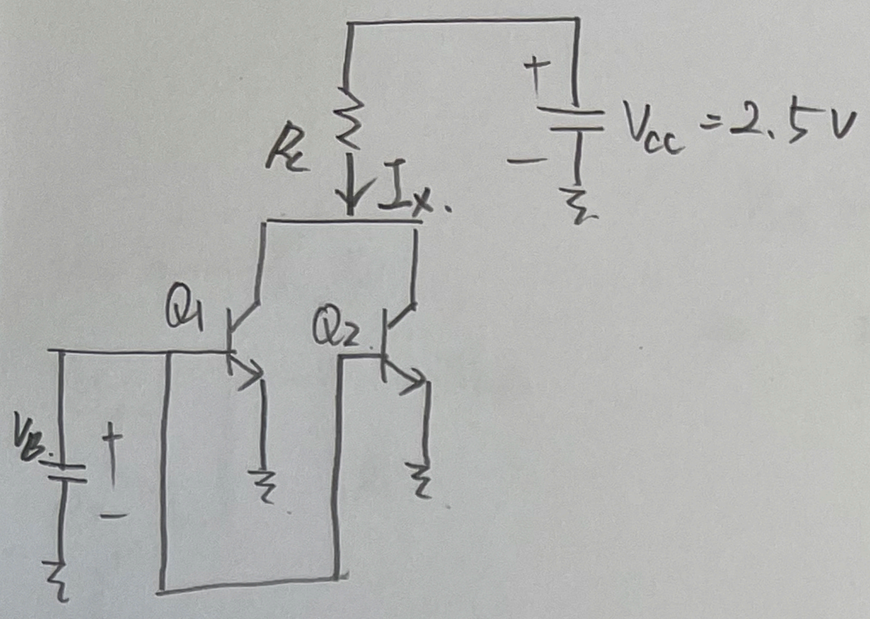
QUIZ 1



$I_{S1} = 2I_{S2} = 5\times10^{-16}A$

$I_x = 1.2\,mA$

$V_B = ?$

$I_{C1} = I_{S1}\left[\exp(V_B/V_T) - 1\right]$

$I_{C2} = \frac{1}{2} I_{S2}\left[\exp(V_B/V_T) - 1\right]$

$I_x = \frac{3}{2} I_{S1}\left[\exp(V_B/V_T) - 1\right] = 1.2\,mA.$

5×10^{-16}. use $V_T = 0.026$

then $V_B = 0.731V$ //

voltage drop at $R_c = R_c \times I_x$.

$V_{CE} = 2.5 - R_c I_x \geq V_{BE}$

$\Rightarrow 2.5 - R_c \times 1.2\times10^{-3} = 0.731$. → edge of active mode.

$R_c = 1474.17\,\Omega$. //

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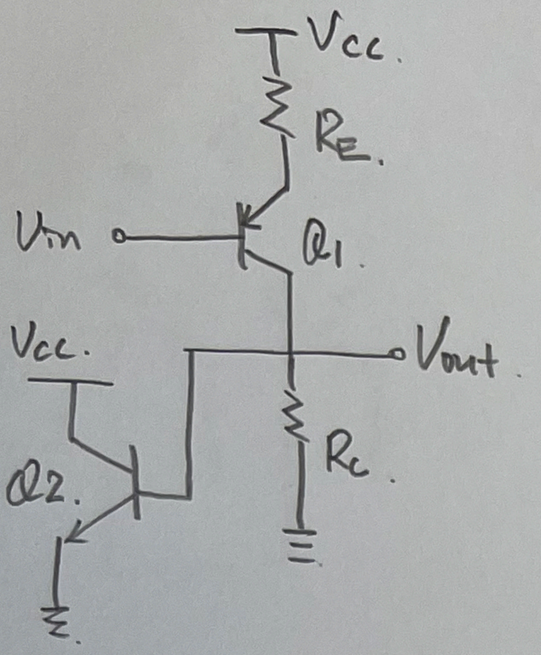

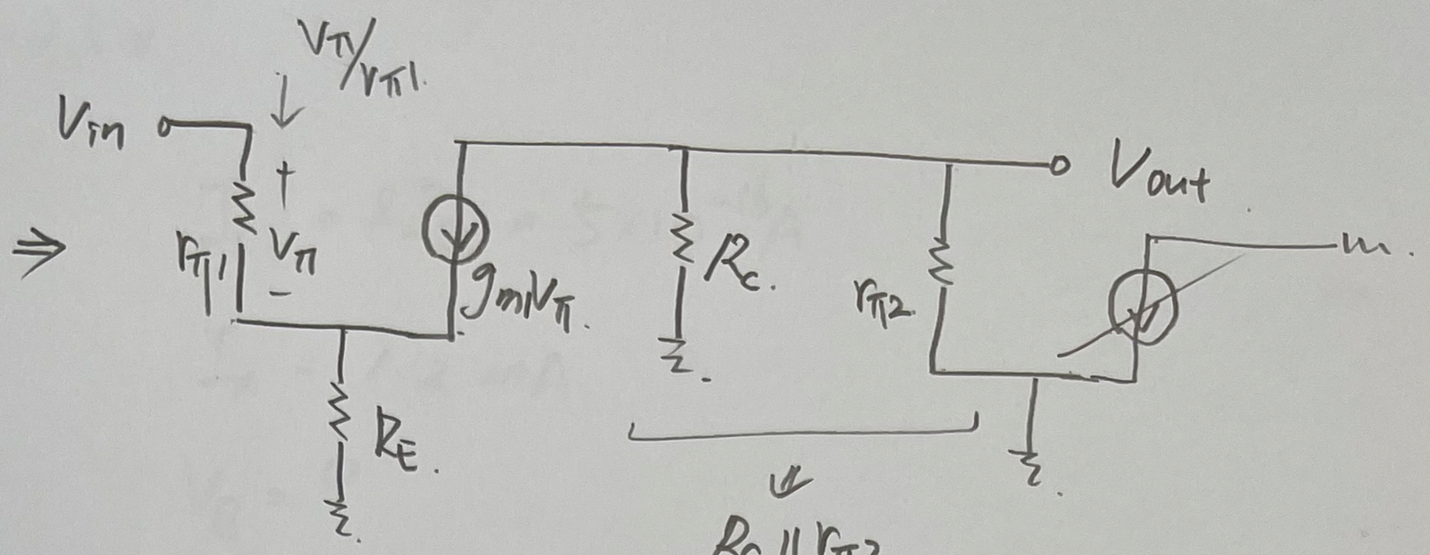

$$V_{out} = -g_{m1} V_\pi (R_C \parallel r_{\pi 2})$$

$$-V_{in} + V_\pi + R_E \left(V_\pi / r_{\pi 1} + g_{m1} V_\pi \right) = 0$$

$$V_{in} = V_\pi \left(1 + R_E / r_{\pi 1} + g_{m1} R_E \right)$$

$$V_{out} = -g_{m1} \frac{V_{in}}{1 + R_E / r_{\pi 1} + g_{m1} R_E} (R_C \parallel r_{\pi 2})$$

$$A_V = -g_{m1} \frac{R_C \parallel r_{\pi 2}}{1 + R_E / r_{\pi 1} + g_{m1} R_E} \quad \text{or} \quad -g_{m1} \frac{R_C \parallel r_{\pi 2}}{1 + g_{m1} R_E}$$

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or seen from the small-signal model

the circuit is C-E stage with emitter degeneration.

$$A_V = -\frac{g_m R_C}{1 + g_m R_E} \Rightarrow -\frac{g_{m1} (R_C \parallel r_{\pi 2})}{1 + g_{m1} R_E}$$
