03 Homogeneity Theorem and Superposition Theorem

1. Fill in the blanks of Table 1 in our class (you can find it from replay), and analyze data from the perspective of homogeneity theorem and superposition theorem.

2．Under what condition does superposition theorem not hold true?
Design an experiment to testify your conclusion.
Note: there are two possibilities

1) we need to change element
2) we don’t need to change element but there may be some other problems with the circuit

A Report By

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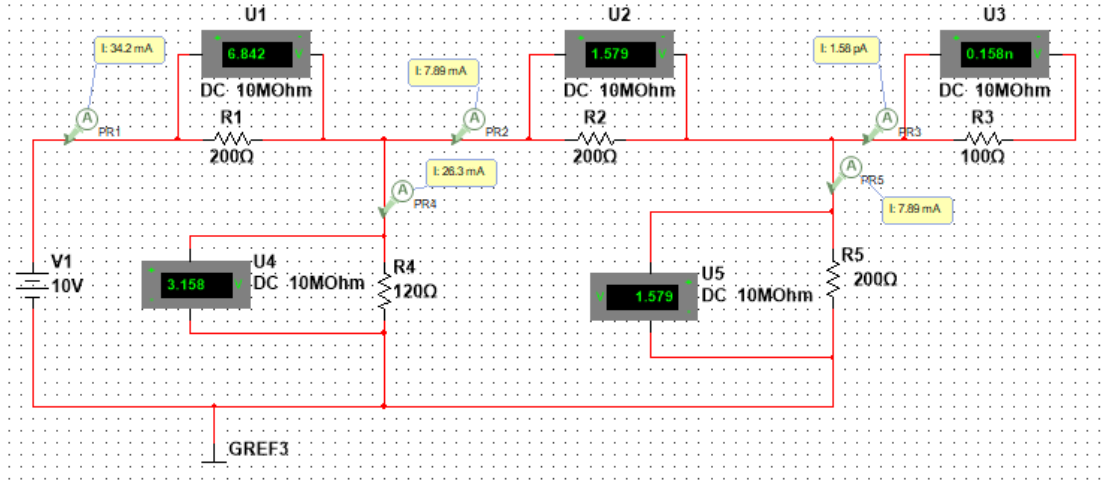
1. Fill in the blanks of Table 1 in our class (you can find it from replay), and analyze data from the perspective of homogeneity theorem and superposition theorem.

1



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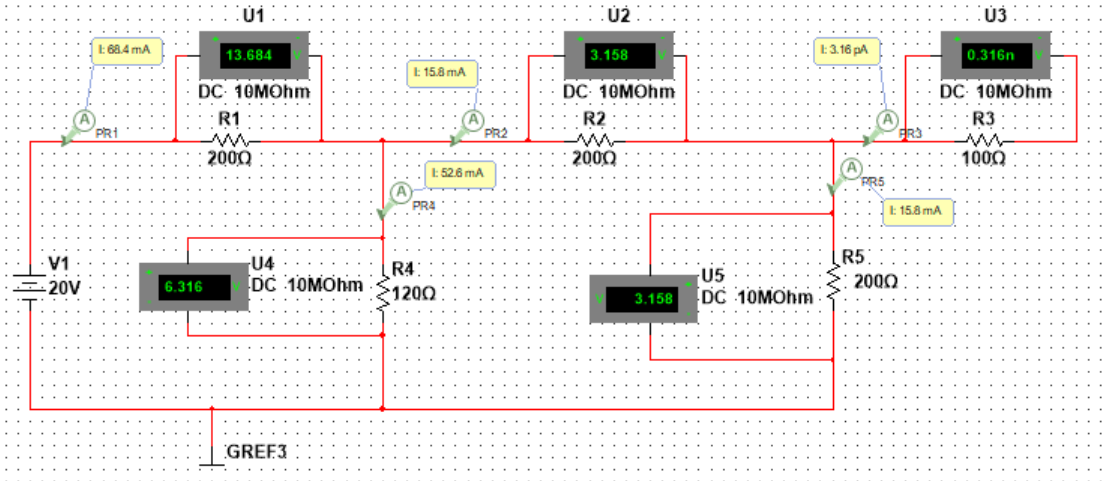
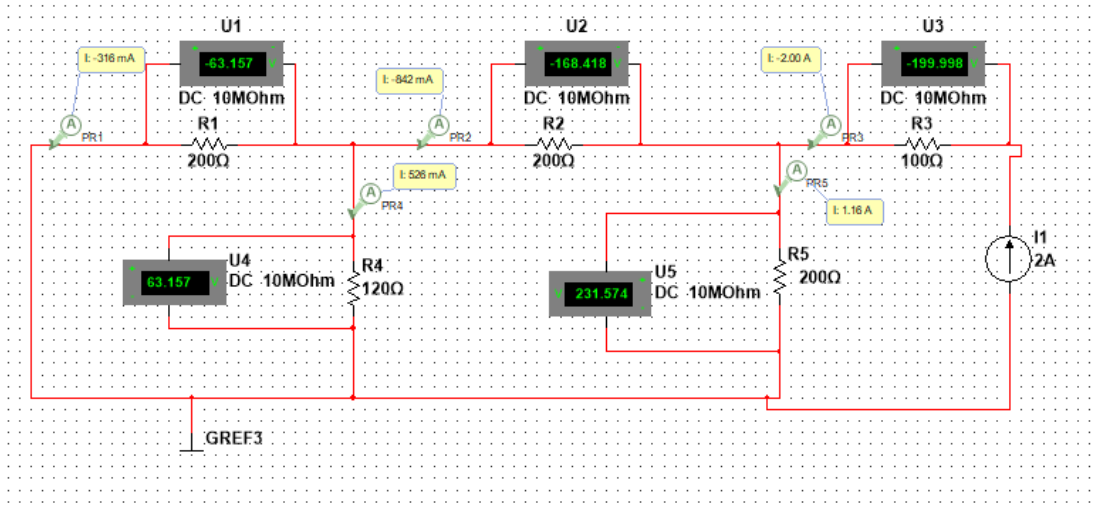
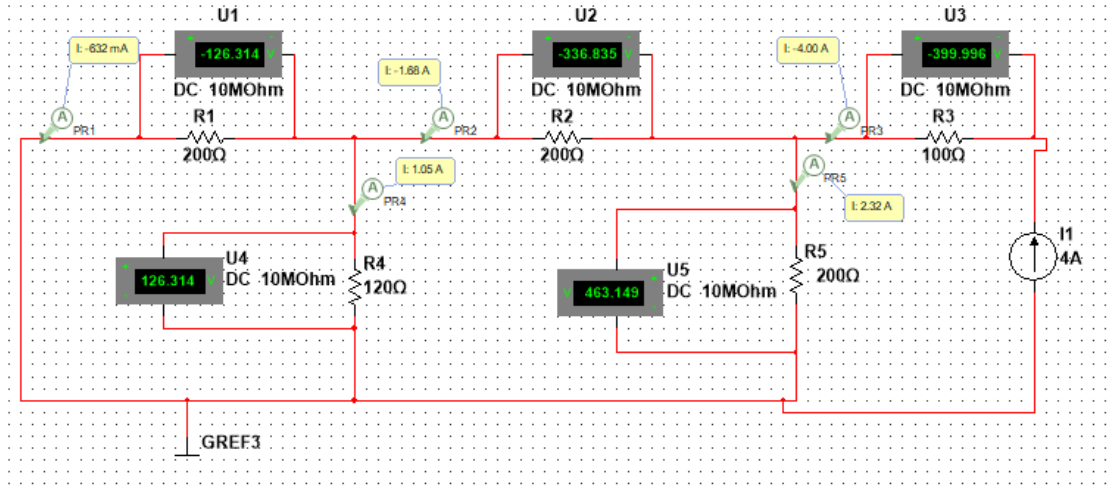


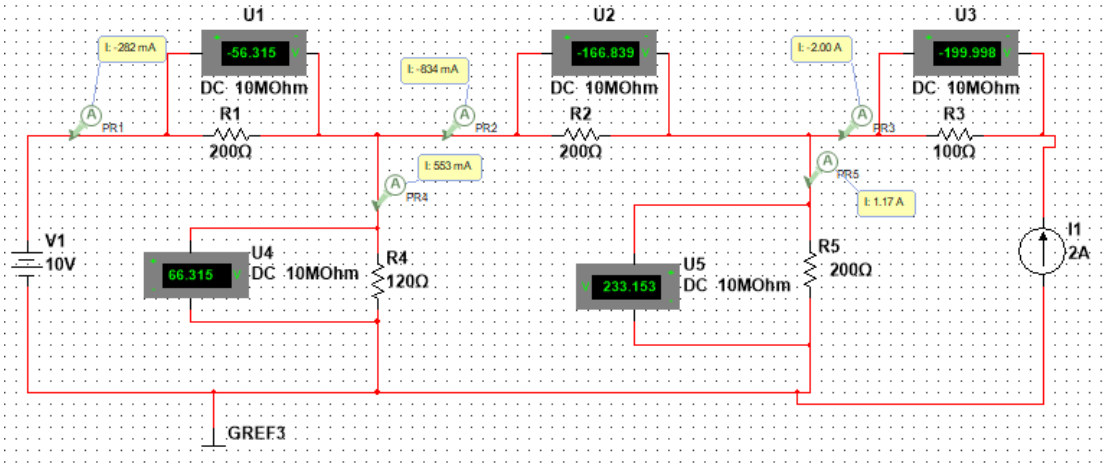
3


U1
-63.157
DC 10MOhm
I: -316 mA
PR1
R1
200Ω
U2
-168.418
DC 10MOhm
I: -842 mA
PR2
R2
200Ω
U3
-199.998
DC 10MOhm
I: -2.00 A
PR3
R3
100Ω
I: 526 mA
PR4
I: 1.16 A
PR5
U4
63.157
DC 10MOhm
R4
120Ω
U5
231.574
DC 10MOhm
R5
200Ω
I1
2A
GREF3

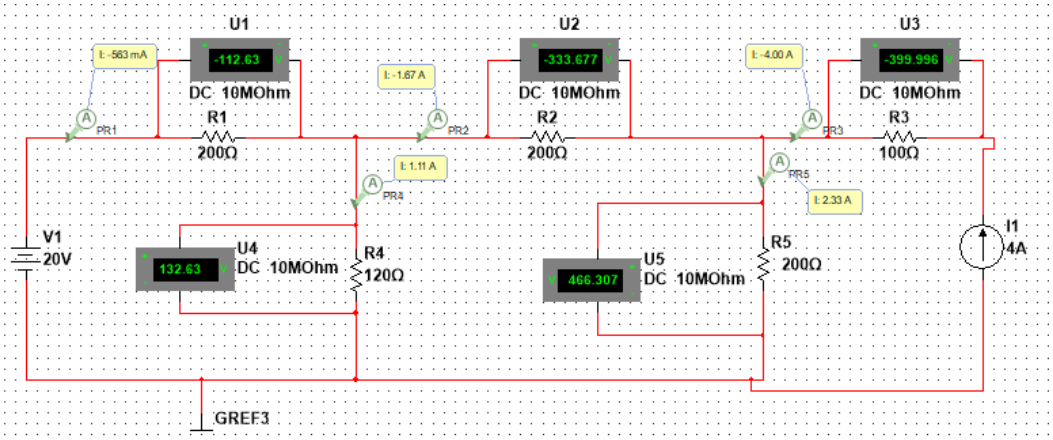
4


U1
-126.314
DC 10MOhm
I: -632 mA
PR1
R1
200Ω
U2
-336.835
DC 10MOhm
I: -1.68 A
PR2
R2
200Ω
U3
-399.996
DC 10MOhm
I: -4.00 A
PR3
R3
100Ω
I: 1.05 A
PR4
I: 2.32 A
PR5
U4
126.314
DC 10MOhm
R4
120Ω
U5
463.149
DC 10MOhm
R5
200Ω
I1
4A
GREF3

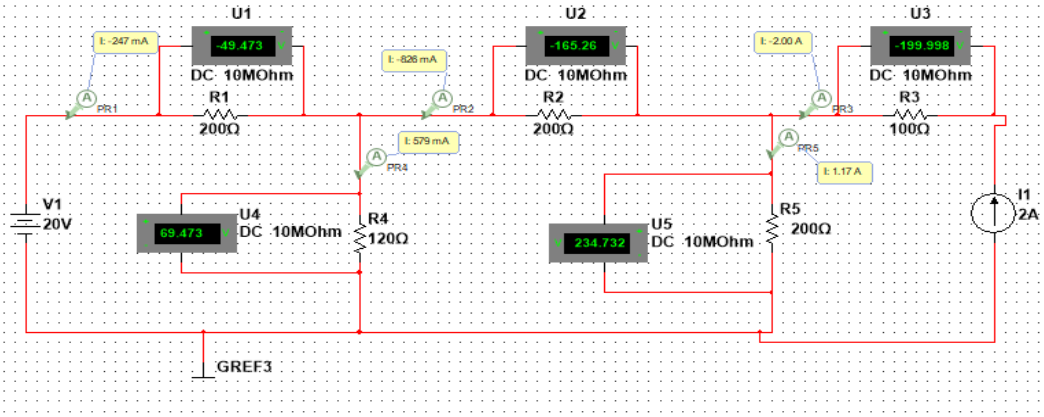
5


U1
-56.315
DC 10MOhm
I: -282 mA
PR1
R1
200Ω
U2
-166.839
DC 10MOhm
I: -834 mA
PR2
R2
200Ω
U3
-199.998
DC 10MOhm
I: -2.00 A
PR3
R3
100Ω
I: 553 mA
PR4
I: 1.17 A
PR5
V1
10V
U4
66.315
DC 10MOhm
R4
120Ω
U5
233.153
DC 10MOhm
R5
200Ω
I1
2A
GREF3

6



7



Us1	Is1	I1	I2	I3	I4	I5	UR1	UR2	UR3	UR4	UR5
10	0	34.2	7.89	7.89	26.3	7.89	6.842	1.579	0	3.158	1.579
20	0	68.4	15.8	15.8	52.6	15.8	13.684	3.158	0	6.316	3.158
0	2	-316	-842	-2	526	1.16	-63.157	-168.418	-199.998	63.157	231.574
0	4	-632	-1.68	-4	1.05	2.32	-126.314	-336.835	-399.996	126.314	463.149
10	2	-282	-834	-2	553	1.17	-56.315	-166.839	-199.998	66.315	233.153
20	4	-583	-1.67	-4	1.11	2.33	-112.63	-333.677	-399.996	132.63	466.307
20	2	-247	-826	-2	579	1.17	-49.473	-165.26	-199.998	69.473	234.732

From the above data, it is quite evident that when we change the voltage and the current source altogether, the homogeneity theorem holds true. But when we only change the voltage source or the current source the homogeneity theorem doesn't hold true. So, in conclusion, if we want to satisfy the homogeneity theorem, we need to change both sources, not just only one source.

2．Under what condition does superposition theorem not hold true?

Design an experiment to testify your conclusion.

Note: there are two possibilities

Superposition theorem only works in linear circuits. Superposition theorem would not work in nonlinear circuits. Here we have used a diode which is a nonlinear element. From the circuits below we can see If we double the value of the voltage and the current source from 10V and 2A respectively to 20V and 4A, the voltage across the R1 and the diode changes. But no relationship can be found which satisfies the linearity of the circuit.