R_E}$$

$$R_i = \frac{V_b}{I_b} = r_\pi + (1+\beta) R_E$$

$$A_{v_A}\Big|_{R_E=0} = -\frac{\beta R_L'}{r_\pi}$$

$\beta R_L'$ ... $\gg 1$

$R_E = 0$

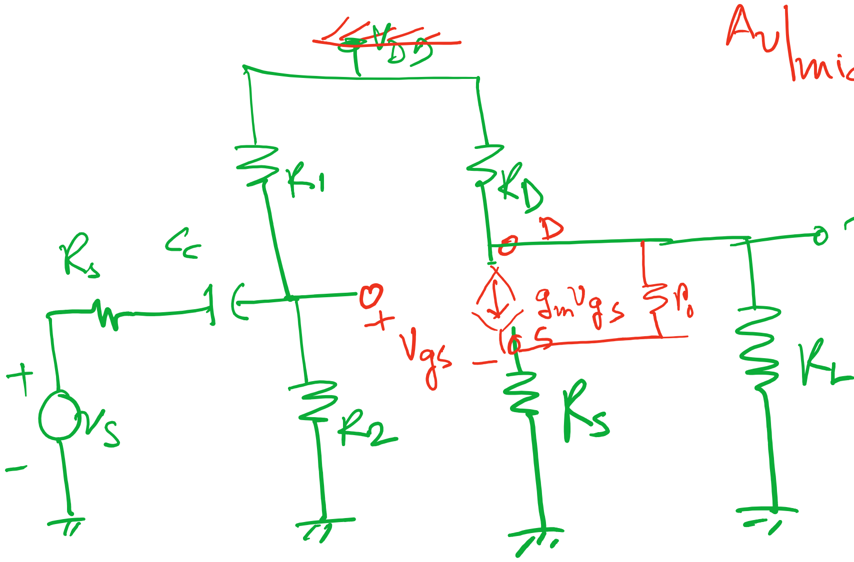
$$A_{v_A}\Big|_{R_E \neq 0} = \frac{-\beta R_L'}{r_\pi + (1+\beta) R_E} \qquad \beta \gg 1$$

$$\simeq \frac{-\beta R_L'}{(1+\beta) R_E} \simeq -\frac{R_L'}{R_E}$$

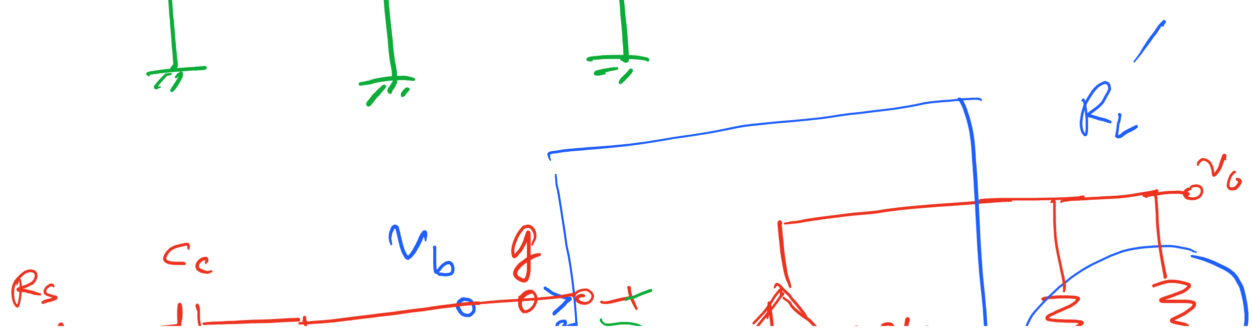
$$A_v\Big|_{\text{Low freq}} = A_{v_A} \cdot \frac{v_b}{v_s}$$

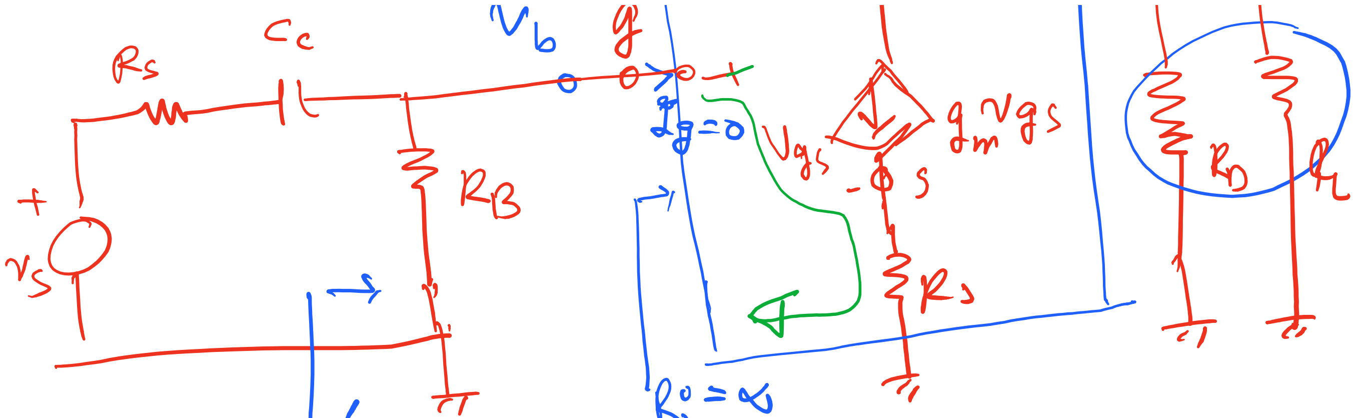
$$= \frac{-\beta R_L'}{r_\pi + (1+\beta) R_E} \times \frac{R_i'}{R_i' + R_s + \frac{1}{sC_c}}$$

$$A_v\Big|_{\text{midband}} = \frac{-\beta R_L'}{r_\pi + (1+\beta) R_E} \times \frac{R_i'}{R_i' + R_s}$$



$r_o = \infty$





$$R_i^o = \infty = \frac{v_b}{I_g} = \frac{v_b}{0} = \infty$$

$$R_i' = R_B \| R_i = R_B$$

$$[R_L' = R_D \| R_L]$$

$$A_{vA} = \frac{v_o}{v_b} = \frac{-g_m v_{gs} R_L'}{v_{gs} + g_m v_{gs} R_s}$$

$$= \frac{-g_m R_L'}{(1 + g_m R_s)}$$