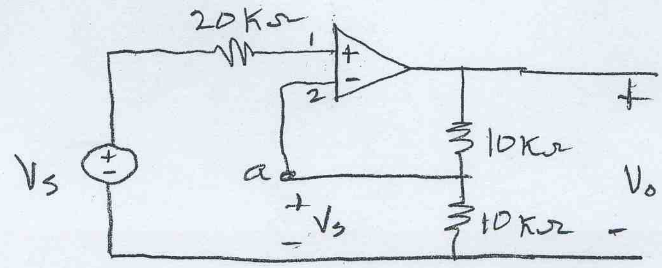
5.10 Find the gain V_o/V_s for the circuit below.



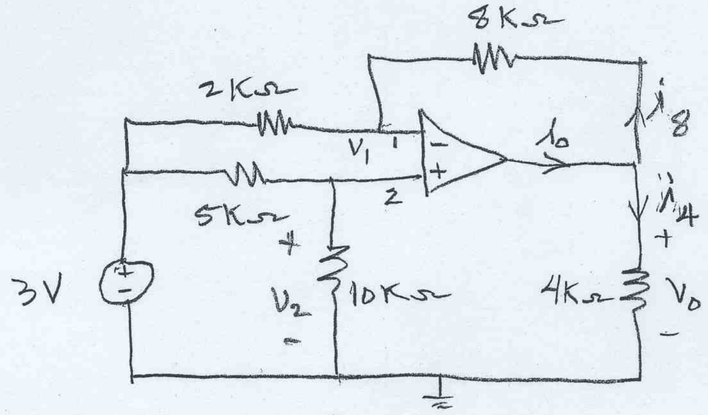
The voltage at point a will be V_s because no current passes from 1 to 2. On the right side, the voltage at a is the voltage division;

$$V_s = \frac{V_o \times 10k}{10k + 10k}$$

$$V_s = \frac{V_o}{2}$$

$$\boxed{\frac{V_o}{V_s} = 2}$$

5.11 Find V_o and i_o in the following circuit.



The voltage at point 2 is

$$V_2 = \frac{3 \times 10K}{10K + 5K} = 2V$$

The voltage at $V_1 = V_2 = 2V$.

Writing a nodal equation at V_1 gives;

$$\frac{2-3}{2K} + \frac{2-V_o}{8K} = 0$$

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

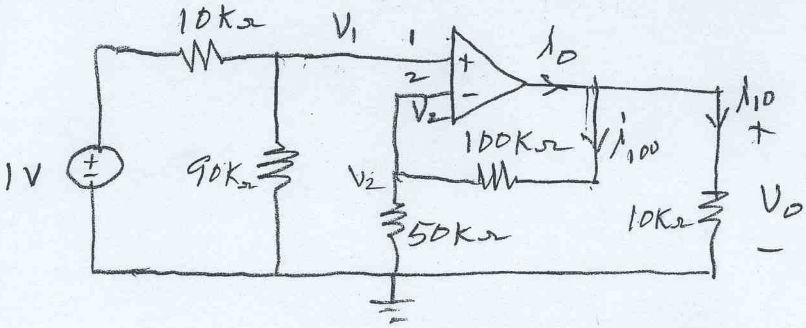
$$\boxed{V_o = -2\ V}$$

$$i_o = i_4 + i_8 = \frac{V_o}{4K} + \frac{V_o - 2}{8K}$$

$$i_o = \frac{-2 \times 2}{8K} + \frac{-4}{8K} = \frac{-4}{8K}$$

$$\boxed{i_o = -1\ mA}$$

5.13 Find V_o and i_o in the following circuit



No current flows from 1 to 2.

voltage $V_1 = V_2$.

The voltage at V_1 is given by

$$V_1 = \frac{1 \times 90K}{10K + 90K} = 0.9V$$

$\therefore V_2 = V_1 = 0.9V$

But V_2 is also given by

$$V_2 = \frac{V_o \times 50K}{50K + 100K} = \frac{V_o}{3}$$

$$V_o = 3V_2 = 3 \times 0.9V$$

$$V_o = 2.7V$$

$$i_o = i_{100} + i_{10}$$

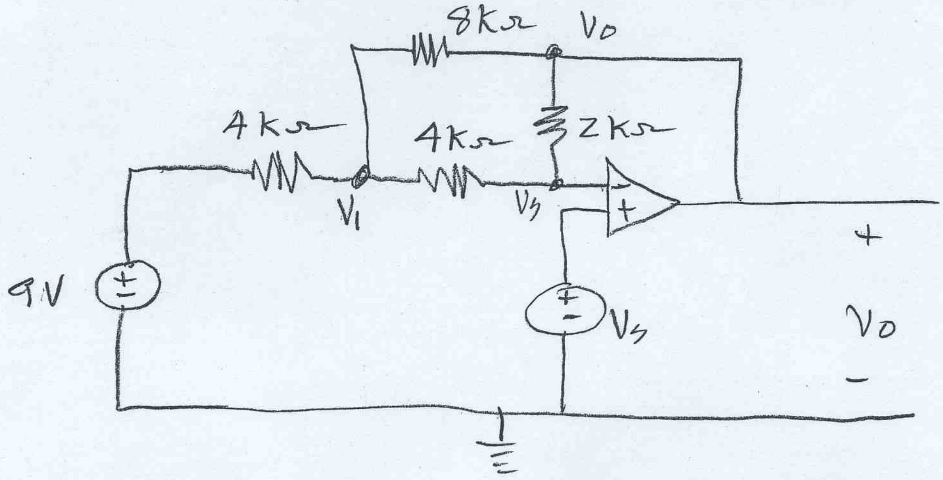
$$= \frac{V_o}{150K} + \frac{V_o}{10K} = \frac{2.7}{150K} + \frac{15 \times 2.7}{150K}$$

$$i_o = \frac{2.7}{150K}[16] = 0.288 mA$$

$$\boxed{i_o = 288 \mu A}$$

5.20

Find V_o for the following circuit.



$$\frac{V_1 - 9}{4K} + \frac{V_1 - V_o}{8K} + \frac{V_1 - V_s}{4K} = 0$$

$$2V_1 - 18 + V_1 - V_o + 2V_1 - 2V_s = 0$$

$$\boxed{5V_1 - V_o - 2V_s = 18} \quad (1)$$

$$\frac{V_s - V_1}{4K} + \frac{V_s - V_o}{2K} = 0$$

$$V_s - V_1 + 2V_s - 2V_o = 0$$

$$\boxed{V_1 = 3V_s - 2V_o} \quad (2)$$

Put (2) into (1)

$$5(3V_s - 2V_o) - V_o - 2V_s = 18$$

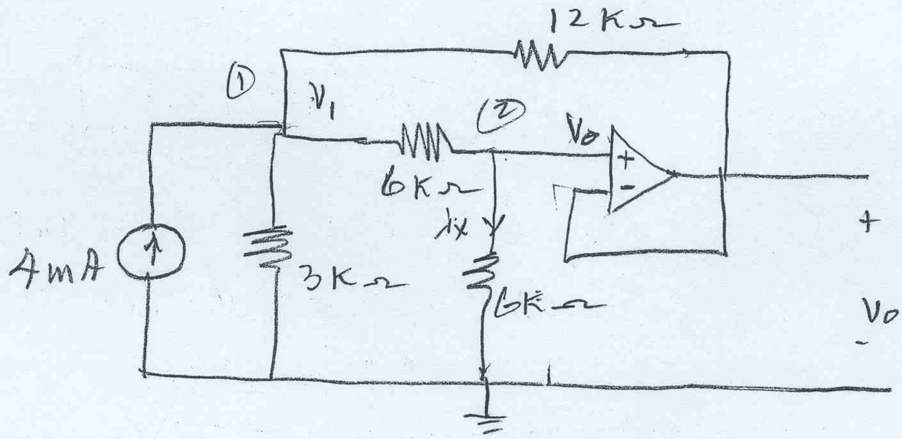
$$15V_s - 10V_o - V_o - 2V_s = 18$$

$$13V_s = 11V_o + 18$$

$$V_o = \frac{13V_s - 18}{11} \Big|_{V_s = 0}$$

$$\boxed{V_o = -1.636V}$$

5.31 Find V_o & i_x.



At ①

$$\frac{V_1}{3K} + \frac{V_1 - V_o}{6K} + \frac{V_1 - V_o}{12K} = 4K^{-1}$$

$$4V_1 + 2V_1 - 2V_o + V_1 - V_o = 48$$

$$\boxed{7V_1 - 3V_o = 48} \qquad (1)$$

At ②

$$\frac{V_o - V_1}{6K} + \frac{V_o}{6K} = 0$$

$$\boxed{2V_o - V_1 = 0} \qquad (2)$$

Substitute (2) into (1)

$$7(2V_o) - 3V_o = 48$$

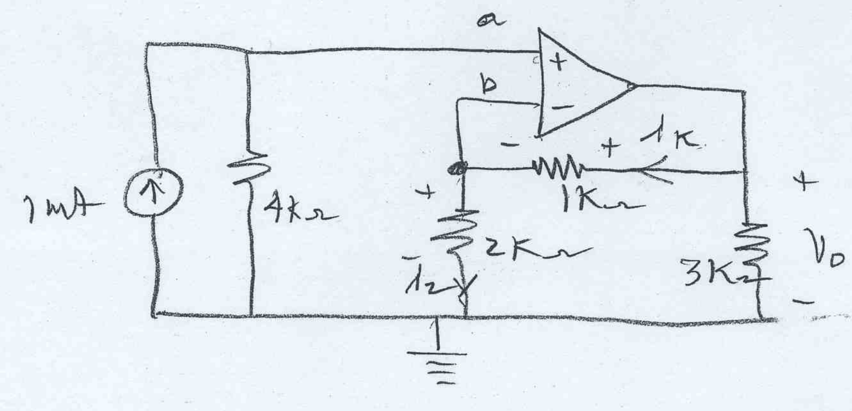
$$11V_o = 48$$

$$\boxed{V_o = \frac{48}{11} = 4.3636\text{ V}}$$

$$i_x = \frac{V_o}{6K} = 0.7273\text{ mA}$$

$$\boxed{i_x = 727.3\,\mu A}$$

5.33 Find i_x and the power dissipated in the 3kΩ resistor.



The voltage at V_a is

$$V_a = 1K^{-1} \times 4K = 4V$$

$$i_2 = i_x = \frac{4V}{2K} = 2mA$$

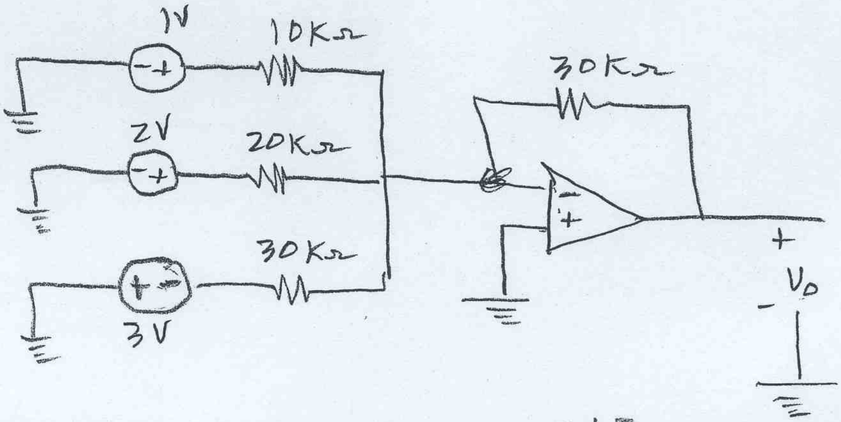
$$\boxed{i_x = 2mA}$$

$$V_0 = 2K^{-1} \times 1K + 4 = 6V$$

$$P_{3K} = \frac{V_0^2}{3K} = \frac{6^2}{3K} = \frac{36}{3}K^{-1}$$

$$\boxed{P_{3K} = 1.2\,mW}$$

5.37 Determine the output of the summing amplifier.



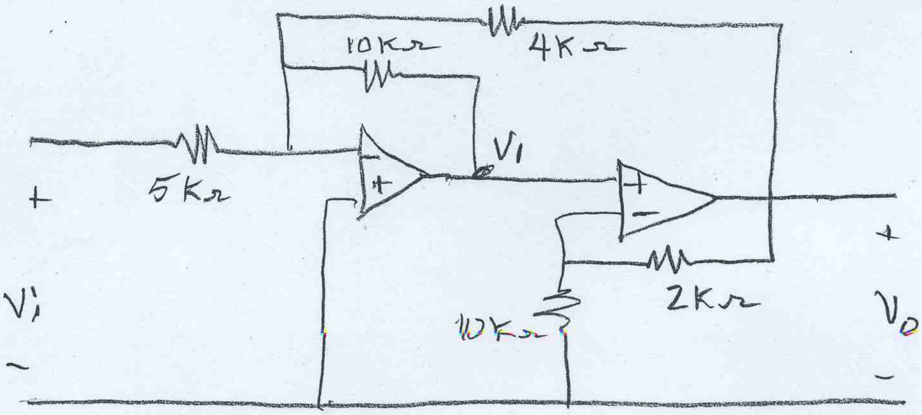
$$\frac{0-1}{10K} + \frac{0-2}{20K} + \frac{0+3}{30K} + \frac{0-V_o}{30K} = 0$$

$$V_o = -\left[\frac{30K}{10K} \times 1 + \frac{30K \times 2}{20K} - \frac{30K \times 3}{30K}\right]$$

$$V_o = -[3 + 3 - 3]$$

$$\boxed{V_o = -3V}$$

5.60 Find $\frac{V_o}{V_i}$ for the following circuit



$$\frac{0 - V_i}{5K} + \frac{0 - V_1}{10K} + \frac{0 - V_o}{4K} = 0$$

$$-4V_i - 2V_1 - 5V_o = 0$$

$$V_1 = \frac{-4V_i - 5V_o}{2} \qquad (1)$$

But

$$V_1 = \frac{V_o \times 10K}{2K + 10K} = \frac{10V_o}{12} = \frac{5V_o}{6} \qquad (2)$$

Put (2) into (1)

$$2 \times \frac{5V_o}{6} + 4V_i + 5V_o = 0$$

$$5V_o + 12V_i + 15V_o = 0$$

$$\frac{V_o}{V_i} = -\frac{12}{20} = -\frac{6}{10}$$

$$\boxed{\frac{V_o}{V_i} = -0.6}$$