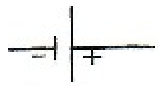
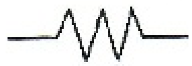
Electrical Networks

Symbols and Variables:

An electrical source (a battery, for example): 

A resistor (a light bulb, for example): 

E = electrical potential in volts (V) R = resistance in ohms (Ω) I = current in amperes (A)

Laws:

(1) Ohm's Law: $E = IR$ voltage (rise or drop) = (current)(resistance)

(2) Kirchoff's Current Law: Σ *incoming currents* = Σ *outgoing currents* (*at all nodes*)

(3) Kirchoff's Voltage Law: $\Sigma\ EMF = \Sigma\ IR$

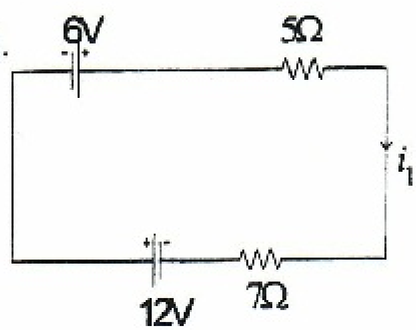
<u>Problem Set I</u>

Solve for the currents in each of the following:

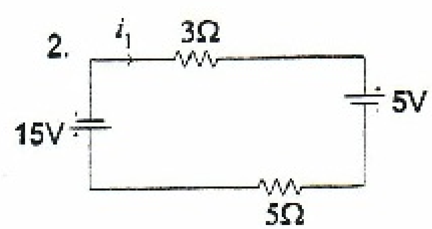
Note (1) Interpret any negative answers

(2) With the exception of numbers (1) and (2), use an augmented matrix to solve the system of equations. The coefficient matrix should be square and the solution to the system of equations should be unique. The number of equations obtained from the loops is equal to the number of small loops. The number of equations obtained from the nodes is equal to the number of nodes minus 1.

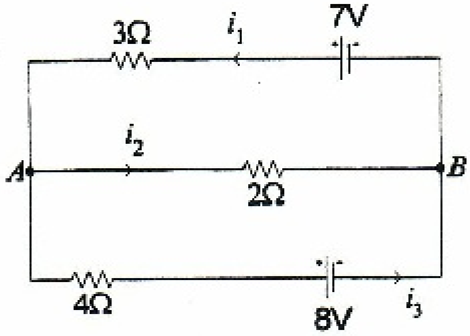
1.



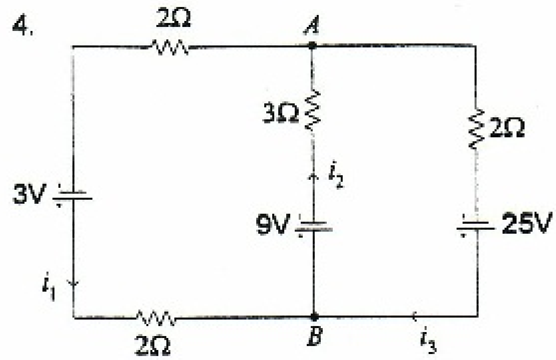
2.



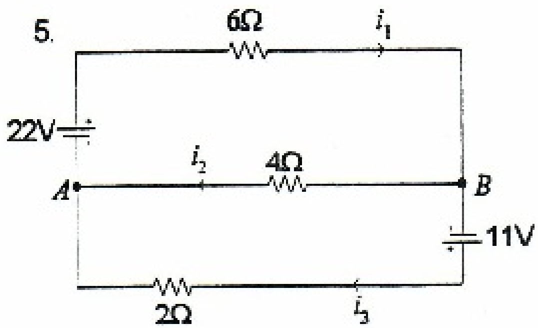
3.


3Ω
i_1
7V
i_2
A
2Ω
B
4Ω
8V
i_3

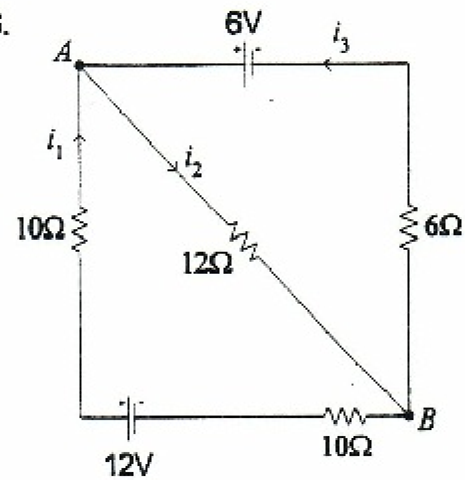
4.


2Ω
A
3Ω
2Ω
i_2
3V
9V
25V
i_1
2Ω
B
i_3

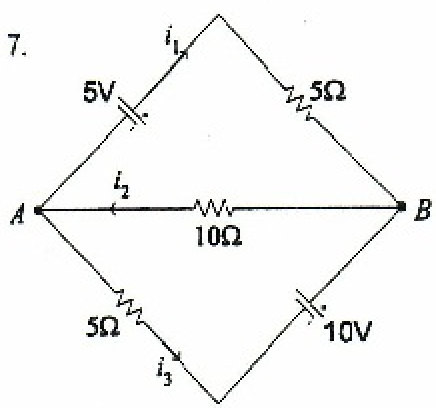
5.


6Ω
i_1
22V
i_2
4Ω
A
B
11V
2Ω
i_3

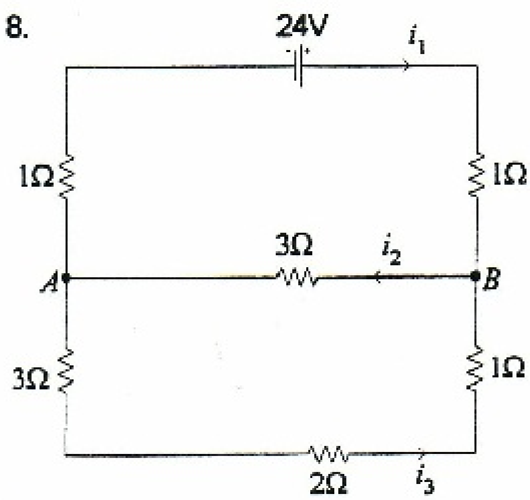
6.


6V
i_3
A
i_1
i_2
10Ω
12Ω
6Ω
12V
10Ω
B

7.


i_1
5V
5Ω
i_2
A
10Ω
B
5Ω
10V
i_3

8.


24V
i_1
1Ω
1Ω
3Ω
i_2
A
B
3Ω
1Ω
2Ω
i_3

Answers (in amperes): (Interpret all negative signs)

1) $i_1 = \frac{3}{2}$

3) $i_1 = 1$, $i_2 = 2$, $i_3 = -1$

5) $i_1 = 4$, $i_2 = -\frac{1}{2}$, $i_3 = \frac{9}{2}$

7) $i_1 = -\frac{1}{5}$, $i_2 = \frac{3}{5}$, $i_3 = \frac{4}{5}$