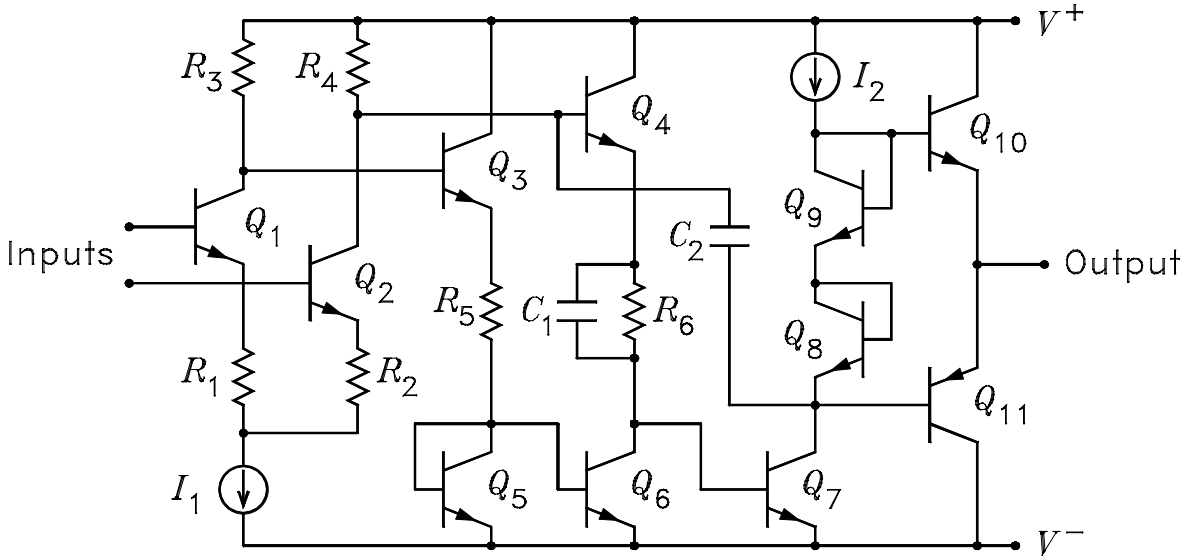
ECE 3050 Analog Electronics Quiz 6

June 24, 2009

Professor Leach Last Name:_____ First Name:_____

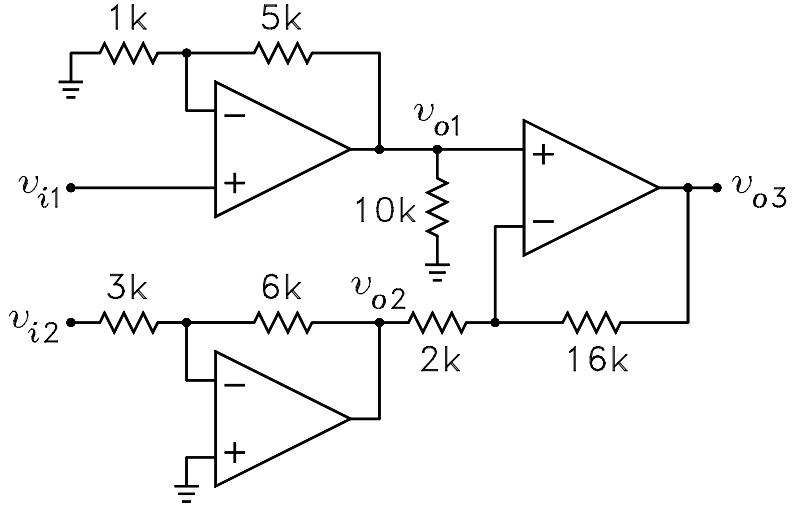
Instructions. Print your name in the spaces above. Place a box around any answer. **Honor Code Statement:** *I have neither given nor received help on this quiz.* Initials _____ For credit, you must give all equations that you use to calculate your answers. Credit will not be given for any answer without full supporting work.

1. The circuit diagram of an operational amplifier is shown. Consider the capacitors to be open circuits.
   (a) Draw a ground symbol connected to the lower input. Use your pencil to mark the path (or paths) that a signal takes from the upper input to the output.
   (b) Identify the connection of each transistor, i.e. common emitter, diode connected, current mirror, etc.
   (c) Draw an up arrow at the upper input and trace the "ups and downs" along the signal path (or paths) identified in part (a). Is the upper input the inverting or the non-inverting input?



   Path 1: Up at Q_1 B, down at Q_1 C, down at Q_3 E, down at Q_6 B, up at Q_7 B, down at Q_7 C, down at Q_{10} B and Q_{11} B, down at Output.
   Path 2: Up at Q_1 B, up at Q_1 E, up at Q_2 E, up at Q_4 B, up at Q_4 E, up at Q_7 B, down at Q_7 C, down at Q_{10} B and Q_{11} B, down at Output.
   Both paths are inverting. Thus the upper input is inverting.

2. An operational amplifier circuit is shown. Solve for v_{o1}, v_{o2}, and v_{o3} as functions of v_{i1} and v_{i2}.



$$v_{o1} = 6v_{i1} \qquad v_{o2} = -3v_{i2} \qquad v_{o3} = 9v_{o1} - 8v_{o2} = 54v_{i1} + 24v_{i2}$$