NAME (please print) _____ SID _____

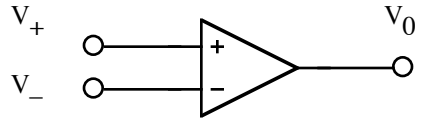
UNIVERSITY OF CALIFORNIA, BERKELEY
Electrical Engineering and Computer Sciences Department

EECS 145L Electronic Transducer Lab
MIDTERM #1 (100 points maximum)
October 5, 2005

(closed book, calculators OK, equation sheet provided)
(You will not receive full credit if you do not show your work)

PROBLEM 1 (15 points)

An amplifier has two inputs V_+ and V_-, and one output, V_0.



If $V_0 = aV_+ + bV_-$, derive the common mode and differential mode gains as a function of a and b.

PROBLEM 2 (15 points)

In the table below, fill in YES or NO in each of the 15 boxes

	Op Amp	Inverting op-amp circuit amplifier	Non-inverting op-amp circuit amplifier	Differential op-amp circuit amplifier	Instrument-ation amplifier
High Z_{in}					
Differential input					
Defined gain over a frequency band					

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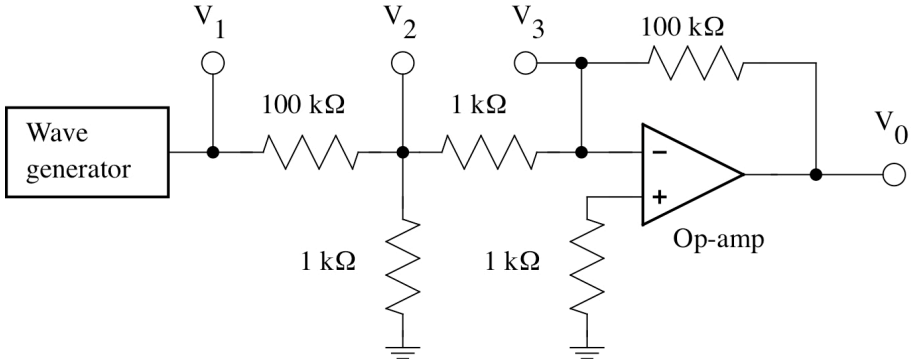
PROBLEM 3 (35 points)

In the op-amp amplifier circuit shown below, assume the following:

- The op-amp open-loop gain $A = 10^6$ Hz/f.
- Op-amp input currents are zero
- Output offset can be neglected
- The wave generator produces a pure sinewave of frequency f and has zero output impedance



3a (15 points) Derive expressions for V_2, V_3, and V_0 as a function of input V_1 at the frequency f = 10 Hz. You may neglect small terms that contribute less than a few percent.

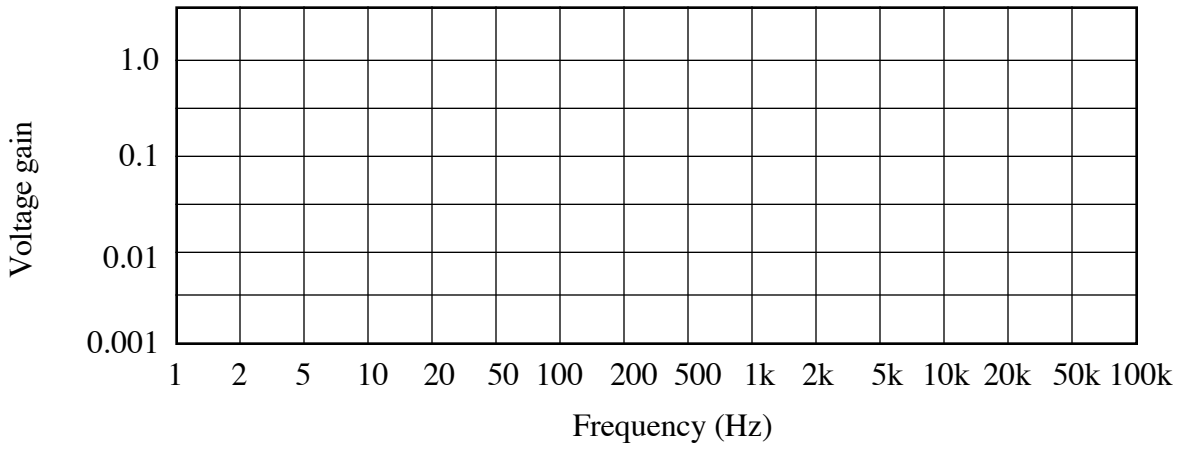
3b (20 points) Derive expressions for V_2, V_3, and V_0 as a function of input V_1 at the frequency $f = 10^6$ Hz. You may neglect small terms that contribute less than a few percent.

PROBLEM 4 (35 points)

Design an analog filter circuit that has the following properties

- Gain between 0.9 and 1.0 for frequencies between 100 Hz and 20 kHz
- Gain less than 0.001 for frequencies above 55 kHz
- Gain less than 0.01 at 60 Hz
- Gain less than 0.001 for frequencies below 2 Hz

4a (10 points) Sketch the required gain vs. frequency below



4b (25 points) Design a filtering circuit that meets the requirements above with the minimum complexity and cost. **For each filtering element, give type, corner frequency, and order number.** (Hint: see equation sheet for a table of f/f_c vs. gain and order.) Do not give resistor and capacitor values.