

Ques 3.1

(a) CS stage $A_v = |g_m R_o| = 5$ where $R_o = 500\Omega$.

$$g_m = \frac{1}{100}$$

$$g_m = M_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH}) = \sqrt{2 M_n C_{ox} \frac{W}{L} I_D}$$

Unknown.

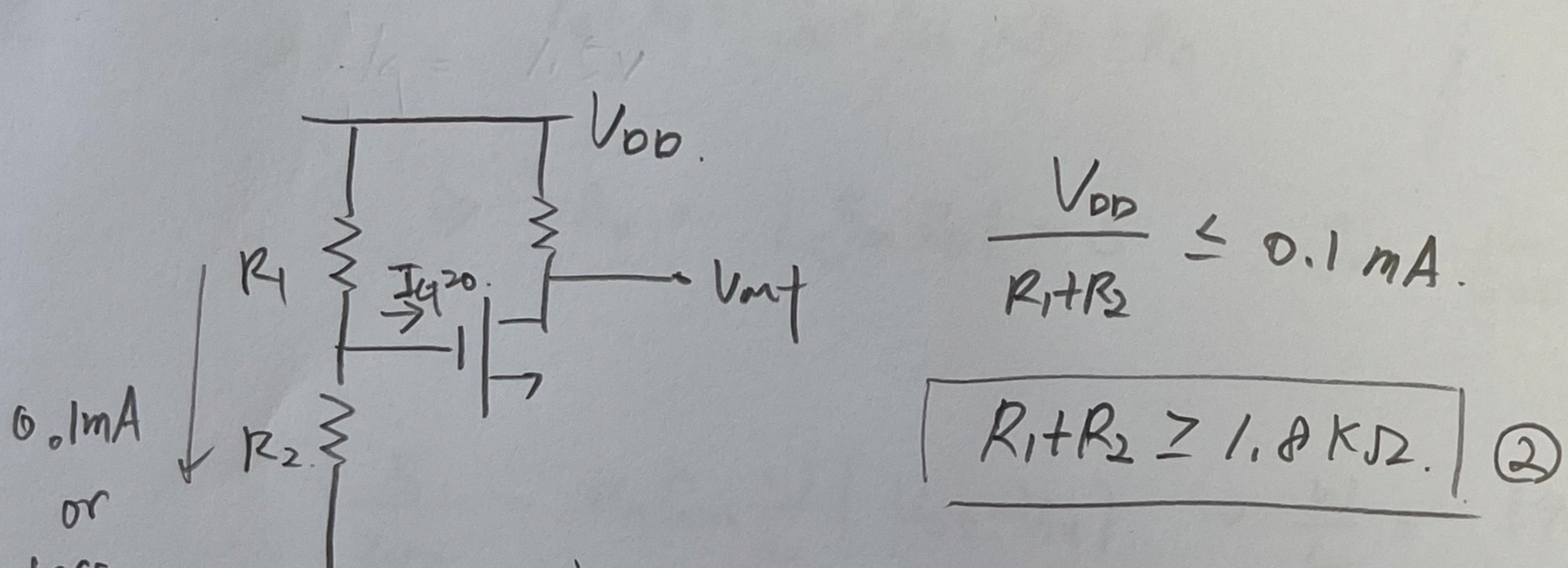
$$0.01 = \sqrt{2 \times 200 \times 10^{-6} \times \frac{W}{L} \times 10^3} \Rightarrow \frac{W}{L} \approx 250$$

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$$(b) V_{DS} \geq V_{GS} - V_{TH} + 0.2 \Rightarrow V_D \geq V_G - V_{TH} + 0.2 \Rightarrow V_g \leq 1.5V$$

$$\begin{aligned} V_{out} &= V_D = V_{DD} - R_D I_D = 1.8 - 500 \times 1mA \\ &= 1.3V. \end{aligned}$$

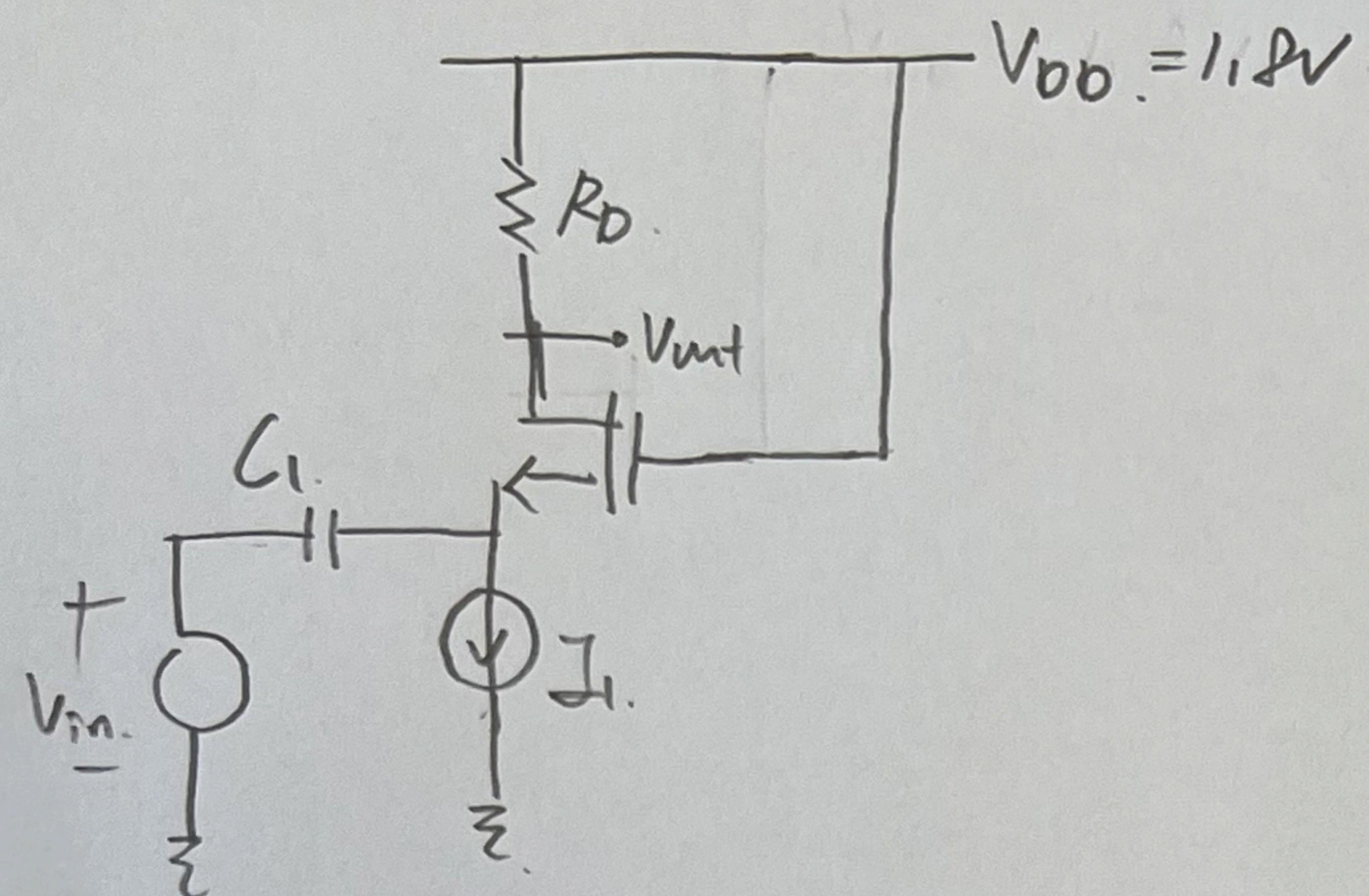
(1)



$$\text{by voltage division } V_g = \frac{R_2}{R_1 + R_2} \times V_{DD} = \left[\frac{R_2}{1.2K} \times 1.8 \right] \quad (3)$$

$$\text{from (1)-(3), } R_2 = 15K \text{ and } R_1 = 8K$$

Quiz 3.2



$$(a) \quad V_{DS} = V_{GS} - V_{TH} + 0.1 \Rightarrow V_b = V_g - V_{TH} + 0.1.$$

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$$V_{out} = V_{DD} - R_D I_D - 1.8 - R_o \times I_m A.$$

$$1.8 - R_o \times 10^{-3} = 1.8 - 0.4 + 0.1$$

$$R_o = 300 \Omega.$$

$$(b) \quad A_v = \frac{[(g_m + g_{mb})r_o + 1]R_o}{r_o + R_o + (g_m + g_{mb})R_o B_S + R_o}$$

no g_{mb} , $R_S = 0$, $r_o = \infty$.

$$\Rightarrow A_v = |g_m R_o| = 5 \quad g_m = \frac{5}{300}$$

$$\frac{5}{300} = M_n C_{ox} \frac{W}{L} (V_{GS} - V_{TH}) \Rightarrow \frac{W}{L} = 59.5$$

$$\frac{5}{300} = \sqrt{2 M_n C_{ox} \frac{W}{L} I_D} \Rightarrow \frac{W}{L} = 694$$