

ECE 211: Homework #1

CircuitLab, Matlab, & Lab Kit

Voltage, Current, Resistance, & Power

1) Determine the remaining terms given the following information. Use the equations

- $V = IR$
- $P = VI$

Volts (V)	Amps (I)	Ohms (R)	Watts (P)
10	2	5	20
10	2.5	4	25
6.667	3	2.22	20
10	4	2.5	40

Sample Calculations:

$V = 10, I = 2$

$$R = \frac{V}{I} = 2\Omega$$

$$P = VI = 20W$$

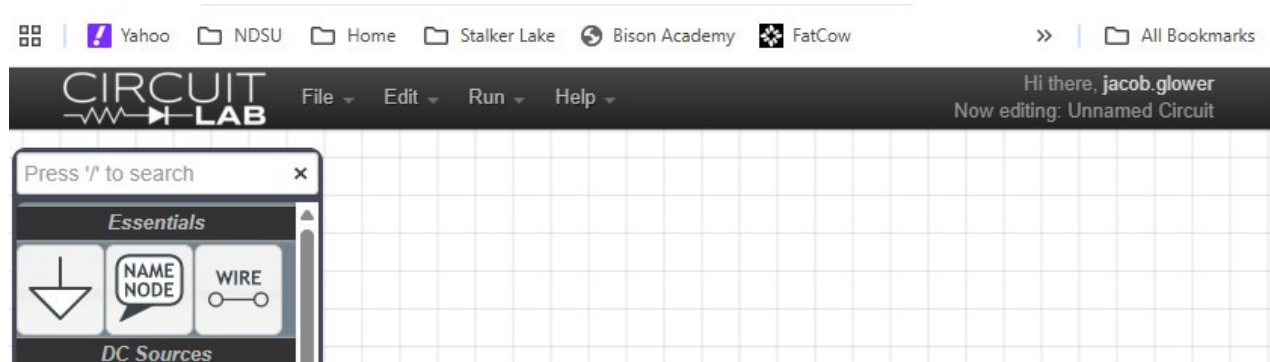
$V=10, R = 4$

$$I = \frac{V}{R} = 2.5$$

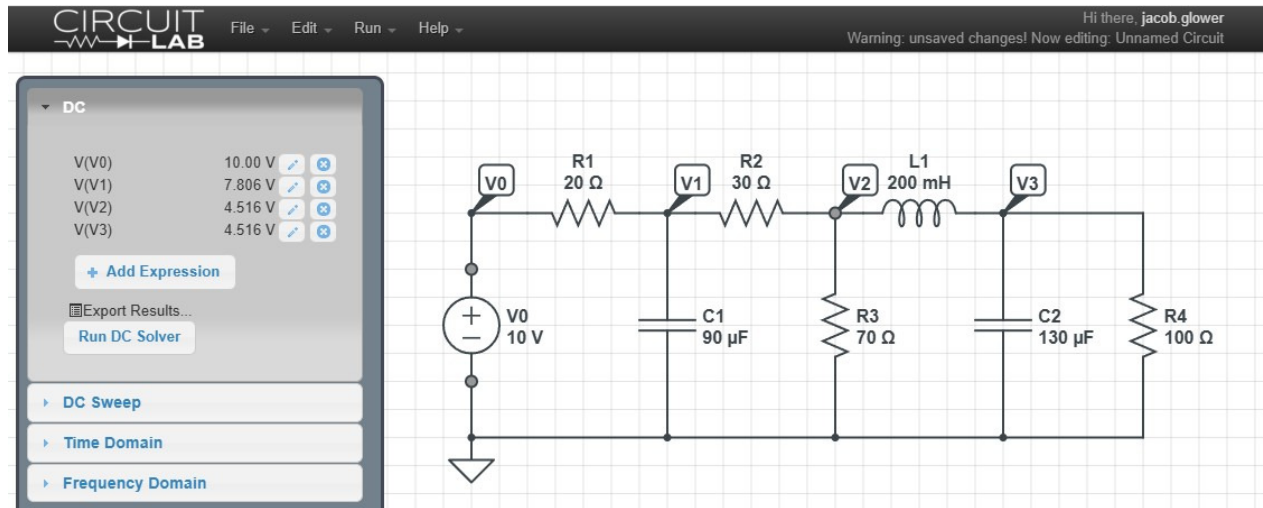
$$P = VI = 25$$

CircuitLab

2) Register with CircuitLab (use your @ndsu.edu email address to register and it's free).



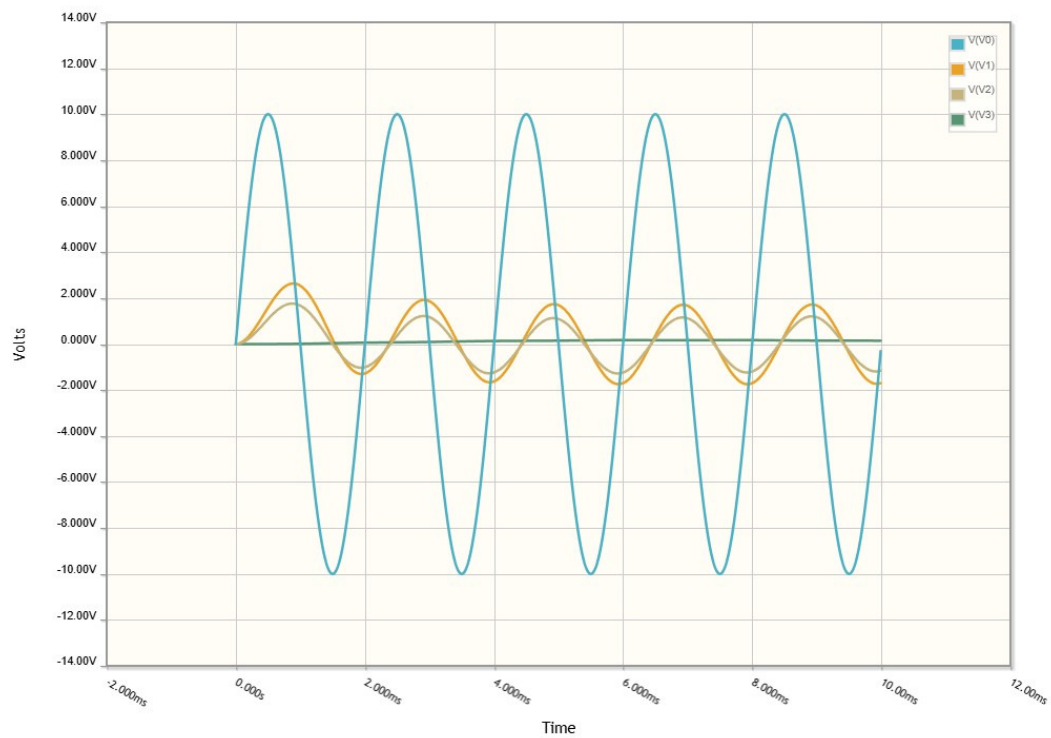
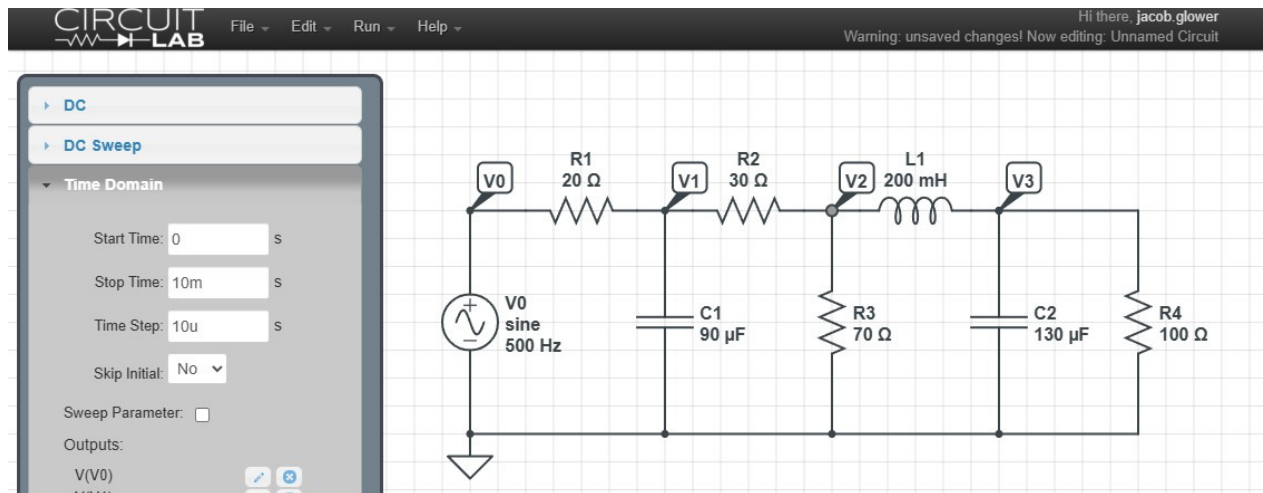
3) Build the following circuit in CircuitLab and find the voltages at {V0, V1, V2, V3} when V0 is a 10V DC source. Include a screen-shot of the CircuitLab results.



4) Change V0 to a 500Hz sine wave that's 10V peak. for V0 = 10V (DC) source

- Run a time-domain simulation
- Max time = 2ms (4 cycles)
- Time step = 2 μ s (1000 points on the plot)

Include a screen shot of the resulting graph from CircuitLab



Matlab

5) Using Matab, solve for {x, y, z}

$$2x + 3y + 4z = 7$$

$$7x + 2y - 2z = 12$$

$$x + y + z = 10$$

Place in matrix form

$$\begin{bmatrix} 2 & 3 & 4 \\ 7 & 2 & -2 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 7 \\ 12 \\ 10 \end{bmatrix}$$

Solve using Matlab

```
>> A = [2,3,4 ; 7,2,-2 ; 1,1,1]
```

```
      2      3      4  
      7      2     -2  
      1      1      1
```

```
>> B = [7 ; 12 ; 10]
```

```
      7  
     12  
     10
```

```
>> xyz = inv(A)*B
```

```
x -100.0000  
y  233.0000  
z -123.0000
```

```
>>
```

6) Use Matlab to solve for {x, y, z}

$$2x + 3y + 8z = 2 + 3j$$

$$4x - (7j)y + (1 + 2j)z = 0$$

$$8x + (1 - 2j)y + 3z = 5$$

Place in matrix form

$$\begin{bmatrix} (2) & (3) & (8) \\ (4) & (-7j) & (1+2j) \\ 8 & (1-2j) & 3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 2+3j \\ 0 \\ 5 \end{bmatrix}$$

Solve using Matlab

```
>> A = [2, 3, 8 ; 4, -7j, 1+2j ; 8, 1-2j, 3]

2.0000          3.0000          8.0000
4.0000          0 - 7.0000i    1.0000 + 2.0000i
8.0000          1.0000 - 2.0000i    3.0000

>> B = [2+3j ; 0 ; 5]

2.0000 + 3.0000i
0
5.0000

>> xyz = inv(A)*B

x    0.6528 - 0.1576i
y    0.0062 - 0.2409i
z    0.0845 + 0.5047i
```

Resistors & Color Code

black	brown	red	orange	yellow	green	blue	violet	grey	white
0	1	2	3	4	5	6	7	8	9

7) Using the color code for resistors, determine the resistance for the following colors

brown - black - red = 1 0 2

$$R = 10 \cdot 10^2 \Omega$$

$$R = 1k\Omega$$

orange - yellow - brown = 3 4 1

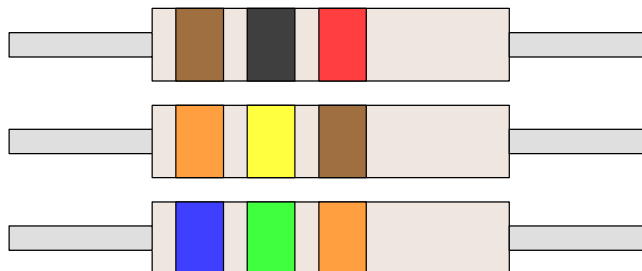
$$R = 34 \cdot 10^1 \Omega$$

$$R = 340\Omega$$

blue - green - orange = 6 5 3

$$R = 65 \cdot 10^3 \Omega$$

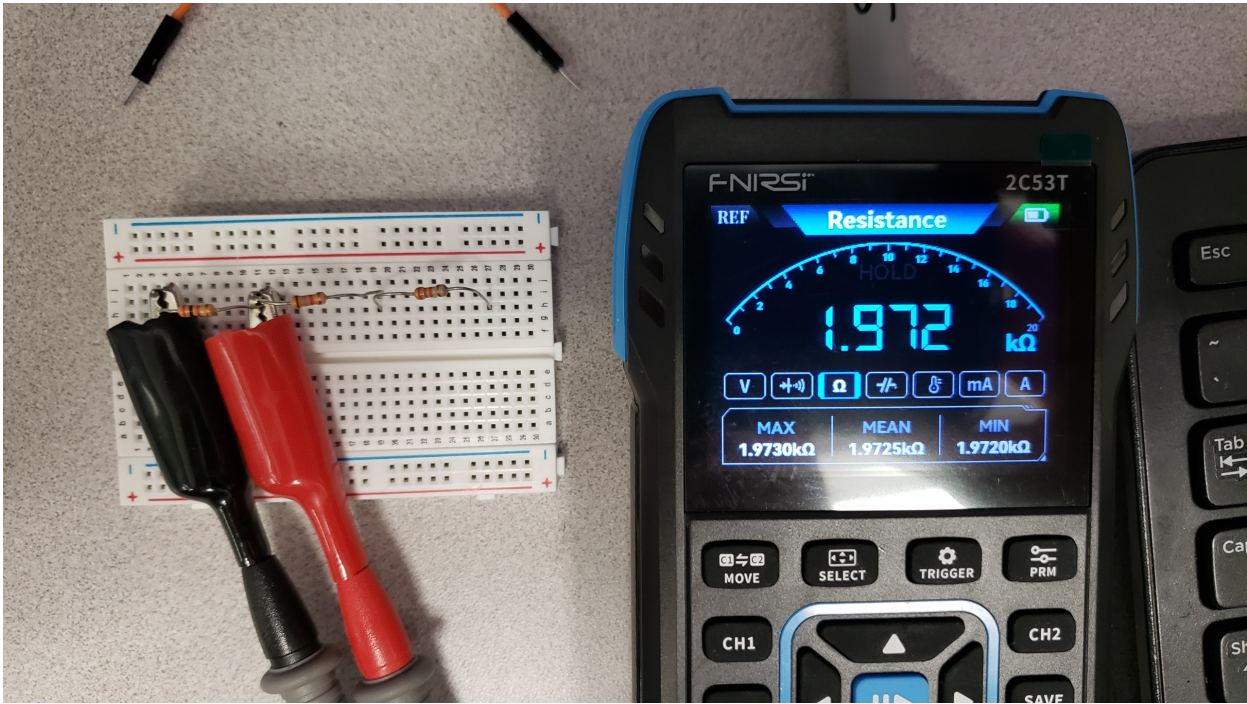
$$R = 65k\Omega$$



FNRSI Multimeter (Lab Kit)

- 8) Grab three resistors with different values (different color bands) from your lab kit
- Determine the value of these resistors using the color bands
 - Determine the resistance using your multimeter

Resistor	Colors	Value	Measured
R1	Red - Black - Red 2 0 2	2k	1972 Ohms
R2	brown - grey - red 1 8 2	1.8k	1782.4 Ohms
R3	orange - orange - orange 3 3 3	33k	32.45k



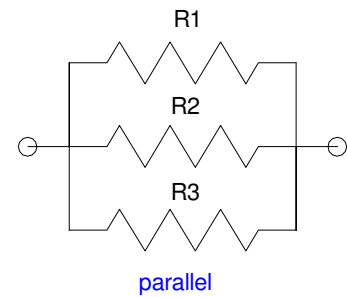
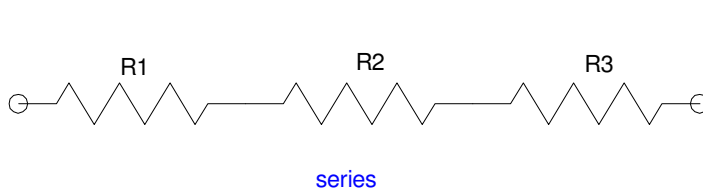
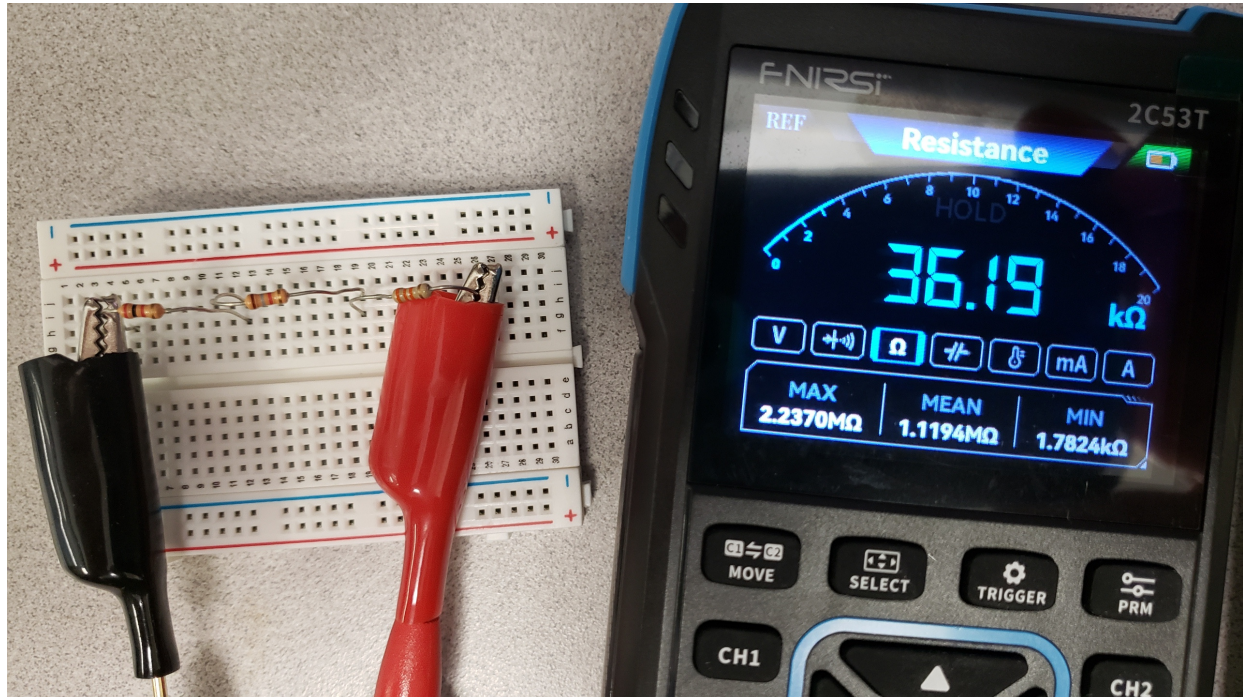
9) Using a multimeter (there should be a FNIRSI multimeter in your lab kit), measure the resistance of

- Three resistors (at random)
- These same three resistors in series
- These same three resistors in parallel

Include a photo of your multimeter with one of these readings

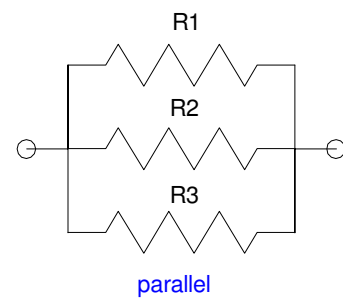
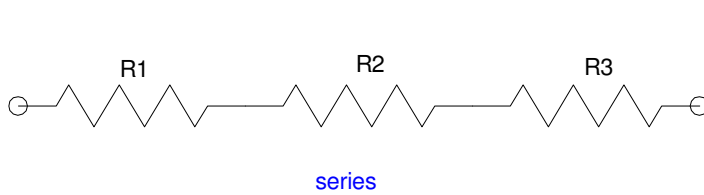
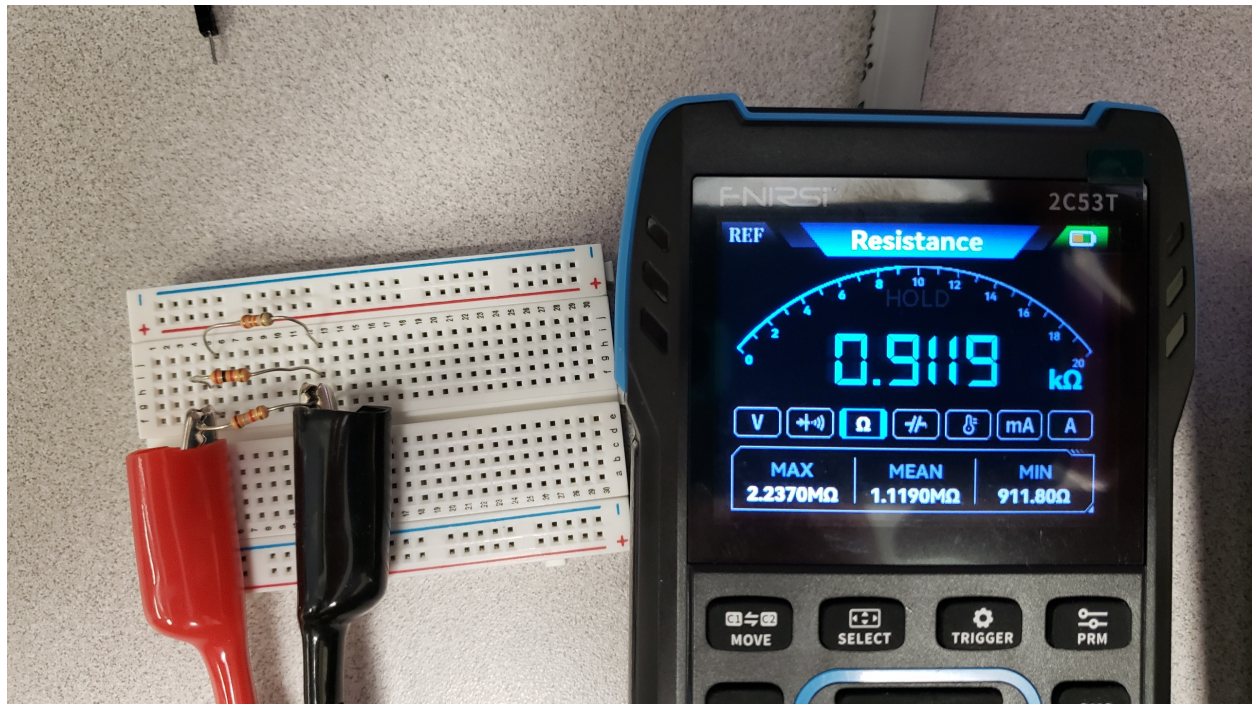
Series: $R = 36.19k$

- Resistors get bigger when placed in series (they add)
- $R_1 + R_2 + R_3 = 36.19k$



Parallel: $R = 911.9 \text{ Ohms}$

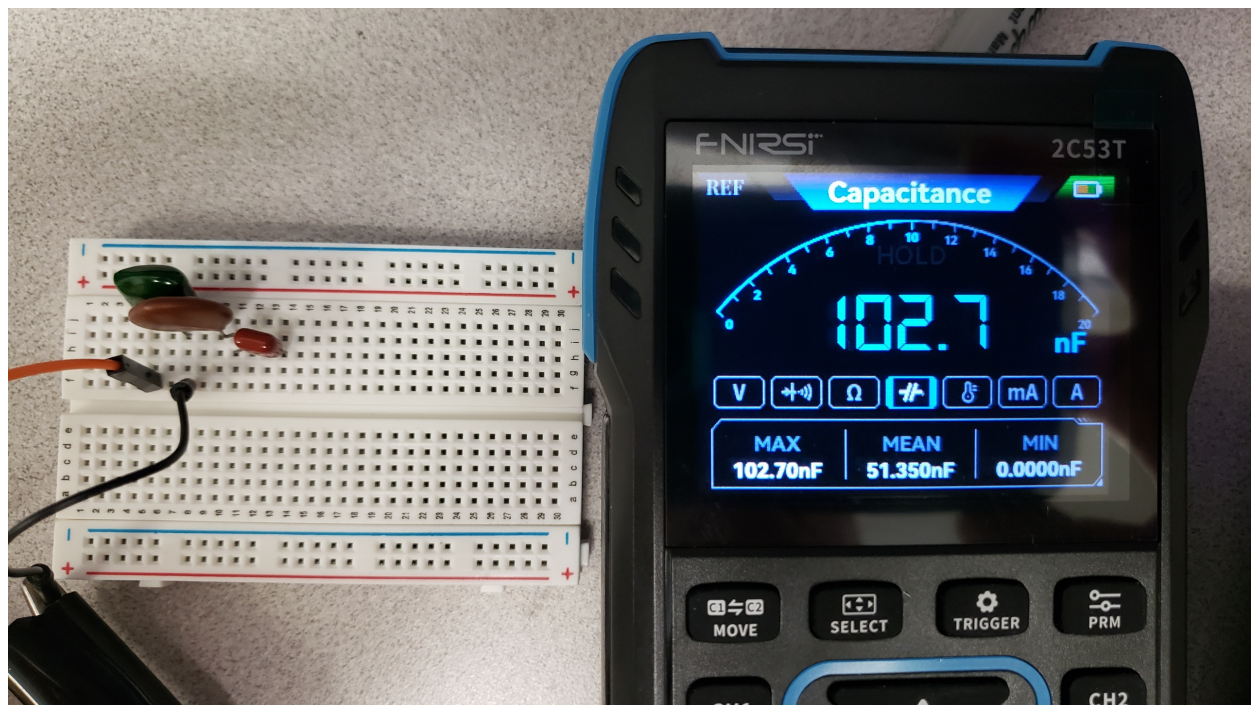
- Resistors get smaller when placed in parallel



10) Using a multimeter (there should be a FNRSI multimeter in your lab kit), measure the resistance of

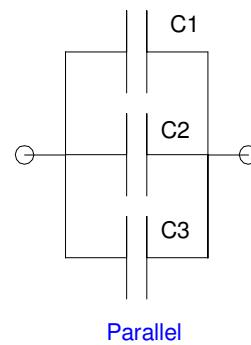
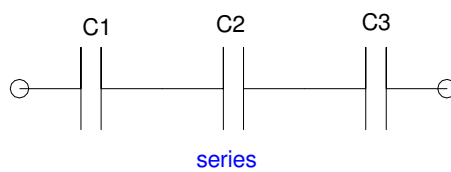
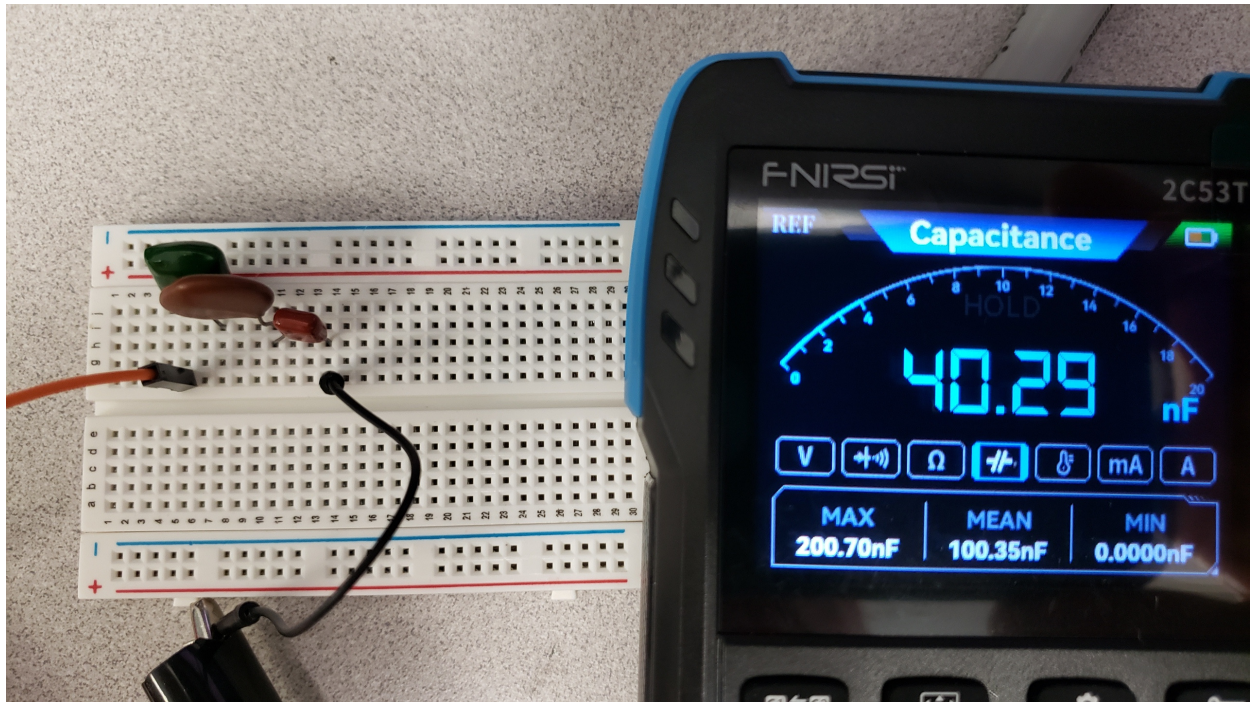
- Three capacitors (at random)
- These same three capacitors in series
- These same three capacitors in parallel

Capacitor	Markings	Value	Measured
C1	1 0 5	100nF	102.7nF
C2	2 0 5	200nF	200.6nF
C3	1 0 5	100 nF	102.8 nF



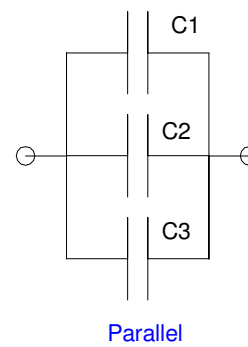
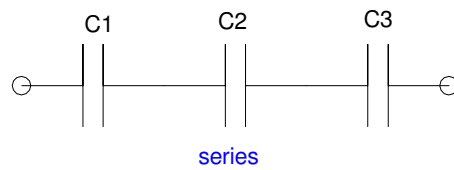
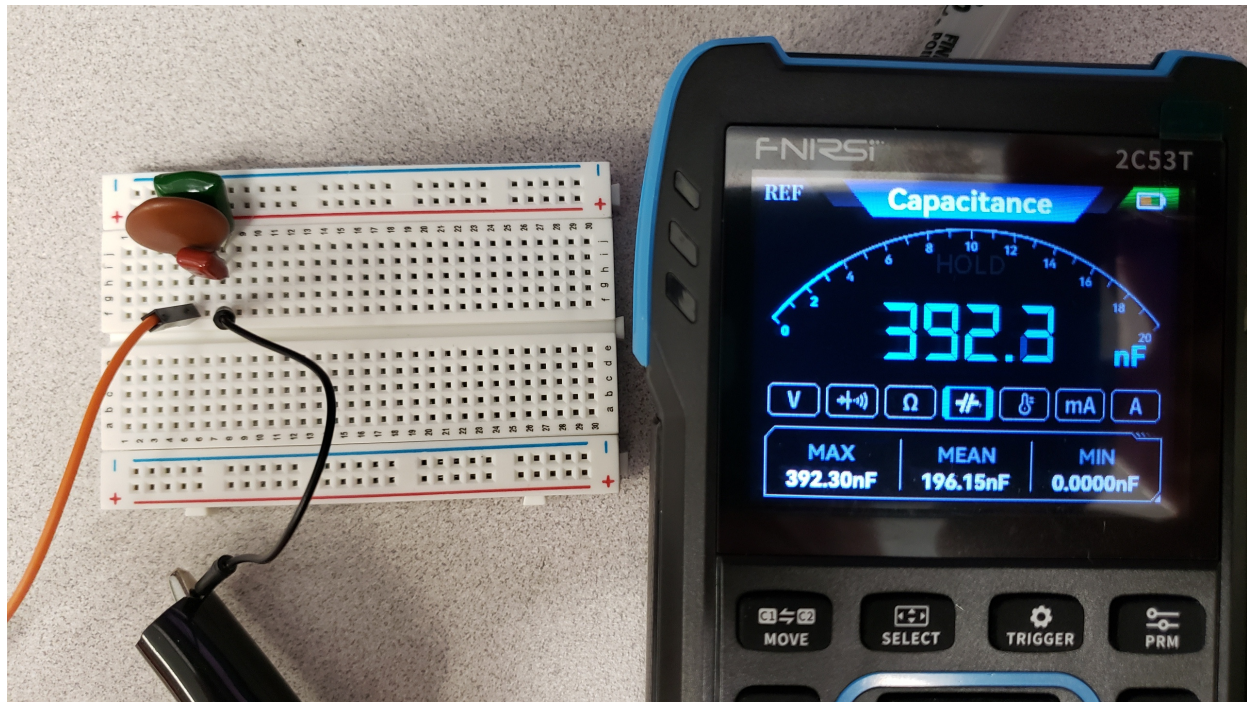
In Series

- $C = 40.29\mu\text{F}$
- Capacitors get smaller when placed in series



In Parallel

- $C = 392.5\mu\text{F}$
- Capacitors get larger when placed in parallel (they add)



Fun with Resistors

The resistance of the thermistor in your lab kit is approximately

$$R = 2000 \cdot \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right) \Omega$$

Measure the resistance with your FNRSI meter

- In your room (1755 Ohms)
- In a refrigerator (2465 Ohms)
- In a freezer (9657 Ohms)

From these measurements, compute the temperature

Room: $T = 28.00\text{C}$

Refrigerator: $T = 20.32\text{C}$

Freezer: $T = -6.96\text{C}$



Room Temperature



Freezer