

Difference Amplifiers

Q1

For the circuit shown below, assuming the op amp is ideal, and given that $R_2 = R_4 = 90\text{ k}\Omega$, $R_1 = R_3 = 10\text{ k}\Omega$, $v_1 = 1\text{ V}$ and $v_2 = 2\text{ V}$,

- Find I_1 and I_2 ;
- Find v_a and v_b ;
- Find I_3 , I_F and v_o .

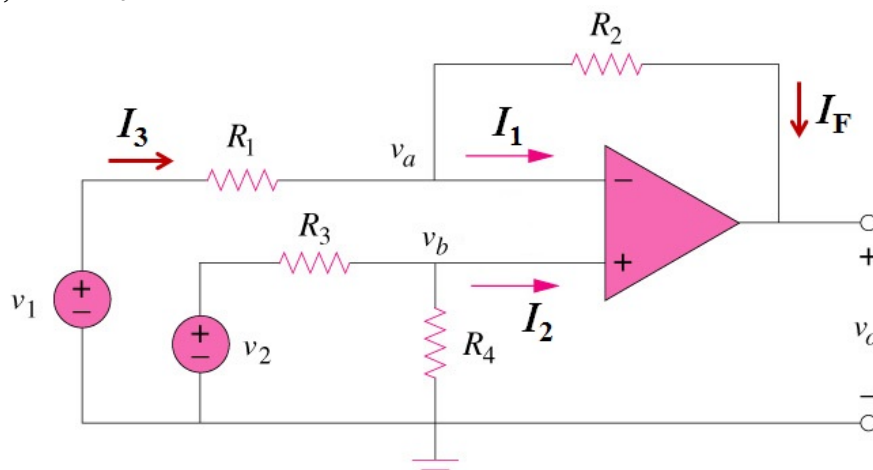


Figure for Q1

Q2

For the circuit shown below, assuming the op amp is ideal,

- Find the voltage at the input terminals by applying nodal analysis at the non-inverting input terminal,
- Hence find v_o by applying nodal analysis at the inverting input terminal.

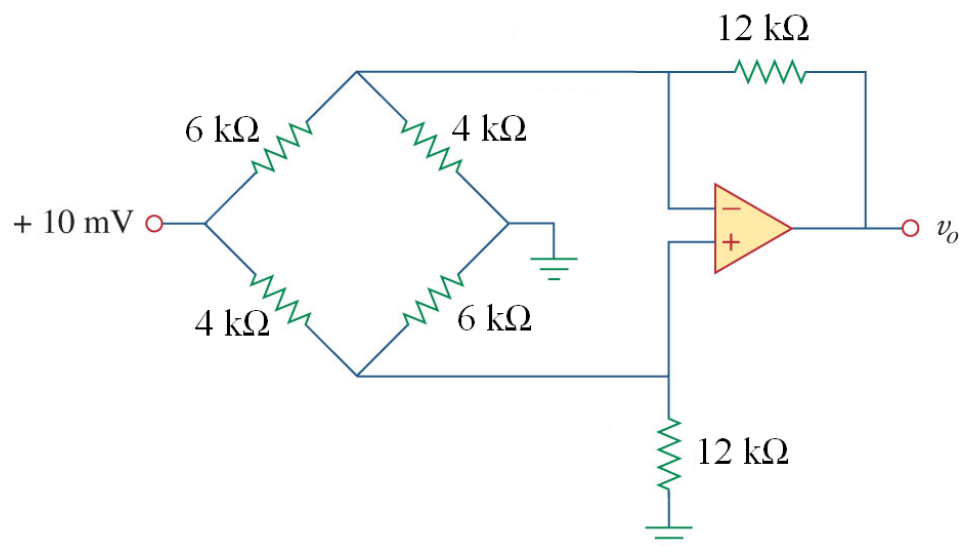


Figure for Q2

Cascaded Amplifiers

Q3 [Modified from Alexander Problem 5.57]

For the circuit in Figure 5.84, assuming the op amps are ideal, given $v_{s1} = 1$ V and $v_{s2} = 2$ V,

- Find i_1 , i_2 , and v_{o1} ;
- Find i_3 , i_4 , and v_{o2} ;
- Find i_5 ;
- Hence find v_o .

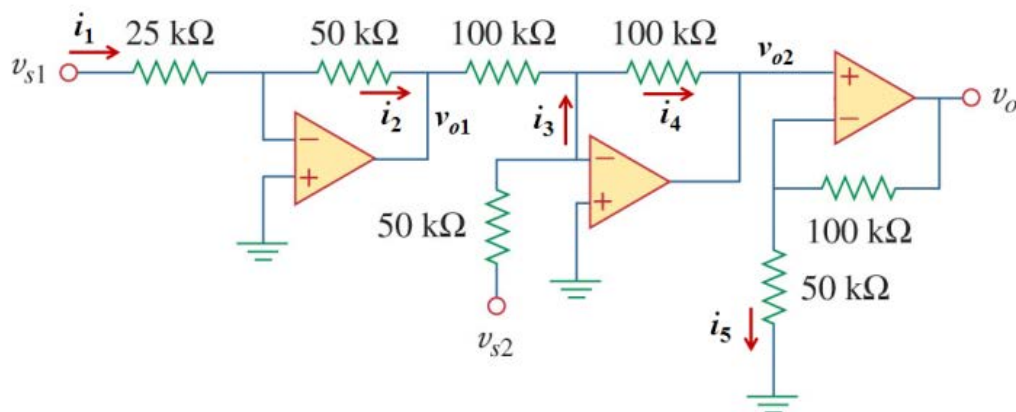


Figure 5.84

Q4 [Alexander Problem 5.60]

Assuming the op amps are ideal, obtain v_o/v_i for the circuit in Figure 5.87.

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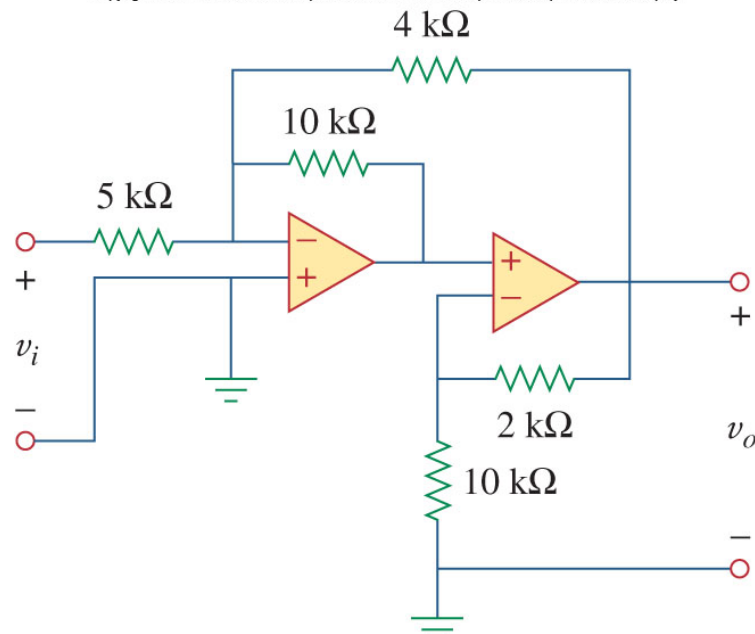


Figure 5.87

Practical Limits**Q5**

For the circuit below, given $R_F = 10\text{k}\Omega$, $R_S = 2\text{k}\Omega$, $V_S^+ = 5\text{V}$, and $V_S^- = -5\text{V}$,

- Find V_{out} when $V_S = 1.2\text{V}$.
- Sketch the graph of V_{out} (y-axis) vs. V_S (x-axis).

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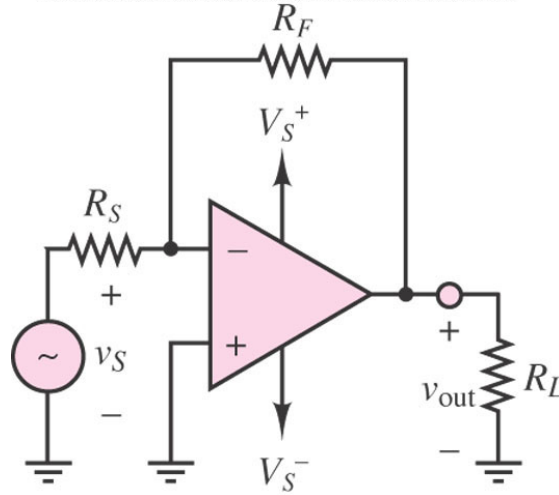


Figure for Q5

Numerical solutions**Q1**

- a) $I_1 = 0 \text{ A}$, $I_2 = 0 \text{ A}$
- b) $v_a = 1.8 \text{ V}$, $v_b = 1.8 \text{ V}$
- c) $I_3 = -0.08 \text{ mA}$, $I = -0.08 \text{ mA}$, $v_o = 9 \text{ V}$

Q2

- a) Input voltages = 5 mV
- b) $V_o = 10 \text{ mV}$

Q3 [Modified from Alexander Problem 5.57]

- a) $i_1 = 0.04 \text{ mA}$, $i_2 = 0.04 \text{ mA}$, $v_{o1} = -2 \text{ V}$
- b) $i_3 = 0.04 \text{ mA}$, $i_4 = 0.02 \text{ mA}$, $v_{o2} = -2 \text{ V}$
- c) $i_5 = -0.04 \text{ mA}$, $v_o = -6 \text{ V}$

Q4 [Alexander Problem 5.62]

Closed loop gain $v_o/v_i = -0.6 \text{ V}$

Q5

- a) $V_{\text{out}} = -5 \text{ V}$