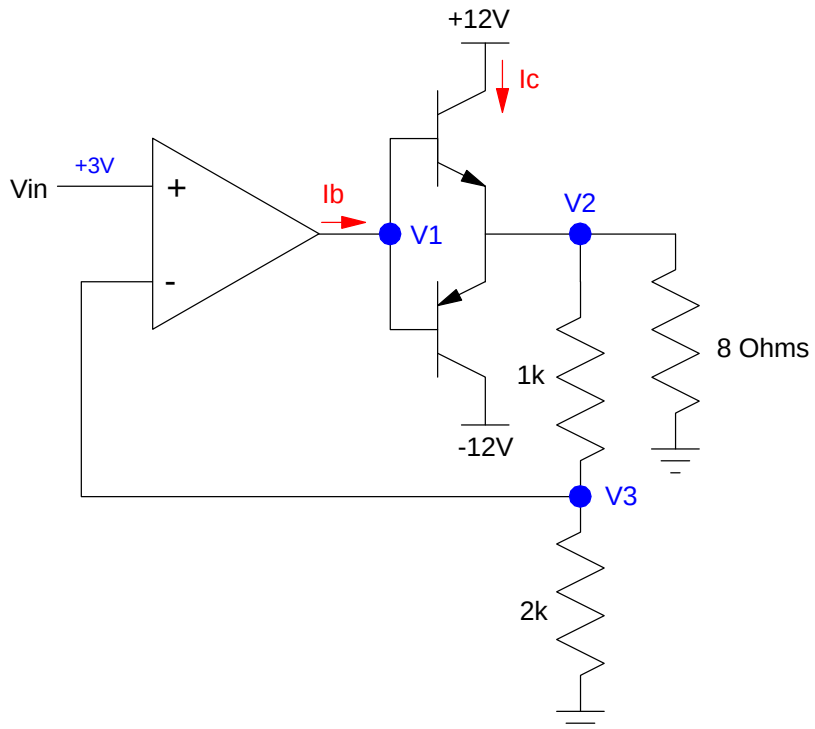
ECE 321 - Final - Name _____

Fall 2019

1) Push-Pull: Determine the voltages and currents for the following push-pull amplifier. Assume TIP transistors

- $|V_{be}| = 1.4V$
- $\beta = 1000$

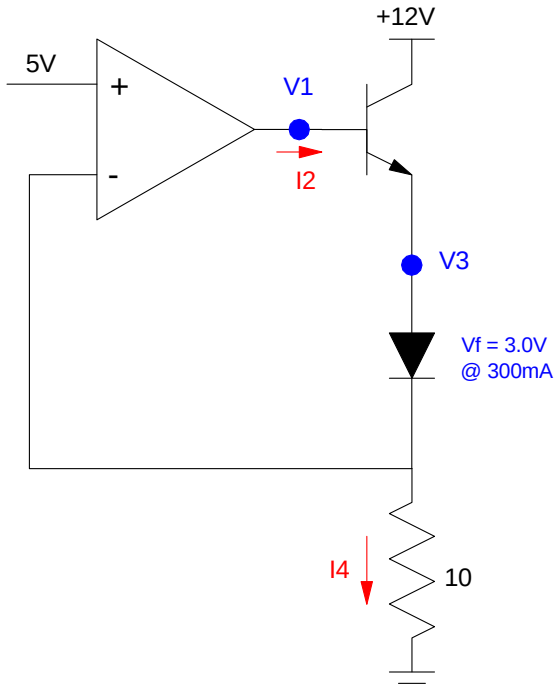
V1	V2	V3	Ib	Ic



2) Determine the voltages, current, and power dissipated by the transistor for the following push-pull amplifier. Assume TIP transistors

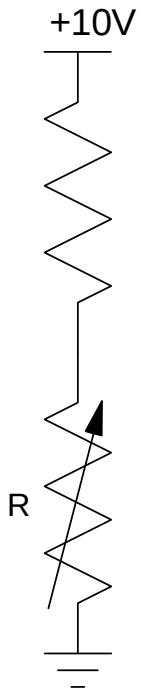
- |Vbe| = 1.4V
- β = 1000

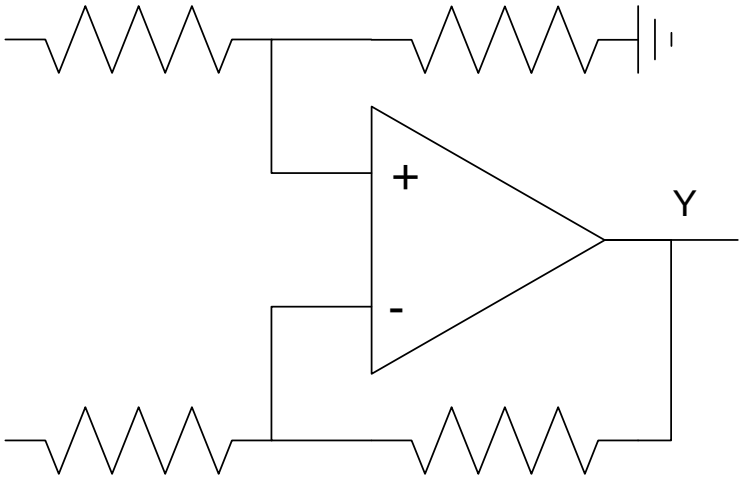
V1	I2	V3	I4	Power dissipated by the transistor



3) Design an instrumentation amplifier so that

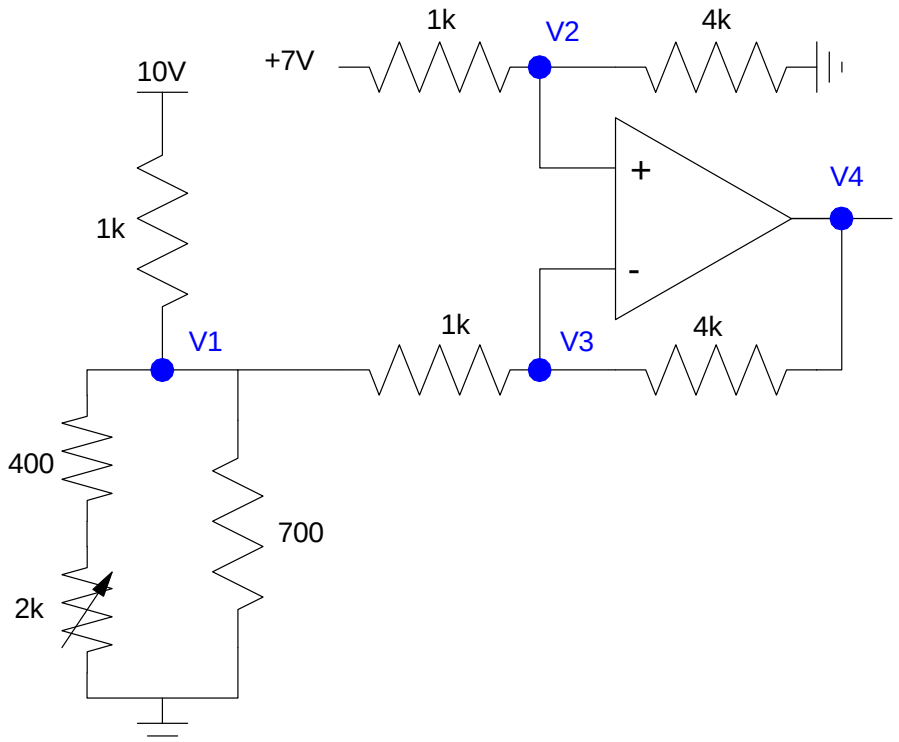
- Y = -10V when R = 2k
- Y = +10V when R = 3k





4) Determine the voltages for the following amplifier. Assume ideal op-amps.

V1	V2	V3	V4



5) Filter Analysis: Assume X and Y are related by the following transfer function

$$Y = \left(\frac{200}{(s+3)(s+6)(s+12)}\right)X = \left(\frac{200}{s^3+21s^2+126s+216}\right)X$$

What is the differential equation relating X and Y?

Determine y(t) assuming

$$x(t) = 5 + 6\cos(10t) + 7\sin(10t)$$

6) Design a filter to meet the following specs (approximately):

- 0.9 < gain < 1.1 for frequencies below 400 rad/sec
- 0.1 < gain for frequencies above 700 rad/sec

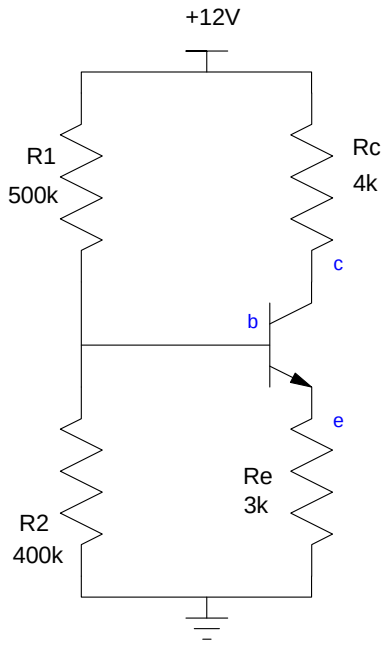
Determine the number of poles requried and give the transfer function for a Butterworth filter which meets these specs (they may require some fine tuning in Matlab). The poles for a Butterworth filter with a corner at 1 rad/sec are:

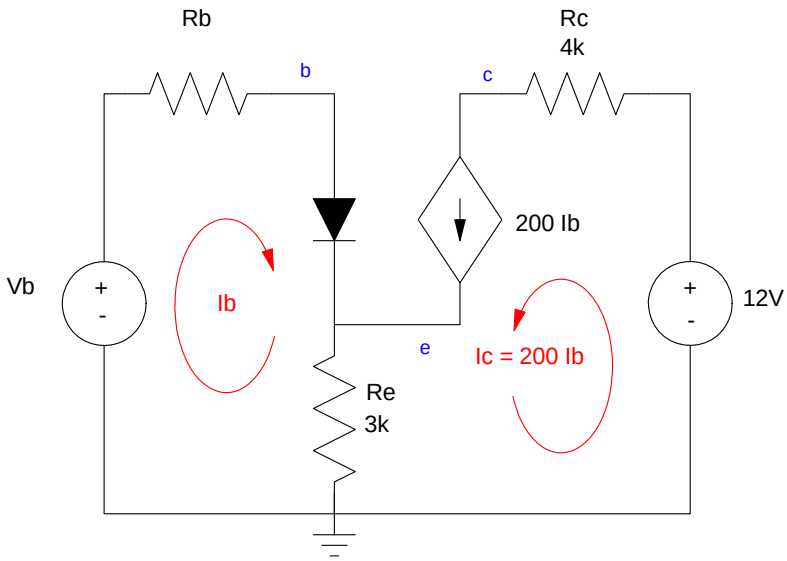
	N=2	N=3	N=4	N=5	N=6
zeros	none	none	none	none	none
poles	$-1\angle\pm 45^0$	-1 $-1\angle\pm 60^0$	$-1\angle\pm 22.5^0$ $-1\angle\pm 67.5^0$	-1 $-1\angle\pm 36^0$ $-1\angle\pm 72^0$	$-1\angle\pm 15^0$ $-1\angle\pm 45^0$ $-1\angle\pm 75^0$

7) CE Amplifier: Determine the operating point for the following transistor circuit. Assume LM833 transistors:

- $\beta = 200$
- $|V_{be}| = 0.7V$

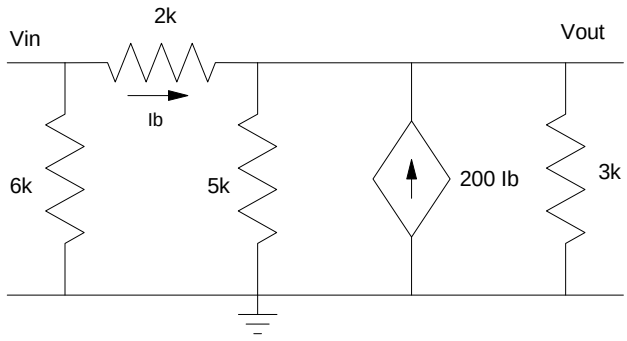
Vce	Ic	Vb	Rb

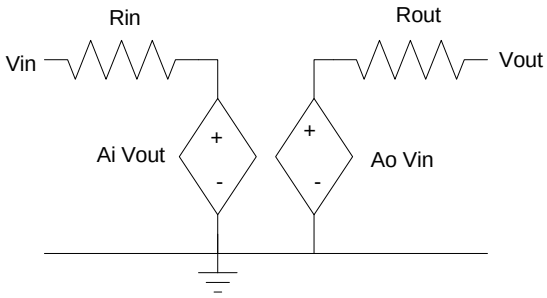




8) Determine the 2-port model for the following amplifier

Rin	Ai	Rout	Ao





Bonus! What is the purpose of the Age-Inator?

- Make kids grow up faster to get rid of that annoying day care that was put up next door
- Turn puppies into dogs because Dr. Doofemschmirtz hates puppies.
- Turn Dr. Doofemschmirtz's younger brother's hair white for calling Dr. Doofenschmirtz "old man"
- Make cheese age faster because Dr. Doofenschmirtz is hungry now.