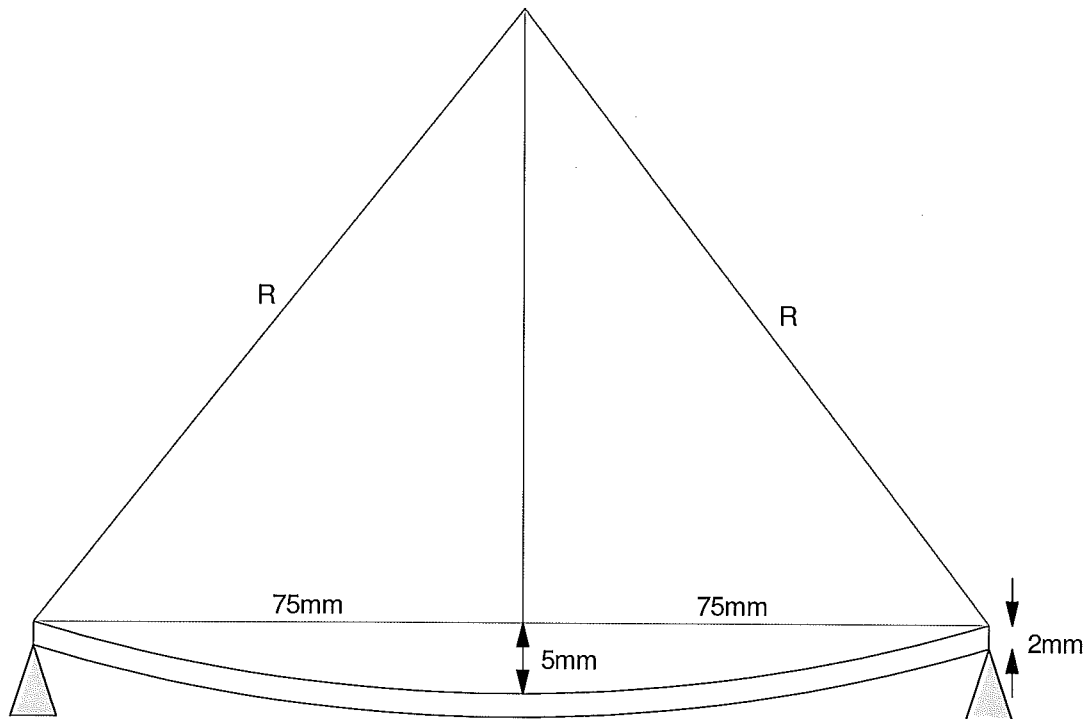


# ECE 321 - Quiz #2 - Name \_\_\_\_\_

Strain Gages, Audio Sensors, Calibration. Fall 2019

1) A beam that is 150mm long deflects 5mm when a force is applied in the middle. Determine the radius of curvature and the strain on the inside and outside edge. Assume the center line has zero strain.

Radius, R	Strain on inside edge	Strain at center line	Strain on outside edge
565.01	-0.0018	0.0000	+0.0018



$$R^2 = (R-5)^2 + 75^2$$

$$R = 565.01$$

$\epsilon$

$$\epsilon_{\text{inner}} = \frac{-1}{565} = -0.0018$$

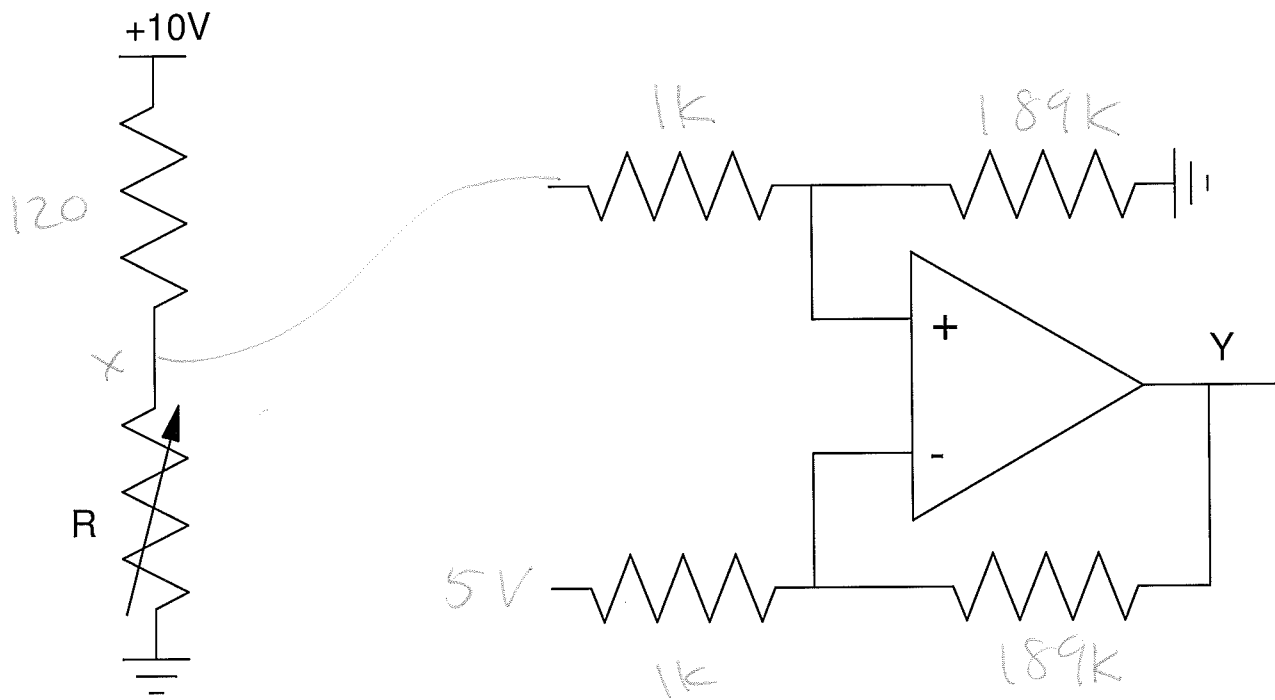
$$\epsilon_{\text{outer}} = \frac{+1}{565} = 0.0018$$

2) A strain sensor has a strain - resistance relationship of

$$R = 120(1 + 2.14\epsilon) \Omega$$

Design a circuit which outputs

- 0V when the strain is 0.000
- +10V when the strain is +0.01



$$\epsilon = 0.01$$

$$R = 128.568$$

$$V_x = \left( \frac{128.568}{128.568 + 120} \right) 10$$

$$= 5.0529$$

$$\text{gain} = \frac{10 - 0}{5.0529 - 5}$$

$$= 188.9$$

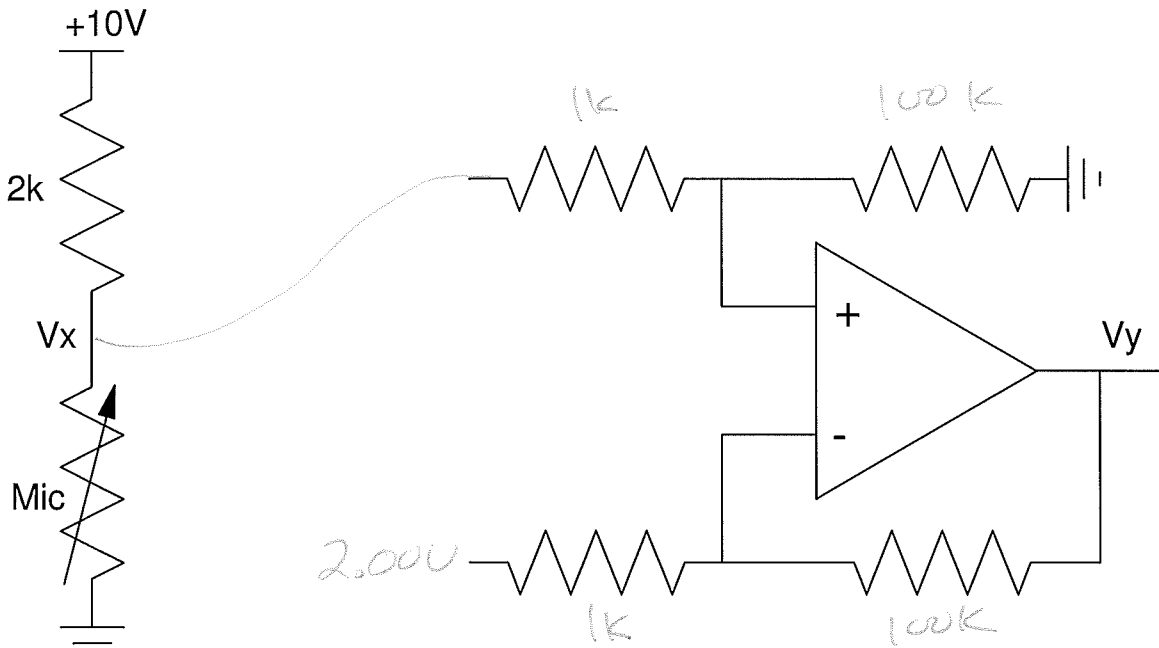
3) The voltage at a microphone is

$$V_x = 2.00 + 0.1 \sin(\omega t)$$

Design a circuit so that the output is

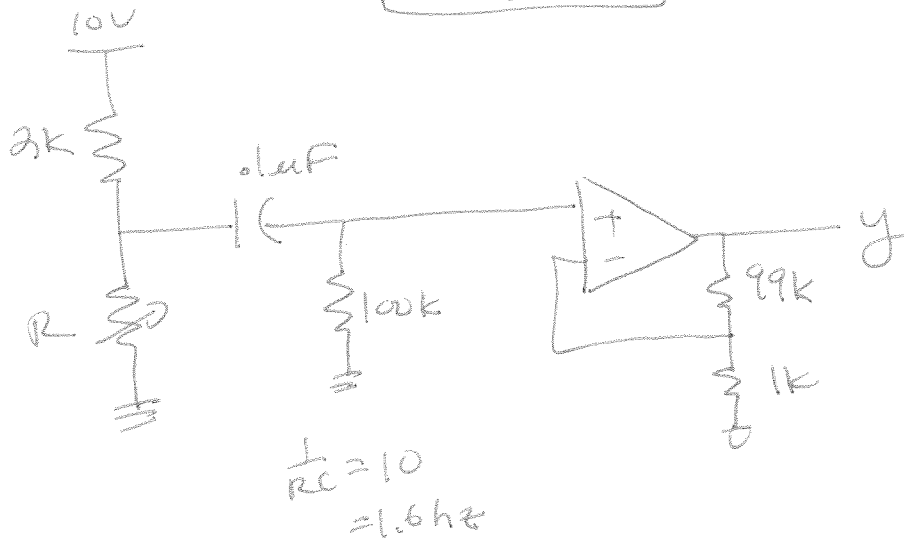
$$V_y = 0.00 + 10.0 \sin(\omega t)$$

design #1



$$g_{ain} = 100$$

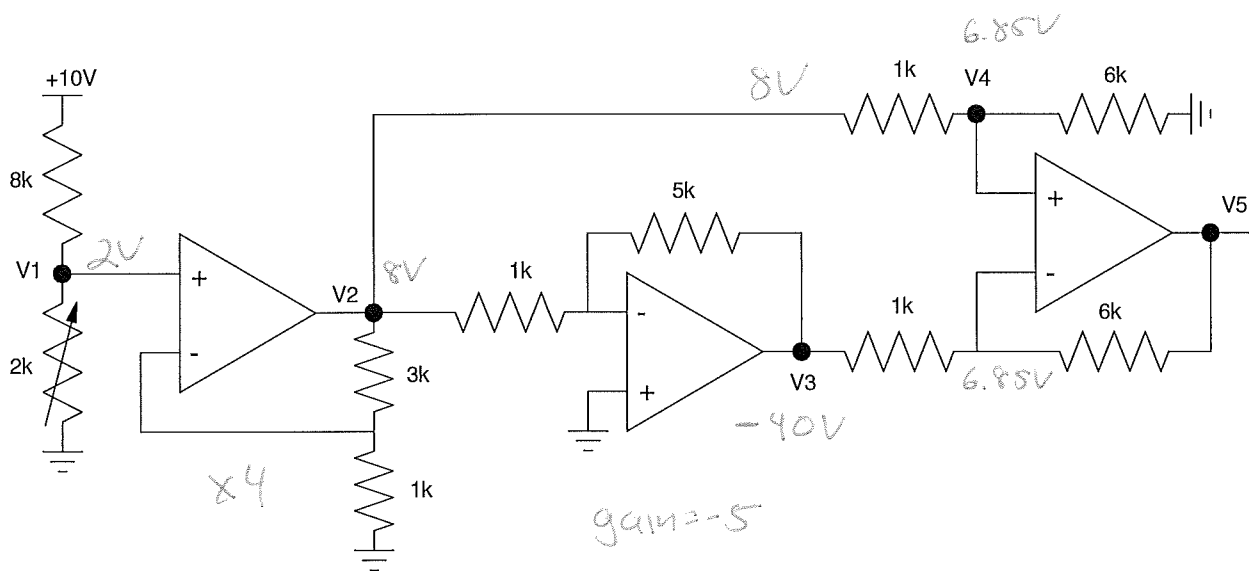
design #2



4) Determine the voltages V1..V5 for the following op-amp circuit. Assume ideal op-amps.

V1	V2	V3	V4	V5
2.0V	8.0V	-40.0V	<del>2.88V</del> 6.85V	288V

$\xrightarrow{4x}$        $\xrightarrow{-5x}$        $6(V_2 - V_3)$



$$V_4 = \left(\frac{6}{7}\right) \cdot 8V$$

$$= 6.85V$$

$$V_5 = 6(A - B)$$

$$V_5 = 6(8 - (-40))$$

$$V_5 = 6 \cdot 48$$

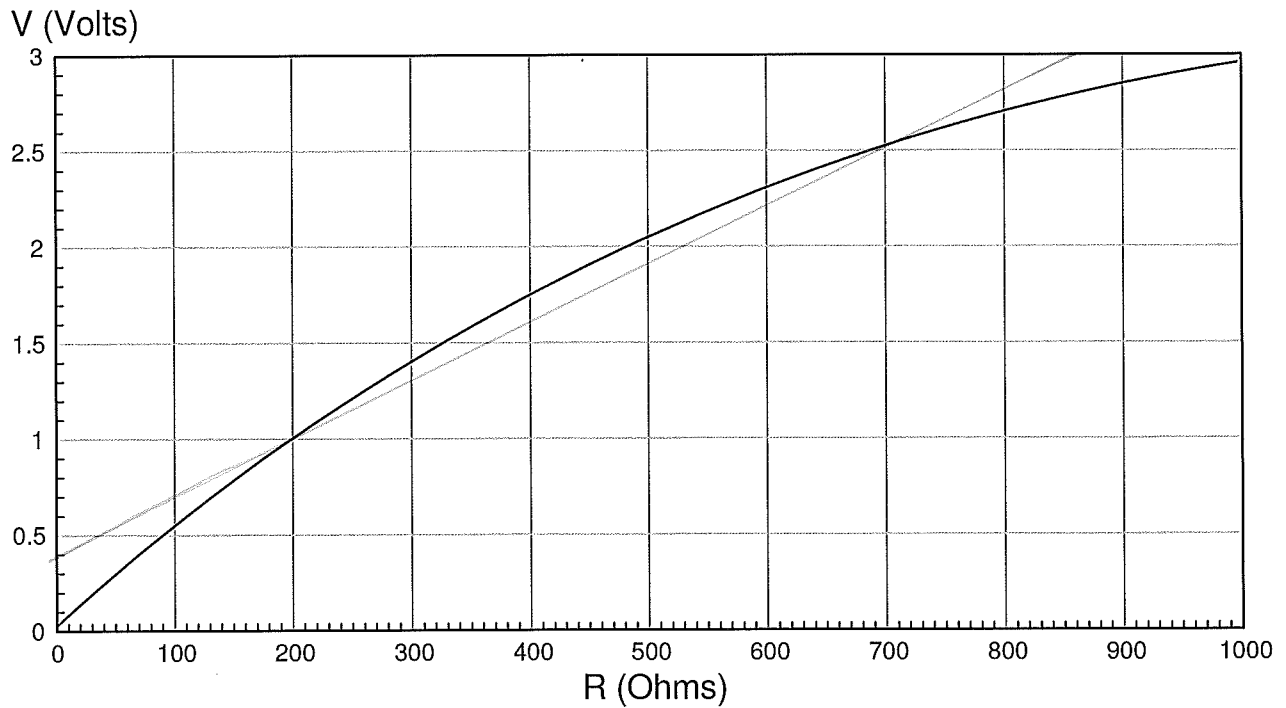
$$V_5 = 288V$$

5) The voltage across a voltage divider is shown below. Determine a calibration function

$$R = aV + b$$

to approximate this curve for  $0 < R < 1000$  Ohms

Straight-Line Approximation	Linear Curve Fit $R = aV + b$
show on plot	$R \approx 330V - 132$



$$\text{slope} = \left( \frac{\Delta R}{\Delta V} \right) = \left( \frac{860 \Omega}{2.6V} \right) = 330$$

$$R \approx 330V - 132$$

Phinneas and Ferb Bonus! What was the purpose of the Go-Away-Inator?

- Make door-to-door salesmen go away
- Make Dr. Doofenschmirtz invisible to avoid having to take his girlfriend shopping
- Make the green beans on his plate disappear so Dr. Doofenschmirtz can get to dessert faster
- Keep those pesky neighbor kids off of Dr. Doofenschmirtz's front lawn