

## ENGR 210. Introduction to Circuits and Instruments (4)

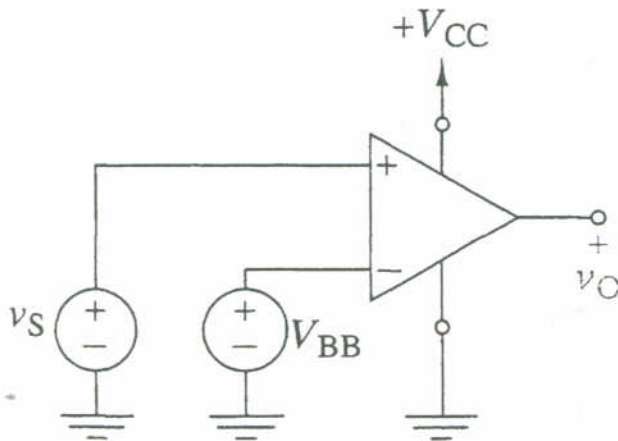
Quiz No. 8

3/21/05

PUT ANSWERS IN THE SPACE PROVIDED AND, IF APPROPRIATE, SHOW YOUR WORK. BE SURE TO STATE ANY ASSUMPTIONS

## Problem 1 Comparators (10 points)

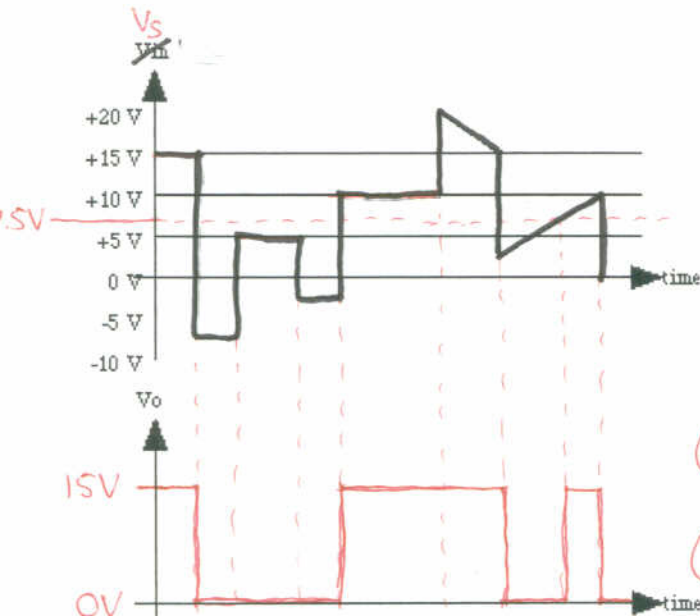
The circuit below has  $V_{CC}=+15$  volts and  $V_{BB}=+7.5$  volts.



(a) What is the range of possible output voltages  $V_o$ ?

$V_o$  range  $\rightarrow$  0 to 15V (2)

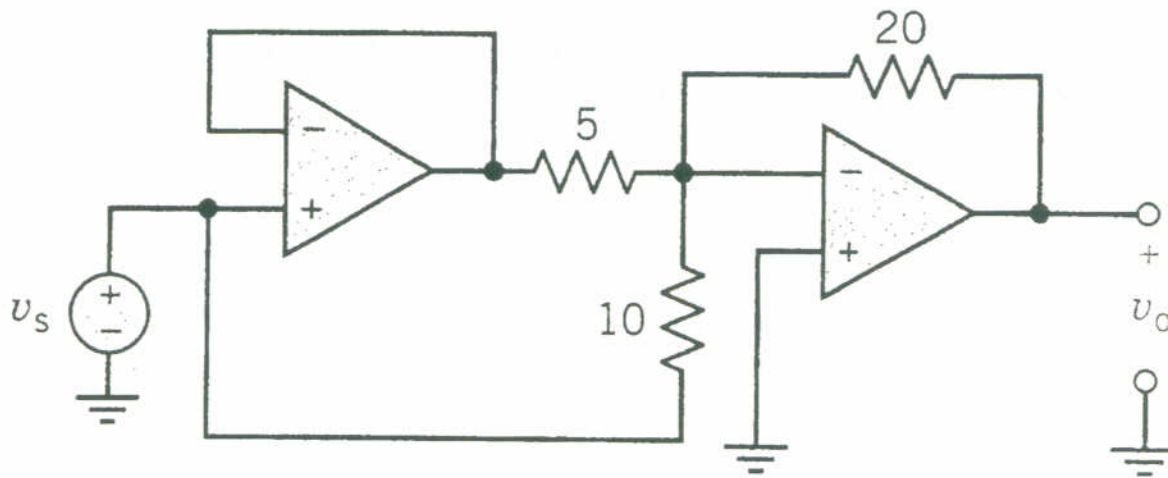
(b) Suppose  $V_{in}$  is the waveform below. Sketch the corresponding values of  $V_o$  for this circuit. Be sure to label the values of the output voltages and when any voltages change.



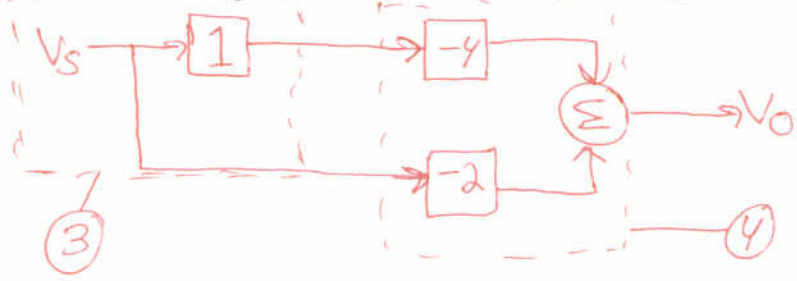
(4)  $\rightarrow$  looks like a comparator (squares)

(4)  $\rightarrow$  accuracy (dotted lines)

**Problem 2 Circuits with Multiple Op-Amps (10 points)**



(a) Draw a block diagram of the above circuit showing the function of each OP AMP.



(b) Determine the output voltage  $v_o$  for this circuit.

$$V_o = -4V_s - 2V_s = -6V_s$$

$$V_o = -6V_s \quad \text{---} \quad \textcircled{3}$$