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《Fundamentals of Electric Circuits》 homework 4

5.14 Determine the output voltage v_o in the circuit of Fig. 5.53. (10')

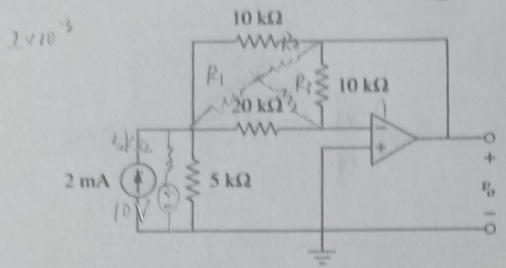

Figure 5.53

解：$R_2 = \frac{10\times10}{10+20+10} = 2.5k\Omega$

$R_1 = \frac{20\times10}{40} = 5k\Omega$

$V_o = -\left(\frac{R_x}{R_1+5k\Omega}\right)V_1 = -\frac{2.5}{10}\times10 = -2.5V$

5.15 (a) Determine the ratio v_o/i_s in the op amp circuit of Fig. 5.54.
(b) Evaluate the ratio for $R_1 = 20\ k\Omega$, $R_2 = 25\ k\Omega$, $R_3 = 40\ k\Omega$. (10')

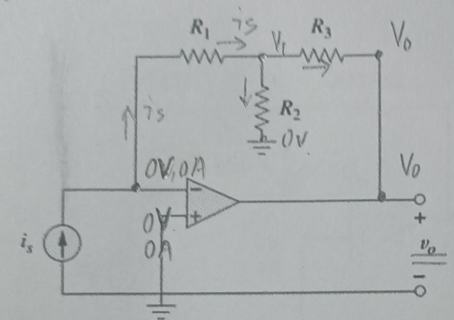

Figure 5.54

解：

a) $\begin{cases} \frac{0-V_1}{R_1} = i_s \\ \frac{0-V_1}{R_1} - \frac{V_1-V_o}{R_3} - \frac{V_1-0}{R_2} = 0 \end{cases}$

$\Rightarrow \frac{V_o}{i_s} = \frac{R_1R_2+R_2R_3+R_3R_1}{-R_2}$

b) $\frac{V_o}{i_s} = \frac{20\times25+25\times40+20\times40}{-25}k\Omega = -92k\Omega$

5.23 For the op amp circuit in Fig. 5.61, find the voltage gain v_o/v_s. (10')

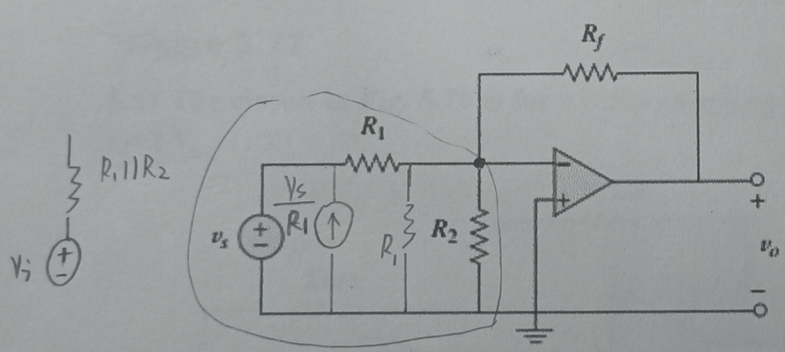

Figure 5.61

解：

$V_i = R_1 \| R_2 \cdot \frac{V_s}{R_1} = \frac{R_2}{R_1+R_2}V_s$

$V_o = -\frac{R_f}{R_1\|R_2}V_i = -\frac{R_f(R_1+R_2)}{R_1R_2}\cdot\frac{R_2V_s}{R_1+R_2}$

$\Rightarrow \frac{V_o}{V_s} = -\frac{R_f}{R_1}$

5.30 In the circuit shown in Fig. 5.68, find i_x and the power absorbed by the 20kΩ resistor. (10')

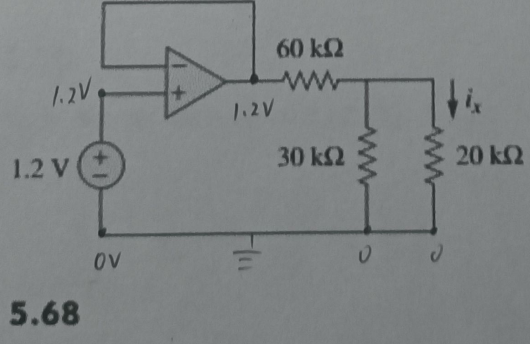

Figure 5.68

解：

$i_x = \frac{1.2}{60+30\|20}\times(30\|20)/20 = 0.01mA$

$P = i_x^2 R = (0.01\times10^{-3})^2\times20\times10^3$

$= 2\times10^{-6}W$

5.32 Calculate i_x and v_o in the circuit of Fig. 5.70. Find the power dissipated by the $60k\Omega$ resistor. (10')

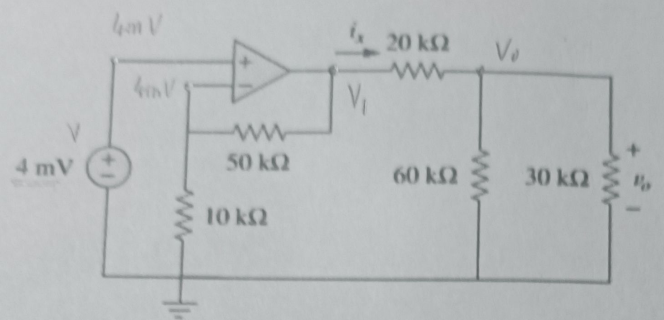

Figure 5.70

解:

$$V_1 = (1+\frac{50}{10})\times 4mV = 24mV$$

$$i_x = \frac{V_1}{20k\Omega + 60\|30k\Omega} = \frac{24\times10^{-3}}{40\times10^{3}} = 0.6\times10^{-3} \text{ mA}$$

$$\frac{V_1-V_0}{20k\Omega} = i_x \Rightarrow V_0 = 12mV$$

$$P = +\frac{V_0^2}{60k\Omega} = \frac{12\times12\times10^{-6}}{60\times10^{3}} = 2.4\times10^{-9} \text{ w}$$

absorb

5.40 Referring to the circuit shown in Fig. 5.77, determine V_o in terms of $\boxed{V_1}$ and $\boxed{V_2}$. (10')

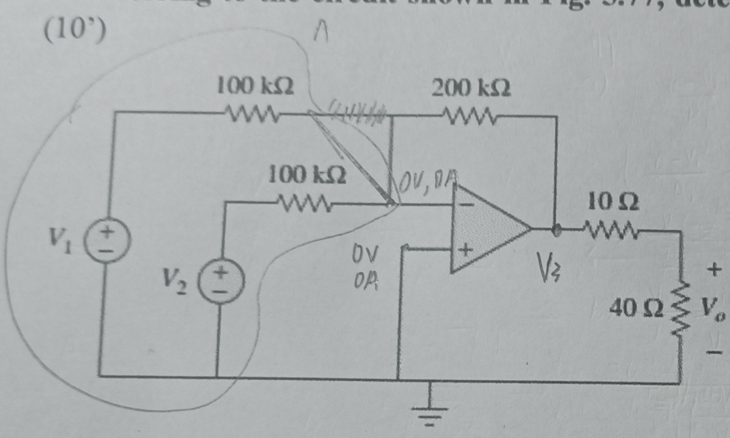

Figure 5.77

解:

$$V_i = (\frac{V_1}{100k\Omega}+\frac{V_2}{100k\Omega})\times 50k\Omega = \frac{V_1+V_2}{2}$$

$$R_i = 100\|100 = 50k\Omega$$

$$V_3 = -\frac{200k\Omega}{50k\Omega}V_i = -2V_1-2V_2$$

$$V_0 = \frac{V_3}{10+40}\times 40 = -1.6V_1-1.6V_2$$

5.47 The circuit in Fig. 5.79 is for a difference amplifier. Find v_o given that v_1=1 V and v_2=2 V. (10')

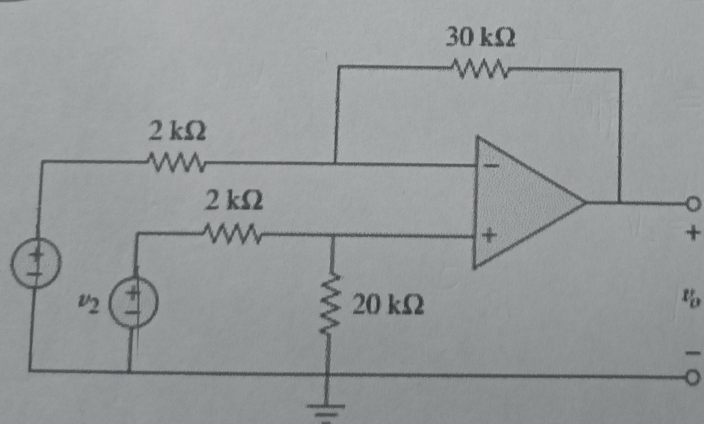

Figure 5.79

解:

$$V_0 = (1+\frac{30}{2})V_2\cdot\frac{20}{2+20} - \frac{30}{2}V_1$$

$$= 16\times2\times\frac{10}{11} - 15$$

$$= 14.09 \text{ V}$$

5.57 Find v_o in the op amp circuit of Fig. 5.84. (10')

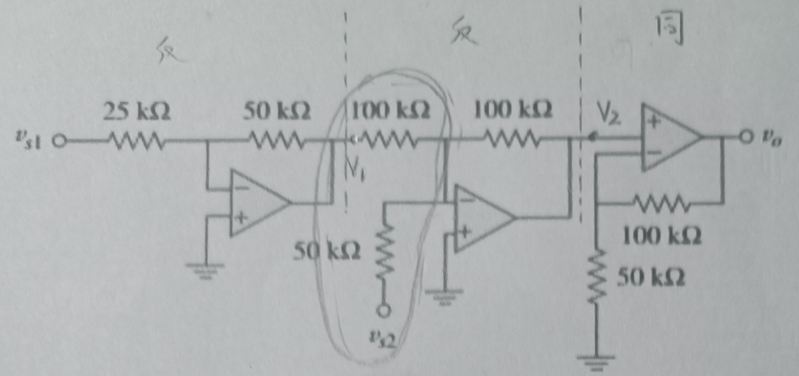

Figure 5.84

解:

$$V_1 = -\frac{50}{25}V_{s1} = -2V_{s1}$$

$$V_2 = -\frac{100}{100}V_1 - \frac{100}{50}V_{s2} = 2V_{s1} - 2V_{s2}$$

$$V_o = \left(1+\frac{100}{50}\right)V_2 = 6V_{s1} - 6V_{s2}$$

5.64 For the op amp circuit shown in Fig. 5.91, find $\boxed{v_o/v_s}$. (10')

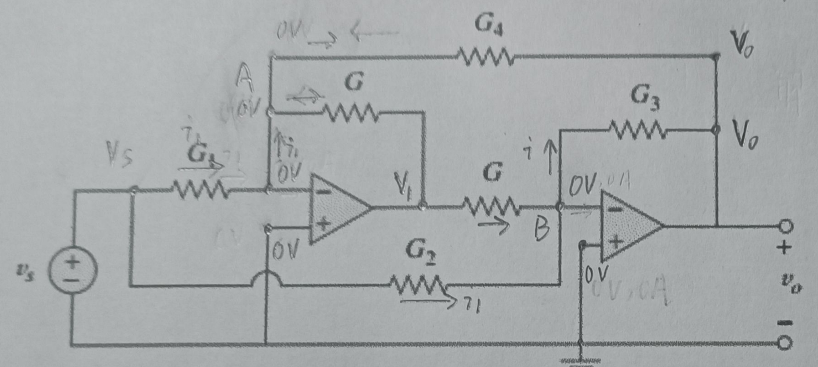

Figure 5.91

解: node A:

$$+V_sG_1 - (0-V_1)G - (0-V_o)G_4 = 0$$

node B:

$$+V_sG_2 + V_1G - (0-V_o)G_3 = 0$$

$$\Rightarrow \frac{V_o}{V_s} = \frac{G_2-G_1}{G_4-G_3}$$

5.90 The op amp circuit in Fig. 5.107 is a current amplifier. Find the current gain i_o/i_s of the amplifier. (10')

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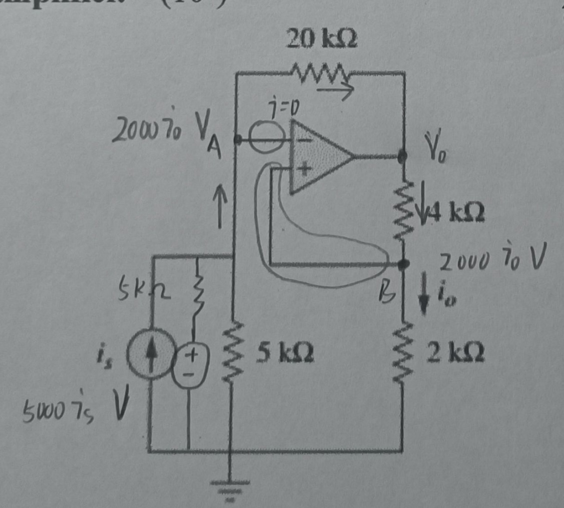

Figure 5.107

解: node A

$$\frac{5000i_s - 2000i_o}{5000} - \frac{2000i_o - V_o}{20\times10^3} = 0$$

node B

$$\frac{V_o - 2000i_o}{4000} - \frac{2000i_o - 0}{2000} = 0$$

$$\Rightarrow \frac{i_o}{i_s} = 5$$