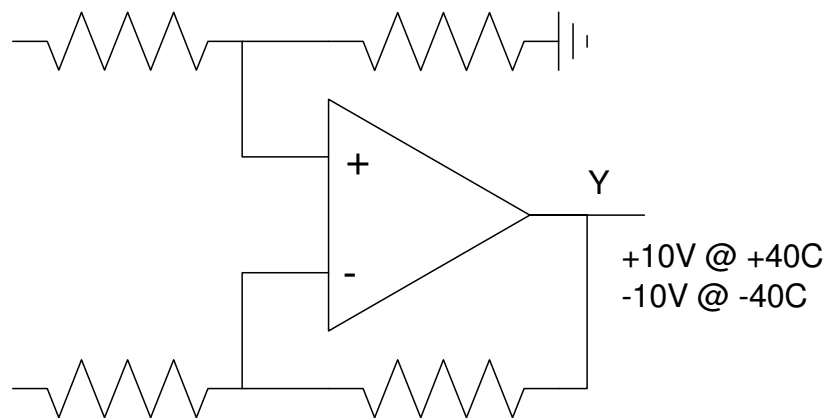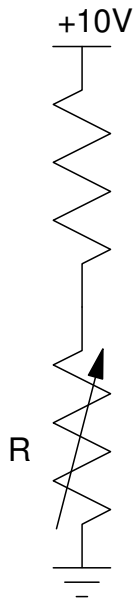# ECE 321 - Quiz #2 - Name _____

Temperature, Strain, Instrumentation Amplifiers. April 11, 2019

1) Temperature Sensor: Assume a temperature sensor has the following characteristics:

$$R = 1000(1 + 0.0043 \cdot T) \ \Omega$$

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

- -10V at -40C and
- +10V at +40C

+10V

R

+

-

Y

+10V @ +40C
-10V @ -40C

1b) For your circuit, what is the output votlage at 0C?

2) Strain Sensor (take 1).   A pressure sensor uses a stain gage to measure the flex of a beam. Assume
  - The length of the beam is 200mm
  - The thickness of the beam is 2mm
  - The beam deflects 10mm when the air pressure is 100 N/m2

Determine the strain on the inside edge and the outside edge. Assume the center line has no strain (free endpoints)

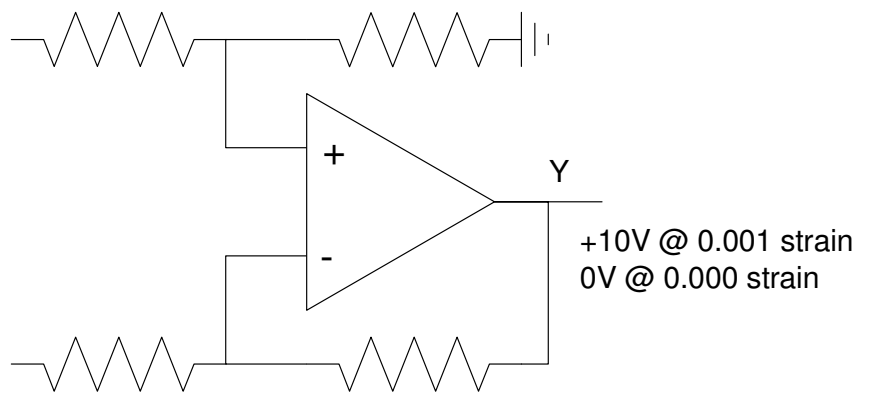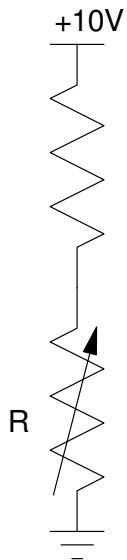| Radius (R)	Strain (inside edge)	Strain (outside edge)
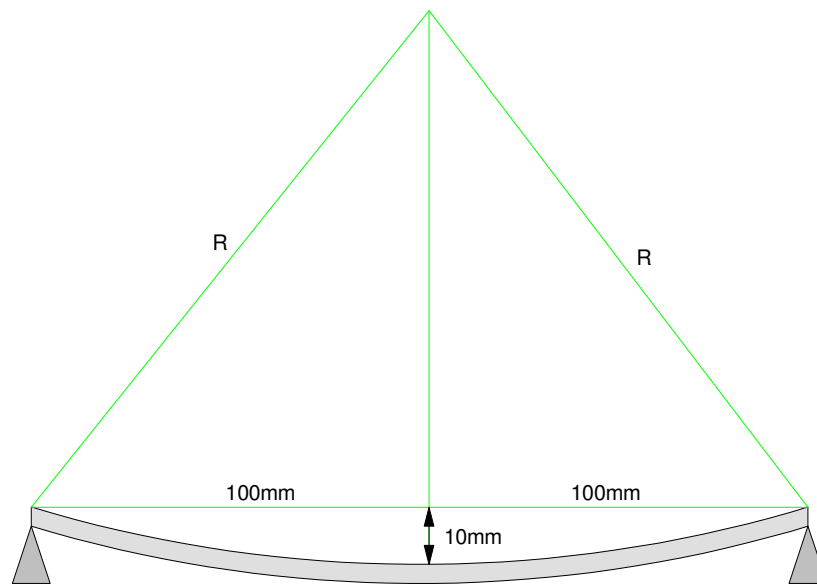
3) Strain Sensor (take 2). Assume a strain sensor has a resistance of

$$R = 120(1 + 2.14\varepsilon)$$

where ε is the strain. Design a circuit which outputs
- 0V when the strain is 0 and
- +10V when the strain is +0.001

+10V

R

+

−

Y

+10V @ 0.001 strain
0V @ 0.000 strain

4) The following circuit uses a linearizing circuit with an instrumentation amplifier. Determine the voltages at V1..V4

V1	V2	V3	V4

1k   V2   3k

+4.0V

10V

1k

V4

+

1k   V1

-

1k   V3   3k

400

700

1k
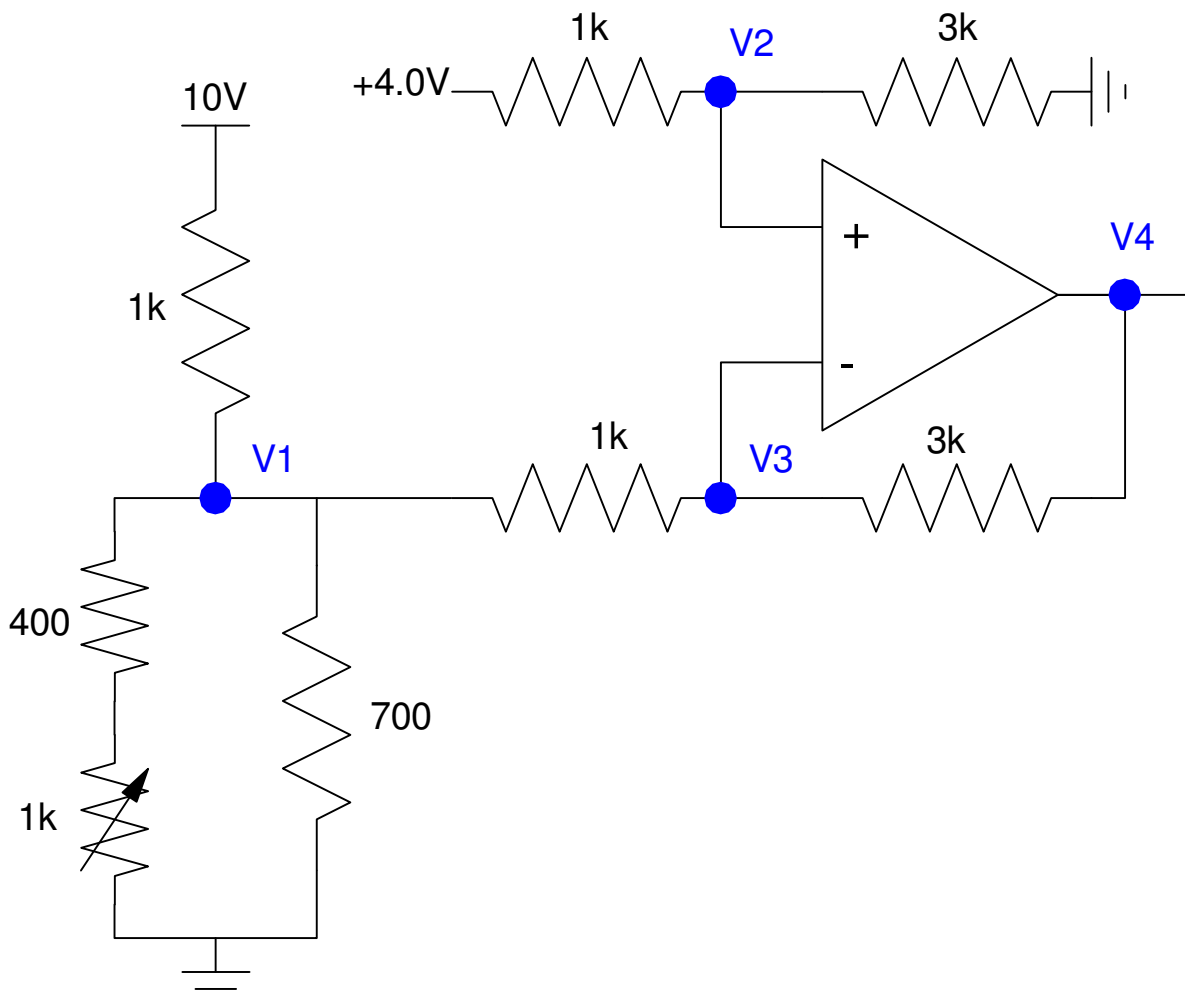
5) Let {A, B, C} be -10V to +10V analog voltages capable of driving 20mA (or less). Design a circuit to implement

$$Y = 2A + 3B - 4C$$

Bonus: All but three of the following countries have tuition-free college. Which three?

Brazil - Canada - Germany - Finland - France - Norway - Slovenia - Sweden - United States