Problem 1 (5 points)
Find $V_o$ and $I_o$ in the circuit shown below. Use the ideal opamp assumptions ($I_+ = 0$, $I_- = 0$, $V_+ = V_-)$.

$\Rightarrow$ Since $I_+ = 0$, the $10k\Omega$ and $5k\Omega$ form a voltage divider.

Therefore $V_+ = \frac{10k\Omega}{10k\Omega + 5k\Omega} \cdot 6V = \frac{2}{3} \cdot 6V = 4V$

$\Rightarrow V_- = V_+ = 4V$

$\Rightarrow$ The voltage across the $1k\Omega$ resistor is $2V$ with polarity as shown; therefore the current is $\frac{2V}{1k\Omega} = 2mA$ flowing right to left

$\Rightarrow$ Since $I_- = 0$, $2mA$ also flows right to left in the feedback $5k\Omega$ resistor producing a voltage drop of $(5k\Omega)(2mA) = 10V$ with polarity as shown

$\Rightarrow$ Looking at feedback resistor $V_o = 4V + 10V = 14V$

$\Rightarrow$ The current in the $10k\Omega$ resistor is $\frac{14V}{10k\Omega} = 1.4mA$

$\Rightarrow$ KCL at output gives $I_o = 2mA + 14mA = 16mA$

$V_o = 14V$

$I_o = 16mA$
Problem 2 (5 points)
Find $V_{o1}$ and $V_{o2}$ in the circuit shown below. Use the ideal opamp assumptions ($I_+ = 0, I_- = 0, V_+ = V_-)$.

$\text{opamp #1: } I_+ = 0 \Rightarrow \text{voltage across the } 10k\Omega \text{ is } 0V$

$\Rightarrow V_+ = 5V \Rightarrow V_- = 5V \Rightarrow V_{o1} = V_- = 5V$

$\text{opamp #2: } V_+ = 0V, V_- = V_+ = 0V$

The voltage across the $5k\Omega$ resistor is $5V$

Therefore the current is $5V/5k\Omega = 1mA$ (left to right)

Since $I_- = 0$, the current through the $2k\Omega$ feedback resistor is $1mA$ and it has $2V$ across it as shown.

Now $V_{o2} = 0 - 2 = -2V$

$V_{o1} = \frac{5V}{\phantom{0}} \quad V_{o2} = \frac{-2V}{\phantom{0}}$

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