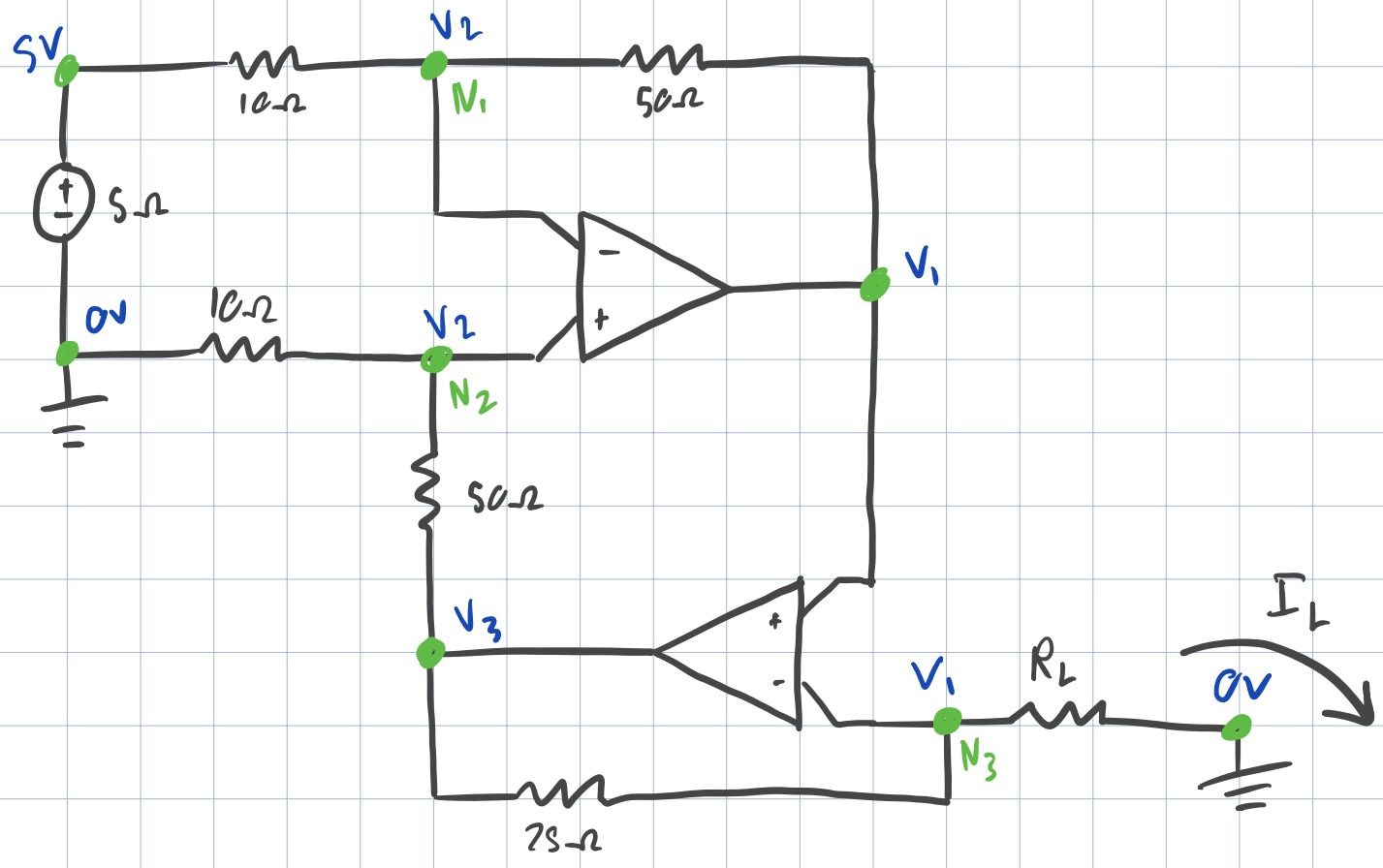
Problem One



KCL at N_1

$$\frac{V_2 - 5}{10} + \frac{V_2 - V_1}{50} = 0$$

$$5V_2 - 25 + V_2 - V_1 = 0$$

$$V_1 = 6V_2 - 25$$

KCL at N_2

$$\frac{V_2 - 0}{10} + \frac{V_2 - V_3}{50} = 0$$

$$5V_2 + V_2 - V_3 = 0$$

$$V_3 = 6V_2$$

KCL at N_3

$$I_L = \frac{V_1 - V_3}{2S}$$

$$V_1 = 6V_2 - 2S$$

$$V_1 = V_3 - 2S$$

$$V_3 - V_1 = 2S$$

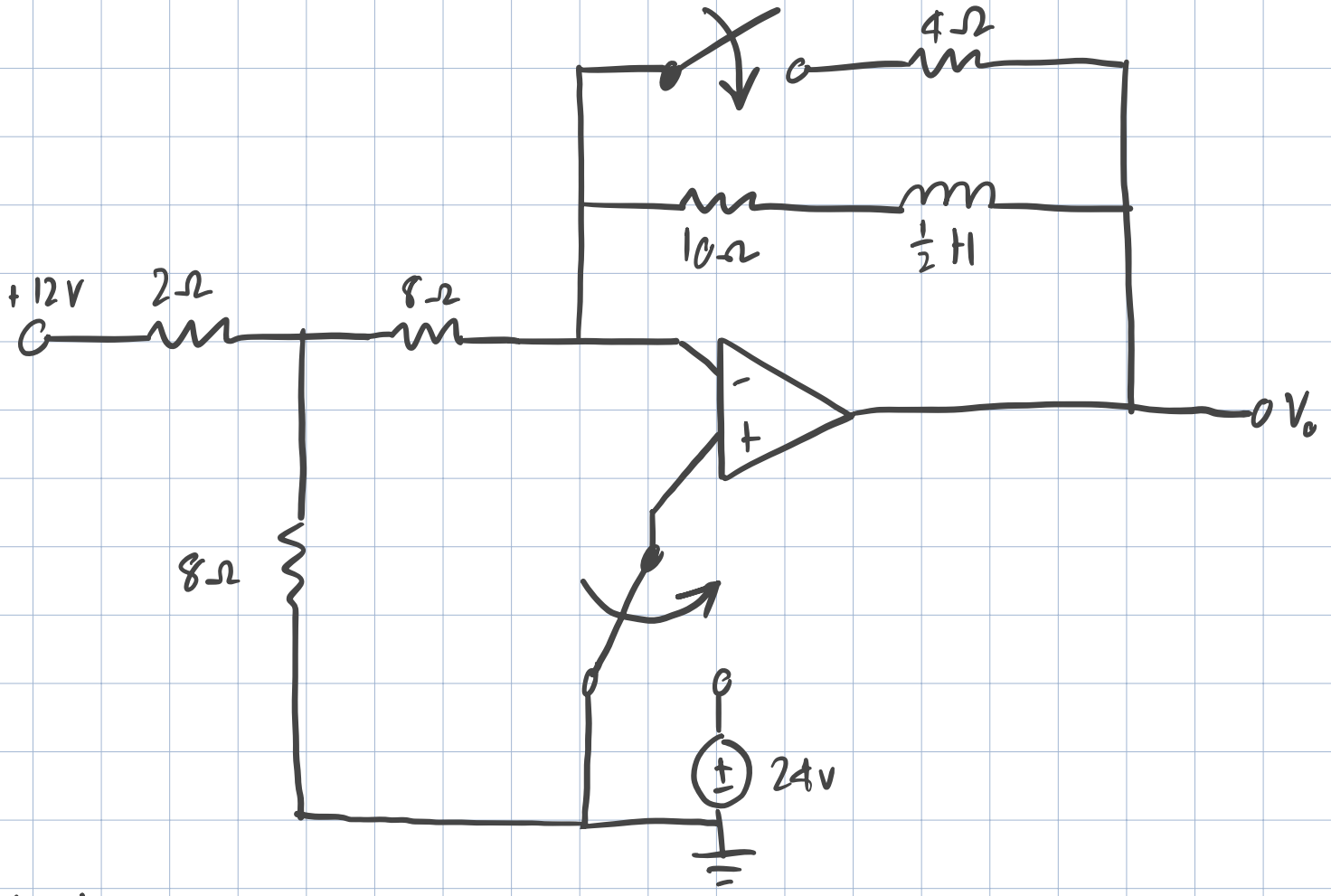
$$I_L = \frac{V_3 - V_1}{2S}$$

$$I_L = \frac{2S}{2S} A$$

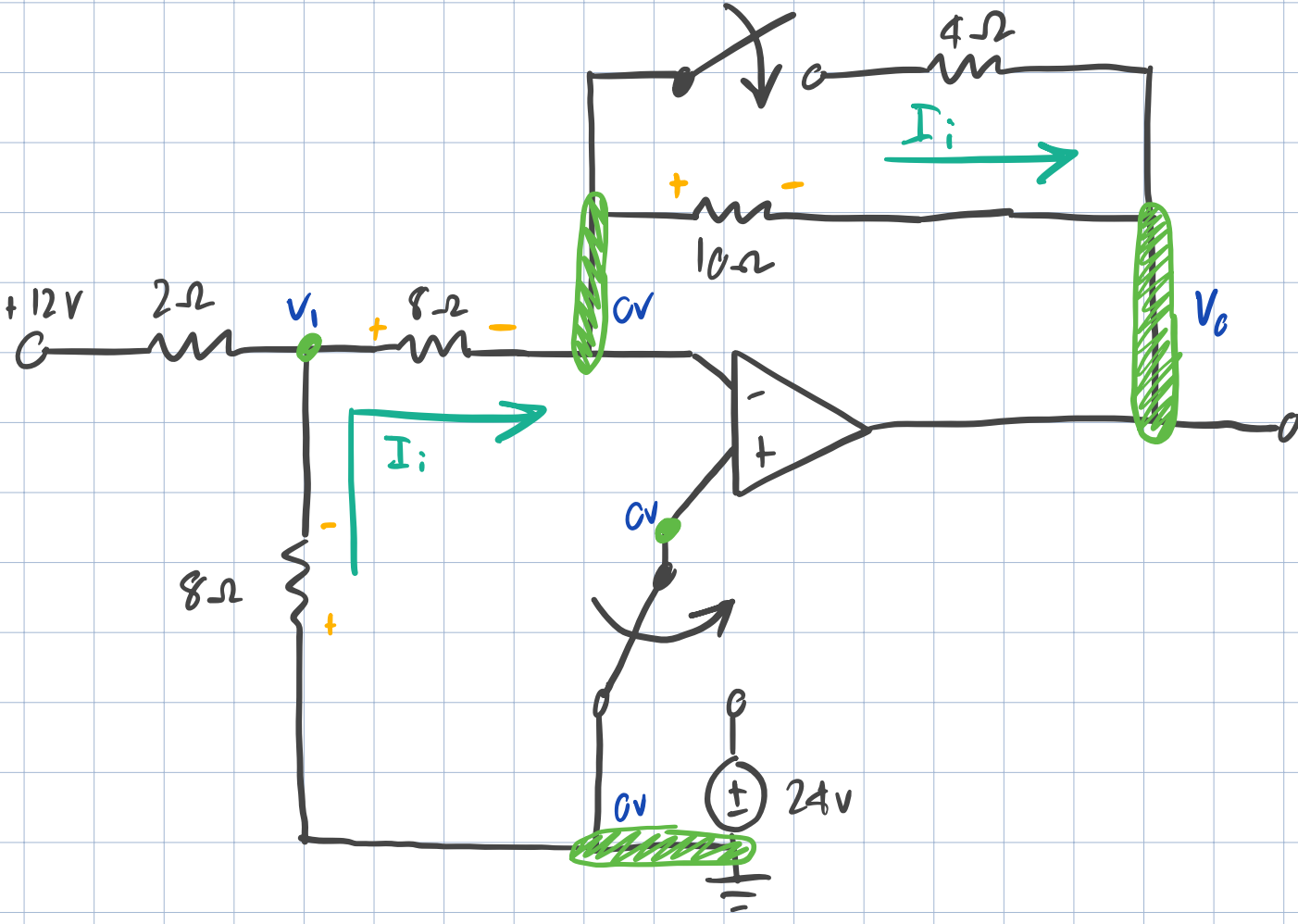
$$= 1$$

I_L is 1 for any R_L

Problem Two


4Ω
10Ω
½ H
+12V
2Ω
8Ω
8Ω
24V
V_o

At $t = 0^-$


4Ω
I_i
+
−
10Ω
+12V
2Ω
V_1
+
8Ω
−
0V
V_o
I_i
−
+
8Ω
0V
0V
24V

KCL at V_1

$$\frac{V_1 - 12}{2} + \frac{V_1 - 0}{8} + \frac{V_1 - 0}{8} = 0$$

$$8(V_1 - 12) + 2V_1 + 2V_1 = 0$$

$$8V_1 - 96 + 4V_1 = 0$$

$$12V_1 = 96$$

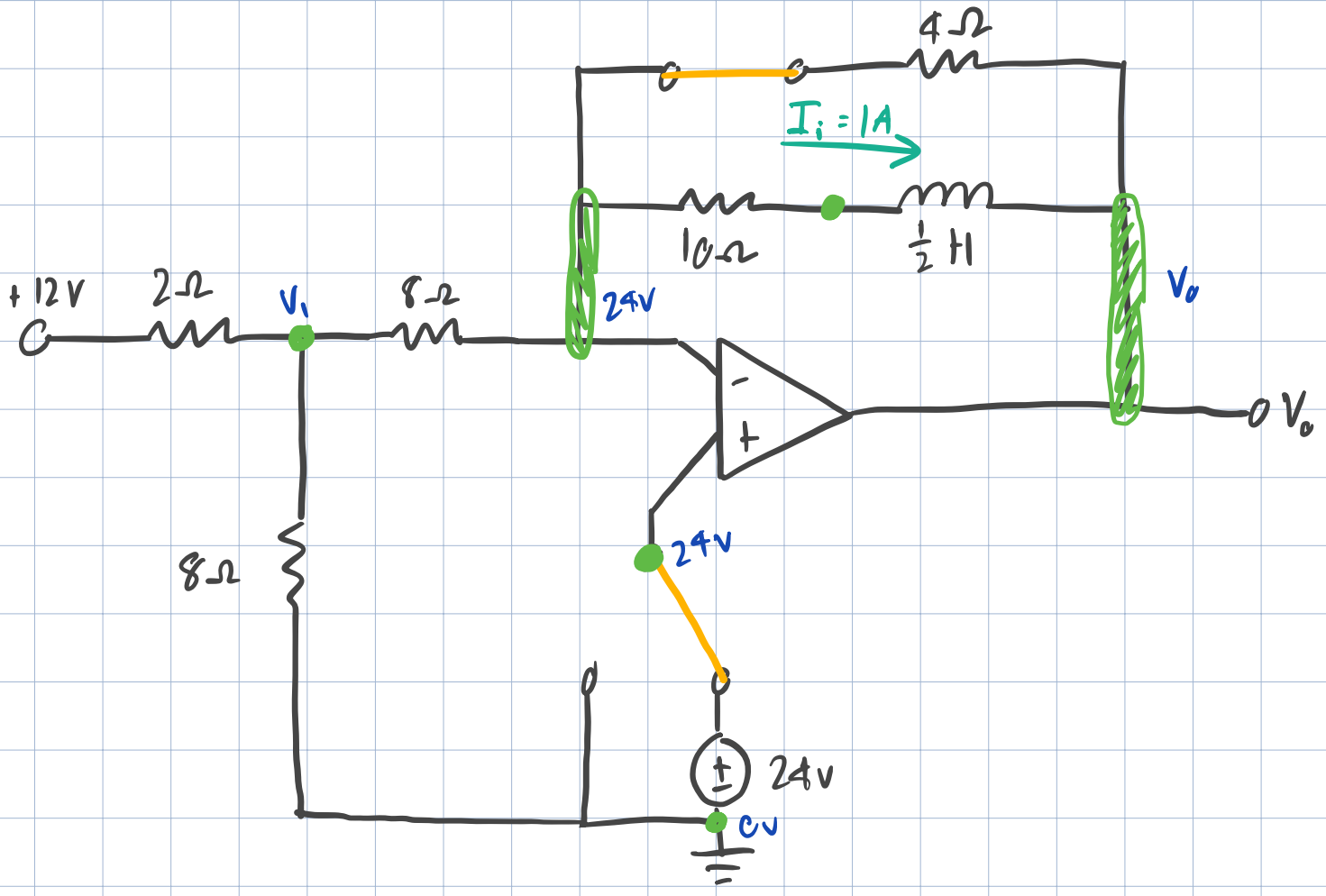
$$V_1 = 8 \text{ V}$$

$$I_i(0^-) = \frac{V_1 - 0}{8}$$

$$= \frac{8}{8}$$

$$= 1 \text{ A}$$

At $t = 0^+$



KCL at V_1

$$\frac{V_1 - 12}{2} + \frac{V_1 - 24}{8} + \frac{V_1 - 0}{8} = 0$$

$$8(V_1 - 12) + 2V_1 - 48 + 2V_1 = 0$$

$$8V_1 - 96 + 4V_1 - 48 = 0$$

$$12V_1 = 144$$

$$V_1 = 12V$$

KCl at top 24 V

$$\frac{24 - V_1}{8} + 1 + \frac{24 - V_o}{4} = 0$$

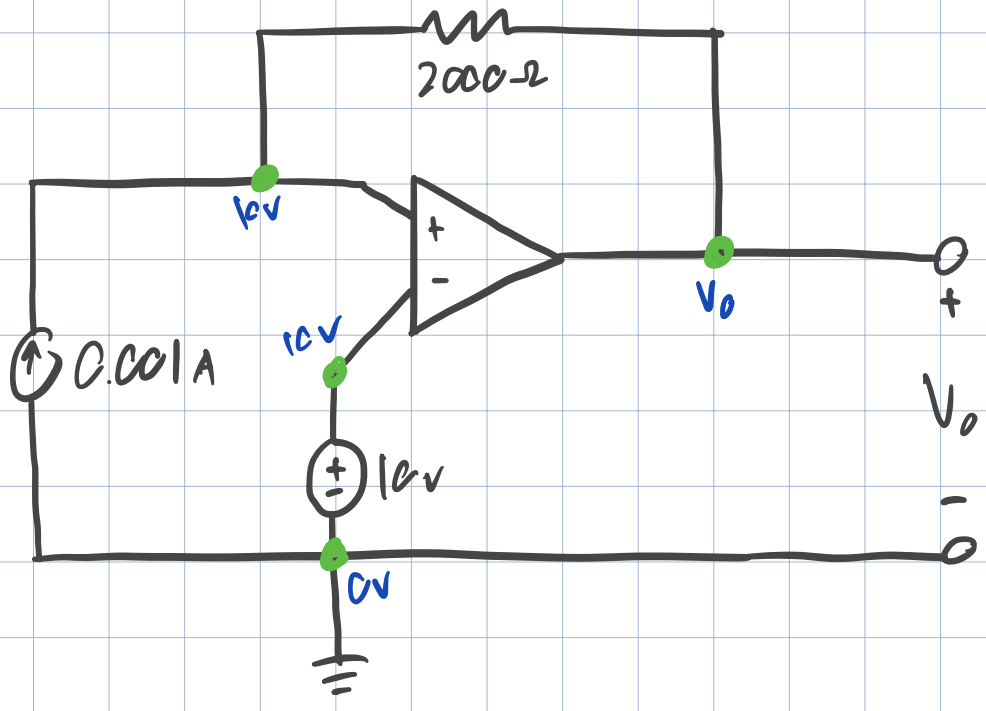
$$\frac{24 - 12}{8} + 1 + \frac{24 - V_o}{4} = 0$$

$$12 + 8 + 48 - 2V_o = 0$$

$$2V_o = 68$$

$$V_o(c') = 34 V$$

Problem Three



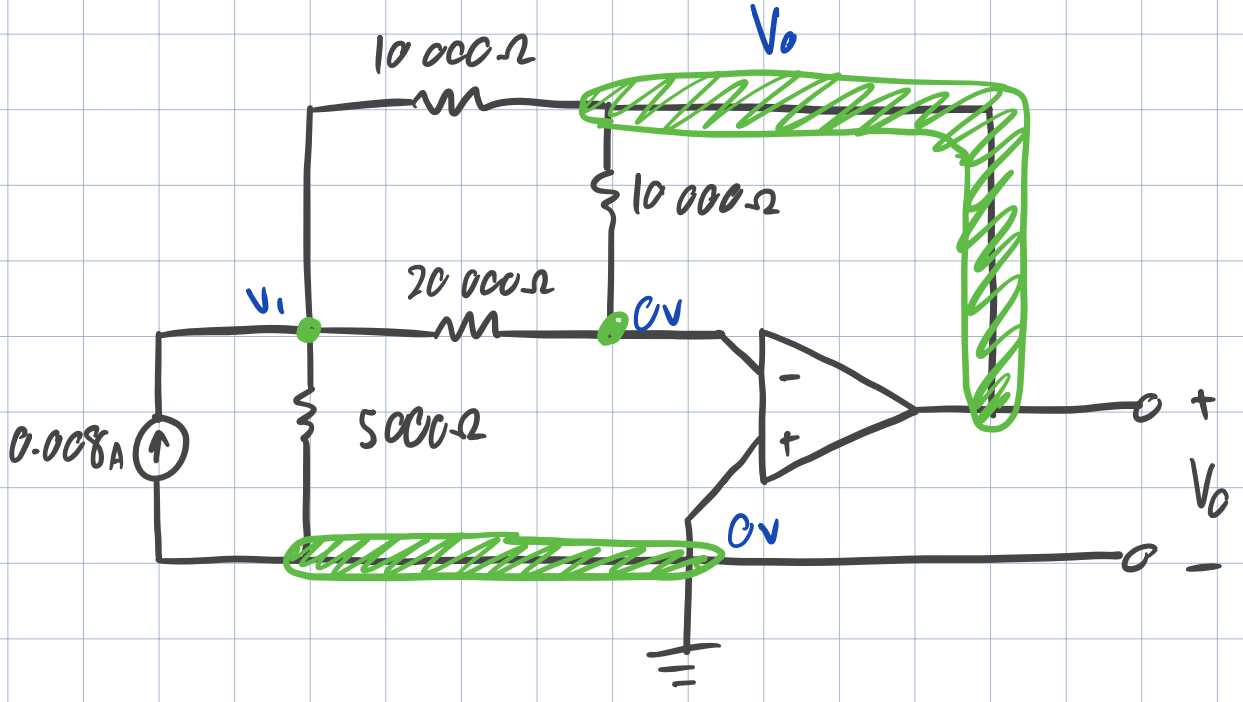
KCl at top left 10 V

$$-0.001 + \frac{10 - V_o}{2000} = 0$$

$$-2 + 10 - V_o = 0$$

$$V_o = 8\ V$$

Problem Four



KCL at V_1

$$-0.008 + \frac{V_1 - V_o}{10000} + \frac{V_1 - 0}{20000} + \frac{V_1 - 0}{5000} = 0$$

$$-160 + 2V_1 - 2V_o + V_1 + 4V_1 = 0$$

$$7V_1 - 2V_o = 160$$

KCL at CV

$$\frac{0 - V_1}{20\,000} + \frac{C - V_o}{10\,000} = 0$$

$$-V_1 - 2V_c = C$$

$$V_1 = -2V_o$$

$$7V_1 - 2V_o = 160$$

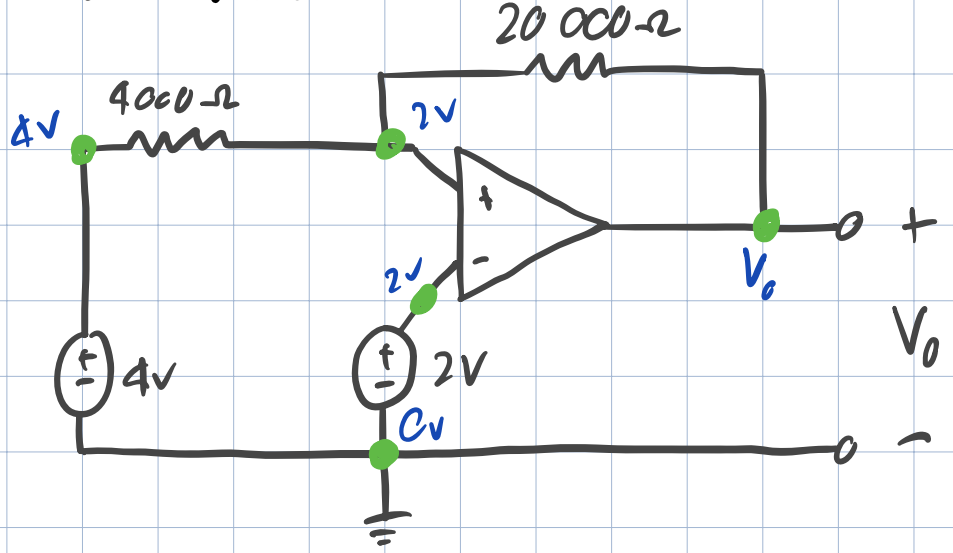
$$7(-2V_o) - 2V_c = 160$$

$$-14V_o - 2V_o = 160$$

$$-16V_o = 160$$

$$V_o = -10V$$

Problem Five



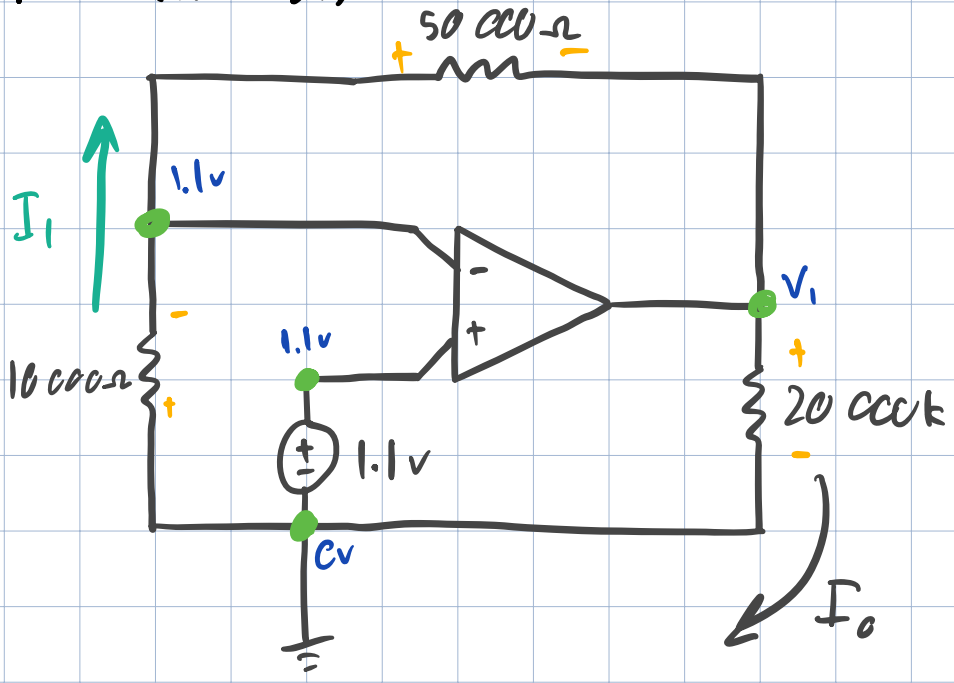
KCL at top CV

$$\frac{2-4}{4000} + \frac{2-V_o}{20000} = 0$$

$$-10 + 2 - V_o = 0$$

$$V_o = -8V$$

Problem Six



$$I_1 = \frac{0-1.1}{10000}$$

$$I_1 = \frac{1.1 - V_1}{50000}$$

$$\frac{-1.1}{10000} = \frac{1.1 - V_1}{50000}$$

$$-5.5 = 1.1 - V_1$$

$$50000 = 1.1 - V_1$$

$$V_1 = -\frac{50000}{1.1}$$

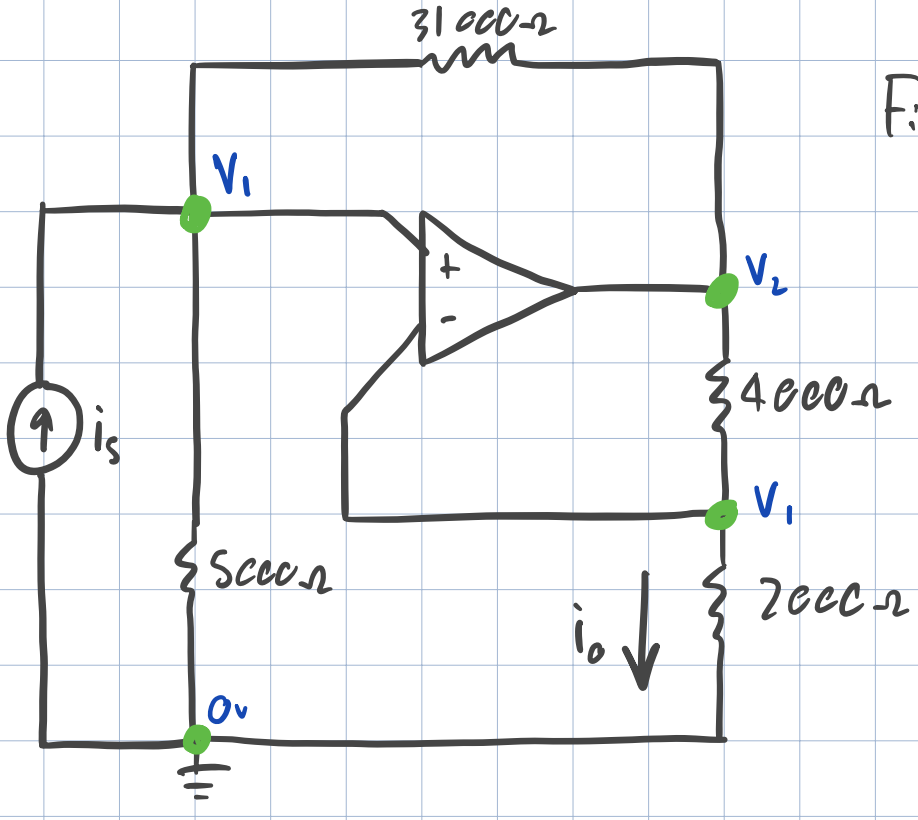
$V_1 = 6.6\ V$

$I_o = \frac{V_1 - 0}{20\,000}$

$= \frac{6.6}{20.000}$

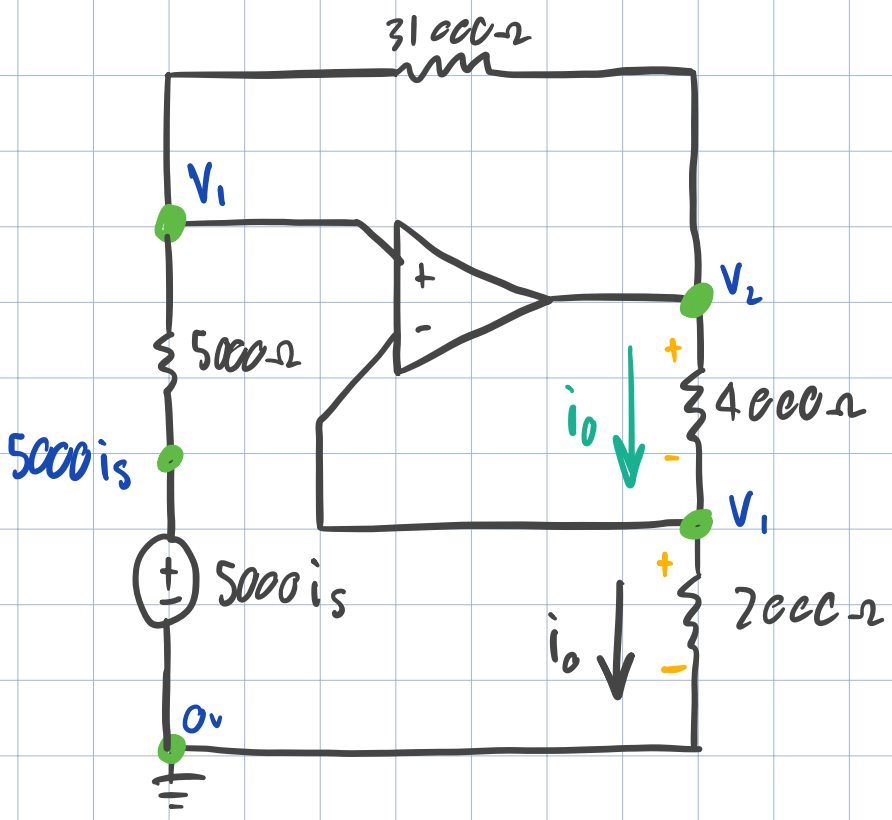
$= 0.33\ mA$

Problem Seven



Find $\frac{i_o}{i_s}$

Transform i_s



KCL at V_1

$$\frac{V_1 - V_2}{31000} + \frac{V_1 - 5000 i_s}{5000} = 0$$

$$5V_1 - 5V_2 + 31V_1 - 155000 i_s = 0$$

$$36V_1 - 5V_2 - 155000 i_s = 0$$

$$36V_1 = 5V_2 - 155000 i_s = 0$$

KCL at V_1

$$-i_o + \frac{V_1 - 0}{2000} = 0$$

$$-2000 i_o + V_1 = 0$$

$2000 i_o = V_1$