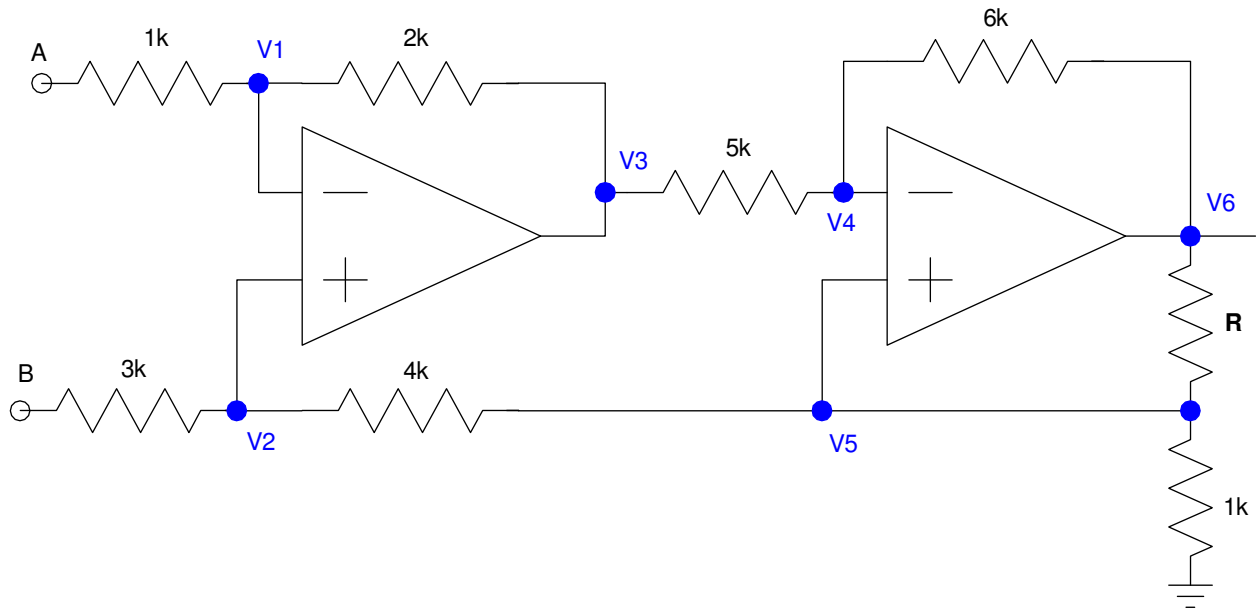


ECE 321 - Quiz #1 - Name _____

Op-Amp Amplifiers & mixers., Push-Pull Amplifiers

1) Give 6 equations which allow you to solve for the 6 unknown voltages. You do not need to solve.

- Assume ideal op-amps.
- Assume $R = 1100 + 100 \cdot (\text{your birth month}) + (\text{your birth day})$. For example, May 14th gives $R = 1614$.



$$V_1 = V_2$$

$$V_4 = V_5$$

$$\left(\frac{V_1 - A}{1k} \right) + \left(\frac{V_1 - V_3}{2k} \right) = 0$$

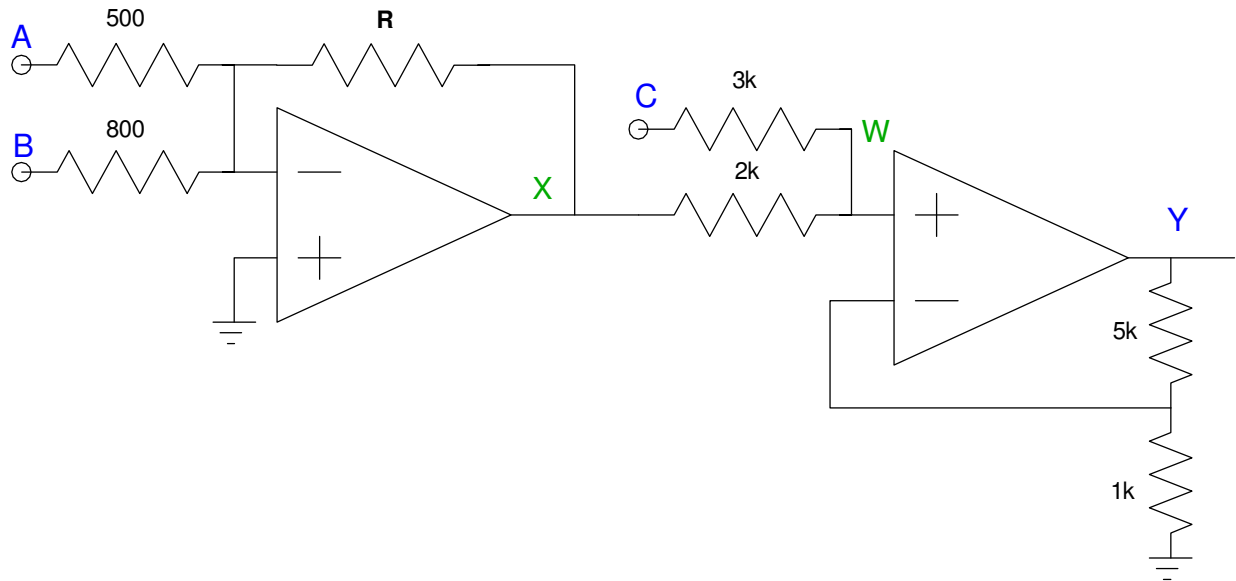
$$\left(\frac{V_2 - B}{3k} \right) + \left(\frac{V_2 - V_5}{4k} \right) = 0$$

$$\left(\frac{V_4 - V_3}{5k} \right) + \left(\frac{V_4 - V_6}{6k} \right) = 0$$

$$\left(\frac{V_5 - V_2}{4k} \right) + \left(\frac{V_5 - V_6}{R} \right) + \left(\frac{V_5}{1k} \right) = 0$$

2) Determine Y as a function of A, B, and C.

- Assume ideal op-amps
- Assume $R = 1100 + 100 \cdot (\text{your birth month}) + (\text{your birth day})$. For example, May 14th gives $R = 1614$.



$R = 1614$

$$X = -\left(\frac{1614}{500}\right)A - \left(\frac{1614}{800}\right)B$$

$$W = \left(\frac{2}{5}\right)C + \left(\frac{3}{5}\right)X$$

$$Y = 6W$$

Putting it all together

$$Y = 6\left(\left(\frac{2}{5}\right)C + \left(\frac{3}{5}\right)\left(\left(\frac{-1614}{500}\right)A + \left(\frac{-1614}{800}\right)B\right)\right)$$

$$Y = -11.62A - 7.26B + 2.40C$$

3) Design a circuit which outputs

$$Y = 5A + 2B + 7C$$

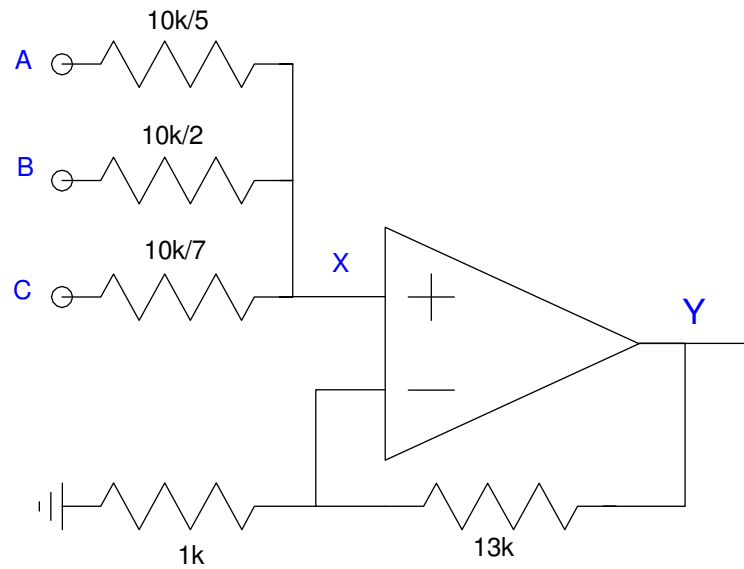
note: the gain on C is positive

Create a voltage, X

$$X = \left(\frac{5A+2B+7C}{14} \right)$$

along with

$$Y = 14X$$



There are other solutions

4) Design a circuit which outputs

$$Y = 5A + 2B - 7C$$

note: the gain on C is negative

One solution:

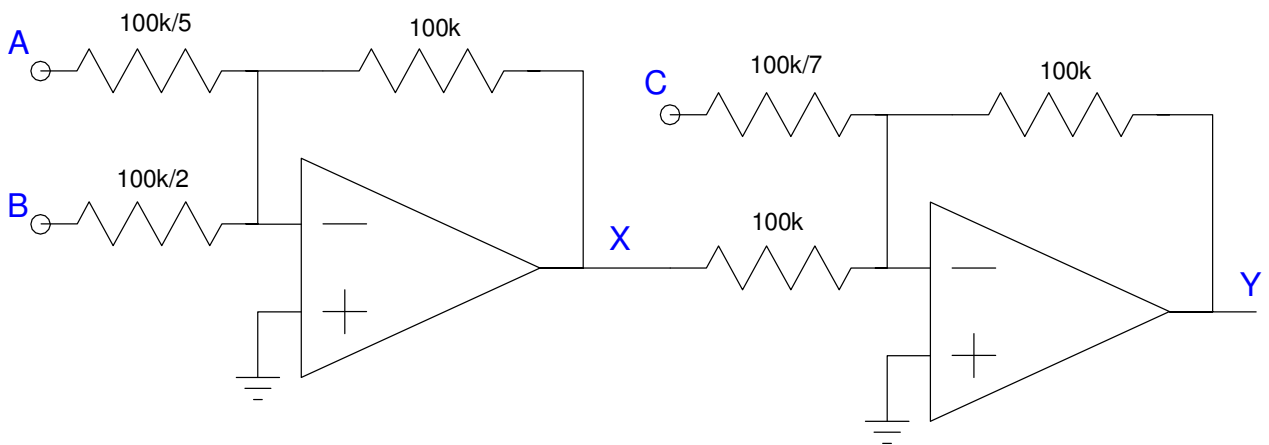
Create a voltage, X

$$X = -5A - 2B$$

Y is then

$$Y = -X - 7C$$

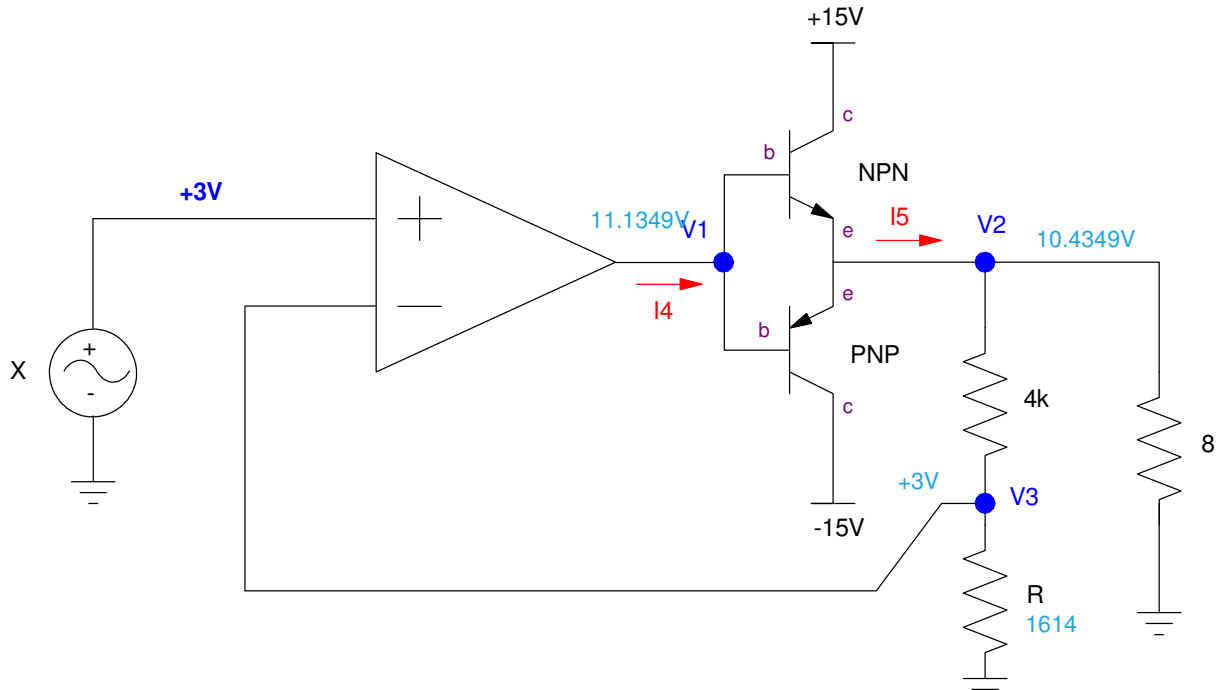
Use inverting amplifiers to implement each stage



5) Determine the voltages and currents for the following push-pull amplifier. Assume

- Ideal op-amps
- $R = 1100 + 100 * (\text{your birth month}) + (\text{your birth day})$
- TIP31 and TIP32 transistors:
 - $\beta = 200$
 - $|V_{be}| = 0.7V$

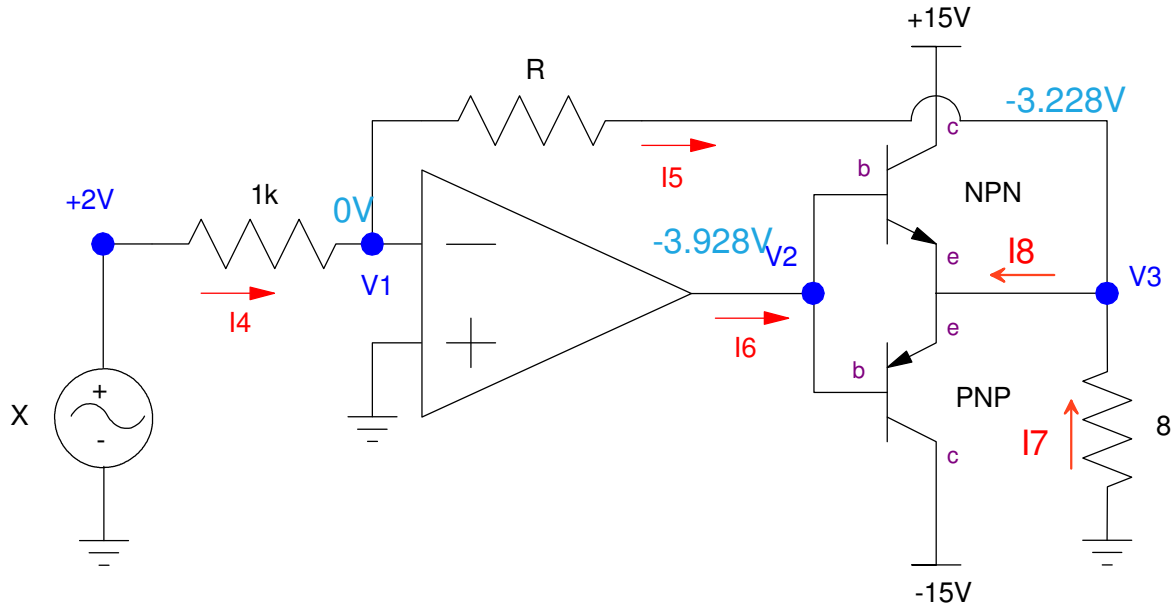
R	V1	V2	V3	I4	I5
$1100 + 100 * \text{mo} + \text{day}$					
1614	11.1349V	10.4349	3.00V	6.498mA	1306mA
	$V2 + 0.7V$	$Y = (1 + R1/R2) * X$	$Vp = Vm$	$I5 / 201$	



6) Determine the voltages and currents for the following push-pull amplifier. Assume

- Ideal op-amps
- $R = 1100 + 100 * (\text{your birth month}) + (\text{your birth day})$
- TIP31 and TIP32 transistors:
 - $\beta = 200$
 - $|V_{be}| = 0.7V$

R	V1	V2	V3	I4	I5	I6
1100 + 100*mo + day						
1614	0V	-3.928V	-3.228V	2mA	2mA	-2.017mA
	$V_p = V_m$	$V_3 - 0.7V$	$-(R/1k) * X$		$I_5 = I_4$	



$$I_7 = \left(\frac{3.228V}{8\Omega} \right) = 403.5mA$$

$$I_8 = 2mA + 403.5mA = 405.5mA$$

$$I_6 = -\frac{I_8}{201} = -2.017mA$$