UNIVERSITY OF WOLLONGONG IN DUBAI
Faculty of Engineering and Information Sciences

Lab Experiment: Equivalent resistance

	1	**2**	**3**	**4**
Family Name:	________	________	________	________
First Name:	________	________	________	________
Student Number:	________	________	________	________

Objectives:

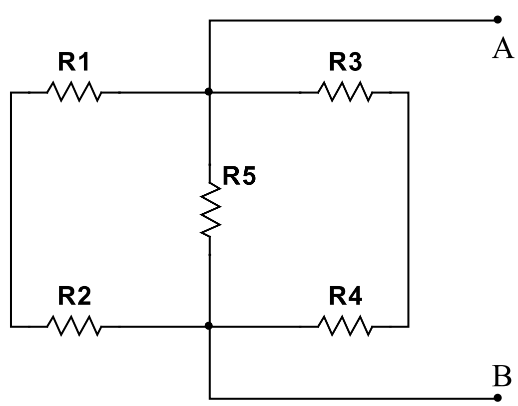
1) Determining experimentally equivalent resistance
2) Working with linear systems
3) Working with RC circuits
4) Comparing theoretical results with experimental results
5) Fitting exponential curve using a linear fit model

Part 1: Equivalent resistance

Equipment:

- Power supply
- 5 resistors (what is available in lab)
- Multimeter or Ammeter
- 4 banana cables

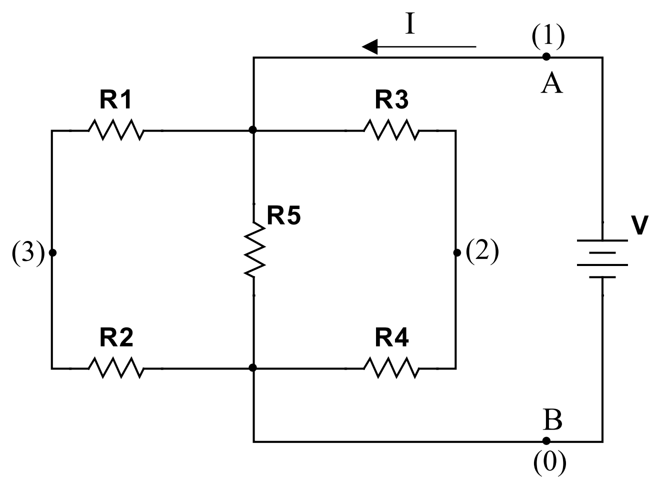
Find the equivalent resistance both experimentally and by applying parallel/series



Select known resistances R_1 to R_5 according to what is available in the lab

1) Find $R_{eq.}$ using formulas for resistances in parallel and in series.

2) Implement the following circuit to determine R_{eq} by applying a DC voltage source across points A and B (repeat the calculations for different voltage sources).



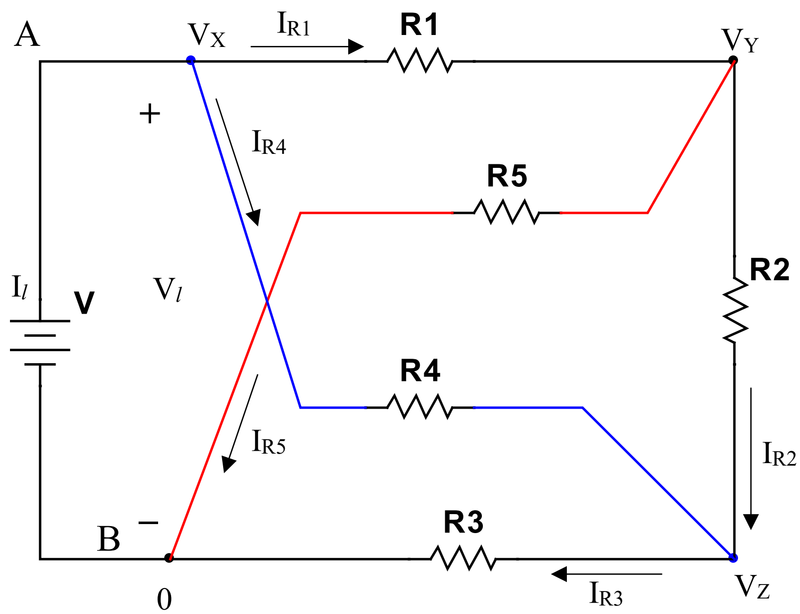
Calculate: $R_{eq} = {}^{V_{AB}}/_{I}$ (use ampere meter to measure the current I)

Experiment	V_{AB}	R_1	R_2	R_3	R_4	R_5	R_{eq} (calculated)	R_{eq} (experimental)	Relative Error
1									
2									
3									

Part 2:

Equipment:

- Power supply
- 5 resistors
- Multimeter or Ammeter
- 4 banana cables



Experimental Measurements

1) Implement the following circuit
2) Apply a voltage source across AB and measure the current I and the currents through each resistance I_{R1} to I_{R5}.

Theoretical Calculations

3) Write down 3 equations using Kirchhoff's junction rule.
4) Write down 3 equations using Kirchhoff's Loop rule given the source voltage.
5) Use Matlab (or manually) to solve the Linear System AX=b where

$$AX = b$$

$$X = \begin{bmatrix} I \\ I_{R1} \\ I_{R2} \\ I_{R3} \\ I_{R4} \\ I_{R5} \end{bmatrix}$$

Circuit input Data		Measured Currents		Calculated Currents	Relative error
R_1=		I_{R1}=			
R_2=		I_{R2}=			
R_3=		I_{R3}=			
R_4=		I_{R4}=			
R_5=		I_{R5}=			
V_A-V_B		I			

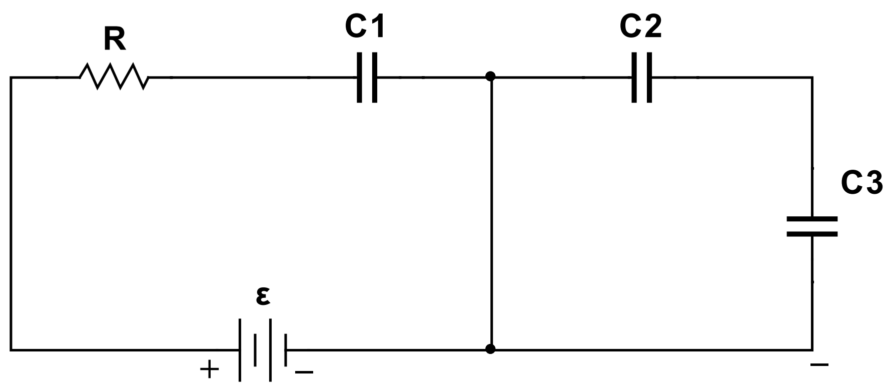
Compare the currents measured experimentally with the theoretical. Deduce the equivalent resistance.

Part 3:

Equipment:

- Power supply
- One large resistor value
- 3 capacitors
- 3 multimeters or voltmeters
- 8 banana cables

Implement the following circuit



Select RC such that the time constant of the circuit is as large as possible (Use large R). Fill the following table: RC

Time	Measured Voltage Across V_{C1}	Theoretical Voltage Across V_{C1}	Measured Voltage Across V_{C2}	Theoretical Voltage Across V_{C2}	Measured Voltage Across V_{C3}	Theoretical Voltage Across V_{C3}
0.2 RC						
0.4 RC						
0.6 RC						
0.8 RC						
1.0 RC						
1.2 RC						
1.4 RC						
1.6 RC						
1.8 RC						
2.0 RC						

You may miss some measurements

Use Excel to estimate the time constant from the above experimental obtained data

$$V_{C1} = V_{\max\_C1}\left(1 - e^{-t/\tau}\right)$$

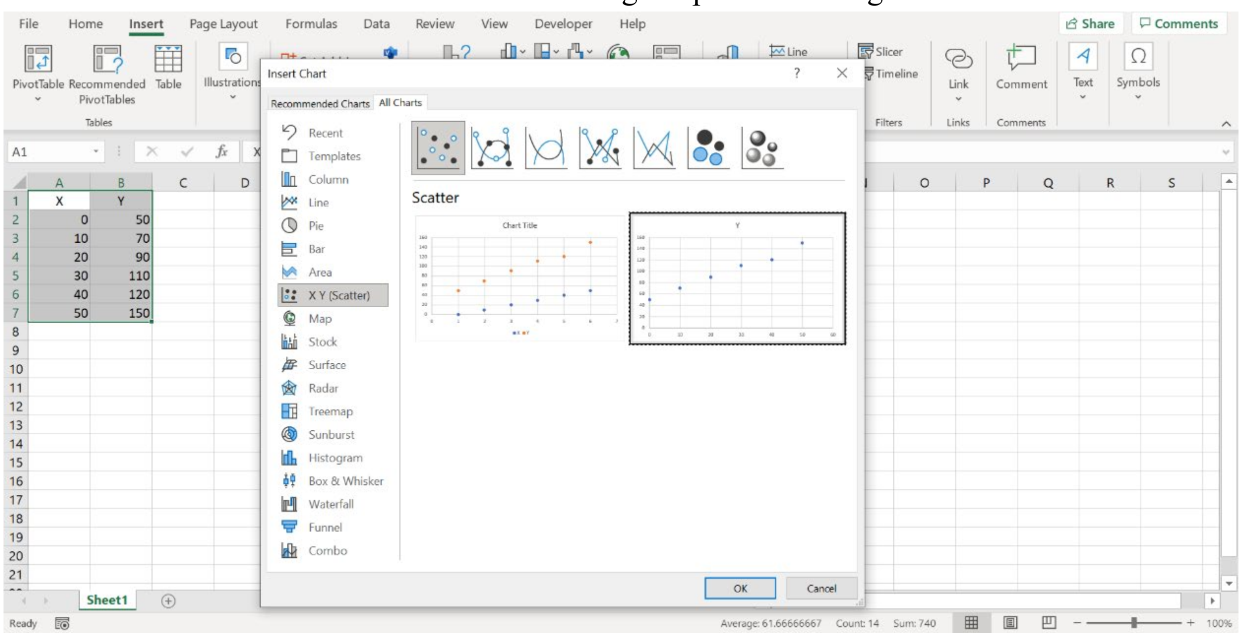
$$\frac{V_{\max\_C1} - V_{C1}}{V_{\max\_C1}} = e^{-t/\tau}$$

$$\ln\left(\frac{V_{\max\_C1} - V_{C1}}{V_{\max\_C1}}\right) = -t/\tau$$

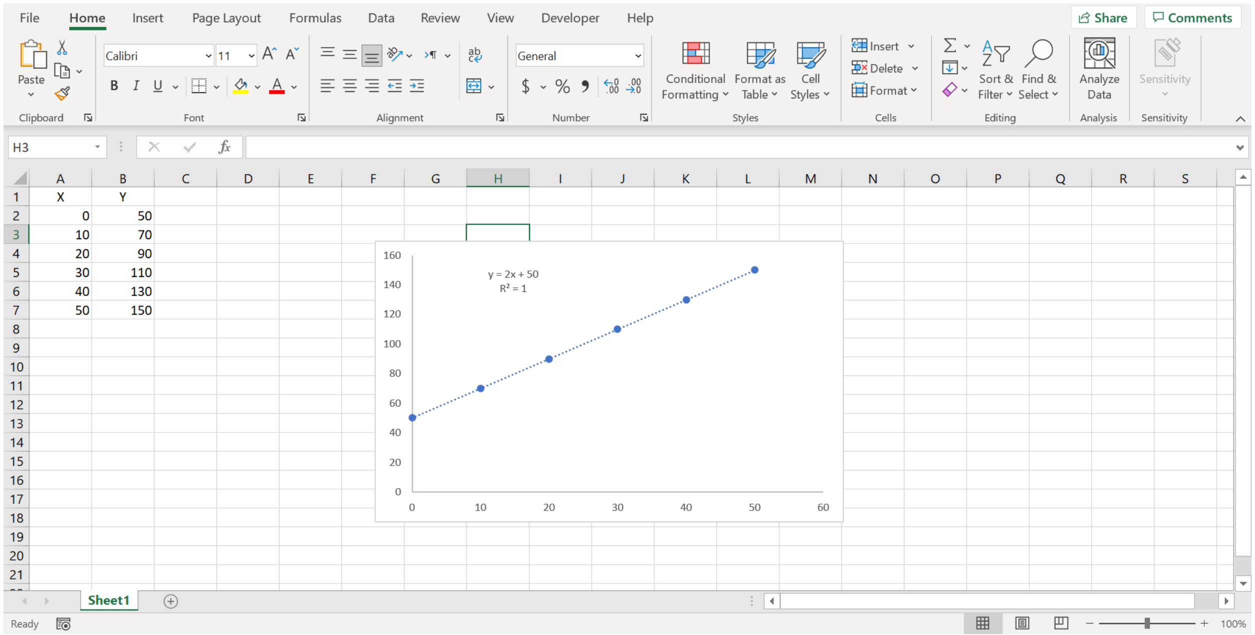
$$\ln\left(\frac{V_{\max\_C1}}{V_{\max\_C1} - V_{C1}}\right) = \frac{1}{\tau}t$$

$$Y = mX$$

Record in excel X and Y and use Excel for fitting the points to straight line as indicated below:



To add a trendline, right click on one of the data points, then select Add Trendline…
Select Linear Trend\Regression type.



The equation for the Y=mX will be displayed and deduce time constant = 1/slope

Part 4:

Equipment:

- Power supply
- 2 capacitors
- Multimeter or voltmeter
- 4 banana cables

Implement the following circuit

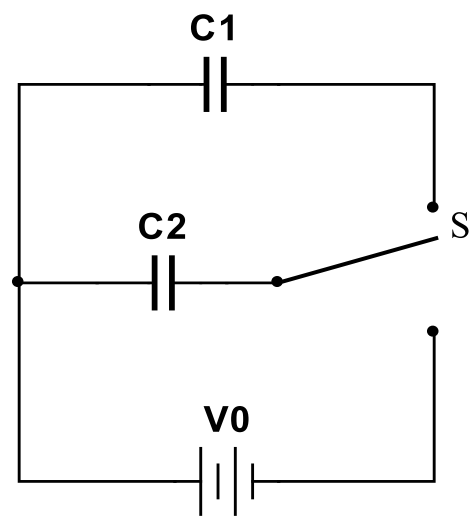


Figure 1: Circuit 4

1) First set the switch in order to charge C_2

2) After a long time, set the switch so that your charge C_1 from only C_2.

3) After a long time, measure the voltage across the capacitance (C_1) and deduce the charge on each capacitance. Compare your experimental measures with the theoretical calculations.