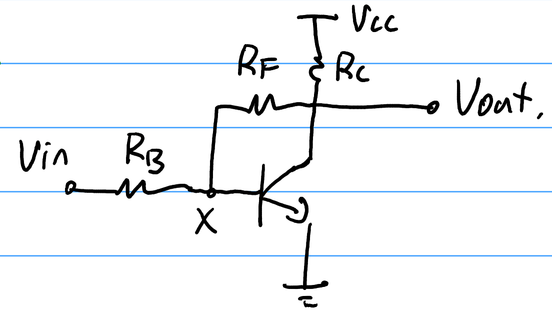
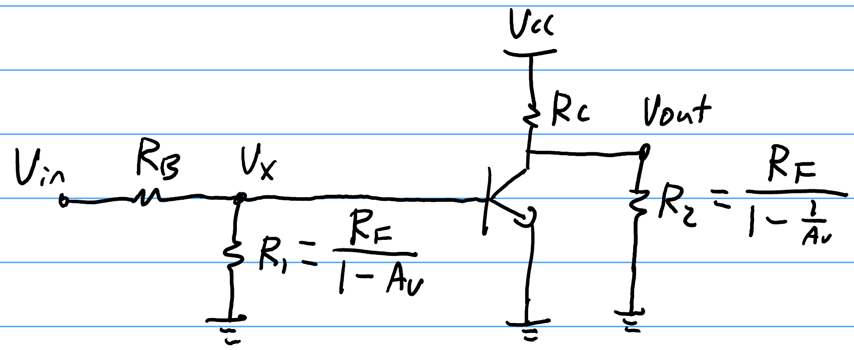
11.16



Assume $V_A = \infty$

R_F large $\therefore \dfrac{V_{out}}{V_X} = -g_m R_C$.

Transform this circuit using Miller's Theorem.



Using approx A_v here.

Impedances are divided by $(1-A_v)$ & $(1-\frac{1}{A_v})$ respectively.

$$R_1 = \frac{R_F}{1+g_m R_C}, \qquad R_2 = \frac{R_F}{1+\frac{1}{g_m R_C}} \approx R_F. \quad \text{Also } R_F \gg R_C.$$

Notice voltage divider at $V_X = \dfrac{V_{in} R_1}{R_B + R_1}$

$$\therefore \frac{V_{out}}{V_{in}} = \frac{V_{out}}{V_X}\frac{V_X}{V_{in}} = -g_m R_C \frac{R_1}{R_B+R_1}$$

$$= \frac{-g_m R_C \frac{R_F}{1+g_m R_C}}{R_B + \frac{R_F}{1+g_m R_C}} = \frac{-g_m R_C R_F}{R_B(1+g_m R_C)+R_F}$$

$$= \frac{-g_m R_C}{1+K}$$

$-g_m R_C$ ← gain without R_F

$1+K$ ← reduction in gain.

where $K = \dfrac{R_B}{R_F}(1+g_m R_C)$