

CASE WESTERN RESERVE UNIVERSITY
 Case School of Engineering
 Department of Electrical Engineering and Computer Science

ENGR 210. Introduction to Circuits and Instruments (4)

Homework Set No. 8

References: [T&R4] sections 4-4, 4-5, 4-7

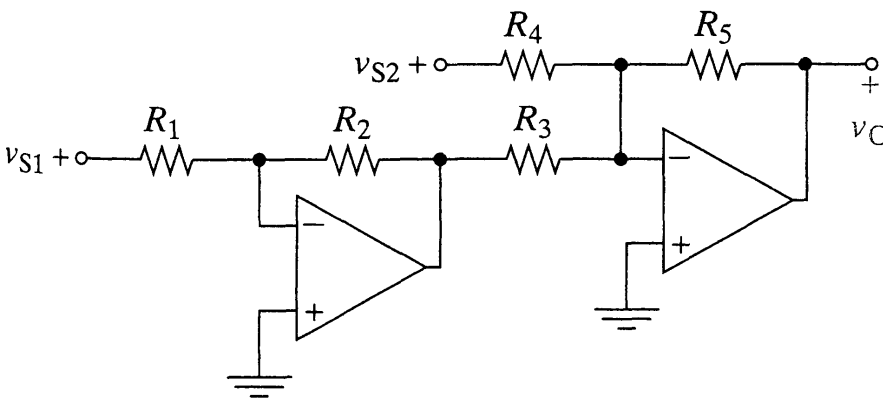
Issued 3/2/05

Due 3/16/05

MULTIPLE OP-AMP CIRCUITS

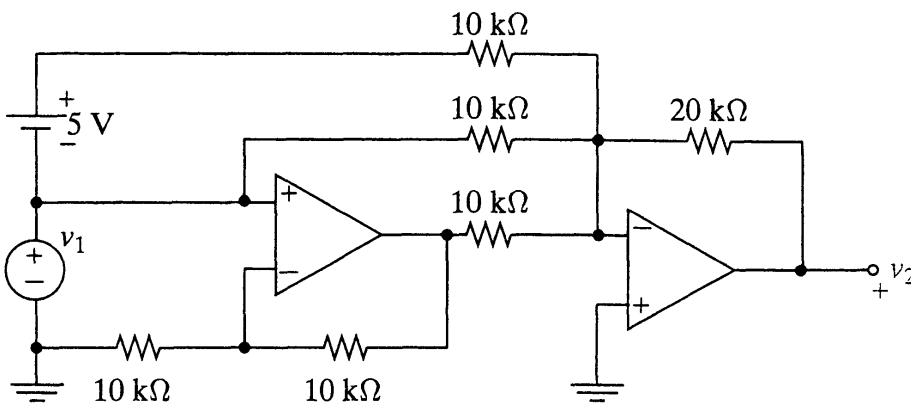
1) (5 pts) . Cascaded Amplifier

Find v_o in terms of v_{s1} and v_{s2} for the circuit below.



2) (5 pts) Summing amplifier.

Find the output v_2 in terms of the input v_1 .



3) (5 pts) Subtractor circuits.

The input/output relationships for CIRCUIT 1 and CIRCUIT 2 are of the form $v_o = K_2 v_2 + K_1 v_1$.

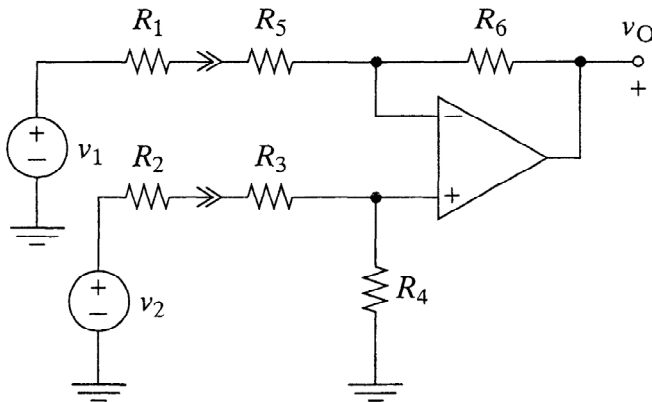
(a) For CIRCUIT 1 and CIRCUIT 2 determine K_1 and K_2 in terms of circuit parameters.

(b) In CIRCUIT 1 with $R_1 = R_2 = 1\text{k}\Omega$ and $R_3 = R_5 = 10\text{k}\Omega$, select the values R_4 and R_6 that produce $v_o = 5(v_2 - v_1)$.

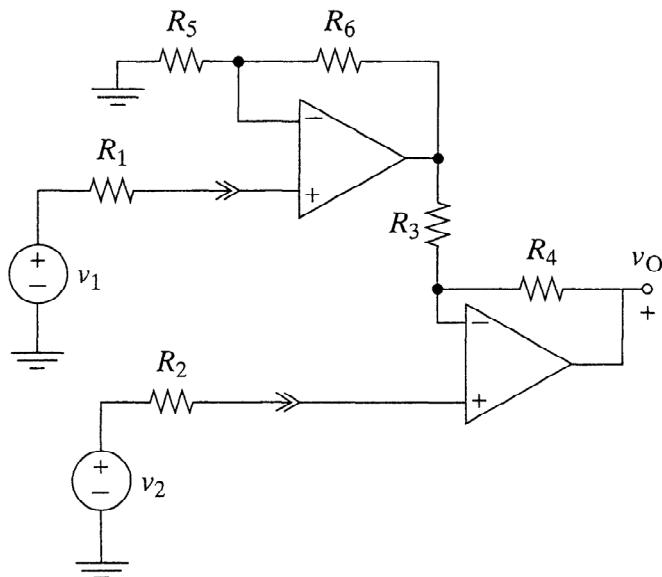
(c) In CIRCUIT 2 with $R_1 = R_2 = 1\text{k}\Omega$ and $R_3 = R_5 = 10\text{k}\Omega$, select the values R_4 and R_6 that produce $v_o = 5(v_2 - v_1)$.

(d) Evaluate the two designs by comparing the number of devices each circuit requires and the input resistance seen by the signal sources v_1 and v_2 .

CIRCUIT 1:



CIRCUIT 2:



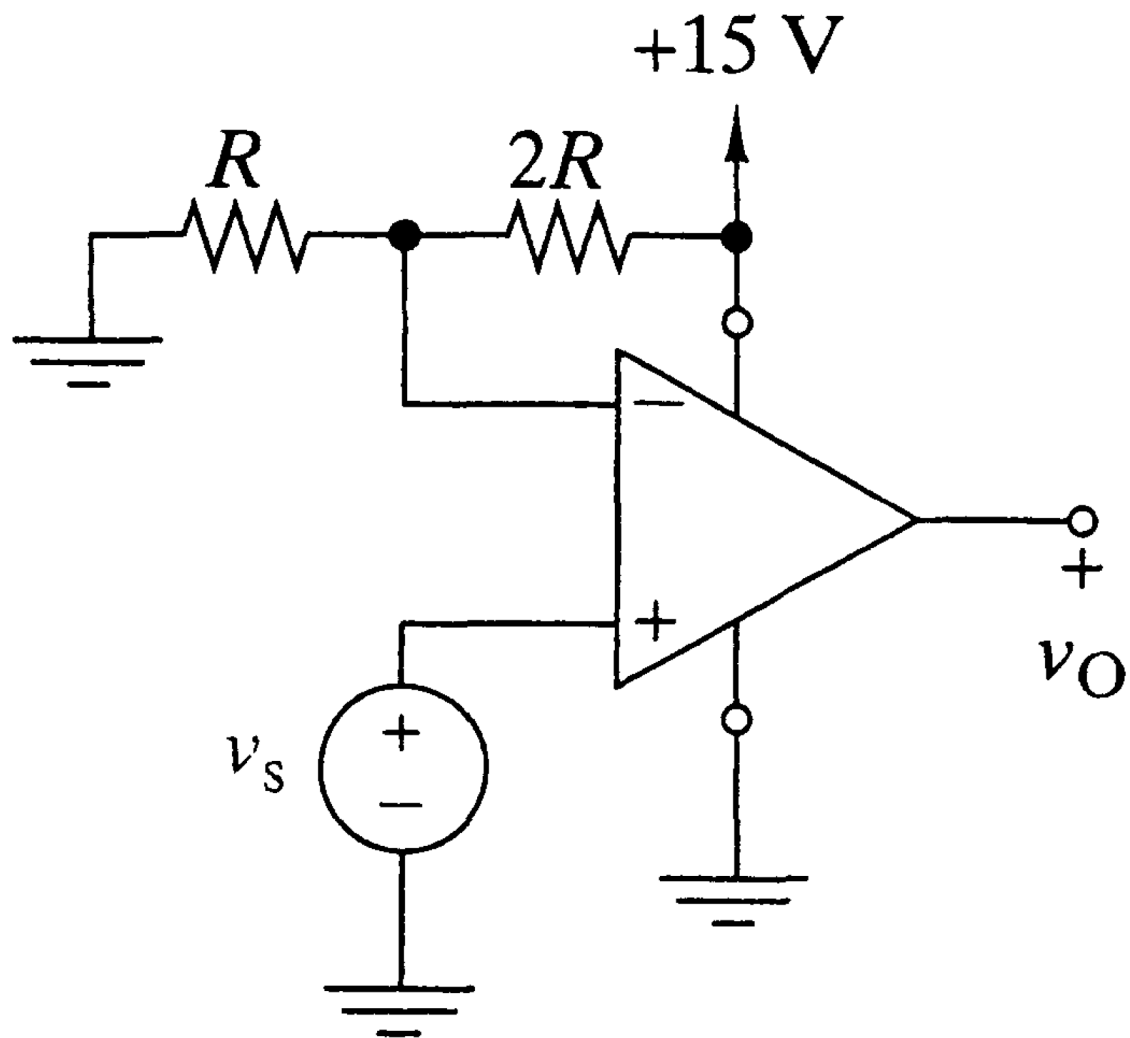
OP-AMP COMPARATOR

4) (5 pts) Use power supply for reference.

The circuit shown below has $V_{OH}=15$ volts and $V_{OL}=0$ volts.

(a) Determine the input voltage range for which $v_o=V_{OH}$ and $v_o=V_{OL}$.

(b) Sketch the circuit transfer characteristics for v_s over the range -15 to $+15$ volts.

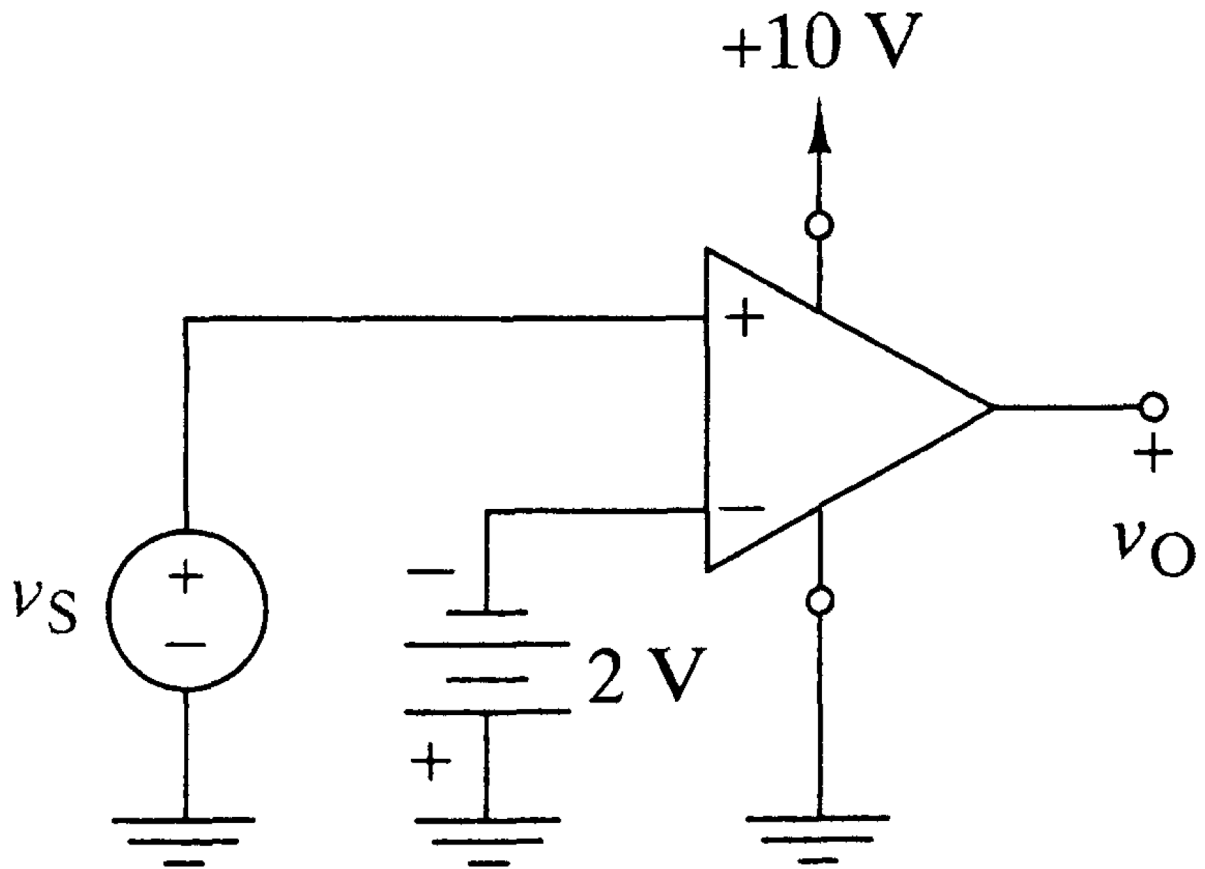


5) (5 pts) Use the battery as your voltage reference.

The circuit shown below has $V_{OH}=10$ volts and $V_{OL}=0$ volts.

(c) Determine the input voltage range for which $v_o=V_{OH}$ and $v_o=V_{OL}$.

(d) Sketch the circuit transfer characteristics for v_s over the range -15 to +15 volts.



NOTE: Please put your section code AND your CWRU e-mail next to your name at the top of the page. Section codes are

- MA (Monday Afternoon)
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- TE (Tuesday Evening)
- WA (Wednesday Afternoon)
- WE (Wednesday Evening)