

ECE 321 - Quiz 1: Name _____

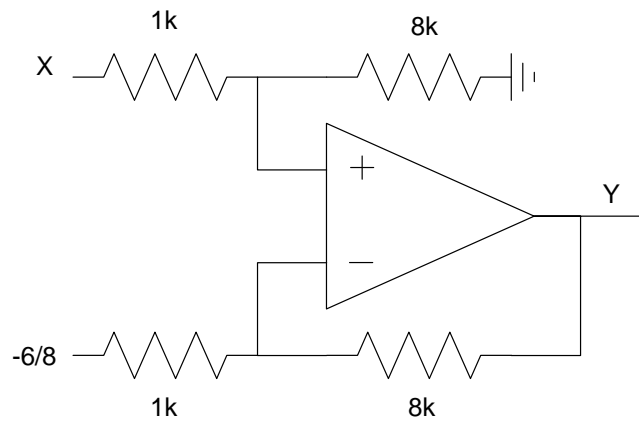
Op-Amp Amplifiers, Push-Pull Amplifiers - November 13, 2015

1) Design an op-amp circuit to generate the function

$$Y = 8X + 6$$

Rewrite

$$Y = 8\left(X - \left(\frac{-6}{8}\right)\right)$$



2) Design a circuit which outputs

- -10V for a magnetic field of -1 Gauss to
- +10V for a magnetic field of +1 Gauss,
- The voltage is proportional to Gauss inbetween.

Assume a magnet-sensitive resistor with

$$R = 1000 \cdot (1 + 0.01G)\Omega$$

where G is the magnetic field strength from -1 Gauss (south) to +1 Gauss (North)

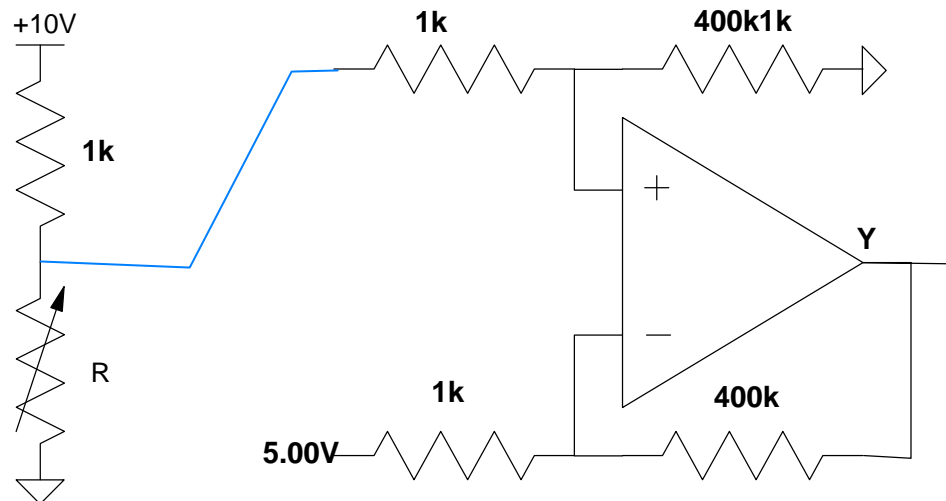
Assume a 1k resistor for the voltage divider

$$\text{-1 Gauss: } R = 990 \text{ Ohms, } V_a = 4.9749\text{V}$$

$$\text{0 Gauss: } R = 1000 \text{ Ohms, } V_a = 5.000\text{V}$$

$$\text{+1 Gauss: } R = 1010 \text{ Ohms, } V_a = 5.0249\text{V}$$

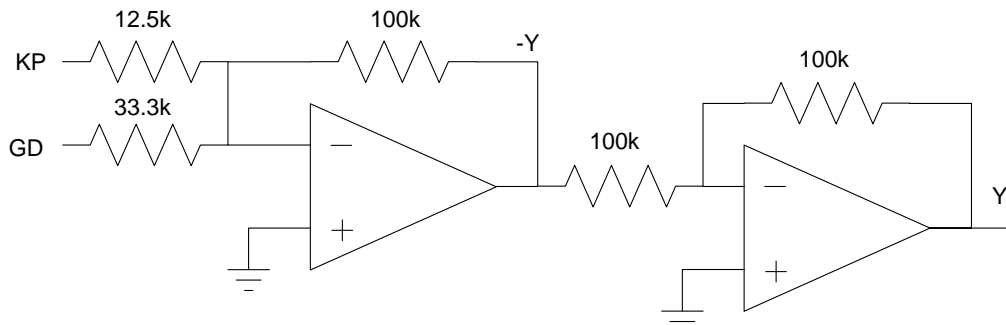
$$\text{Gain} = \frac{10\text{V} - (-10\text{V})}{5.0249\text{V} - 4.9749\text{V}} = 400$$



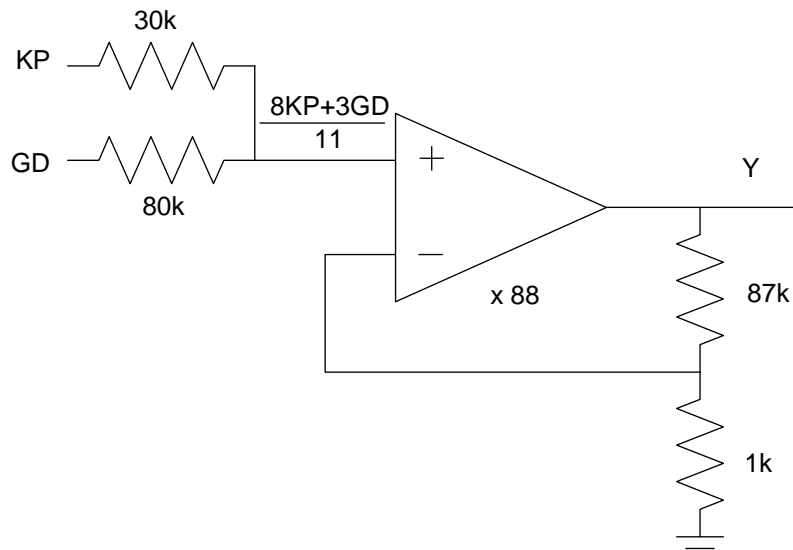
3) Design a circuit to mix Katty Perry with the Grateful Dead. The output should be a $\pm 11V$ signal equal to

$$Y = 8 \cdot KP + 3 \cdot GD$$

where KP and GD soundtracks with an amplitude of $\pm 1V$ capable of 20mA.



- or -

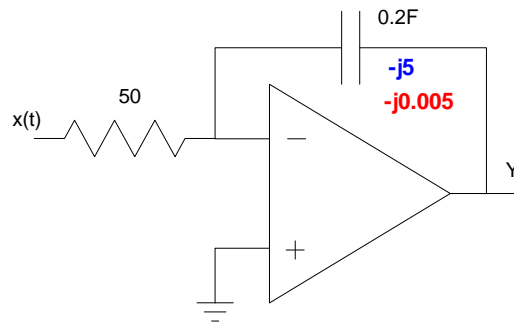


4a) Determine $y(t)$ assuming $x(t) = 2 \sin(t) + 0.3 \sin(1000t)$

@ $j1$ Gain = $-\left(\frac{Z_1}{Z_2}\right) = -\left(\frac{-j5}{50}\right) = j0.1$

$j1000$ Gain = $-\left(\frac{-j0.005}{50}\right) = j0.0001$

$$y(t) = 0.2 \sin(t + 90^\circ) + 0.00003 \sin(1000t + 90^\circ)$$

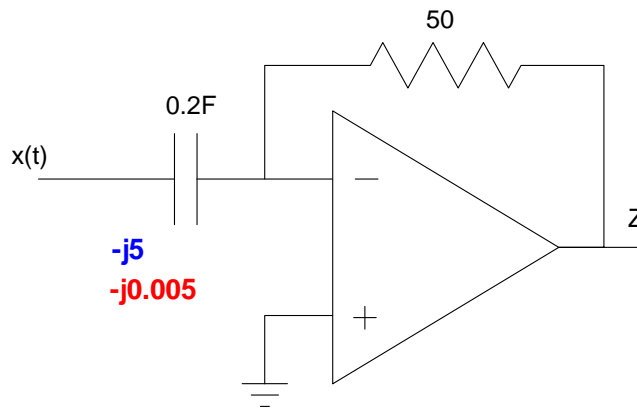


4b) Determine $z(t)$ assuming $x(t) = 2 \sin(t) + 0.3 \sin(1000t)$

@ $j1$ gain = $-\left(\frac{50}{-j5}\right) = -j10 = 10 \angle -90^\circ$

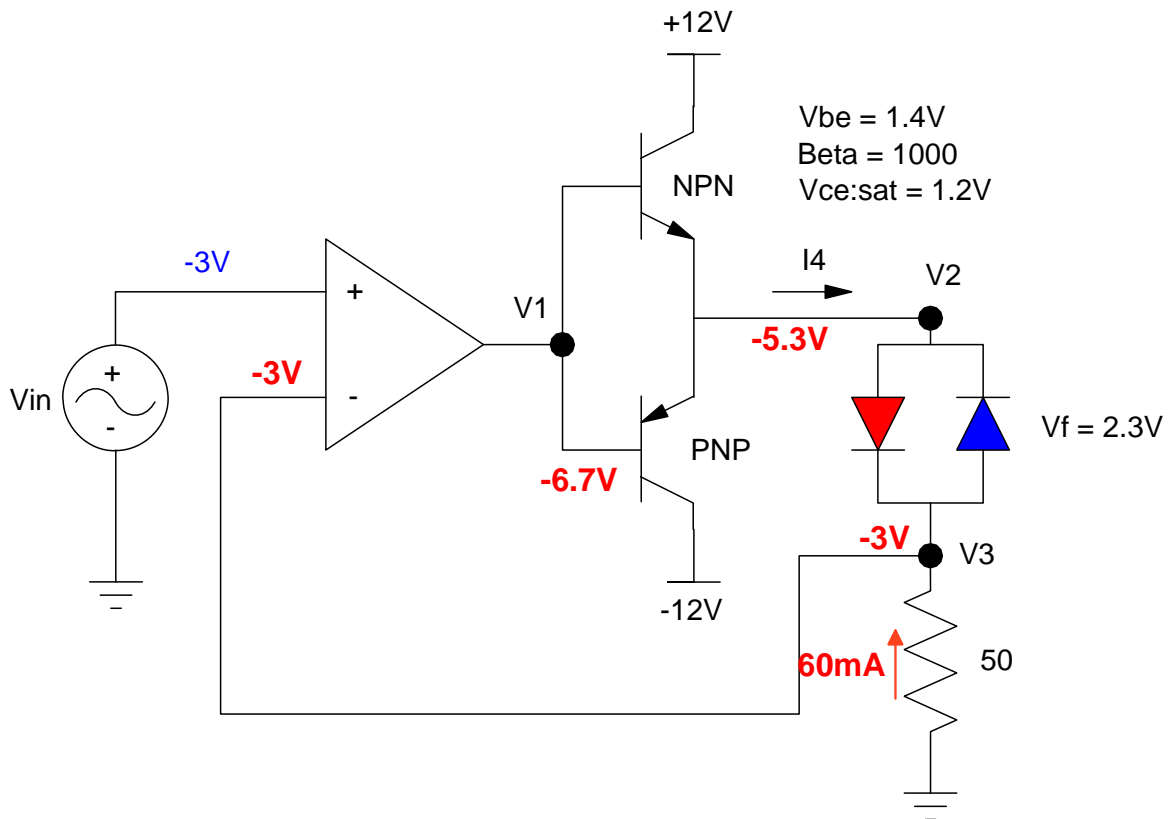
@ $j1000$ gain = $-\left(\frac{50}{-j0.005}\right) = -j10,000 = 10,000 \angle -90^\circ$

$$y(t) = 20 \sin(t - 90^\circ) + 3000 \sin(1000t - 90^\circ)$$



5) Determine the voltages and currents for the following push-pull amplifier when $V_{in} = -3V$

V1	V2	V3	I4
-6.7V	-5.3V	-3.0V	-60mA



Colbert Bonus! Who starred in Colbert's skit "Pointless and CounterPointless"?

- **Big Bird vs. Oscar the Grouch**
- Bill O'Rilley vs. Rachel Maddow
- Spongebob vs. Patrick Star
- Peyton Manning vs. Eli Manning
- Caesar (played by Colbert) vs. Marx (played by Daily)

