國立成功大學工程科學系

電子學第二次作業 2023/3/18

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1. Fig. 1 shows a weighted summer circuit using an ideal op amp has three inputs resistors and a feedback resistor of 40 kΩ. A signal v_1 is connected to two of the inputs while a signal v_2 is connected to the third input. Express v_o in terms of v_1 and v_2. If v_1 = 1 V and v_2 = -1 V, what is v_o?

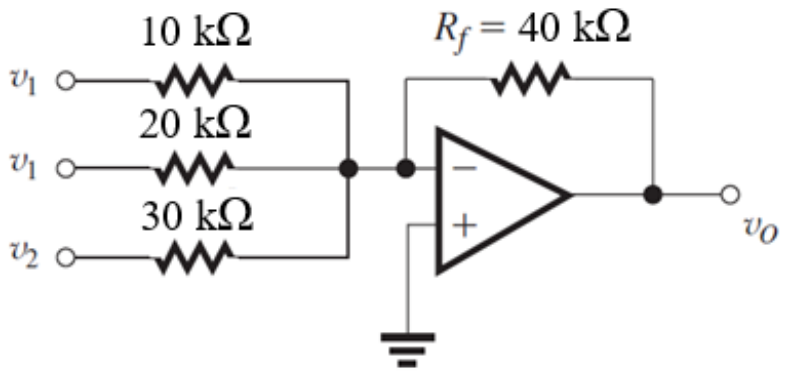

Fig. 1

2. For the circuit in Fig. 2, assuming an ideal op amp, find the currents through all branches (2, 3, 5, 6) and the voltages at all nodes (1, 4).

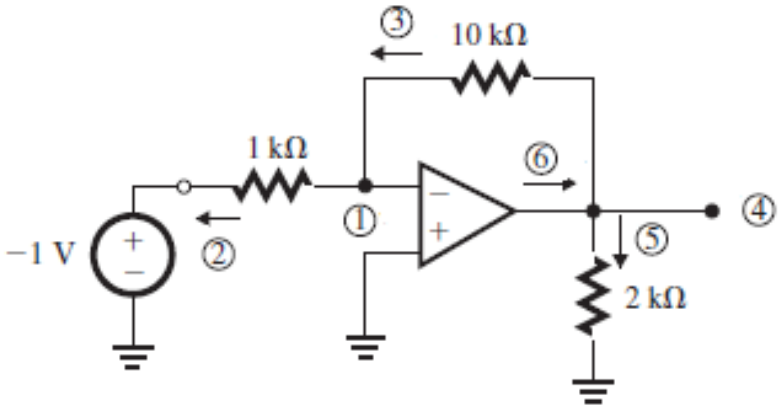

Fig. 2

3. For the circuit in Fig. 3, $R_1 = R_3 = 5$ kΩ and $R_2 = R_4 = 100$ kΩ. Find the differential voltage gain $A_d \equiv v_o/v_{id}$ and differential input resistance R_{id}. If the resistance ratios (R_2/R_1) and (R_4/R_3) are different from each other by 1%, what do you expect the common-mode gain $A_{cm} \equiv v_o/v_{Icm}$ to be?

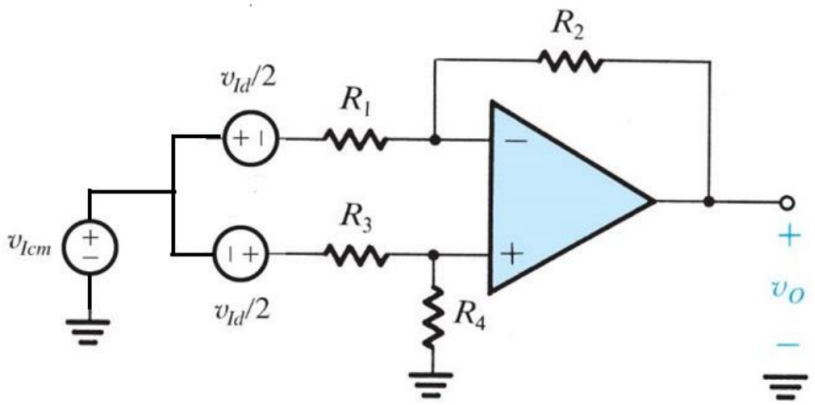

Fig. 3

4. The circuit in Fig. 4 utilizes an ideal op amp.

(a) Find I_1, I_2, I_3, I_L, and V_x.

(b) If V_O is not to be lower than -13 V, find the maximum allowed value for R_L.

(c) If R_L is varied in the range 100 Ω to 1 kΩ, what is the corresponding change in I_L and in V_O?

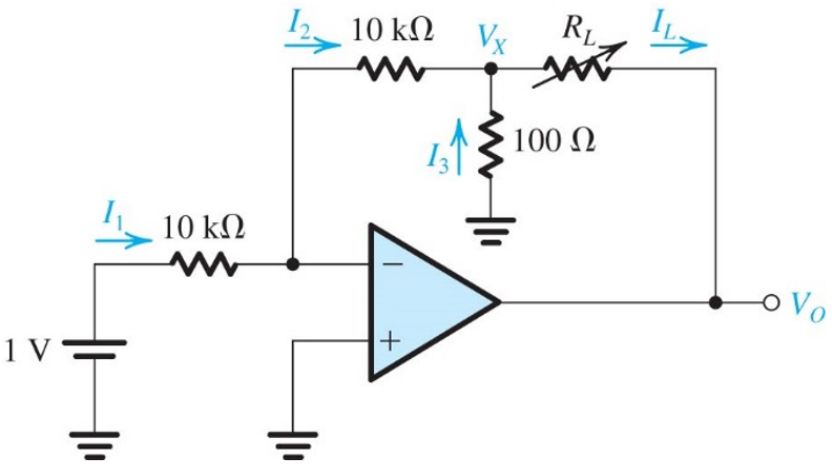

Fig. 4

5. For the circuit shown in Fig. 5, a circuit that performs a low pass STC function. Such a circuit is known as a first-order, low-pass active filter. Derive the transfer function and show that the dc gain is ($-R_2/R_1$) and the 3-dB frequency $\omega_0 = 1/CR_2$. Design the circuit to obtain an input resistance of 10 kΩ, a dc gain of 40 dB, and a 3-dB frequency of 1 kHz. At what frequency does the magnitude of the transfer function reduce to unity?

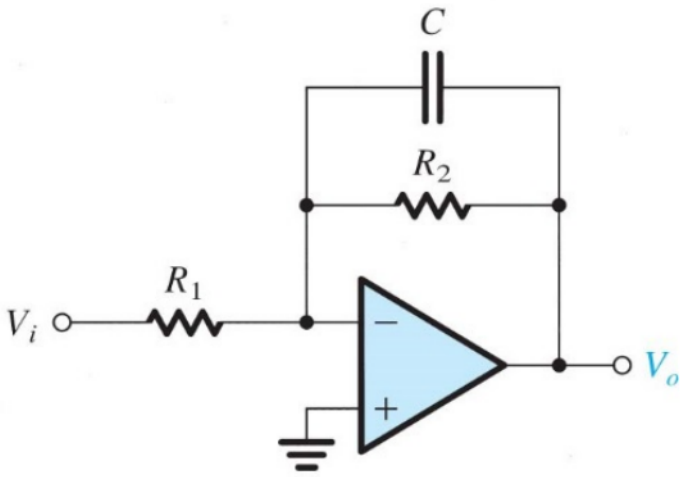

Fig. 5