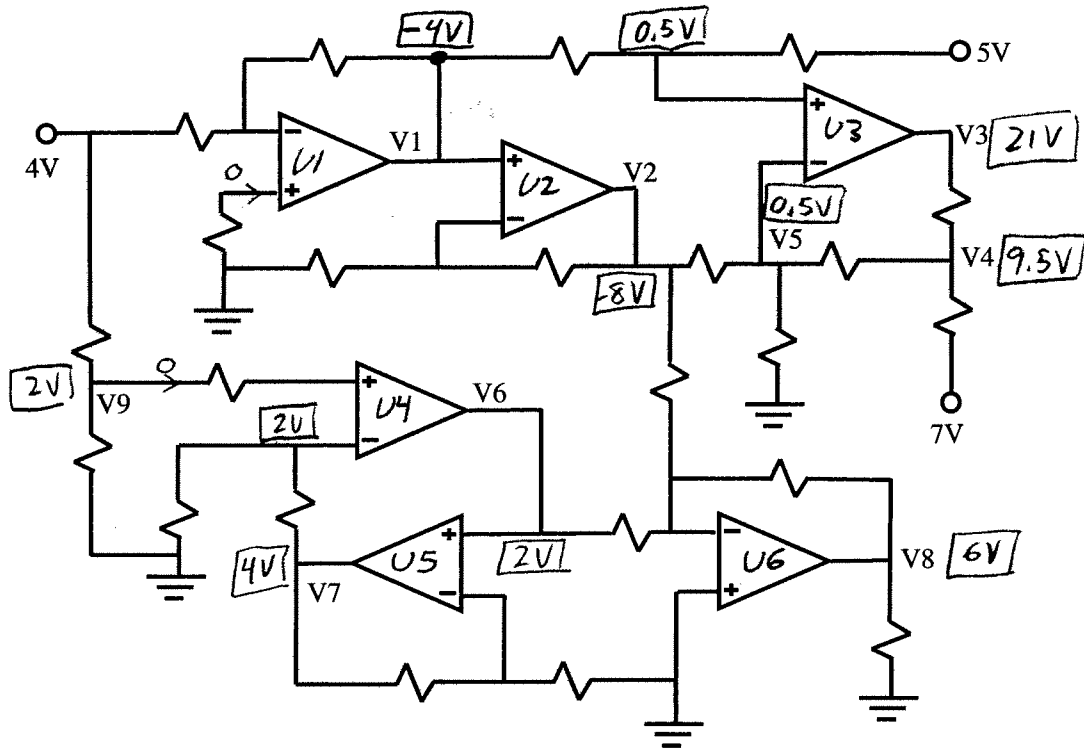


ELEE 3302 – Electronics II – Fall 2009
Homework Assignment #1

Find all the marked voltages in the circuit below. The op-amps can be assumed to be ideal in all respects, with no power supply limitation, and all the resistors are 1K.



Op Amp U1 $V_+ = 0, \text{ so } V_- = 0$. Node V_- : $\frac{0-4V}{1K} + \frac{0-V_1}{1K} = 0 \Rightarrow V_1 = -4V$

Op Amp U2 $V_+ = 4, \text{ so } V_- = 4$. Node V_- : $\frac{-4-0}{1K} + \frac{4-V_2}{1K} = 0 \Rightarrow V_2 = -8V$

Op Amp U3 $\frac{V_+ - (-4)}{1K} + \frac{V_+ - 5}{1K} = 0 \Rightarrow V_+ = 0.5V \Rightarrow V_- = 0.5 \Rightarrow V_5 = 0.5V$

Node V_5 : $\frac{0.5 - (-8)}{1K} + \frac{0.5 - 0}{1K} + \frac{0.5 - V_4}{1K} = 0 \Rightarrow V_4 = 9.5V$

Node V_4 : $\frac{9.5 - 0.5}{1K} + \frac{9.5 - 7}{1K} + \frac{9.5 - V_3}{1K} = 0 \Rightarrow V_3 = 21V$

Op Amp U4 Node V_9 : $\frac{V_9 - 4}{1K} + \frac{V_9 - 0}{1K} = 0 \Rightarrow V_9 = 2V$

$V_+ = V_9 = 2V \Rightarrow V_- = 2V$

Node V_- : $\frac{2-0}{1K} + \frac{2-V_7}{1K} = 0 \Rightarrow V_7 = 4V$

Op Amp U5 Node V_- : $\frac{V_- - 4}{1K} + \frac{V_- - 0}{1K} = 0 \Rightarrow V_- = 2V$

so $V_+ = V_- = 2V$

Op Amp U6, Node V_-
 $V_- = 0$, because $V_+ = 0$
 $\frac{0-2}{1K} + \frac{0-(-8)}{1K} + \frac{0-V_8}{1K} = 0$
 $V_8 = 6V$

$V_6 = 2V$