

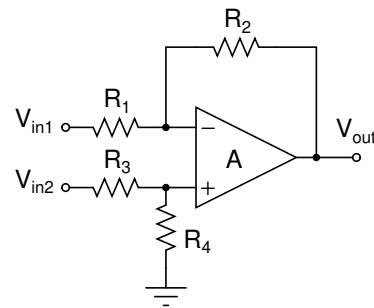
## Homework 8

Name: \_\_\_\_\_

Total of 4 problems.

### Problem 1 (5 points)

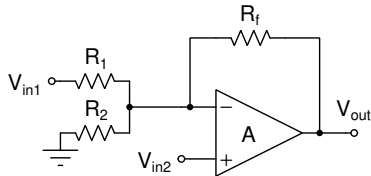
Using superposition principle, derive the output of the shown differential amplifier ( $V_{out}$ ) as function of input potentials  $V_{in1}$ ,  $V_{in2}$ , and resistors used in the circuit diagram.



### Problem 2 (5 points)

For the differential amplifier depicted above. Find values of resistors  $R_1$ ,  $R_2$ ,  $R_3$ , and  $R_4$  which provide  $V_{out} = 10 \times (V_{in2} - V_{in1})$ . Express, your answers as ratios of resistors values relative to  $R_1$

**Problem 3 (5 points)**



Using superposition principle, derive the output of the shown above "mixed" amplifier ( $V_{out}$ ) as function of input potentials  $V_{in1}$ ,  $V_{in2}$ , and resistors used in the circuit diagram. Note: the non-inverting input contribution is trickier than you might think. How does  $R_1$  and  $R_2$  combo look when they are both connected to the reference?

**Problem 4 (5 points)**

Design a circuit, which will perform the following math operation on its inputs  $V_1$ ,  $V_2$ , and  $V_3$ :  $V_{out} = -0.1V_1 + 10V_2 - 20V_3$

It is OK to assign actual numbers to your resistors, but do your best to keep majority of them in the range from  $k\Omega$  to  $M\Omega$ .