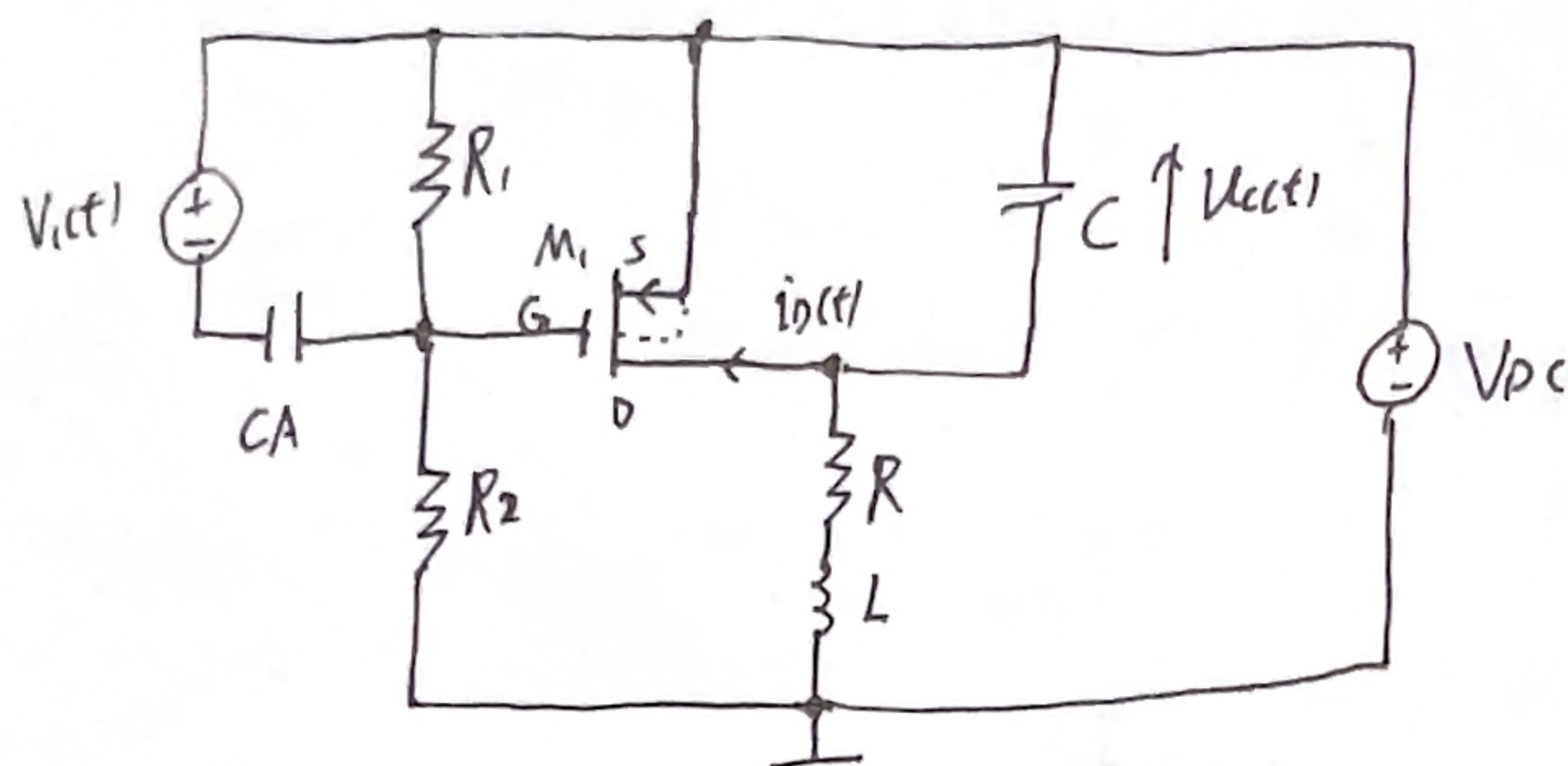


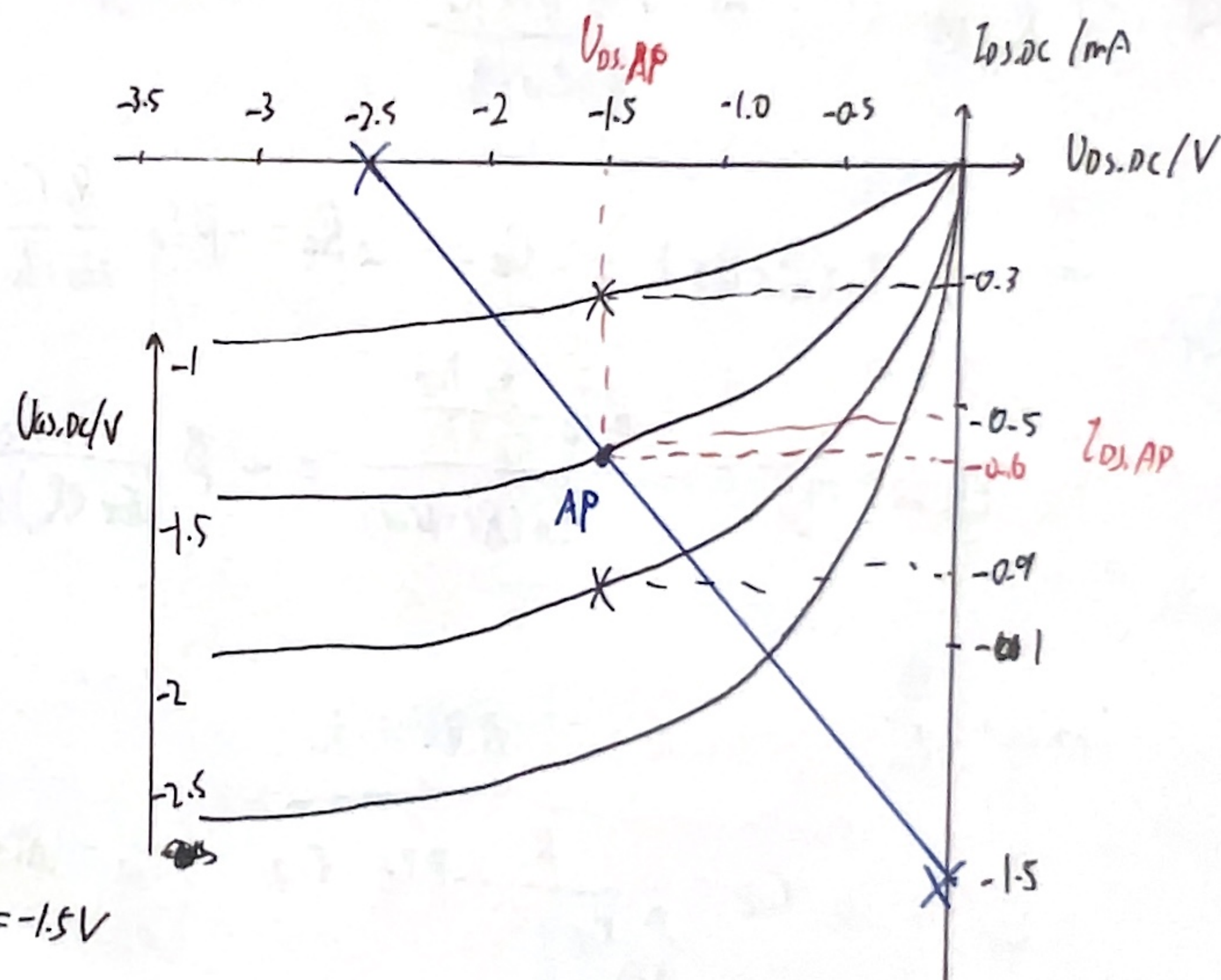
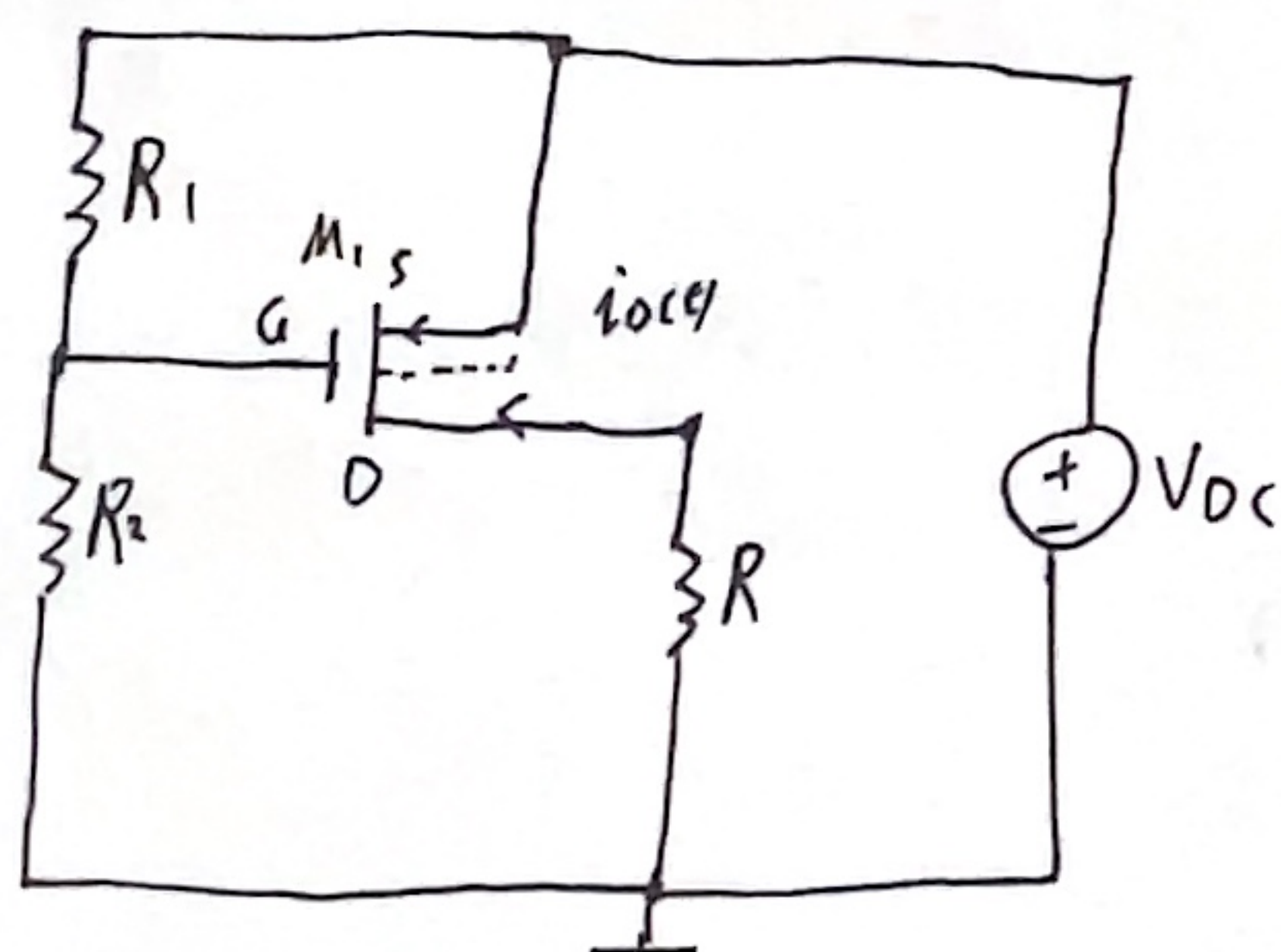
Aufgabe 10

Gegeben: Hochfrequenzverstärkerschaltung, PMOSFET M_1 , $R_1 = 3k\Omega$, $R_2 = 2k\Omega$, $R = \frac{5}{3}k\Omega$,
 $L > 0$, $C_A > 0$, $C > 0$, $V_{DC} = 2.5V$, $V_{in}(t) = V_{in,KS}(t)$ s.d.A.



a. f. DC-Arbeitspunkt

DC \Rightarrow 电容断
 电感短



① V_{GS} ,

$$V_{GS,DC} = -\frac{R_1}{R_1 + R_2} V_{DC} = -\frac{3k\Omega}{3k\Omega + 2k\Omega} \cdot 2.5V = -\frac{3}{5} \cdot 2.5V = -1.5V$$

② V_{DS} ,

$$-V_{DC} = V_{DS,DC} + I_{DS,DC} \cdot R$$

$$V_{DS,DC} = -2.5V - I_{DS,DC} \cdot \frac{5}{3}k\Omega$$

$$\Rightarrow \begin{aligned} I_{DS,DC} = 0A, \quad V_{DS,DC} &= -2.5V \\ V_{DS,DC} = 0V, \quad I_{DS,DC} &= -(2.5V) \cdot \frac{3}{5k\Omega} = -1.5mA \end{aligned}$$

③ I_{DS}

$$\Leftrightarrow I_{DS,DC} \cdot \frac{5}{3}k\Omega = -2.5V - V_{DS,DC}$$

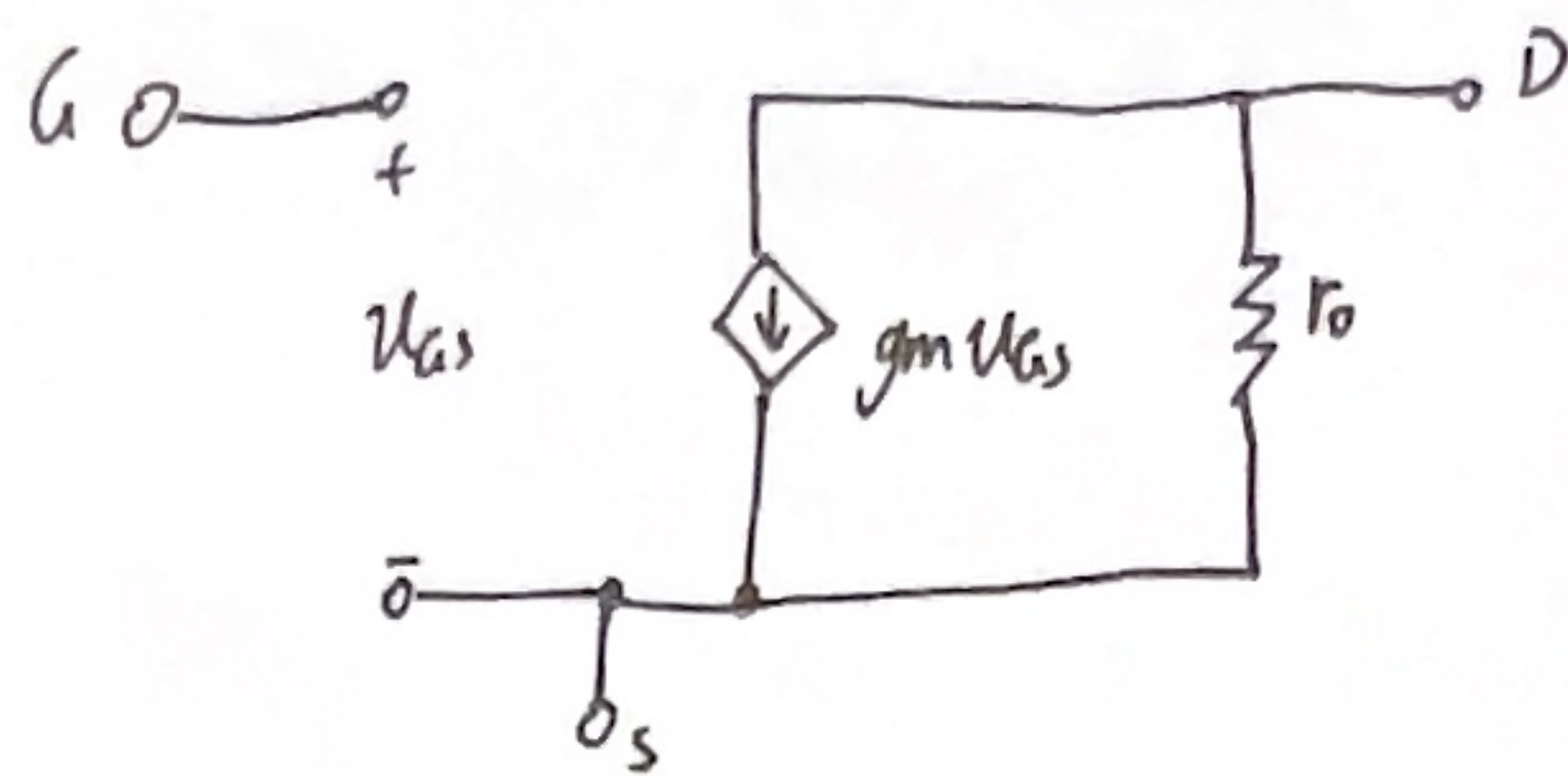
$$I_{DS,DC} = -(2.5V + V_{DS,DC}) \cdot \frac{3}{5k\Omega}$$

$$\Rightarrow V_{GS,AP} = -1.5V$$

$$V_{DS,AP} = -1.5V$$

$$I_{DS,AP} = -0.6mA$$

b. 在 AP 上, PMOSFET 的 小信号行为 等效, r_o , g_m



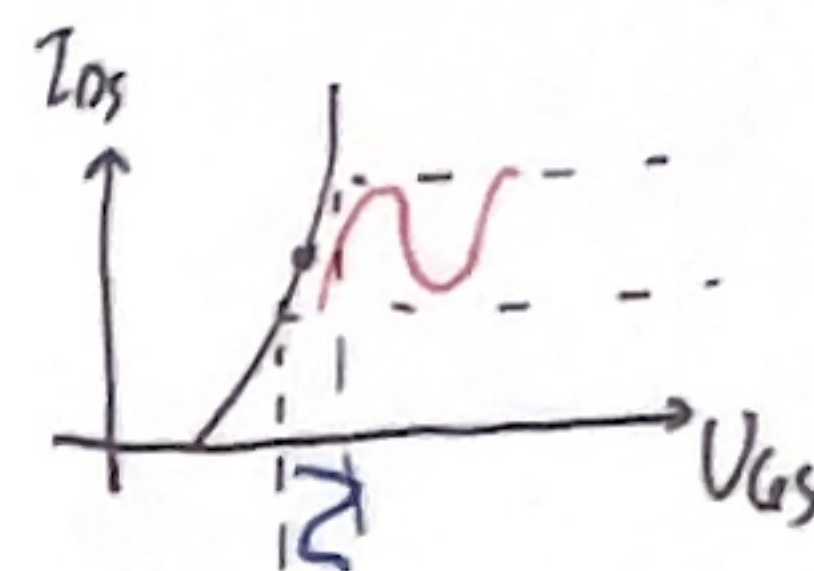
$$g_m = \frac{\partial I_{D,DC}}{\partial U_{GS,DC}} \approx \frac{\Delta I_{D,DC}}{\Delta U_{GS,DC}} = \frac{(-0.9 + 0.3) \text{ mA}}{(-2 \text{ V} + 1 \text{ V})} = 0.6 \text{ mS} = \frac{(-0.9 + 0.6) \text{ mA}}{(2 + 1.5) \text{ V}} = \frac{-0.3}{-0.5} \text{ mS} = 0.6 \text{ mS}$$

$$\Delta U_{GS,DC} \rightarrow -2 \text{ V} - (-1 \text{ V})$$

查图可得

$$\Delta I_{D,DC} \rightarrow -0.9 - (-0.3)$$

U_{GS} 控制 $I_D \Rightarrow$ 用 U_{GS} 确定 I_D



牢记此图

$$r_o = \left(\frac{\partial I_{D,DC}}{\partial U_{DS,DC}} \right)^{-1} = \frac{\partial U_{DS,DC}}{\partial I_{D,DC}} \approx \frac{\Delta U_{DS,DC}}{\Delta I_{D,DC}}$$

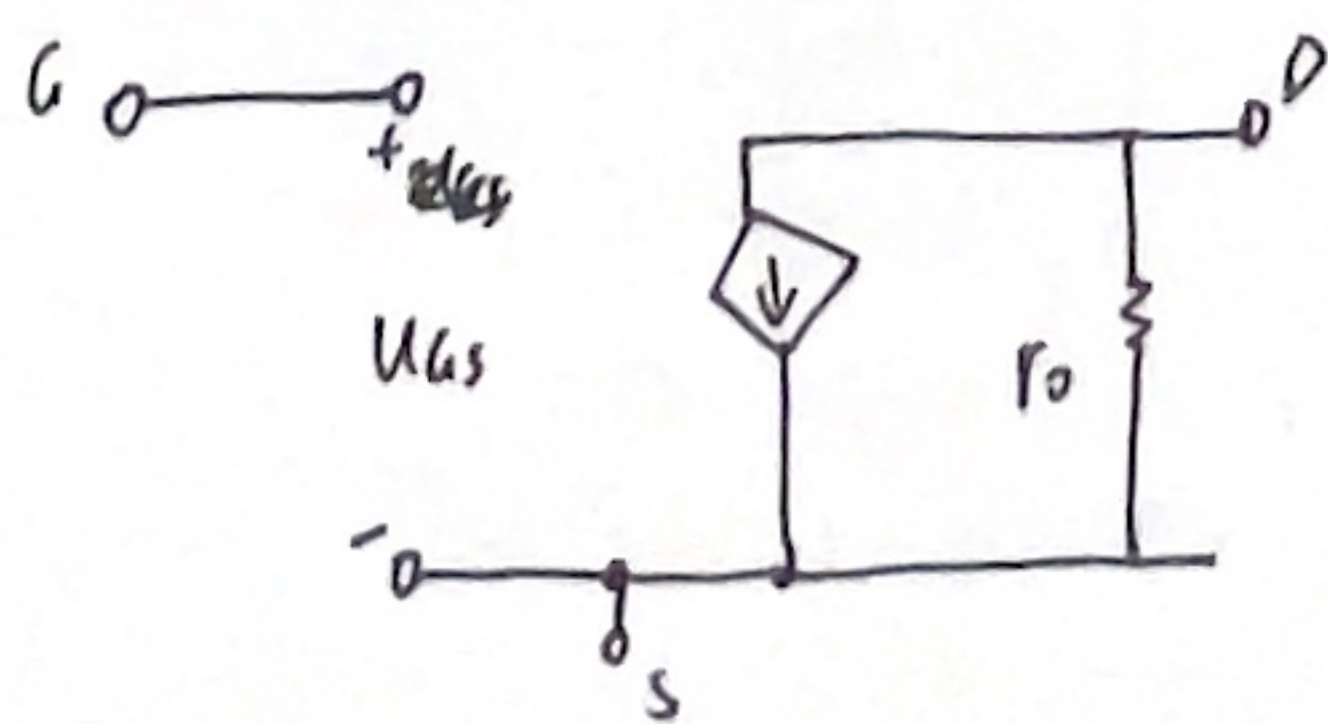
$$\Delta I_{D,DC} \rightarrow -0.7 - (-0.6)$$

$$\Delta U_{DS,DC} \rightarrow -3 \text{ V} - (-1.5 \text{ V})$$

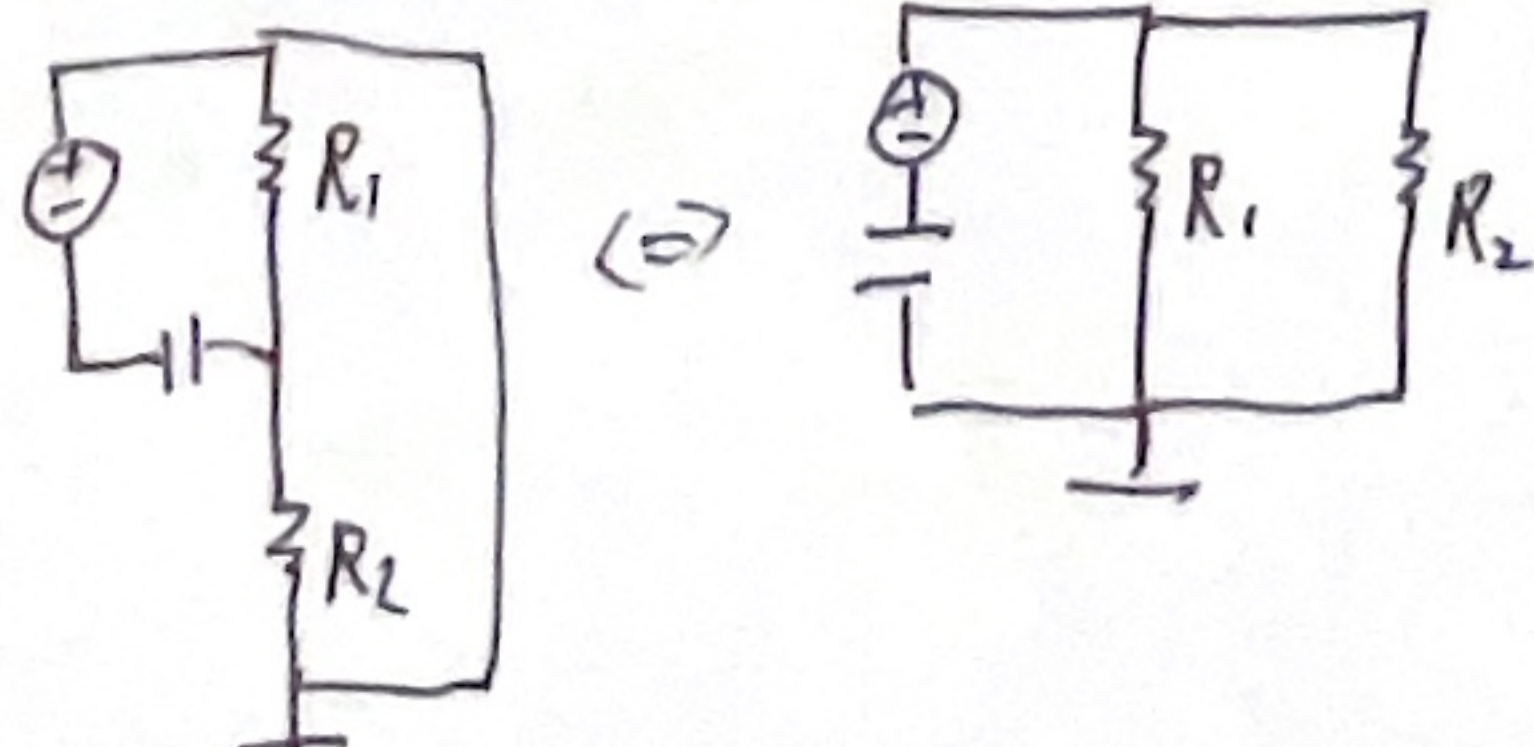
$$\Rightarrow r_o = \frac{(-3 + 1.5) \text{ V}}{(-0.7 + 0.6) \text{ mA}} = \frac{-1.5}{-0.1} \text{ k}\Omega = 15 \text{ k}\Omega$$

c. 画出 小信号等效电路 的 网络图

① 画 MOS 管



② 左边



③ 右边

