ECE 321 - Homework #1

Op Amp Amplifiers, Push-Pull Amplifiers. Due Monday, November 8th

Please make the subject "ECE 321 HW#1" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

For all problems, assume you are using

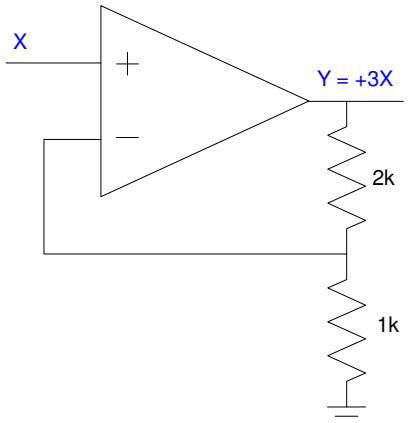
- MCP602 Op Amps (max current = 50mA)
- 2SC6144 transistors (β = 200, 10A max, |Vbe| = 0.7V

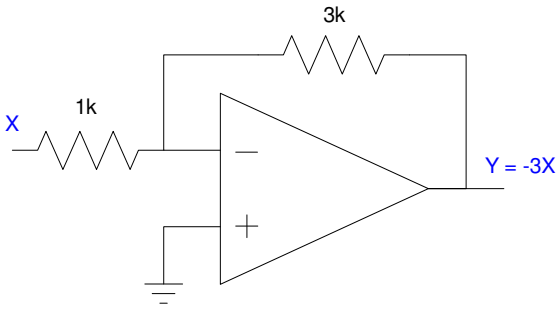
Amplfier:

Design a circuit to implement

1a) Y = +3X

1b) Y = -3X

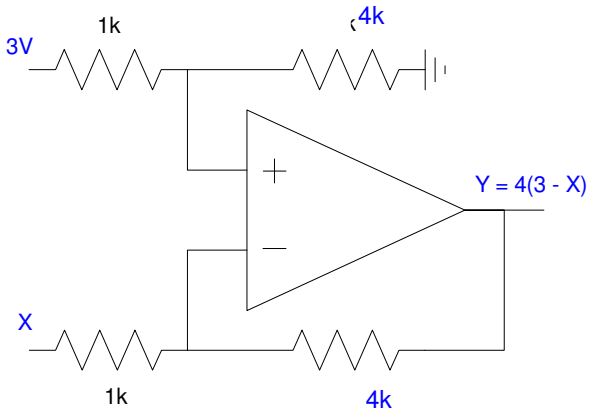




1c) Y = 12 - 4X

Rewrite as

$$Y = 4(3 - X)$$



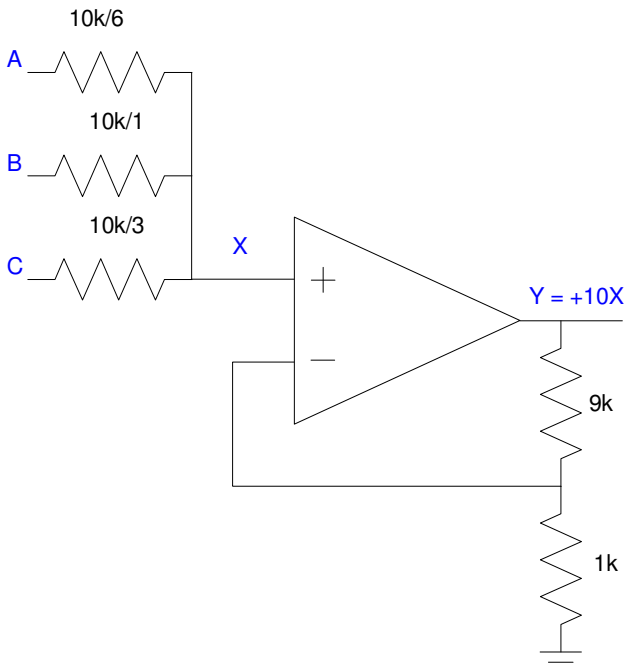
Mixer

2) Design a circuit to mix three signals together:

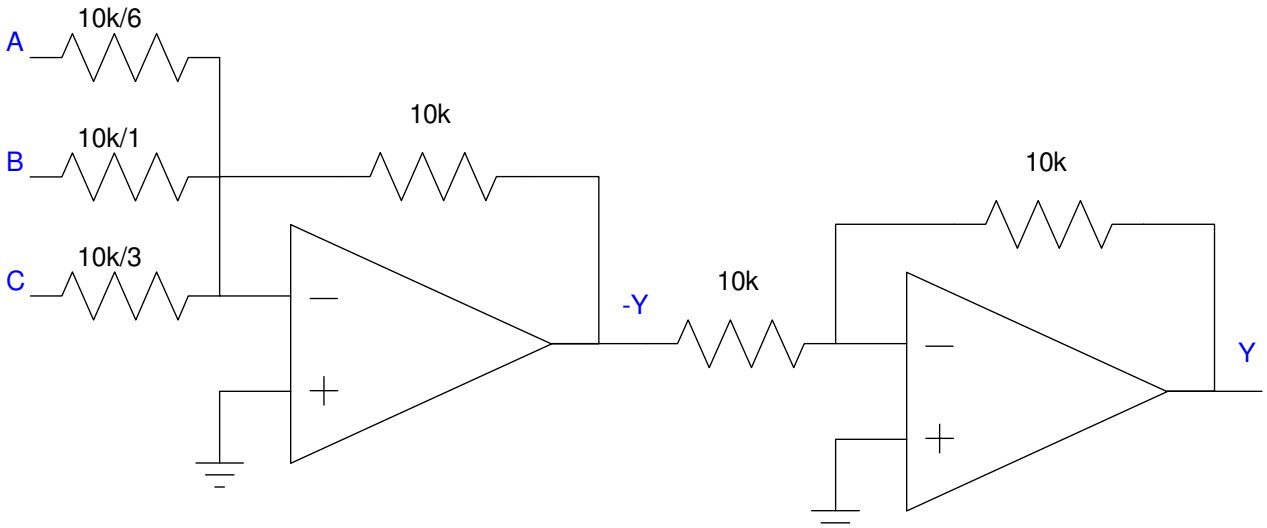
- Y = 6A + 1B + 3C

Option 1: Rewrite as

$$Y = 10\ \frac{6A+B+3C}{10}$$



Option 2: Use inverting summing amplifiers



Push-Pull Amplifier

3) Design a circuit so that Y = X

- X = -5V to +5V, 10mA max
- Y = -5V to +5V, 200mA (25 ohm speaker (net))

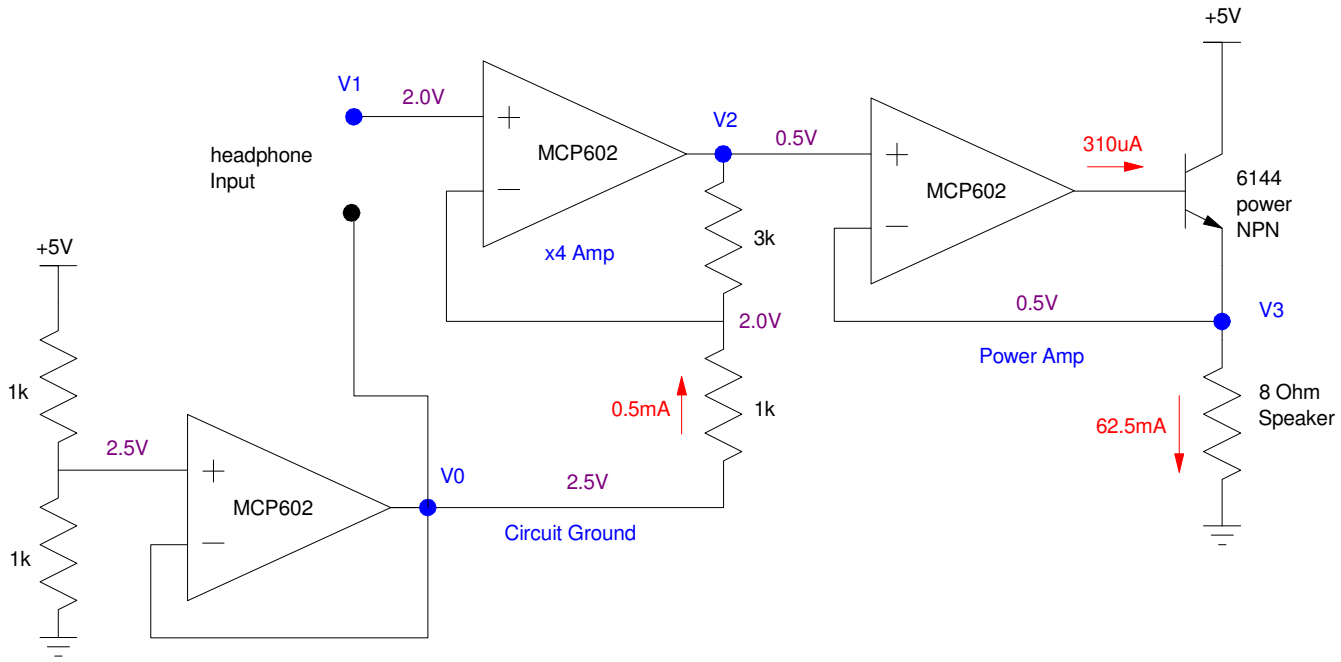
Lab (Hardware)

The following circuit

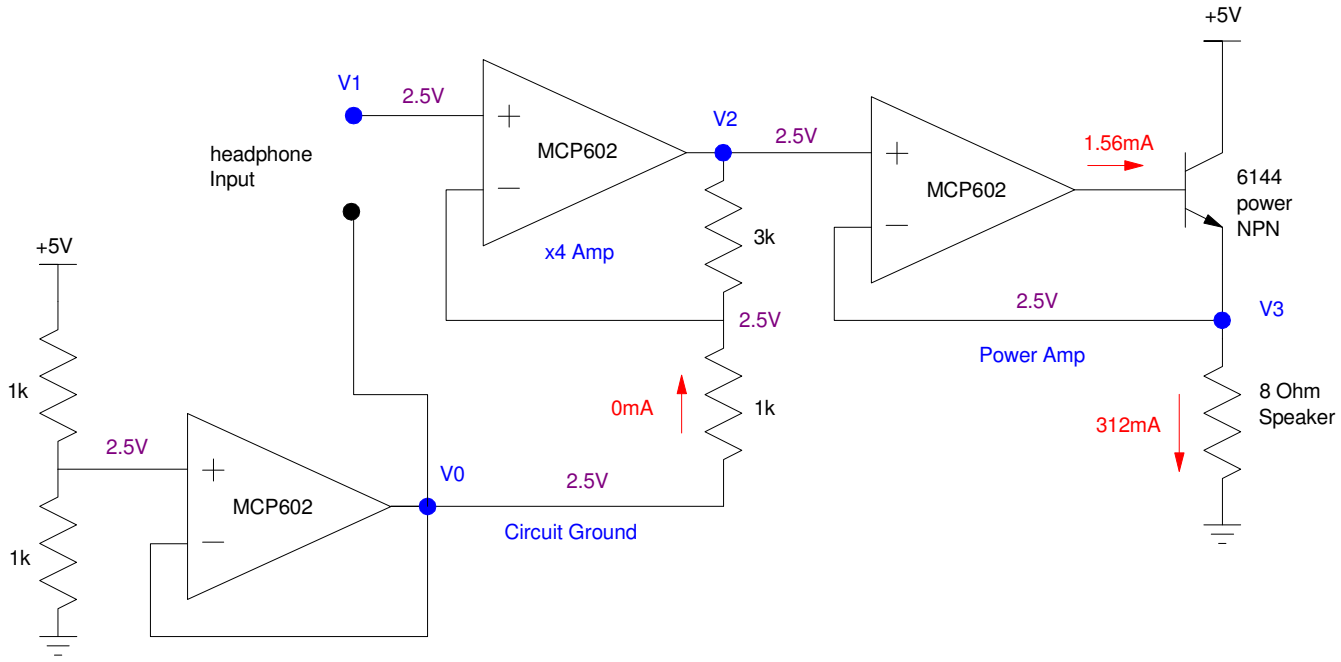
- Creates a 2.5V power supply from a single +5V supply (V0). This 2.5V supply then acts like circuit ground
- Amplifies the output of a cell phone (or computer or 555 timer) (V2), and
- Drives an 8 Ohm speaker (V3)

5) Calculate the voltages and currens when

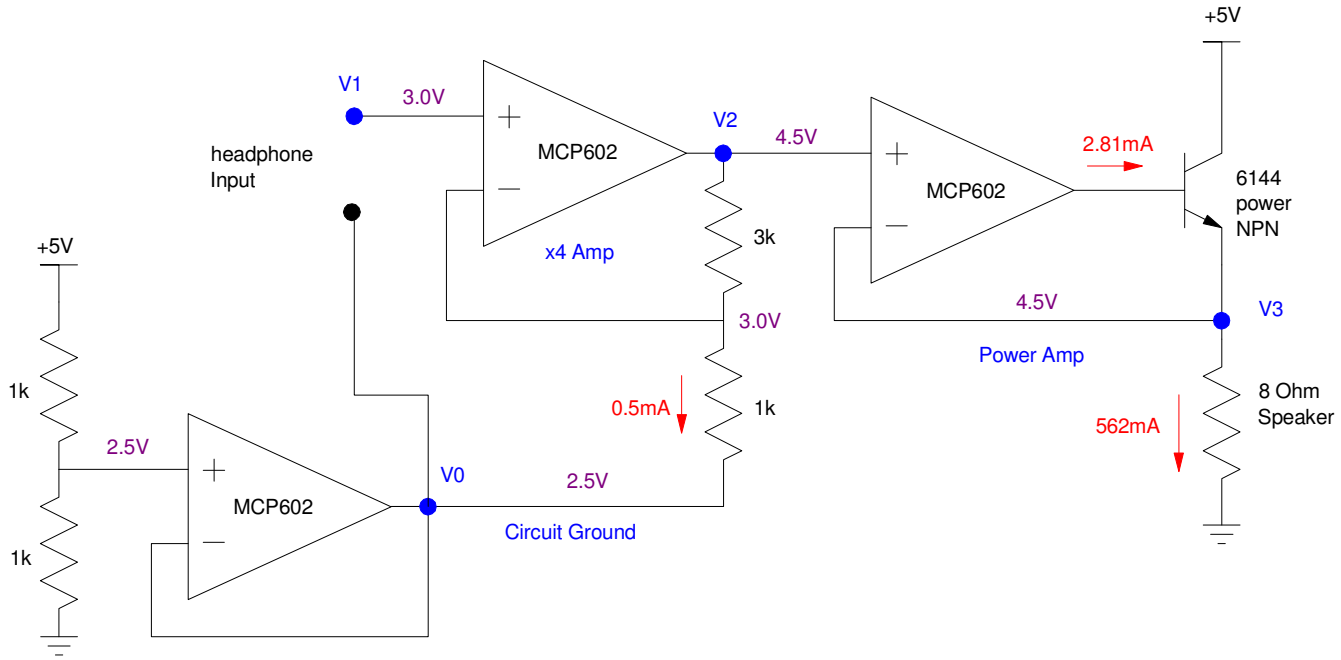
V1 = 2.0V



V1 = 2.5V


+5V
V1
2.5V
headphone
Input
MCP602
V2
2.5V
MCP602
1.56mA
6144
power
NPN
x4 Amp
3k
2.5V
2.5V
V3
Power Amp
+5V
1k
0mA
1k
8 Ohm
Speaker
312mA
2.5V
MCP602
V0
2.5V
1k
Circuit Ground

V1 = 3.0V

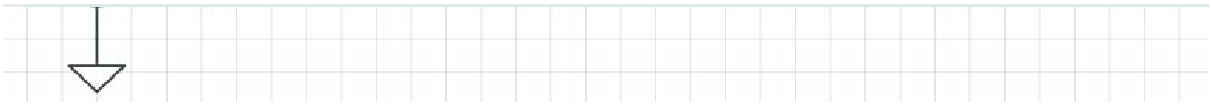

+5V
V1
3.0V
headphone
Input
MCP602
V2
4.5V
MCP602
2.81mA
6144
power
NPN
x4 Amp
3k
4.5V
3.0V
V3
Power Amp
+5V
1k
0.5mA
1k
8 Ohm
Speaker
562mA
2.5V
MCP602
V0
2.5V
1k
Circuit Ground

6) Simulate this curcuit in CircuitLab with

- V1 = 1Vpp, 1kHz sine wave

Note:

- V1 = 4*V0, centered at 2.5V (circuit ground)
- V2 = V1



8) Demo

- Replace V1 with an audio signal and verify the song plays on the speaker

Playing "Hot and Cold" by Elmo and Ms. Perry