Additional Problems

1. Determine the expression for $V_{\text{out}}$ for the circuit shown below.

$$V_{\text{out}} = -RF \left( \frac{V_{\text{in}1}}{R_1} + \frac{V_{\text{in}2}}{R_2} + \ldots + \frac{V_{\text{in}n}}{R_n} \right)$$

2. Use PSpice to determine the response of the circuit shown over the frequency range of frequency between 10 Hz and 100 kHz. Look at the response for three values of $R_3 = 1.5 \, \text{k}\Omega$, $2.5 \, \text{k}\Omega$, and $3.5 \, \text{k}\Omega$. You should be prepared to answer questions such as what function is performed, what happens when $R_3$ is varied, what is (are) the “half power” point(s) to name a few.

$R_1 = 4 \, \text{k}\Omega \quad R_2 = 156 \, \text{k}\Omega \quad R_L = 2.5 \, \text{k}\Omega \quad C = 10 \, \text{nF} \quad V_+ = 15 \, \text{V} \quad V_- = -15 \, \text{V}$
3) Verify that $V_{\text{out}}$ and $V_{\text{in}}$ are equal for the circuit shown below within specific constraints AND indicate the constraints. You should write the associated equations as part of the solution.

![Circuit Diagram]

4) Sketch the response for each of the circuits below on a $V_{\text{in}}$ [X axis] vs. $V_{\text{out}}$ [Y axis] assuming the output has limits of $\pm 12$ V and the op-amps are supplied with a $\pm 15$ V supply. Be careful, these circuits may not respond as you think they should – note the feedback path.

$R_1 = 4 \, \text{k}\Omega$ \quad $R_2 = 6 \, \text{k}\Omega$ \quad $R_x = 2 \, \text{k}\Omega$ \quad $V_{\text{Ref}} = 4 \, \text{V}$