

23/10/19

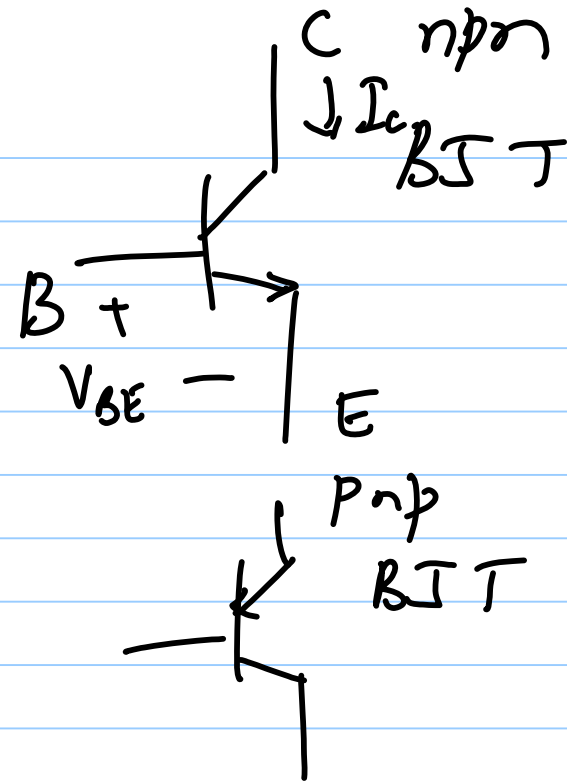
Lec 33

$$I_c = I_s \exp\left(\frac{V_{BE}}{V_T}\right)$$

$$I_B = \frac{I_c}{\beta} ; I_E = I_B + I_c$$

$$V_{BE} \approx 0.75V$$

$$\frac{\partial V_{BE}}{\partial T} = -1.5 \text{ mV/K} @ 300K$$



$$V_{ry} = \alpha_1 V_1 + \alpha_2 V_2$$

$$\frac{\partial V_{ry}}{\partial T} = \alpha_1 \frac{\partial V_1}{\partial T} + \alpha_2 \frac{\partial V_2}{\partial T} = 0 @ 300K$$

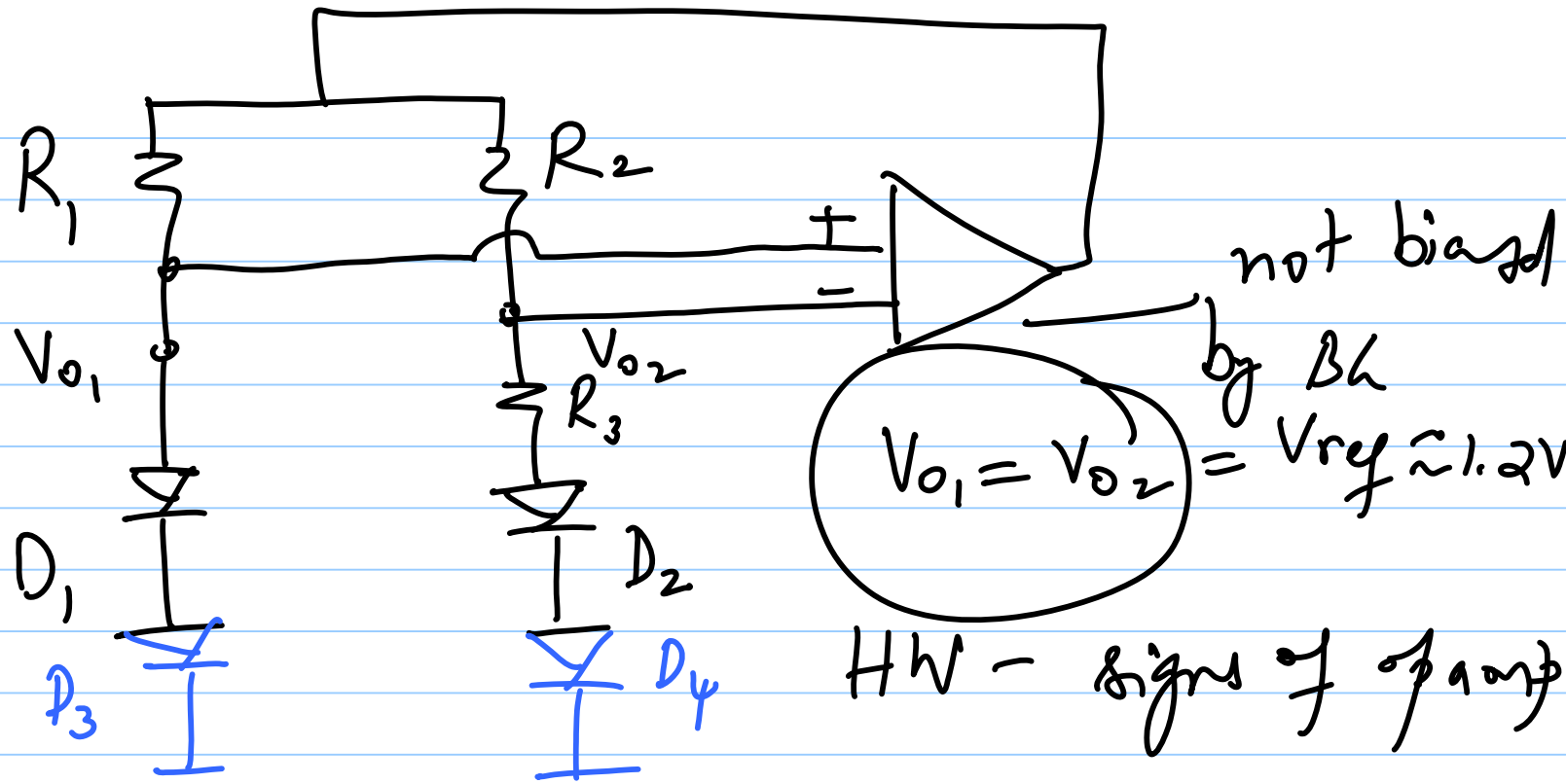
$$\left. \begin{array}{l} \alpha_1 = 1 \\ V_1 = V_{BE} \end{array} \right\} \alpha_2 \frac{\partial V_2}{\partial T} = +1.5 \text{ mV/K}$$

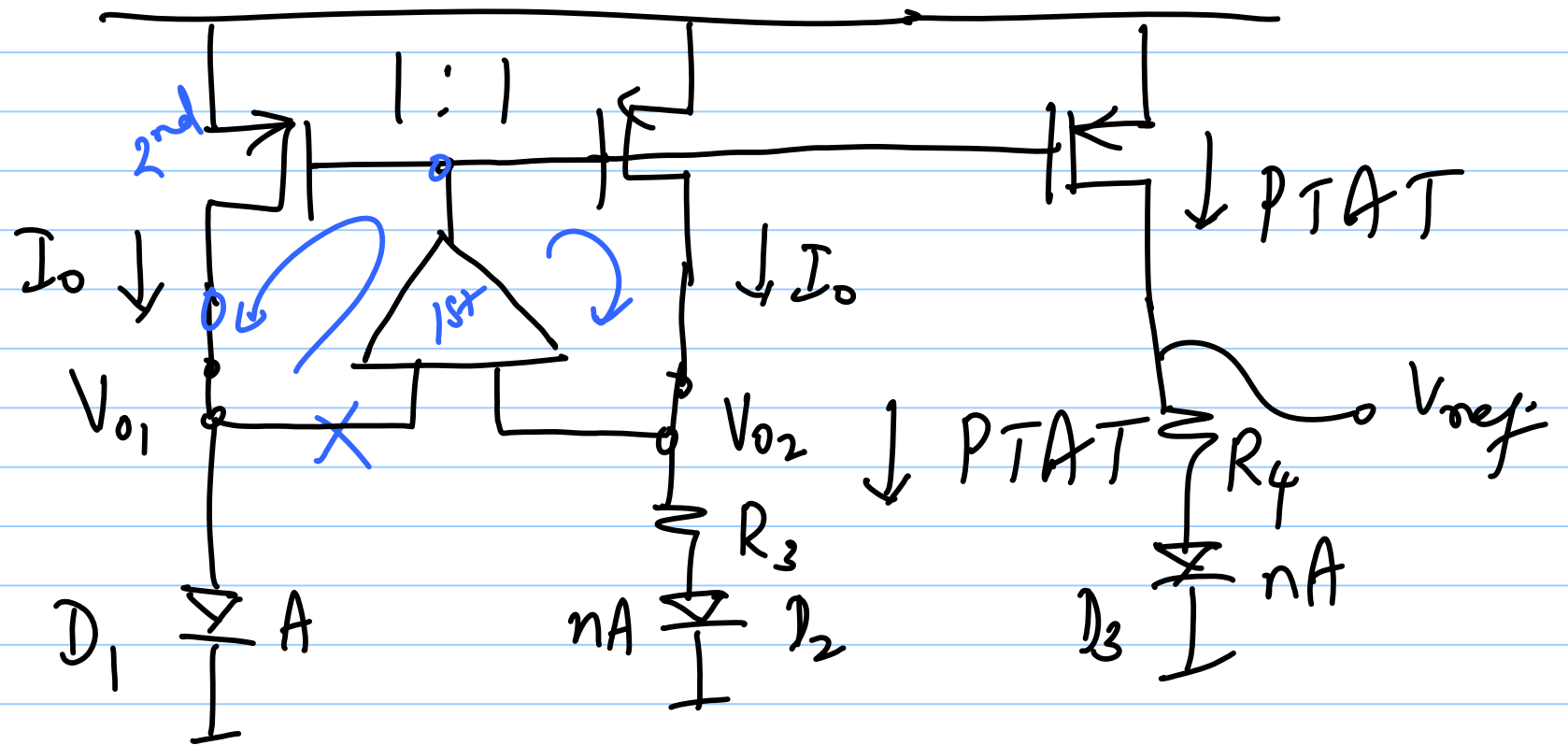
$$\alpha_2 V_2 = \frac{kT}{qV} \ln(n)$$

$$\alpha_2 \frac{\partial V_2}{\partial T} = \frac{k}{q} \ln(n) = +1.5 \text{ mV/K}$$

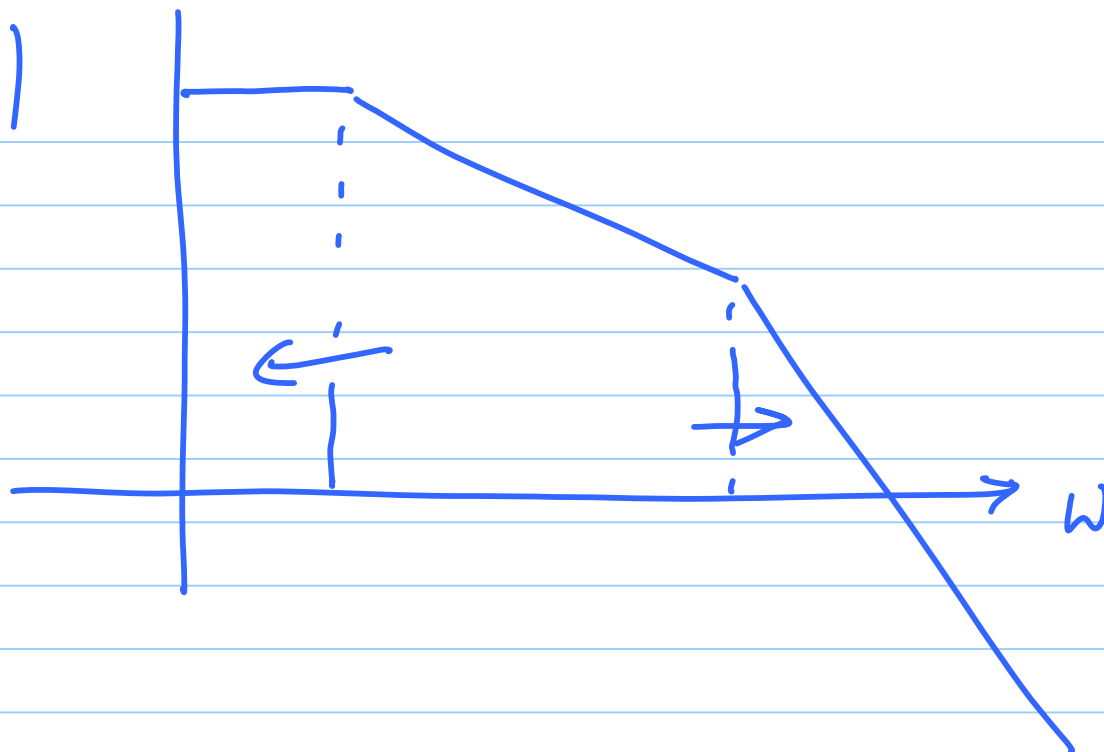
$$\ln(n) = \frac{1.5 e^{-3} \text{ V/K}}{8.63 \times 10^{-5} \text{ V/K}} \approx 17.4$$

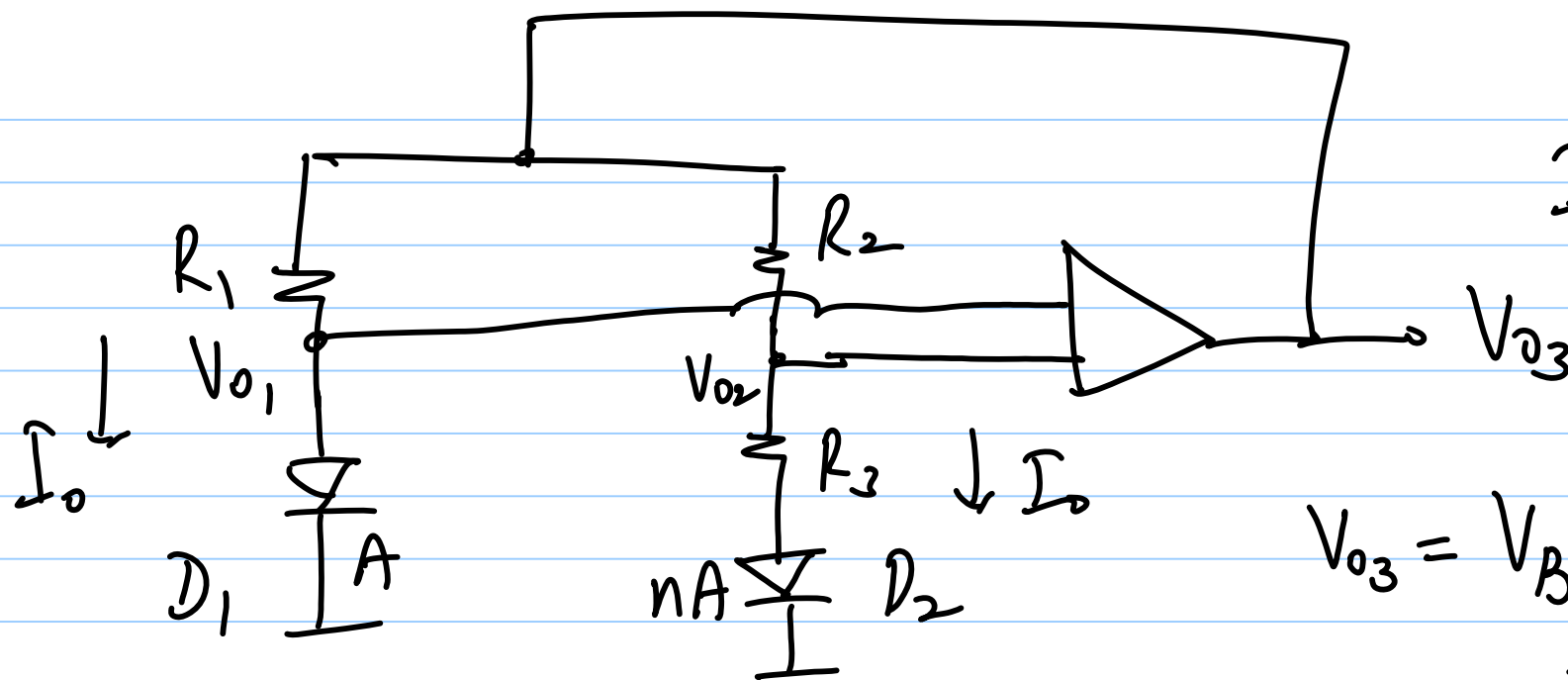
$$V_{ref} \approx 1.2 \text{ V}$$





$|L_h|$





$$R_1 = R_2$$

$$I_0 = \frac{V_T \ln(n)}{R_3}$$

$$V_{03} = V_{BE2} + I_0 R_3 + I_0 R_2$$

$$\text{Set } \frac{\partial V_{03}}{\partial T} = 0 \text{ @ } 300K$$

$$V_{o3} = V_{BE2} + \frac{V_T \ln(n)}{R_3} (R_2 + R_3)$$

$$= V_{BE2} + V_T \ln(n) \left(1 + \frac{R_2}{R_3}\right)$$

$$\frac{\partial V_{o3}}{\partial T} \Big|_{300K} = 0 \Rightarrow \left(1 + \frac{R_2}{R_3}\right) \ln(n) = 17.4$$