ECE 321 - Final - Name _____

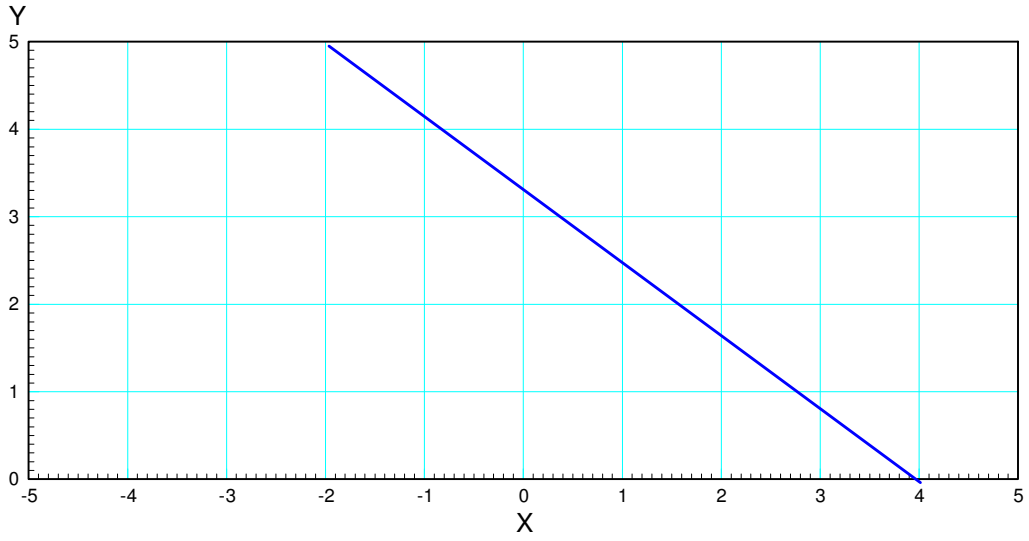
R = _____(Your Birth Month)*1000 + (Your Birthdate)*10

- For example, Feb 14th would be R = 2140 Ohms.

1) Amplifiers

1a) Determine the equation for the line, Y = AX + B

1b) Design an op-amp circuit to implement Y = f(X). Include R in your answer somewhere (birth month & date)



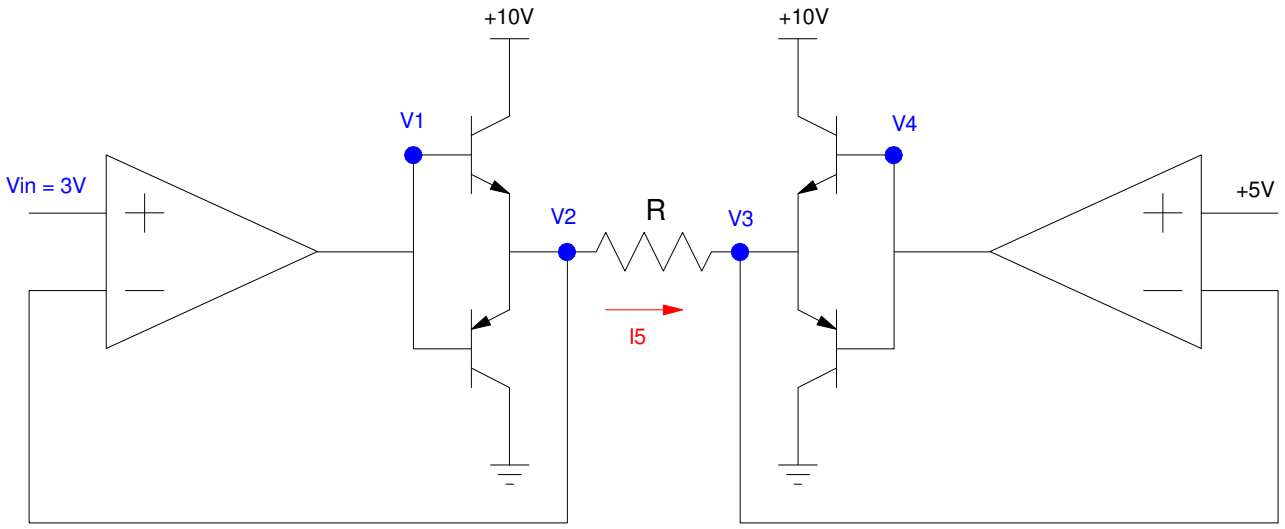
2) Push-Pull Amplifier

The following circuit can output -5V to +5V using only a since 10V power supply. Determine the votlges and currents when Vin = 3V. Assume 3904/3906 transistors

- $\beta = 200$
- $|\ Vbe\ | = 0.7V$

R	V1	V2	V3	V4	I5

R = birth month * 1000 + birth day * 10. Feb 14th = 2140 Ohms



3) Instrumentation Amplifier

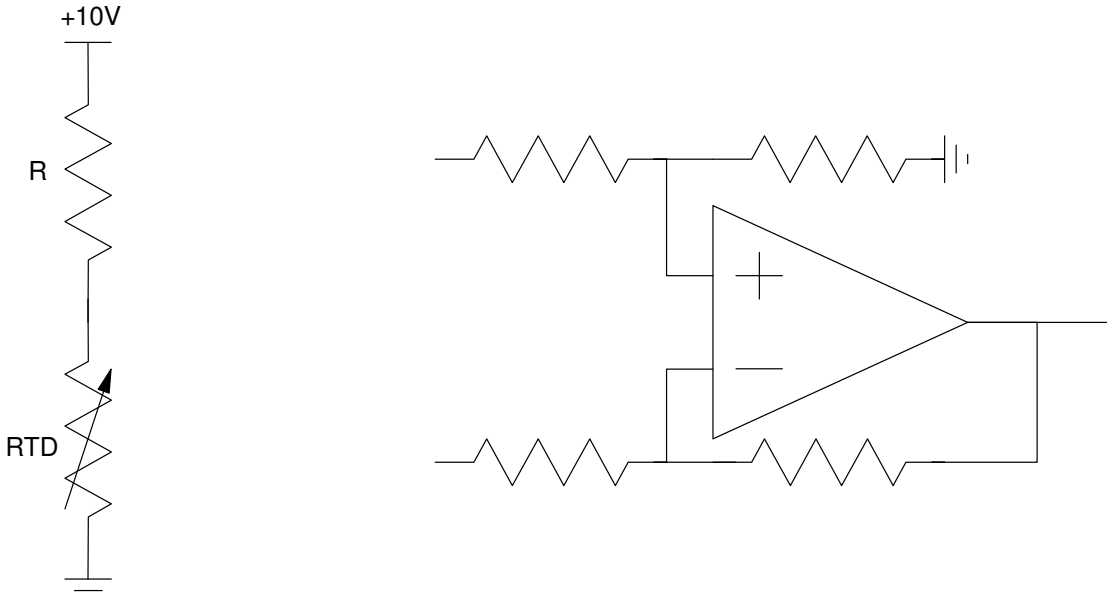
An RTD (type of temperature sensor) has a resistance - temperature relationship of

$$RTD = 2000 \cdot (1 + 0.0043T)\Omega$$

where T is the temperature in degrees C. Design a circuit which outputs

- 0V at 0C and
- 10V at +25C

Let R be your birth month * 1000 + birth day * 10. Feb 14th = 2140 Ohms



4) Filter: Analysis

Assume X and Y are related by the following transfer function

$$Y = \left(\frac{500(s+2)}{(s+10)(s+30)} \right) X$$

a) What is the differential equation relating X and Y?

b) Determine y(t) assuming

$$x(t) = 5 + 2\cos(\omega t) + 4\sin(\omega t)$$

where ω is your birth date (1..31)

5) Filter: Design

Design a circuit so that the gain is

- $0.9 < \text{gain} < 1.1$ for frequencies below 10 rad/sec
- $\text{gain} < 0.3$ for frequencies above 15 rad/sec

Determine the gain of your final design at 10 and 15 rad/sec

6) Filter Design

Design a circuit to imlement the following filter:

$$Y = \left(\frac{10.000}{(s^2+10s+R)\left(s^2+20s+2R\right)} \right) X$$

where R is your birth month * 1000 + birth date * 10. For example, Feb 14 = 2140

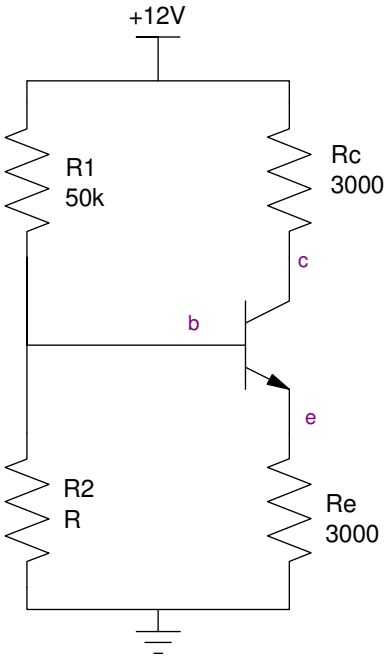
7) CE Amplifier (DC)

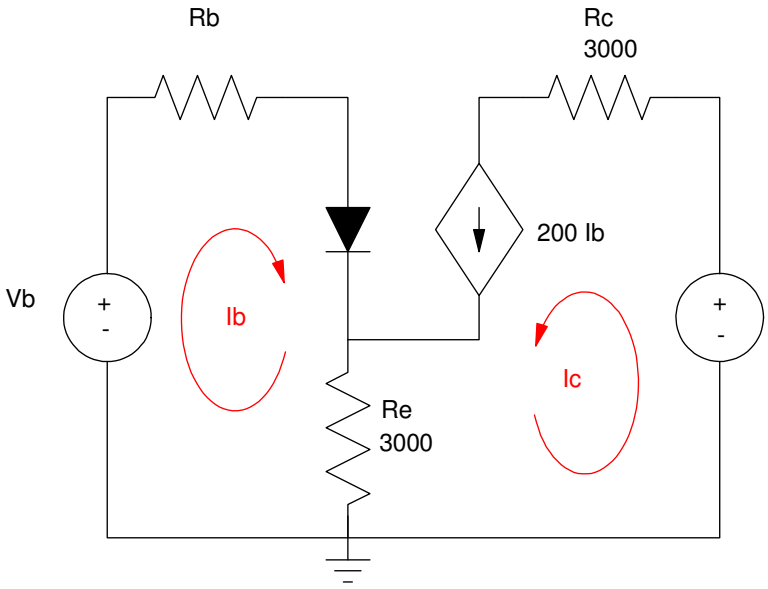
Determine the Q-point (Vc, Rc) for the following transistor circuit. Assume a 3904 transistor

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

R	Vb	Rb	Vce	Ic

R = birth month * 1000 + birth day * 10. For example, Feb 14th = 2140 Ohms





8) CE Amplifier (AC)

Draw the small signal model for this amplifier and the resulting 2-port model. Assume 3904 transistors

- $\beta = 200$
- Vbe = 0.7V

R	Rin	Ai	Rout	Ao

R = birth month * 1000 + birth day * 10. For example, Feb 14th = 2140 Ohms