Solution of EECS 300 Test 5 F08

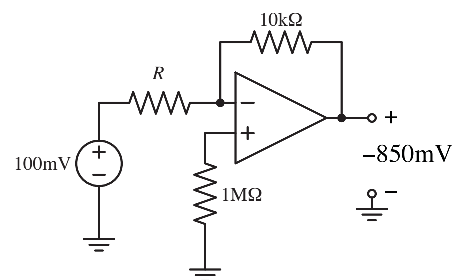
1. With reference to the circuit below

   (a) Find the numerical value of *R*.

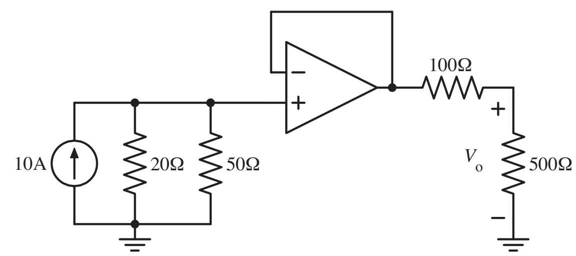
$$-850\text{mV} = (100\text{mV})\left(-\frac{10000}{R}\right) \Rightarrow R = 1176.5\Omega$$

   (b) If the independent voltage source is replaced by an independent current source of +1 mA with the arrow pointing upward, what is the new numerical value of the output voltage that replaces the –850mV? (Use the same *R* found in part (a).)

   The +1 mA current from the current source flows to the inverting input of the operational amplifier and then must flow from that node to the output node through the 10,000 ohm resistor. The voltage at the inverting input is zero because the non-inverting input is at zero volts (no current can flow through the $1\text{M}\Omega$ resistor). So the new output voltage is $0\text{V} - (1\text{mA})(10000\Omega) = -10\text{V}$.



2. Find the numerical value of the voltage V_o in the circuit below.



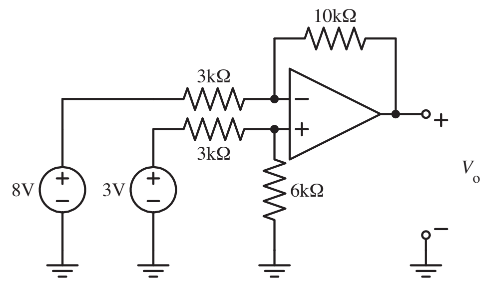
The operational amplifier is configured as a voltage follower with infinite input resistance and a voltage gain of +1. None of the source current can flow into the operational amplifier input and the voltage at that input is therefore

$$V_+ = (10\text{A})(20\Omega \,||\, 50\Omega) = (10\text{A})(14.286\Omega) = 142.86\text{V}$$

Since this is a voltage follower, the voltage at the output terminal of the operational amplifier is also 142.86V. Then, by voltage division, the voltage V_o must be

$$V_o = 142.86\text{V}\frac{500\Omega}{100\Omega + 500\Omega} = 119.05\text{V}$$

3. Find the numerical value of V_o in the circuit below.



We can use superposition here to find V_o.

Due to the 8V source acting alone:

$$V_o = 8\text{V}\left(-\frac{10000\Omega}{3000\Omega}\right) = -26.667\text{V}$$

Due to the 3V source acting alone:

$$V_o = 3\text{V}\left(\frac{6000\Omega}{3000\Omega + 6000\Omega}\right)\left(\frac{10000\Omega + 3000\Omega}{3000\Omega}\right) = +8.667\text{V}$$

Therefore, with both sources active

$$V_o = -26.667\text{V} + 8.667 = -18\text{V}$$

Solution of EECS 300 Test 5 F08

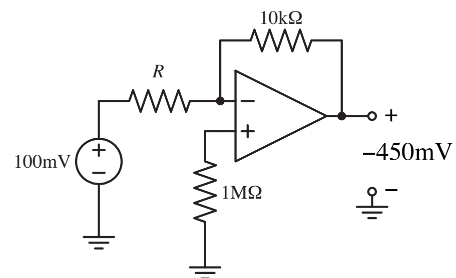
1. With reference to the circuit below

   (a) Find the numerical value of *R*.

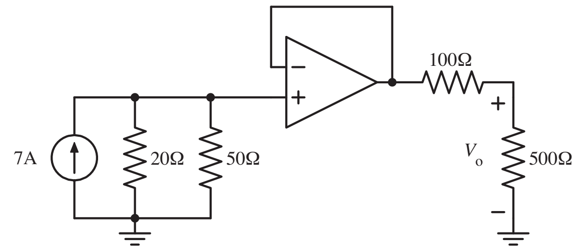
$$-450\text{mV} = (100\text{mV})\left(-\frac{10000}{R}\right) \Rightarrow R = 2222.22\Omega$$

   (b) If the independent voltage source is replaced by an independent current source of +2 mA with the arrow pointing upward, what is the new numerical value of the output voltage that replaces the –450mV? (Use the same *R* found in part (a).)

   The +2 mA current from the current source flows to the inverting input of the operational amplifier and then must flow from that node to the output node through the 10,000 ohm resistor. The voltage at the inverting input is zero because the non-inverting input is at zero volts (no current can flow through the $1\text{M}\Omega$ resistor). So the new output voltage is $0\text{V} - (2\text{mA})(10000\Omega) = -20\text{V}$.



2. Find the numerical value of the voltage V_o in the circuit below.



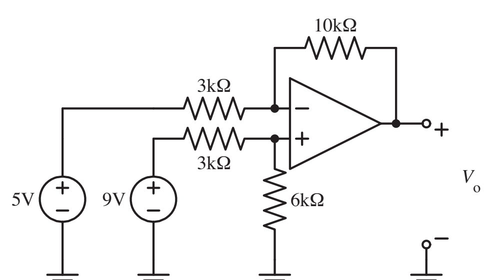
The operational amplifier is configured as a voltage follower with infinite input resistance and a voltage gain of +1. None of the source current can flow into the operational amplifier input and the voltage at that input is therefore

$$V_+ = (7\text{A})(20\Omega \,\|\, 50\Omega) = (7\text{A})(14.286\Omega) = 100\text{V}$$

Since this is a voltage follower, the voltage at the output terminal of the operational amplifier is also 100V. Then, by voltage division, the voltage V_o must be

$$V_o = 100\text{V}\frac{500\Omega}{100\Omega + 500\Omega} = 83.333\text{V}$$

3. Find the numerical value of V_o in the circuit below.



We can use superposition here to find V_o.

Due to the 5V source acting alone:

$$V_o = 5\text{V}\left(-\frac{10000\Omega}{3000\Omega}\right) = -16.667\text{V}$$

Due to the 9V source acting alone:

$$V_o = 9\text{V}\left(\frac{6000\Omega}{3000\Omega+6000\Omega}\right)\left(\frac{10000\Omega + 3000\Omega}{3000\Omega}\right) = 26\text{V}$$

Therefore, with both sources active

$$V_o = -16.667\text{V} + 26 = 9.333\text{V}$$