Difference Amplifiers

Q1

For the circuit shown below, assuming the op amp is ideal, and given that $R_2 = R_4 = 90$ kΩ, $R_1 = R_3 = 10$ kΩ, $v_1 = 1$ V and $v_2 = 2$ V,

a) Find I_1 and I_2;
b) Find v_a and v_b;
c) Find I_3, I_F and v_o.

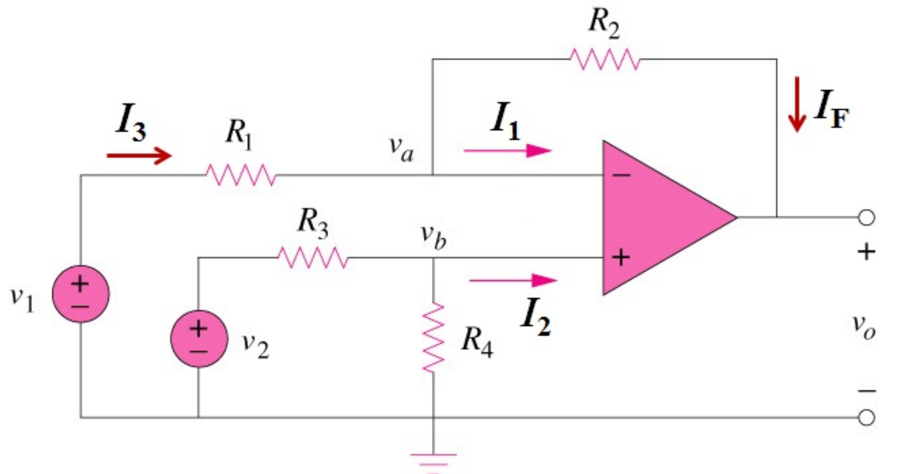

Figure for Q1

Q2

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

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

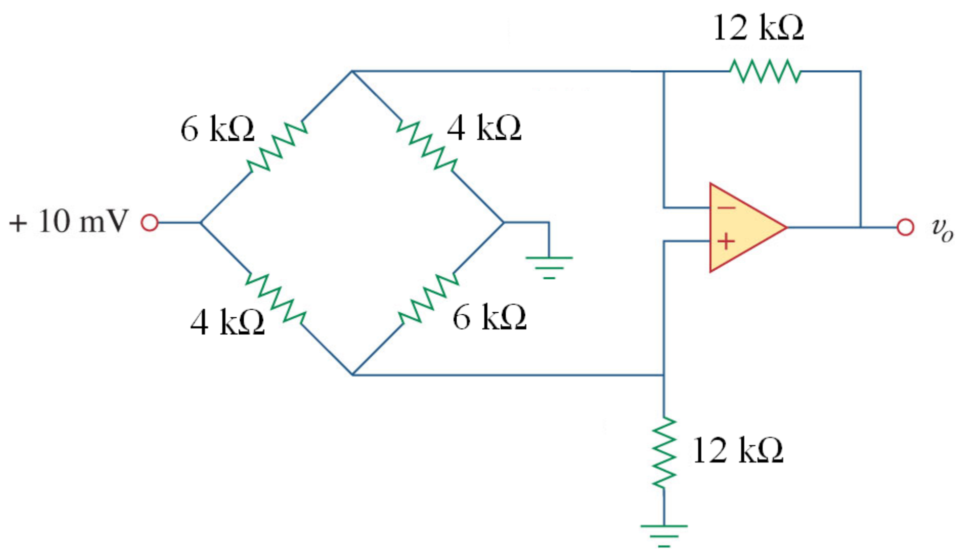

Figure for Q2

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,

a) Find i_1, i_2, and v_{o1};
b) Find i_3, i_4, and v_{o2};
c) Find i_5;
d) Hence find v_o.

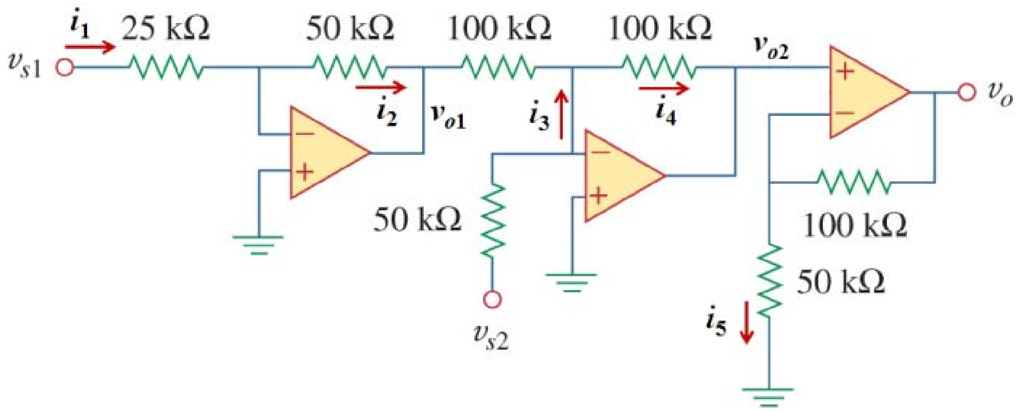

Figure 5.84

Q4 [Alexander Problem 5.60]
Assuming the op amps are ideal, obtain v_o/v_i for the circuit in Figure 5.87.

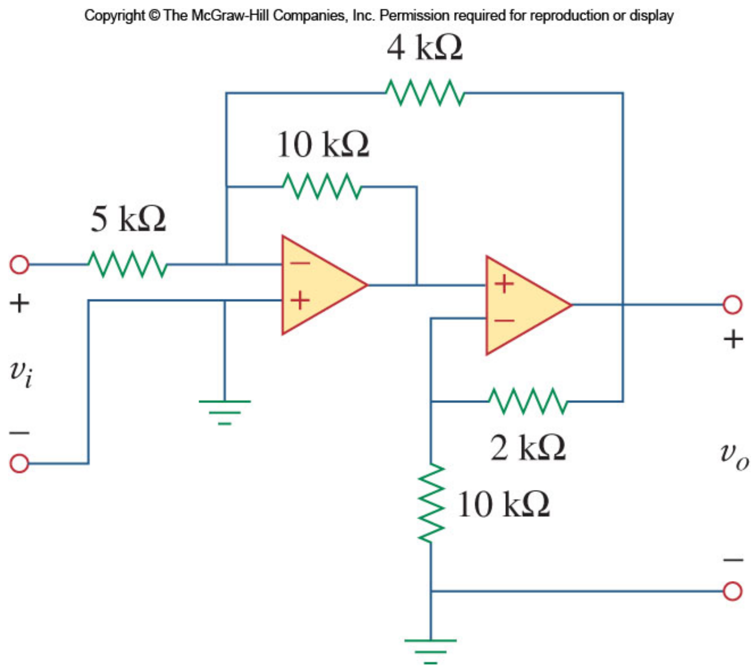

Figure 5.87

Practical Limits

Q5

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

a) Find V_{out} when Vs = 1.2V.
b) Sketch the graph of V_{out} (y-axis) vs. V_S (x-axis).

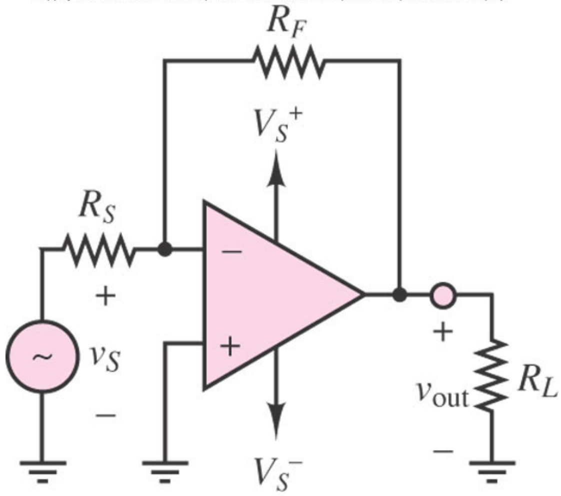

Figure for Q5

Numerical solutions

Q1

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

Q2

a) Input voltages = 5 mV
b) V_o = 10 mV

Q3 [Modified from Alexander Problem 5.57]

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

Q4 [Alexander Problem 5.62]

Closed loop gain v_o/v_i = -0.6 V

Q5

a) V_{out} = -5 V