Homework Assignment # 1, Due January 26, 2001

Announcements for Week of January 16-19 see web for full details:
Discussion: Sections will meet and review material from EE40
Laboratories: Will not meet this week. Purchase an inexpensive laboratory notebook (such as a Mead Composition book ~$2.00) and number about 30 pages. Also procure a floppy disk to carry just in case the printer is not working.
Textbooks: Copies of the Howe and Sodini texts are available at ASUC (36) and Ned's Berkeley Bookstore (30).
Reading: H&S Chapter 1, (emphasis on circuits rather than physics), 8.4 (idealized current source), 8.2.2, 9.1 (just use of dependent sources in block stages and gain)

1.1) Fundamental equivalents. Consider the following circuit:

![Circuit Diagram]

- a) Find the Thévenin equivalent circuit.
- b) Find the Norton equivalent circuit.

1.2) Dependent sources. Consider the following unloaded amplifier circuit:

![Circuit Diagram]

- a) Find the open circuit voltage gain, $V_{out}/V_{in}$, of this amplifier.
b) Find $R_{out}$, the resistance an ohm-meter would measure between the two output nodes.

c) Find $R_{in}$, the resistance an ohm-meter would measure between the two input nodes.

d) Draw the standard two-port voltage amplifier that is equivalent to the above circuit.

1.3) Sources and loads. Consider the following loaded amplifier circuit with a non-ideal source.

\[ \begin{align*}
R_1 &= 1\, \text{k}\, \Omega \\
R_2 &= 2\, \text{k}\, \Omega \\
R_3 &= 100\, \Omega \\
V_{in} &\quad + \\
&\quad - \\
V_{out} &\quad + \\
&\quad - \\
R_s &= 100\, \Omega \\
V_s &\quad + \\
&\quad - \\
V_{in} &\quad + \\
&\quad - \\
R_2 &= 2\, \text{k}\, \Omega \\
R_1 &= 1\, \text{k}\, \Omega \\
R_5 &= 10\, \text{k}\, \Omega \\
I_{in} &\quad + \\
&\quad - \\
V_x &\quad + \\
&\quad - \\
V_{in} &\quad + \\
&\quad - \\
R_4 &= 100\, \Omega \\
R_5 &= 10\, \text{k}\, \Omega \\
V_{x} &\quad + \\
&\quad - \\
R_2 &= 2\, \text{k}\, \Omega \\
R_{L} &= 5\, \text{k}\, \Omega
\end{align*} \]

a) Find the overall gain of this amplifier, $V_{out}/V_{s}$, and write it in a form so that it is factored into three terms: input voltage divider, open circuit voltage gain, and output voltage divider. Hint: substituting the simplified two-port from part 1.2d into this circuit will make this problem easier.

1.4) Cascaded amplifiers. Consider the following pair of cascaded amplifier circuits:

\[ \begin{align*}
R_1 &= 1\, \text{k}\, \Omega \\
R_2 &= 2\, \text{k}\, \Omega \\
R_3 &= 100\, \Omega \\
V_{in} &\quad + \\
&\quad - \\
V_{out} &\quad + \\
&\quad - \\
R_4 &= 100\, \Omega \\
V_{in} &\quad + \\
&\quad - \\
R_{4} &= 100\, \Omega \\
R_{5} &= 10\, \text{k}\, \Omega \\
V_{x} &\quad + \\
&\quad - \\
R_{5} &= 10\, \text{k}\, \Omega \\
R_{2} &= 2\, \text{k}\, \Omega \\
R_{L} &= 5\, \text{k}\, \Omega
\end{align*} \]

a) Draw the single standard two-port voltage amplifier that is equivalent to the above pair of amplifiers.