

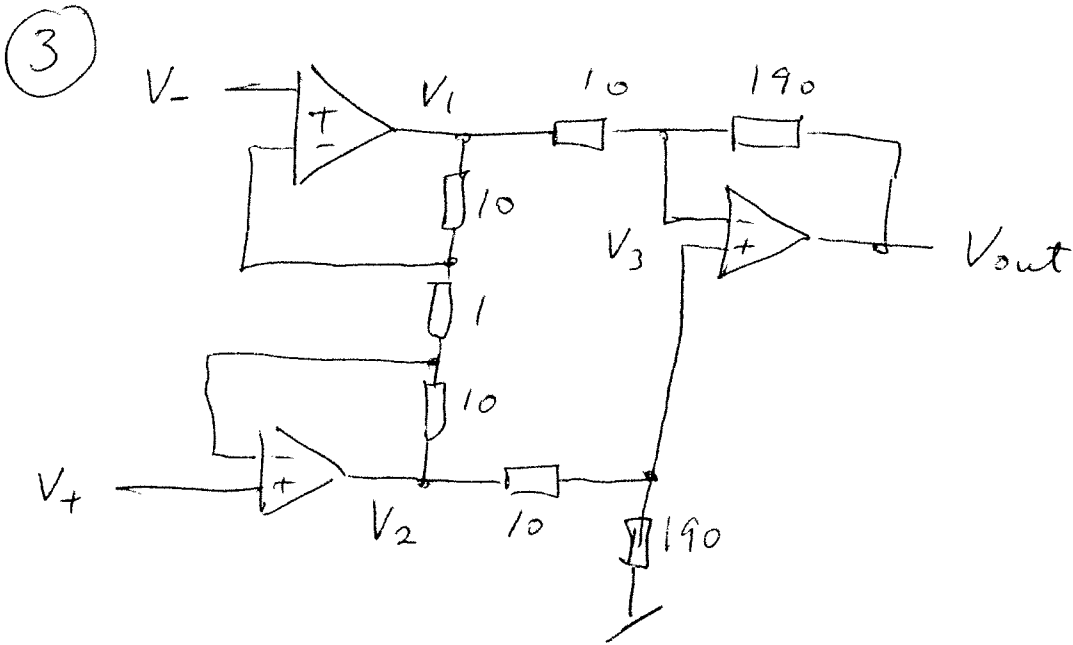
①

$$\textcircled{2} \quad \frac{V_a - V_x}{10} = \frac{V_x - V_{out}}{10} \quad \text{og} \quad V_x = \frac{V_b}{2}$$

$$V_a - V_x = V_x - V_{out}$$

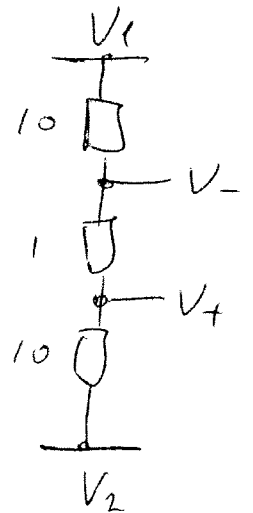
↙

$$\Rightarrow V_{out} = 2V_x - V_a = \underline{\underline{V_b - V_a}}$$



$$V_- - V_+ = (V_1 - V_2) \cdot \frac{1}{21}$$

$$\Rightarrow V_1 - V_2 = \underline{\underline{(V_- - V_+) \cdot 21}} \quad (\text{1. trinn})$$



(2)

$$\frac{V_1 - V_3}{10} = \frac{V_3 - V_{out}}{190} \Rightarrow 190(V_1 - V_3) = 10(V_3 - V_{out})$$

$$V_1 = \frac{10(V_3 - V_{out}) + 190V_3}{190}$$

$$V_3 = V_2 \cdot \frac{190}{200}$$

⇓

$$V_2 = V_3 \cdot \frac{200}{190}$$

$$V_1 - V_2 = \frac{10(V_3 - V_{out}) + 190V_3}{190} - \frac{200}{190} \cdot V_3$$

$$= \frac{10}{190}(V_3 - V_{out}) - \frac{10}{190} \cdot V_3$$

$$V_1 - V_2 = -\frac{10}{190} V_{out}$$

$$\underline{V_{out} = 19(V_2 - V_1)} \quad (2. \text{ trinn})$$

$$\text{Totalt: } V_{out} = -19 \cdot 21 \cdot (V_- - V_+) = \underline{\underline{399(V_+ - V_-)}}$$

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(3)

$$\textcircled{1} \quad V_{\text{out}} = V_{\text{ref}} \left(\frac{R_2}{R_1 + R_2} - \frac{R_3}{R_3 + R_4} \right)$$

$$\textcircled{2} \quad V_{\text{out}} = 0 \text{ volts} \quad \frac{R_2}{R_1 + R_2} = \frac{R_3}{R_3 + R_4}$$

$$\Rightarrow \frac{1}{\frac{R_1}{R_2} + 1} = \frac{1}{1 + \frac{R_4}{R_3}} \Rightarrow \frac{R_1}{R_2} = \frac{R_4}{R_3}$$

$$\textcircled{3} \quad V_{\text{out}} = V_{\text{ref}} \left(\frac{R_0(1+\alpha)}{R_0(1+\alpha) + R_0(1-\alpha)} - \frac{R_0(1-\alpha)}{R_0(1-\alpha) + R_0(1+\alpha)} \right)$$

$$V_{\text{out}} = V_{\text{ref}} \left(\frac{R_0(1+\alpha) - R_0(1-\alpha)}{R_0(1+\alpha) + R_0(1-\alpha)} \right) = \alpha$$

$$\frac{V_{\text{out}}}{V_{\text{ref}}} = \alpha \quad (0 \geq \alpha \leq 1)$$