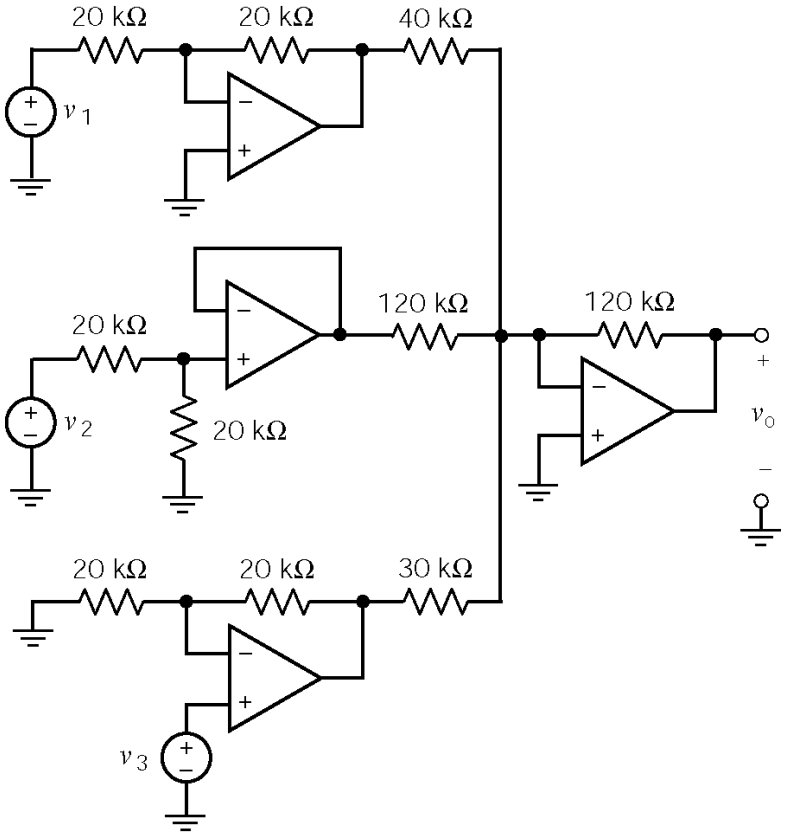
Examples

1. This circuit has three inputs: v_1, v_2 and v_3. The output of the circuit is v_o. The output is related to the inputs by

$$v_o = a\,v_1 + b\,v_2 + c\,v_3$$

where *a*, *b* and *c* are constants.

Determine the values of *a*, *b* and *c*.

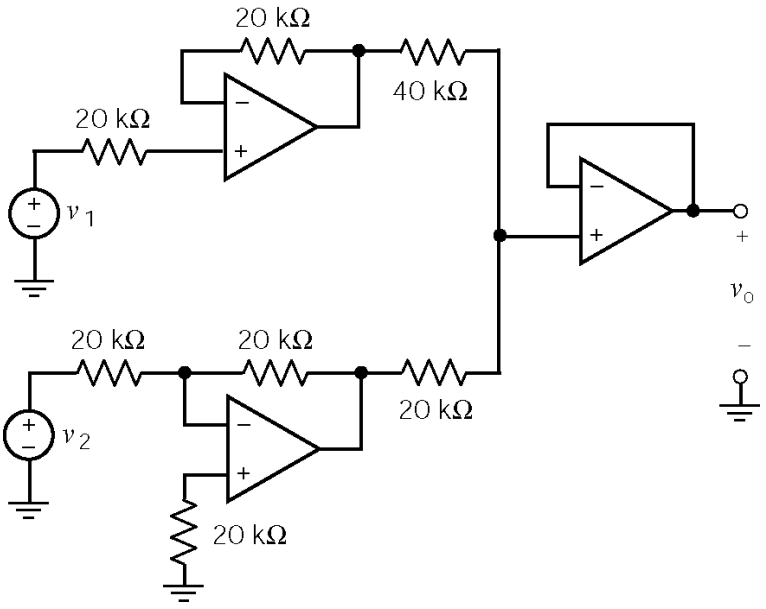


2. This circuit has two inputs: v_1 and v_2. The output of the circuit is v_o. The output is related to the inputs by

$$v_o = a\,v_1 + b\,v_2$$

where *a* and *b* are constants.

Determine the values of *a* and *b*.



Solutions

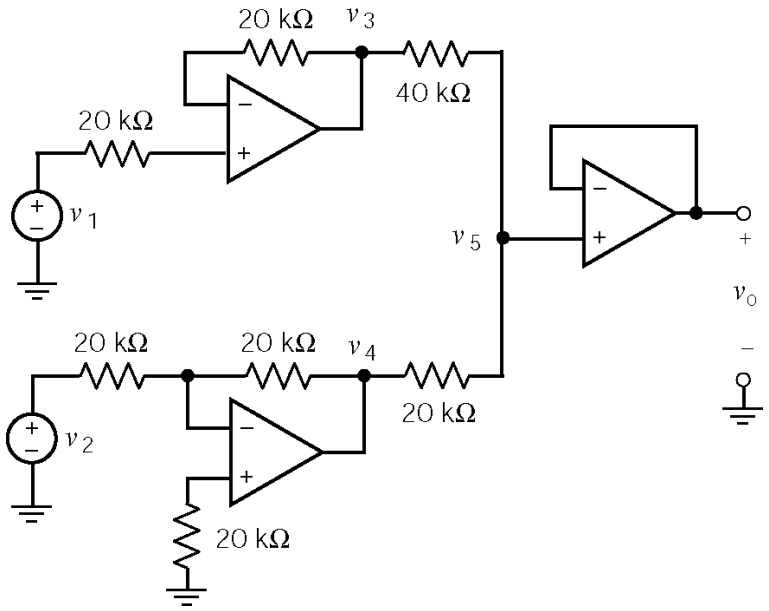
1. Use units of V, mA and kΩ.

$$v_o = -\left[\left(\frac{120}{40}\right)\left(-\frac{20}{20}\right)v_1 + \left(\frac{120}{120}\right)\left(\frac{20}{20+20}\right)v_2 + \left(\frac{120}{30}\right)\left(1+\frac{20}{20}\right)v_3\right] = 3\,v_1 - 0.5\,v_2 - 8\,v_3$$

so

$$a = 3,\ b = -0.5 \text{ and } c = -8$$

2.



Label the node voltages as shown. Use units of V, mA and kΩ.

$$v_3 = v_1 \quad \text{and} \quad v_4 = -v_2$$

Write a node equation

$$\frac{v_5 - v_3}{40} + \frac{v_5 - v_4}{20} = 0$$

Solving for v_5

$$v_5 = \frac{1}{3}\left(v_3 + 2v_2\right) = \frac{1}{3}v_1 - \frac{2}{3}v_2$$

so

$$a = -\frac{1}{3} \quad \text{and} \quad b = -\frac{2}{3}$$