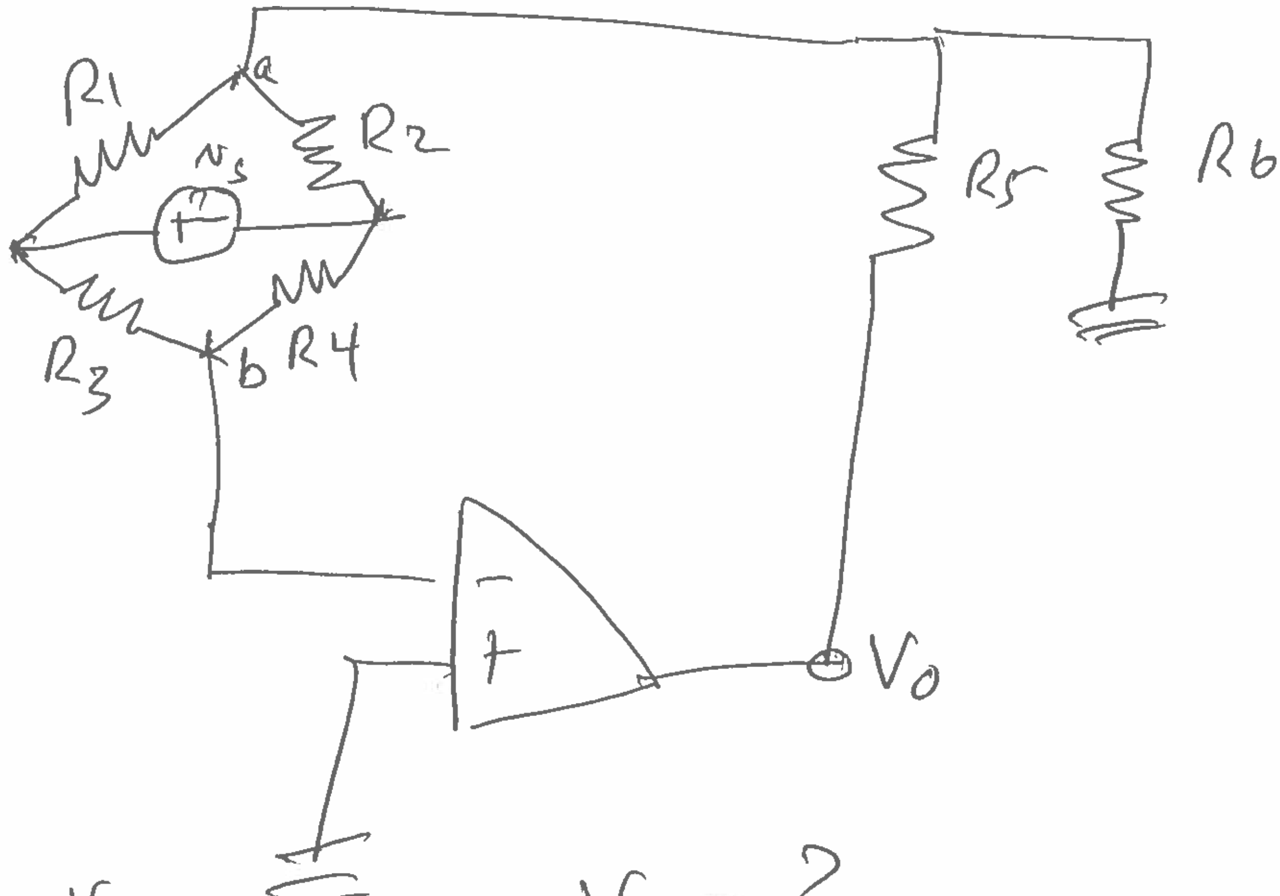
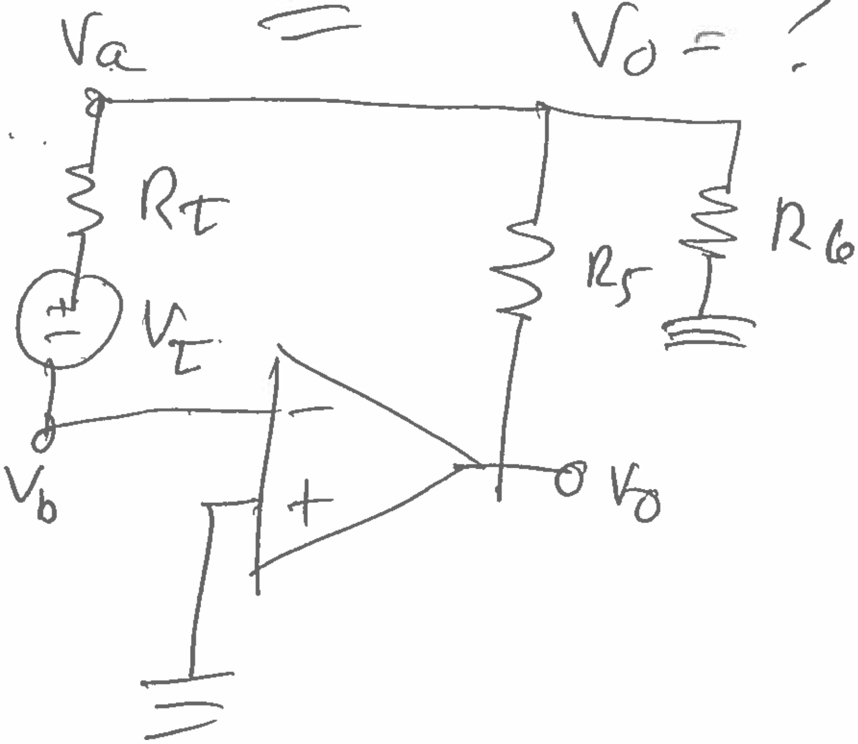
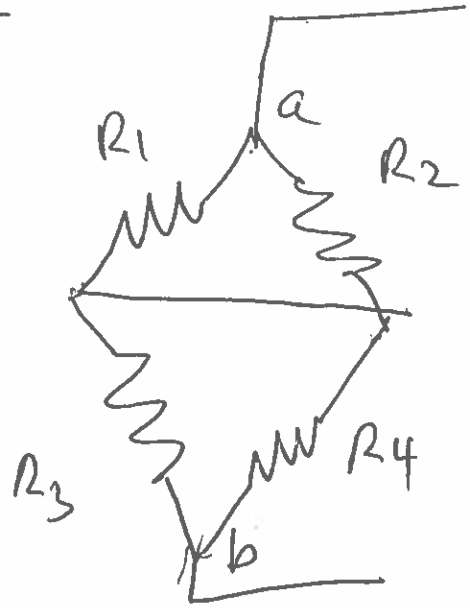


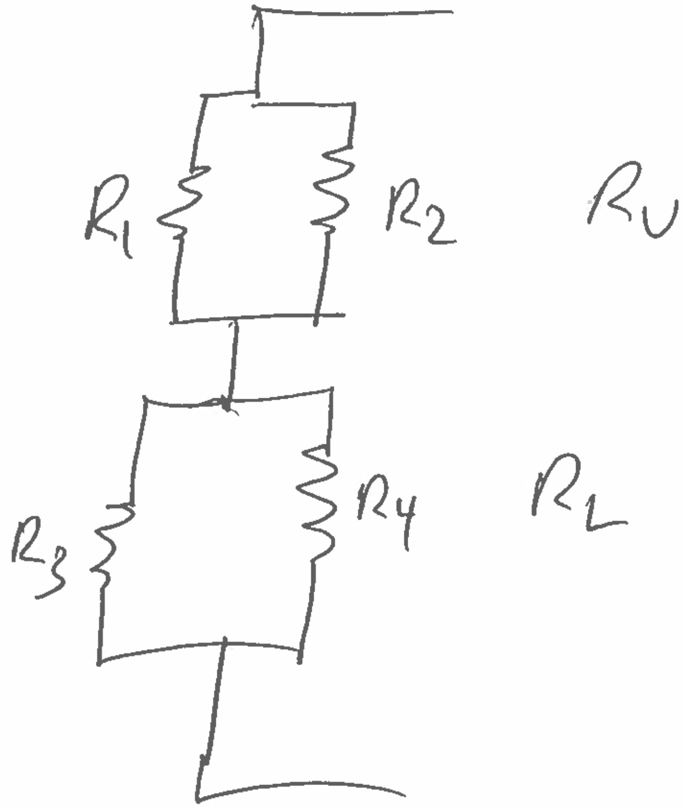
$V_o = ?$



R_t



~~$R_U = R$~~

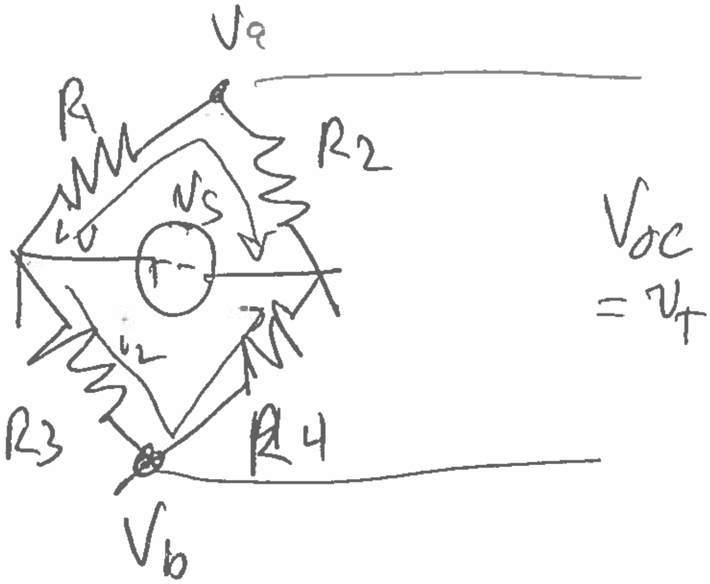


$$R_U = \frac{R_1 R_2}{R_1 + R_2}$$

$$R_L = \frac{R_3 R_4}{R_3 + R_4}$$

$$R_T = \frac{R_1 R_2}{R_1 + R_2} + \frac{R_3 R_4}{R_3 + R_4}$$

$$V_a - V_b = V_t$$



$$i_U = \frac{V_s}{R_1 + R_2}$$

$$i_L = \frac{V_s}{R_3 + R_4}$$

$$V_a = i_U R_2 = \frac{V_s R_2}{R_1 + R_2}$$

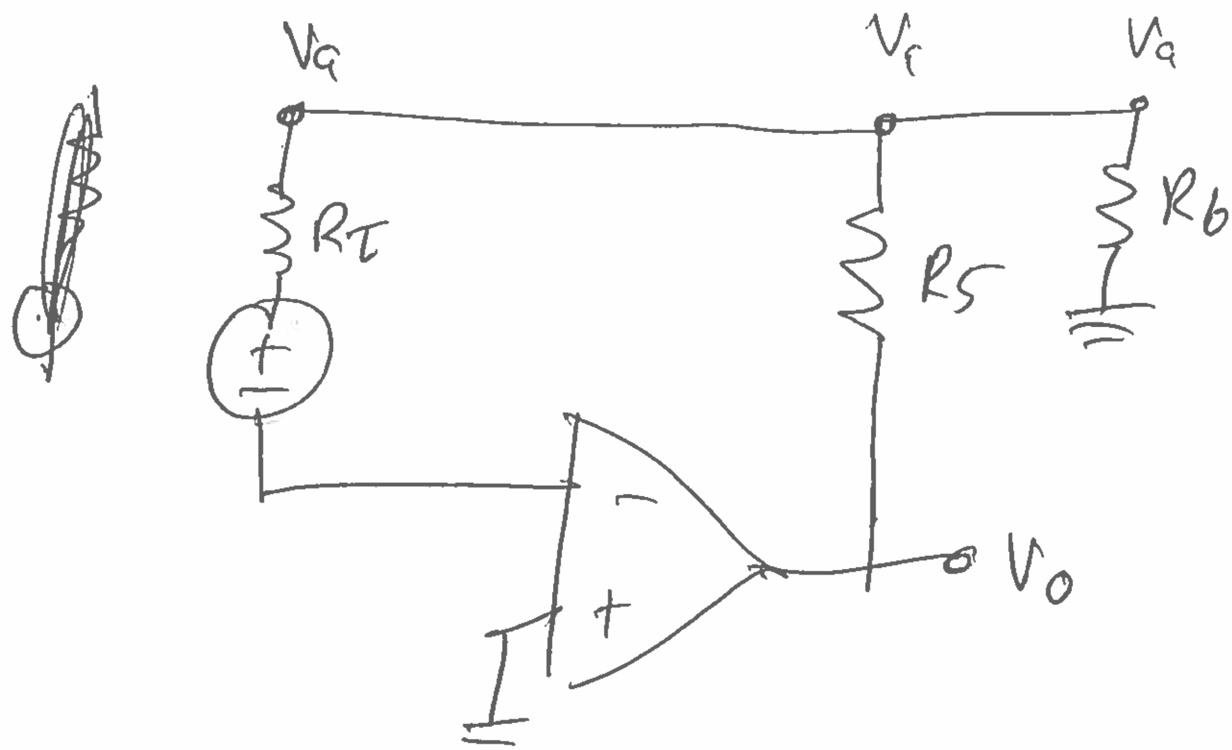
$$V_b = i_L R_4 = \frac{V_s R_4}{R_3 + R_4}$$

$$\boxed{V_T = V_s \left(\frac{R_2}{R_1 + R_2} - \frac{R_4}{R_3 + R_4} \right)}$$

by rules of op-amps No current can be in branch Touching V_-

So $V_a = V_T$

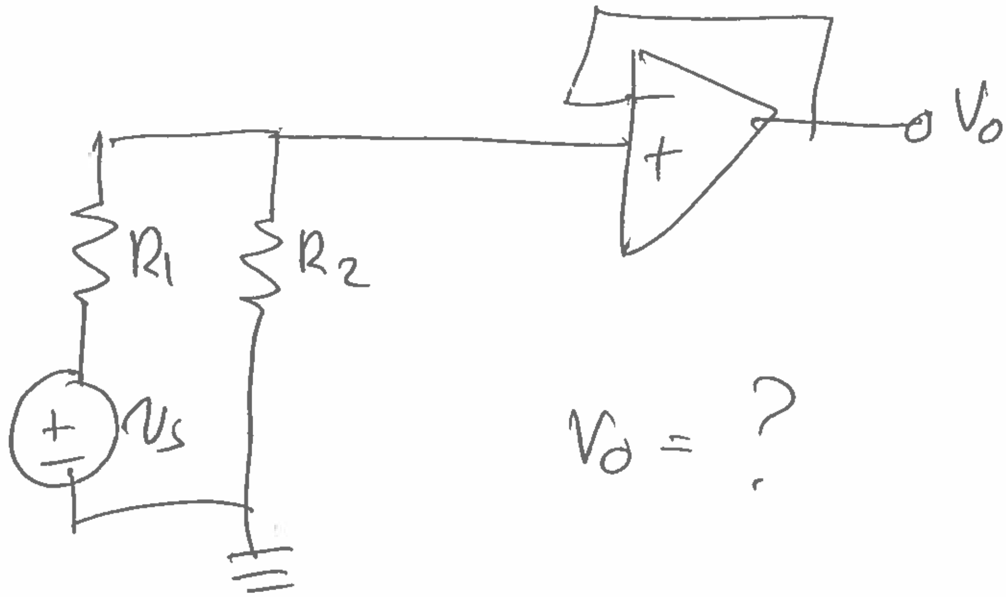
Do a voltage node equation for V_a



$$0 = V_a\left(\cancel{\frac{1}{R_T}} + \frac{1}{R_5} + \frac{1}{R_6}\right) - V_o\left(\frac{1}{R_5}\right)$$

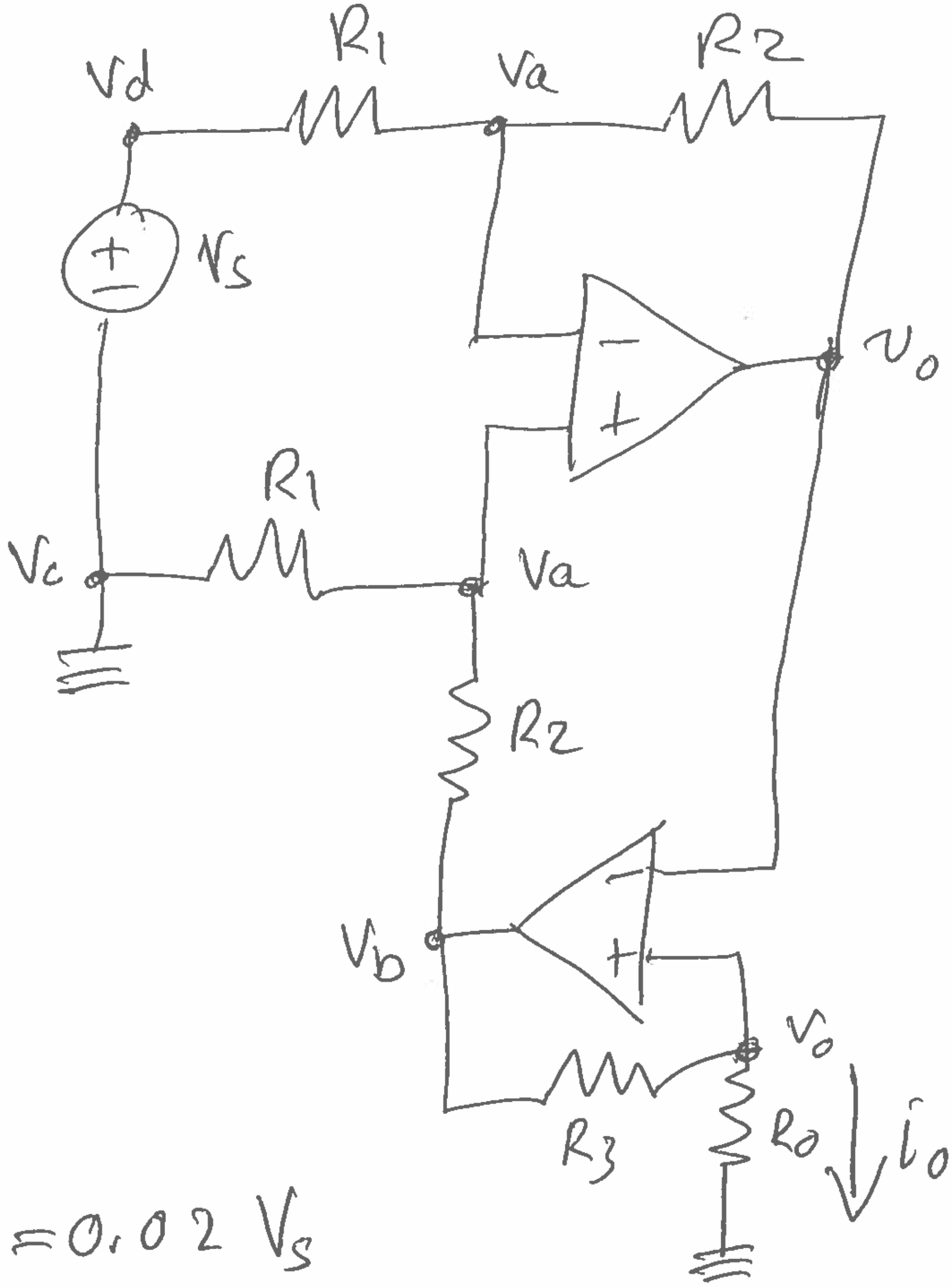
$$V_o = V_a\left(1 + \frac{R_5}{R_6}\right) = V_s\left(\frac{R_2}{R_2+R_1} + \frac{R_4}{R_3+R_4}\right)\left(1+\frac{R_5}{R_6}\right)$$

$$\boxed{V_o = V_s\left(\frac{R_2}{R_1+R_2} + \frac{R_4}{R_3+R_4}\right)\left(1+\frac{R_5}{R_6}\right)}$$



$V_o = ?$

$$V_o = V_s \frac{R_2}{R_1 + R_2}$$



$i_o = 0.02\, V_s$

Find R_o, R_1, R_2, And R_3

$i_o = \dfrac{V_o}{R_o}$ $\quad V_c = 0 \Rightarrow V_d = V_s$

Top V_a node equation

$$0 = V_a\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - V_s\left(\frac{1}{R_1}\right) - V_o\left(1/R_2\right)$$

bottom V_a node equation

$$0 = V_a\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - V_b\left(\frac{1}{R_2}\right)$$

Lower V_o node

$$0 = V_o\left(\frac{1}{R_0}+\frac{1}{R_3}\right) - V_b\left(\frac{1}{R_3}\right)$$

$$V_b = V_o\left(1+\frac{R_3}{R_0}\right)$$

Two V_a node equations can be combined to give

$$V_b\left(\frac{1}{R_2}\right) = V_s\left(\frac{1}{R_1}\right) + V_o\left(\frac{1}{R_2}\right)$$

$$v_o \left(1+\frac{R_3}{R_o}\right)\left(\frac{1}{R_2}\right) = V_s\left(\frac{1}{R_1}\right) + V_o\left(\frac{1}{R_2}\right)$$

$$V_o\left(\frac{1}{R_2}\right) + V_o\left(\frac{R_3}{R_o R_2}\right) - V_o\left(\frac{1}{R_2}\right) = V_s\left(\frac{1}{R_1}\right)$$

$$\boxed{V_o = V_s \frac{R_o R_2}{R_1 R_3}}$$

$$i_o = \frac{v_o}{R_o} = V_s \frac{R_2}{R_1 R_3}$$

$$\boxed{i_o = V_s\left(\frac{R_2}{R_1 R_3}\right)}$$

$$\Rightarrow \frac{R_2}{R_1 R_3} = 0{,}02$$

Ro can be any value Let's make it

$$R_0 = 1K\Omega$$

if $R_1 = R_2 = 1K\Omega$

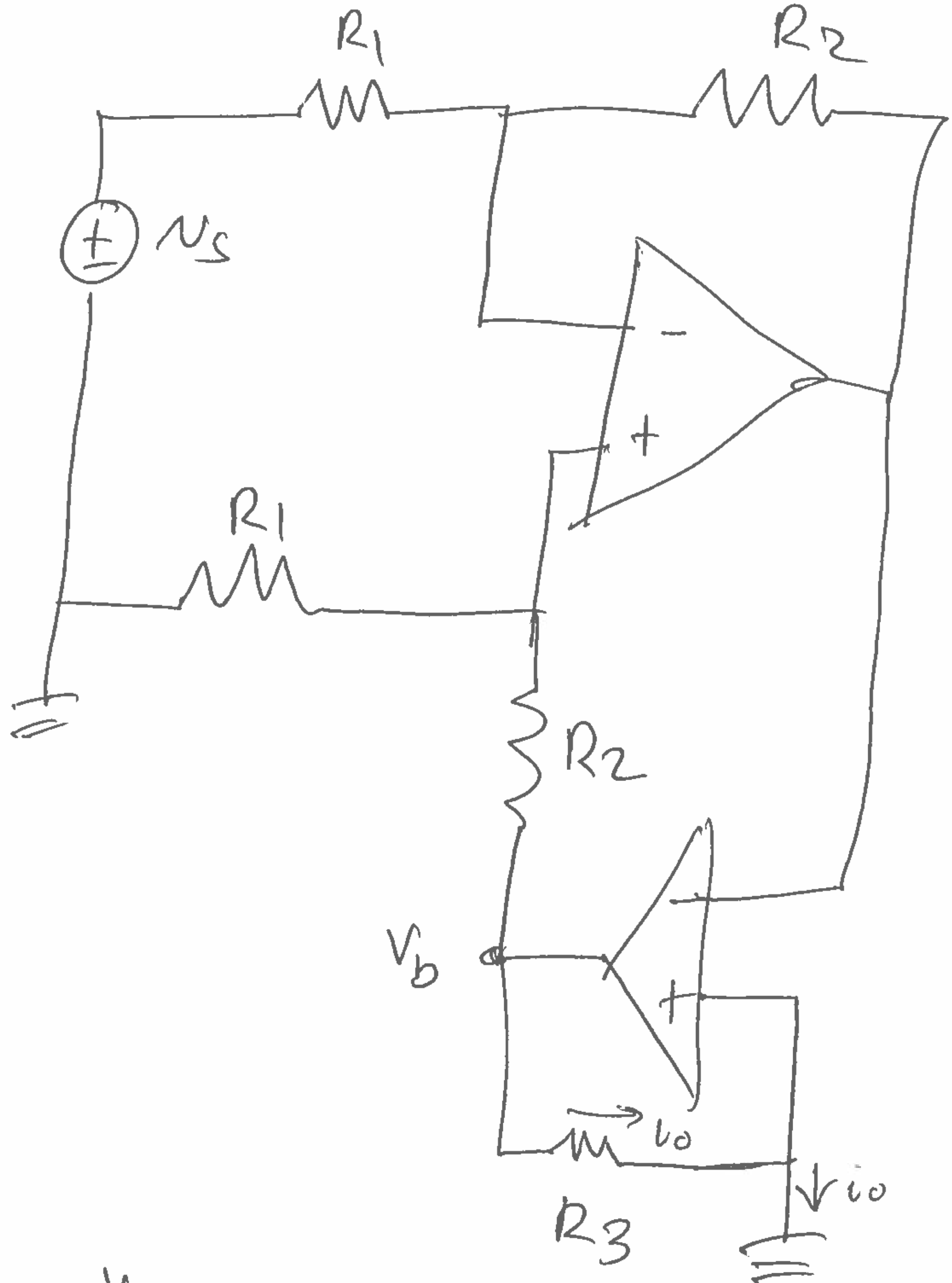
$$\frac{1}{R_3} = 0.02$$

$$R_3 = \frac{1}{0.02} = 50\ K\Omega$$

One Solution is

$$R_0 = R_1 = R_2 = 1K\Omega$$

$$R_3 = 50K\Omega$$



$$i_o = \frac{V_b}{R_3}$$

$$V_b = V_s \frac{R_2}{R_1} + V_0 \qquad V_0 = V_s \frac{R_0 R_2}{R_1 R_3} = 0$$

$$V_b = V_s \frac{R_2}{R_1} \qquad i_o = V_s \frac{R_2}{R_1 R_3} \checkmark$$