

4.1 An op amp with an open-loop gain of  $10^6$  and  $V_{cc} = 12\text{ V}$  has an inverting-input voltage of  $20\ \mu\text{V}$  and a non-inverting input voltage of  $10\ \mu\text{V}$ . What is its output voltage?

4.13 Obtain an expression for the voltage gain  $G = v_o/v_s$  for the circuit in Fig. P4.13.

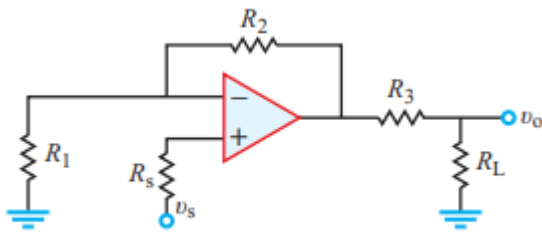


Figure P4.13: Circuit for Problem 4.13.

4.20 Determine the linear range of the source  $v_s$  in the circuit of Fig. P4.20.

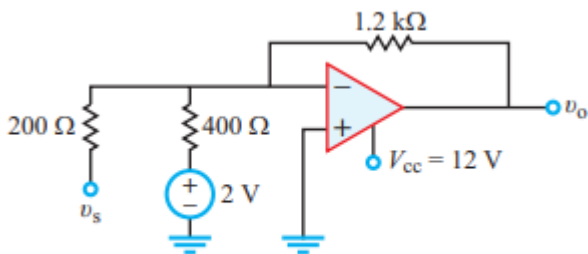


Figure P4.20: Circuit for Problems 4.20 and 4.21.

4.25 Determine the linear range of  $v_s$  for the circuit in Fig. P4.25.

[Note the +/- of each op-amp].

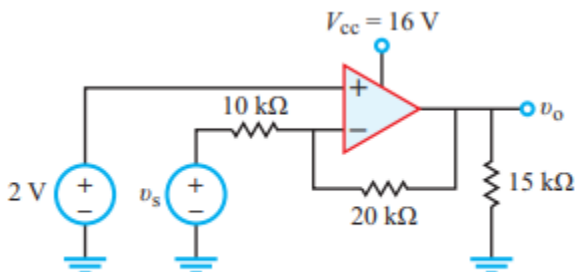


Figure P4.25: Circuit for Problem 4.25.

4.46 Relate  $v_o$  in the circuit of Fig. P4.46 to  $v_s$ . [Solve for  $v_o$  in terms of  $v_s$ ]

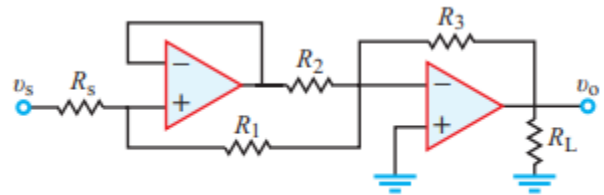


Figure P4.46: Circuit for Problem 4.46.

4.51 Solve for  $v_o$  in terms of  $v_s$  for the circuit in Fig. P4.51.

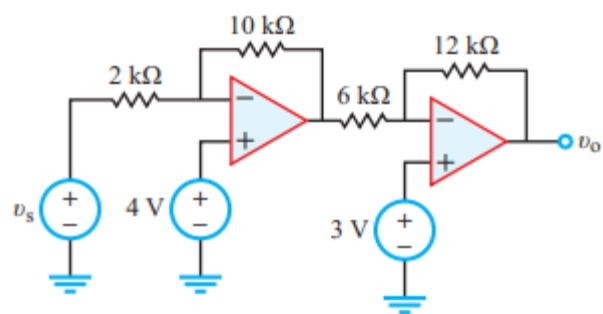


Figure P4.51: Circuit for Problem 4.51.

4.52 Find the value of  $v_o$  in the circuit in Fig. P4.52. [Note the +/- of each op-amp].

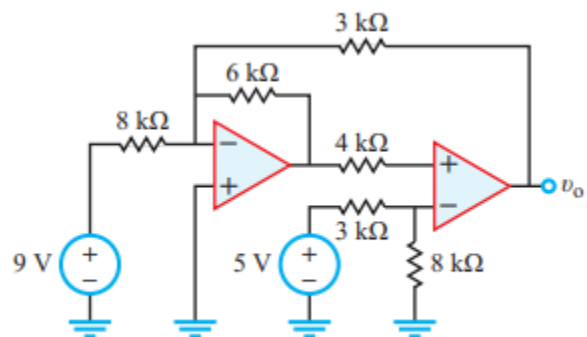


Figure P4.52: Circuit for Problem 4.52.

**Selected Answers:**

- 4.1  $v_o = -10\text{ V}$
- 4.13  $G = R_L(R_1 + R_2)/[R_1(R_3 + R_L)]$
- 4.46  $v_o = -[(R_3/R_2)(R_1 + R_2)/(R_1 + R_s)]v_s$
- 4.52  $v_o = -5.19\text{ V}$