Circuits() Multiloop DC and AC Circuits November 11, 2007

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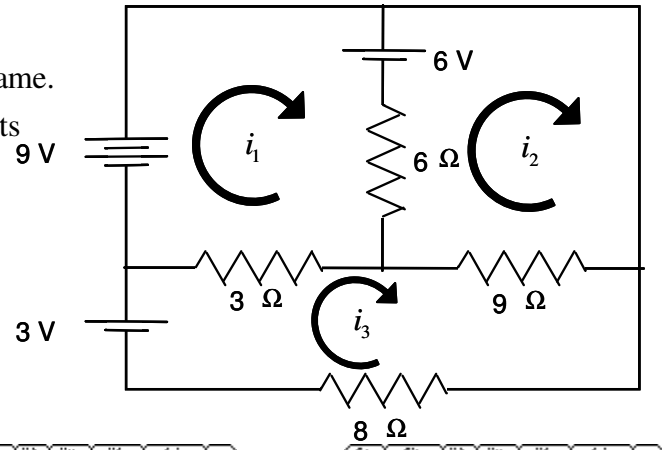
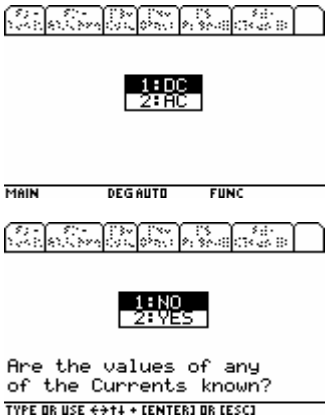
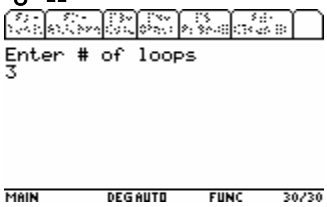
This program uses the loop current method to solve multiloop circuits, either DC or AC. The method is shown in the following examples. It can be used to solve for currents, voltages, charges (on capacitors), or resistances (impedances for AC). Partsequ(), Mtrxedt(), and Copyto_h() are used in Circuits(). Place all programs in the same folder, then run Circuits().

In the 3 loop DC circuit shown, the program will solve for the 3 loop currents shown. They can be either clockwise or counterclockwise but all must be the same. The loop currents are the actual currents in the outer branches of the circuit. The currents in the inner branches can be found from differences in the loop currents. The current in the 6 Ω resistor is $i_1 - i_2$, $i_1 - i_3$ in the 3 Ω, and $i_2 - i_3$ in the 9 Ω.

Example 1. DC circuit, all currents unknown

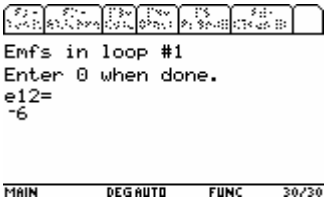




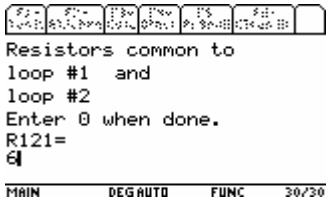


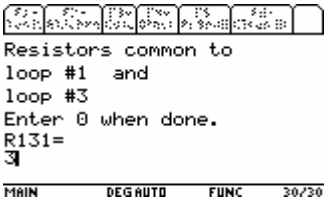
Enter values for the resistors in the loop one at a time. After all are entered, enter 0 to move to the next step.

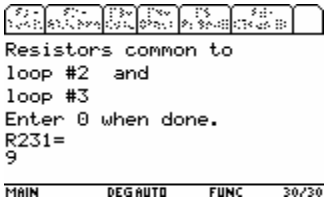
Enter values,including polarity, for the emfs in the loop one at a time. Enter 0 to move to the next step.

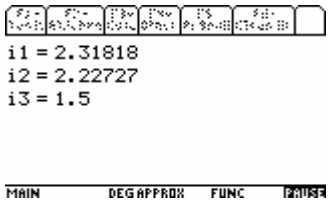


The same procedure is followed for each individual loop.
Then,using a similar procedure, the resistors common to each pair of loops are entered.

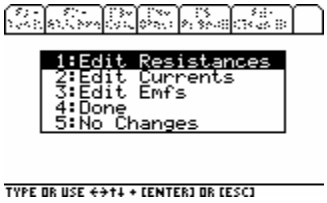


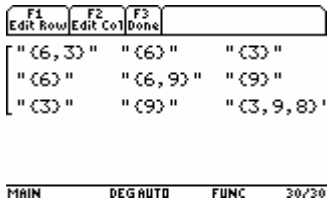


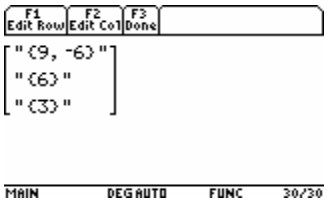




All data can be edited.







When editing Resistances and Emfs, they are shown as elements of lists within a matrix in the format shown at right.
When changing a value, be sure to change it in each matrix element in which it appears. The program used to edit the matric Mtrxedt(), is a simplified version of my program, Mtrxedtr().

$$\begin{bmatrix} \{R_{11}\} & \{R_{12}\} & \{R_{13}\} \\ \{R_{21}\} & \{R_{22}\} & \{R_{23}\} \\ \{R_{31}\} & \{R_{32}\} & \{R_{33}\} \end{bmatrix}$$

$$\begin{bmatrix} \{\varepsilon_1\} \\ \{\varepsilon_2\} \\ \{\varepsilon_3\} \end{bmatrix}$$

R_{11} = all resistors in loop 1

$R_{12} = R_{21}$ = all resistors common to loops 1 and 2

etc.

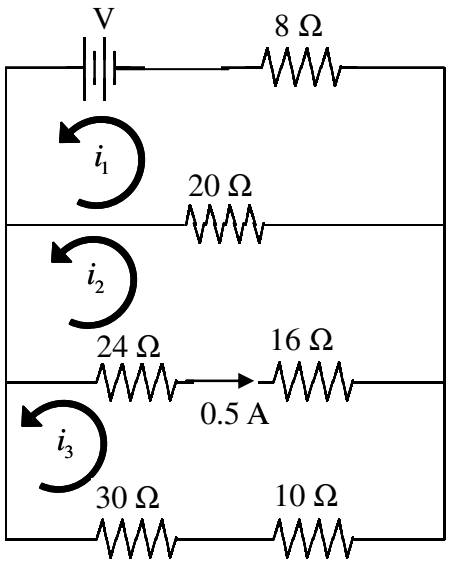
ε_1 = all emfs in loop 1

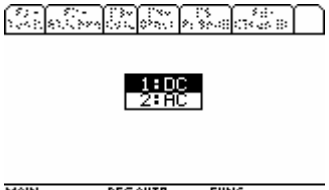
etc.

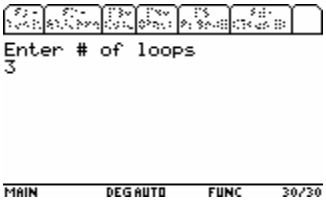
Example 2. DC circuit, one current known

In this DC circuit, the current in the 24 and 16 Ω resistors is given as 0.5 A.

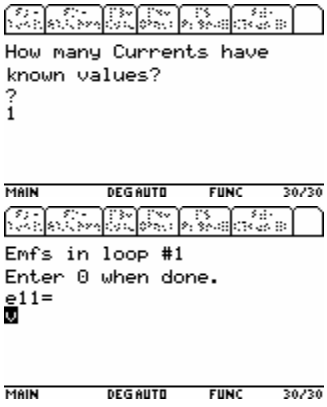
So $i_2 - i_3 = 0.5$, or $i_2 = i_3 + 0.5$



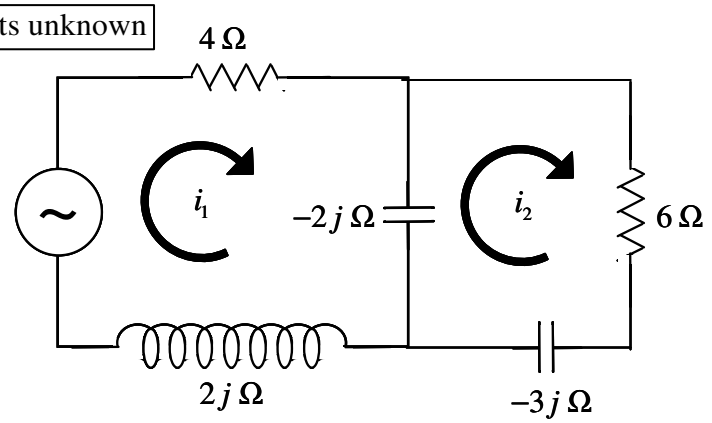




Enter resistors and as in example 1. The entry of the unknown emf in loop 1 is shown at right.



Example 3. AC circuit, all currents unknown



1:DC
2:AC

MAIN DEG AUTO FUNC 30/30

Enter values as complex numbers, either (r∠θ) or x+yi

MAIN DEG AUTO FUNC 30/30

Impedances in loop #1
Enter 0 when done.
Z11=
2i

MAIN DEG AUTO FUNC 30/30

Emfs in loop #1
Enter 0 when done.
e11=
(60∠30)

MAIN DEG AUTO FUNC 30/30

Enter # of loops
2

MAIN DEG AUTO FUNC 30/30

Impedances in loop #1
Enter 0 when done.
Z12=
4

MAIN DEG AUTO FUNC 30/30

Enter values for the other loop.

1:NO
2:YES

Are the values of any of the Currents known?

TYPE OR USE ↔↑↓ + [ENTER] OR [ESC]

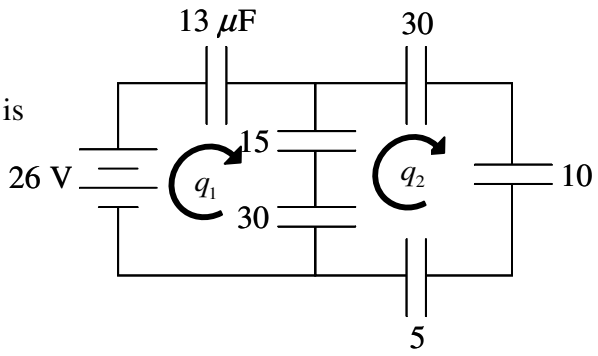
Impedances in loop #1
Enter 0 when done.
Z13=
-2i

MAIN DEG AUTO FUNC 30/30

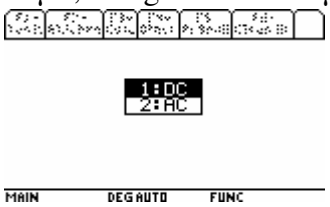
i1=(13.6188 ∠ 25.7321)
i2=(3.48743 ∠ -24.4623)

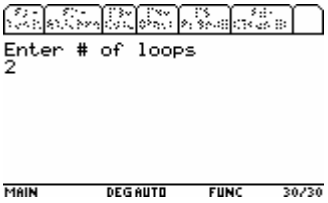
MAIN DEG APPROX FUNC

Example 4. DC capacitor circuit

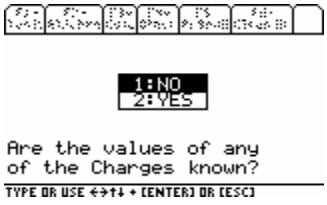


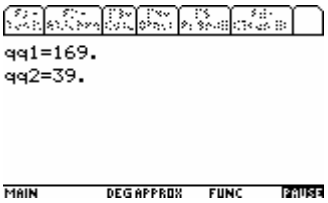
Data is entered as before. If capacitance is in μF, charges will be in μC.





Continue as before.





$qq1 =$ charge on 13μF

$qq2 =$ charge on 5μF, 10μF, 30μF

$qq1 - qq2 =$ charge on 15μF, 30μF

$$C_{eq} = \frac{qq1}{e} = \frac{169\mu\text{C}}{26\text{V}} = 6.5\ \mu\text{F}$$