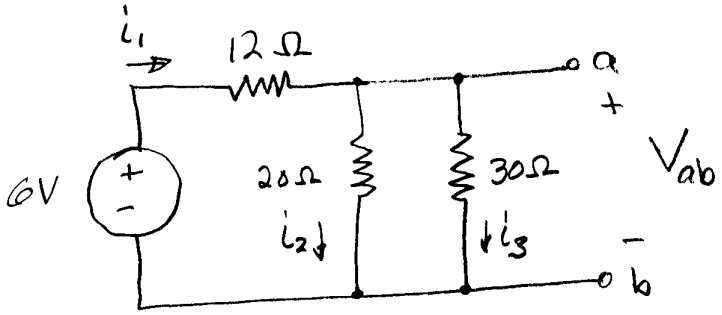
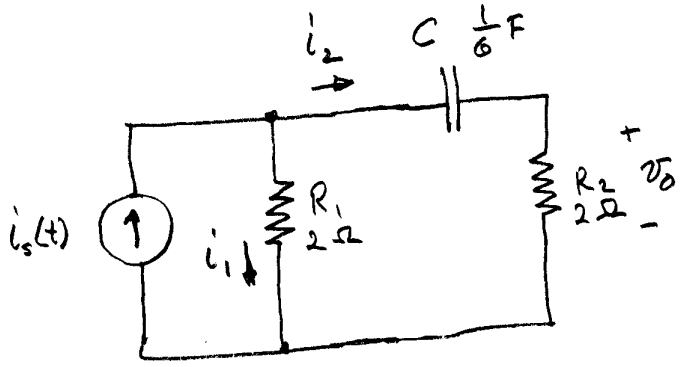
Physics 116A Fall 2004: Exam 1

11/03/2004

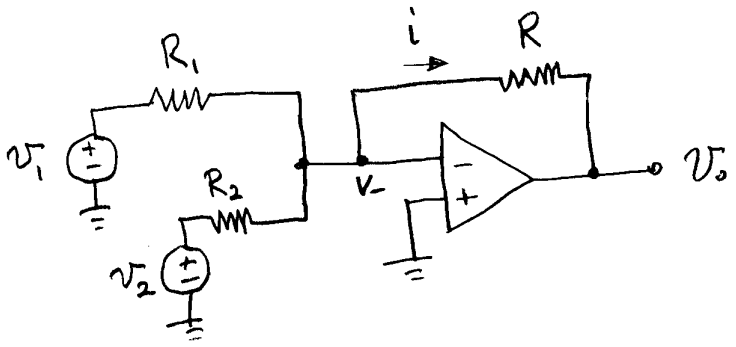
Closed book and notes except for one 8.5 in x 11 in sheet of paper. Show reasoning for full credit. Complex quantities are in **boldface**, *e.g.*, $\mathbf{H}(\mathrm{s})$. Many problems ask for numerical answers. Be sure to put your name on all pages submitted. There are 4 problems and 100 points.



1. *(23 points)*
   In the circuit above,
   (a) find V_{ab};
   (b) find i_3;
   (c) find Thévenin equivalent circuit for the network with output terminals a and b.



2. *(24 points)*
   For the circuit above, $i_s(t) = 5\cos(3t)$.
   (a) Find $\mathbf{Z}_2$, the impedance of C in series with R_2.
   (b) Find $\mathbf{i}_2$ as a phasor. *(Suggestion: use current division).*
   (c) Find $v_o(t)$.
   (d) Find the average power dissipated in R_2.

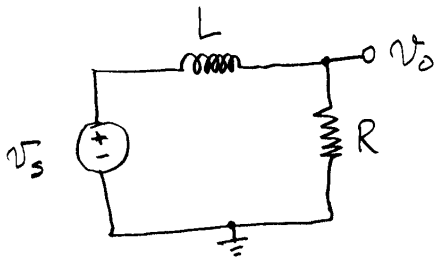


3. *(15 points)*
In the circuit above, the Op-Amp is ideal.

   (a) Does the circuit have a virtual ground? If so, where?

   (b) Find an expression for i in terms of v_1 and v_2.

   (c) Find an expression for v_o in terms of v_1 and v_2.



4. *(38 points)*
Consider the LR circuit above.

   (a) Find an expression for $\mathbf{H}(j\omega) \equiv \mathbf{v_o}/\mathbf{v_s}$.

   (b) Find $A_v \equiv |\mathbf{H}(j\omega)|$

   (c) Show that $\lim_{\omega \to 0} A_v = 1$. (This is the maximum value of A_v.)

   (d) Find an expression for the corner frequency, ω_c, where A_v has fallen to $1/\sqrt{2}$ of its maximum. (That is, find the value of ω such that $A_v = 1/\sqrt{2}$.)

   (e) Find ang$(\mathbf{H}(j\omega_c))$. (This is the angle of $\mathbf{H}$ when $\omega = \omega_c$.)

   (f) Find an expression for $\mathbf{H}(\mathbf{s})$.

   (g) Find any values of $\mathbf{s}$ for which $\mathbf{H}(\mathbf{s})$ has a pole.

   (h) This circuit is a filter of the following type *(choose one)*:

      i. low pass
      ii. bandpass
      iii. high pass
      iv. none of the above.