$Objectives:

Analyze resistive circuits in DC employing:

1. node – voltage method.
2. mesh – current method.
3. superposition method.

$Theory:

In the previous experiment we analyze the circuit using kirchhoff's & ohm's laws, but if the circuit contain more element it will be difficult to use this law's so there is anew method will used to analyze this kind of circuits such that ,node-voltage method , mesh-current method, and superposition method,(mesh & node method using for all types of circuit in general but superposition used only in linear circuits).

*****Definitions of Linear circuits:**

1. linear element: it's a passive element has a linear voltage – current relationship(if you multiply the current by constant k the voltage will also multiply by the same constant).
2. linear dependent source: it's a dependent current or voltage source whose output is proportional only to the first power of a specified current or voltage variable in the circuit or to the sum of each quantities.
3. linear circuit: it's a circuit composed entirely of independent sources, linear dependent sources & linear elements.

1*Node- Voltage Method:

It's technique permits description of the circuit in term of n-1 equations (n: # of nodes), when you calculate the # of node N we select one of it as reference(which usually the ground or the node with the most branches) then the equation written by KCL in term of node voltage.

2*Mesh- Current Method:

It's technique permits description of the circuit in term of b-(n-1) equations (n: # of nodes, b: # of branches), the equations are formulated by applying KVL to each mesh , expressing the voltage across each element on mesh current, then the system of equation will solved & the current in each branch can be calculated.

3*Superposition Principle:

Current (or voltage) in any given branch of a multiple –source linear circuit can be found by determining the currents (or voltages) in a particular branch, produced by each source acting alone, with all other sources replaced by their internal resistances .The total current (or voltage) in the branch is the algebraic sum of the individual source currents (or voltages) in that branch.

$Equipment:

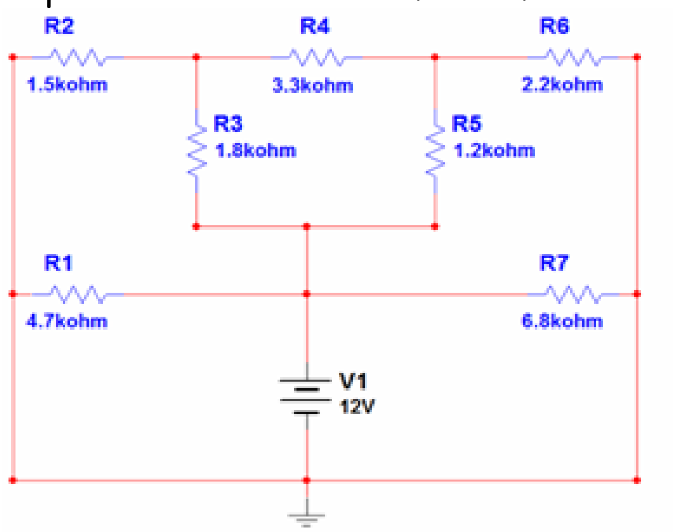
DMM, breadboard ,2 PS, 7resistors, leads ,wires.

$ Procedure:

Part A: Node-Voltage Method:

1.take 7 resistors(1.5, 4.7,1.8, 3.3, 1.2, 2.2,6.8kΩ)& fix them in the breadboard as shown in the figure.

2. provide the circuit of PS of 12 v



3.provide the DMM to measured the voltage.

4. determine the polarity of the voltage across the resistance as in the **sheet** (where the red probe in the +ve pole &the black

in the -ve),then measured the voltage across each resistance & record the values in the table.

Quantity	Vr1	Vr2	Vr3	Vr4	Vr5	Vr6	Vr7
Value (v)	11.99	5.418	-6.168	2.37	-4.25	7.73	11.99

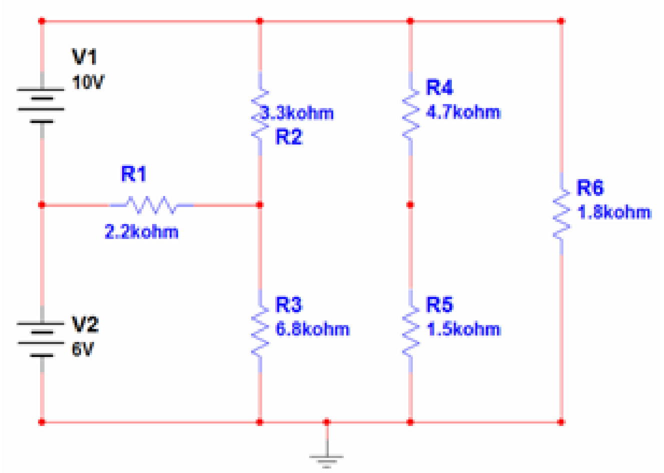
Note:

1) if we reverse the polarity of the voltage the magnitude will not change only the sign of it will change.
2) here we have 4 node 2 of them have 5 branch connected with it & one of this 2 node connected to the ground so we will take it as a reference.
3) the # of equation needed to solved equal 4-1=3 equation & then node voltage are known so we can determine the current in each branch.

Part B: Mesh-Current Method:

1.take 6 resistors(1.5, 4.7,1.8, 3.3, 2.2,6.8kΩ)& fix them in the breadboard as shown in the figure.

2. provide the circuit of two PS of 10&6v.



3.provide the DMM to measured the voltage& then determine the polarity of the voltage across the resistance as in the **sheet** (where the red probe in the +ve pole &the black in the -ve),then measured the voltage across each resistance & record the values in the table.

4.provide the DMM to measured the current & then determine the value of the current in each mesh as the direction in the

sheet (where the red probe in the tail & the black in the top) & filled the table by the resulting values.

Quantity	Vr1	Vr2	Vr3	Vr4	Vr5	Vr6	I1	I2	I3	I4
Value	2.36v	5.23 v	10.73v	12.1 v	3.86v	15.97v	13.7mA	11.4mA	8.87 mA	12.6mA

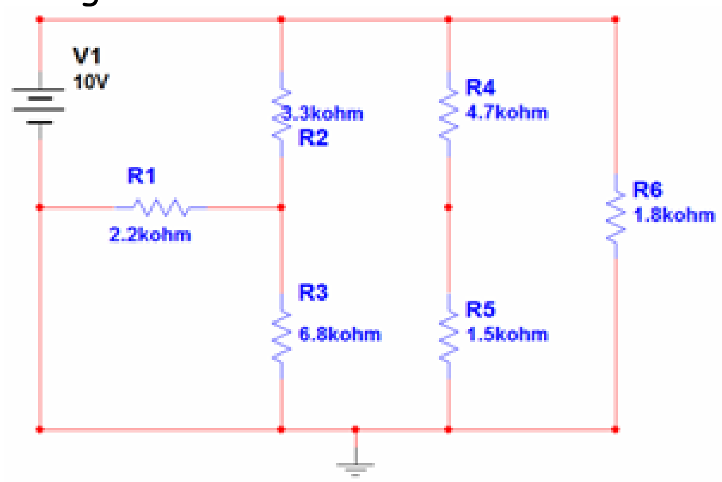
Note:

1) the value of Vr6 mainly equal the sum of the two source.
2) the sum of Vr4+Vr5 mainly equal the sum of he two source.
3) There is 8 branch & 5 node so # of equation needed to determine the current mesh then the voltages =8-(5-1)=4 equations.

Part c: Superposition:

1.effect of 10v source:

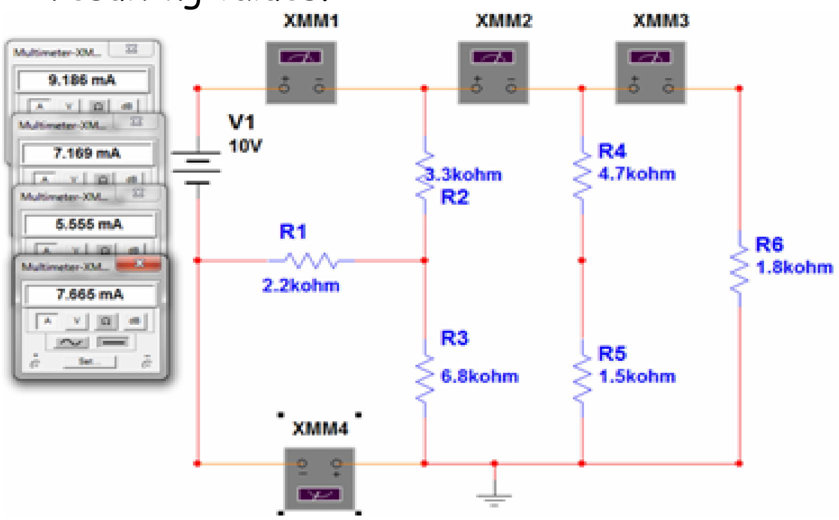
1. take the previous circuit but disconnect the 6v source from the circuit & replace it with a wire as in the figure :



2. provide the DMM to measured the voltage& then determine the polarity of the voltage across the resistance as in the **sheet** (where the red probe in the +ve pole &the black in the -ve),then measured the

voltage across each resistance & record the values in the table.

3. provide the DMM to measured the current & then determine the value of the current in each mesh as the direction in the **sheet** (where the red probe in the tail & the black in the top) & filled the table by the resulting values.



Quantity	Vr1	Vr2	Vr3	Vr4	Vr5	Vr6	I1	I2	I3	I4
Value	3.3v	6.658v	3.3v	7.5 v	2.42v	9.98v	9.14mA	7.169 mA	5.555 mA	7.665

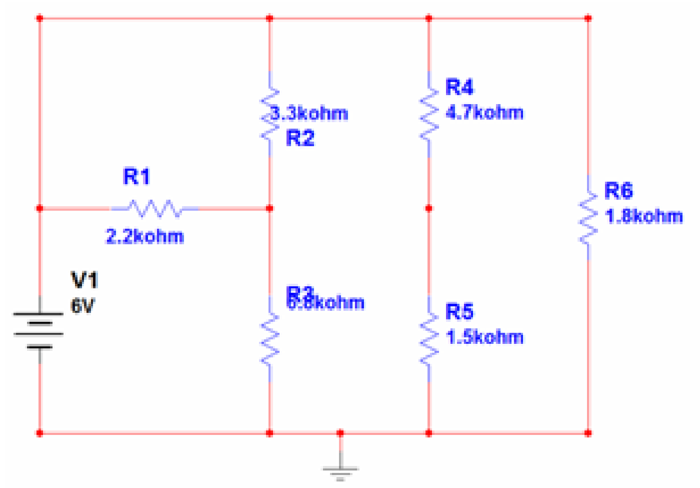
Note:

1.Vr6=Vr4+Vr5=10=Vs(mainly)

2. R1 parallel with R3 so it has the same voltage& can replace by their equivalent R(& the circuit can be redraw as the simple parallel resistance then we can determine the values of the currents & voltages of all resistance)..

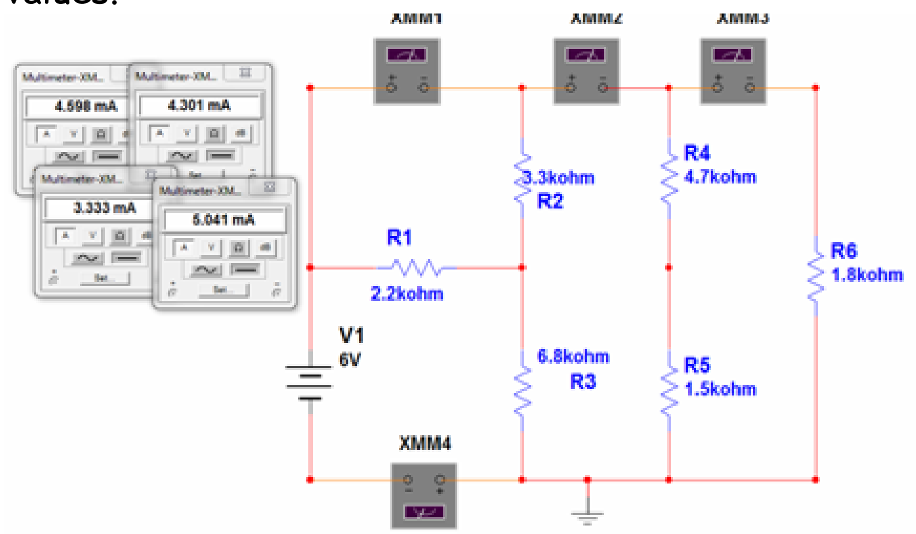
3.effect of 6v source:

1.take the previous circuit but disconnect the 10v source from the circuit & replace it with a wire & connect the 6v in it's place as in the figure :



2.provide the DMM to measured the voltage& then determine the polarity of the voltage across the resistance as in the **sheet** (where the red probe in the +ve pole &the black in the -ve),then measured the voltage across each resistance & record the values in the table.

3.provide the DMM to measured the current & then determine the value of the current in each mesh as the direction in the **sheet** (where the red probe in the tail & the black in the top) & filled the table by the resulting values.



Quantity	Vr1	Vr2	Vr3	Vr4	Vr5	Vr6	I1	I2	I3	I4
Value	-0.97 v	0.975 v	5v	4.3 v	1.4v	5.9v	4.60mA	4.3mA	3.33 mA	5.04m

Note:

1.Vr6=Vr4+Vr5=6=Vs(mainly)

2.R1 parallel with R2 so it has the same voltage& can replace by their equivalent R(& the circuit can be redraw as the simple parallel resistance then we can determine the values of the currents & voltages of all resistance).

General Note: if we want to prove the values which represent in the previous two part are correct , we should prove that the summation of each voltage & current in the previous two table are equal to the corresponding value in the table in part B.

$Conclusion:

1.techniques such as Nodal, Mesh and Superposition provide a simple way to analyze complicated circuits by introducing KVL, KCL, and ohm's law in another form more helpful.

2. In Nodal analysis the voltage drops between the point and the reference node or between the two specified points is what being really measured, and that is the way to obtain the currents flowing in and out of the node in a voltage/resistance form, which leads to KCL applied at each node.

3.In Mesh analysis each branch current measured, leading to obtain the needed responses.