Name: ____________________

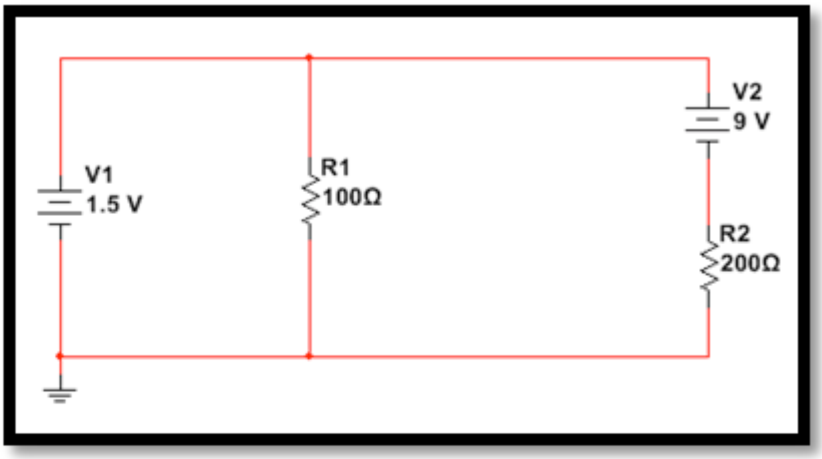
5.2 Kirchoff's laws worksheet VIII

Kirchhoff's Current Law - states that the current entering a point in a circuit is equal to the summation of the currents exiting.

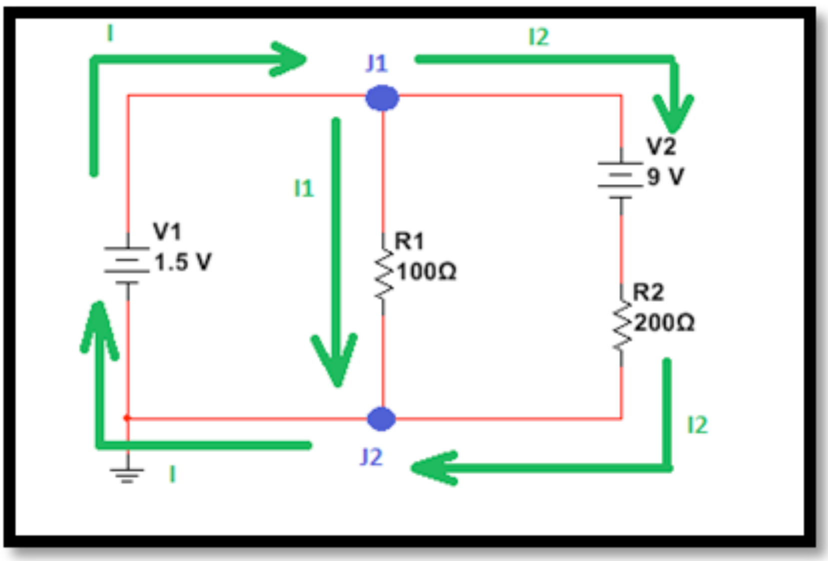
Kirchhoff's Voltage Law - states that the summation of all voltage drops in a closed loop must equal to zero which is a result of the electrostatic field being conservative.

(Conventional) current flowing through the cell has a positive voltage (gains energy). Current going through a resistor has a negative voltage (loses energy).

Example Problem



Begin by labelling the junctions in our circuit, $\mathbf{J_1}$ and $\mathbf{J_2}$. Then we label the currents as **I**, $\mathbf{I_1}$ and $\mathbf{I_2}$ in an arbitrary direction as shown in the figure below. (Direction of currents will be confirmed once we complete the problem).



Junction J_1:

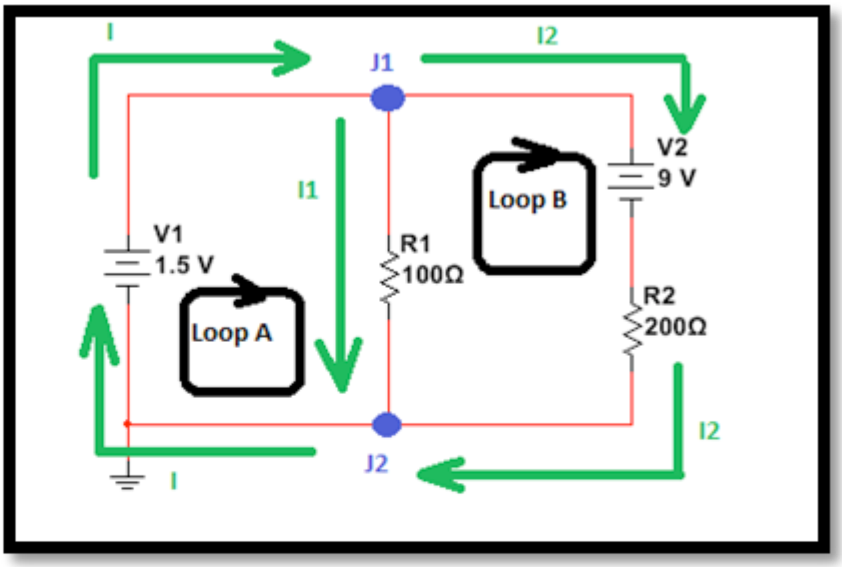
$\mathbf{I = I_1 + I_2}$ (equation 1)

Junction J_2:

$I_1 + I_2 = I$ (which is the exact same equation we got from **J_1** above)

Determine the voltage drops V_{R1} and V_{R2} across each resistor.

Begin by labelling the loops as loop **A** and loop **B** as shown below.



__Loop A__: (start from the upper left corner and move clockwise)

$-I_1$ x (100 Ω) + 1.5V = 0 (equation 2)

Therefore: **I_1 = 0.015 A**

__**Loop B:**__

-9V – I_2 x (200 Ω) + I_1 x (100 Ω) = 0 (equation 3)

Substituting the value of I_1 into equation 3 yields:

-9 – I_2 x (200 Ω) + (0.015)(100 Ω) = 0

-7.5 = (200) x I_2 therefore: **I_2 = -0.0375 A**

And then **I = -0.0225 A**

__Note__ that the negative sign of the current indicates that the arbitrary direction we chose is the opposite of the actual direction the current is flowing in.

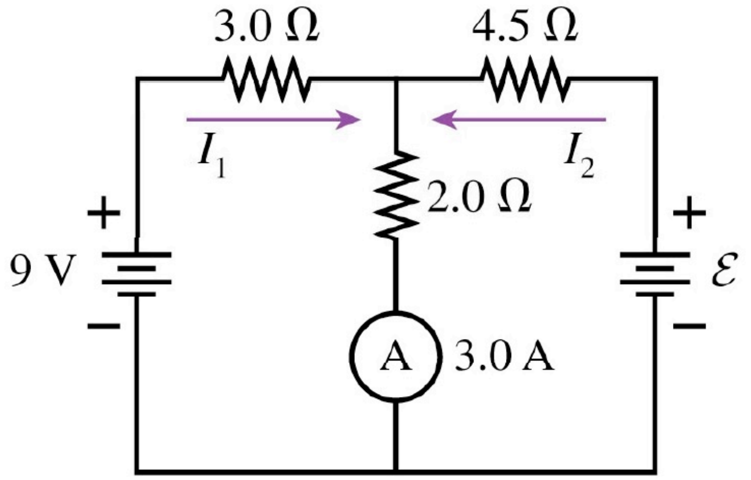
__Answer Sub-Step 3: Determine the values of V_{R1} and V_{R2} based on our calculated values for I_1 and I_2__

$V_{R1} = I_1 \times R_1$ = (0.015 A) x (100 Ω) therefore **V_{R1} = 1.5V**

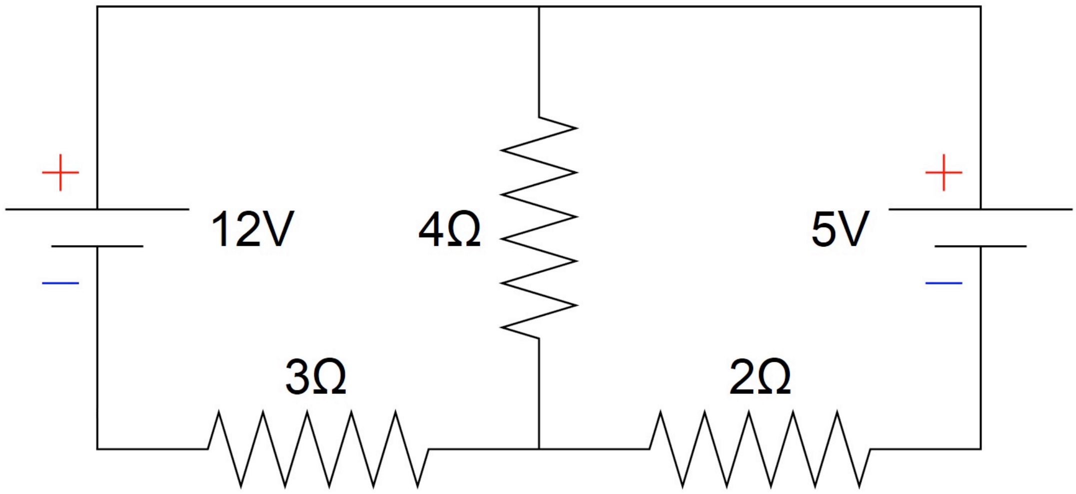
$V_{R2} = I_2 \times R_2$ = (-0.0375 A) x (200 Ω) therefore **V_{R2} = -7.5V**

Find all the currents and voltages across each resistor and cell in the following circuits;

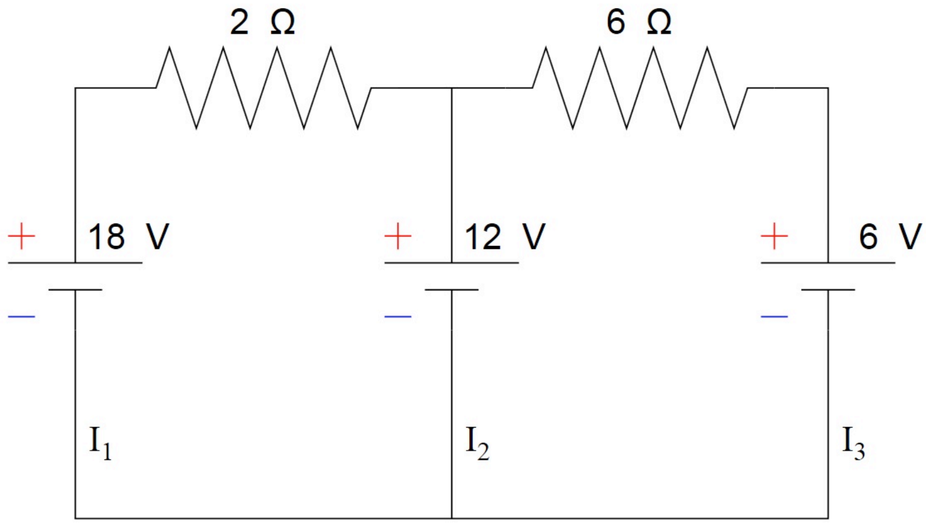
1.



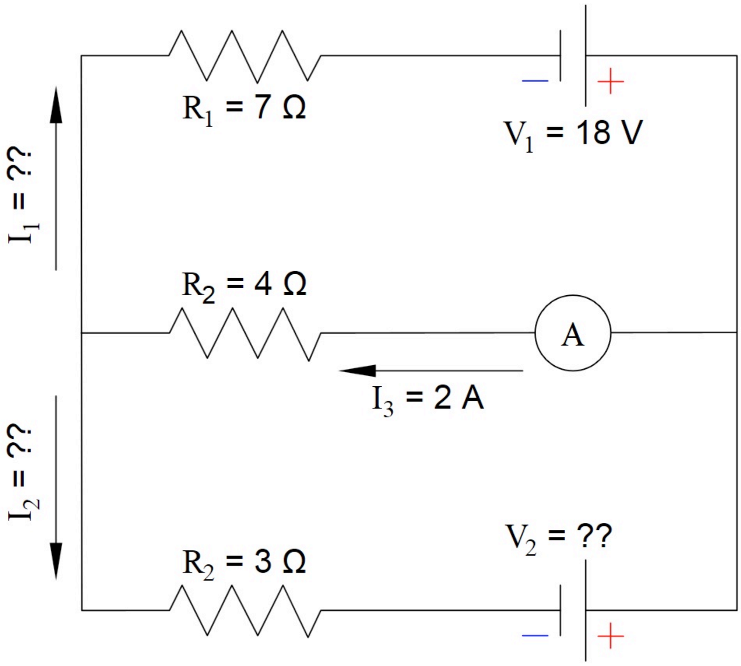
2.



3.

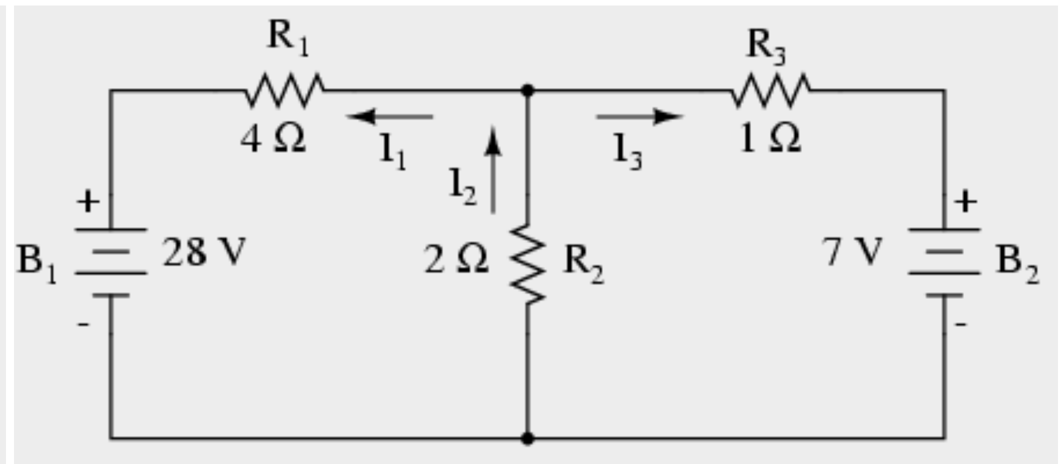


4.



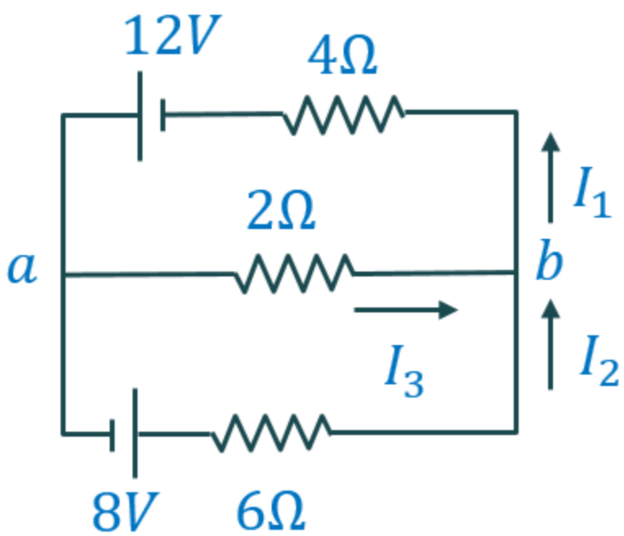
R1 = 7 Ω
V1 = 18 V
I1 = ??
R2 = 4 Ω
A
I3 = 2 A
I2 = ??
V2 = ??
R2 = 3 Ω

5.



R1
4 Ω
I1
I2
R3
I3
1 Ω
B1
28 V
2 Ω
R2
7 V
B2

6.



12V
4Ω
I1
2Ω
a
b
I3
I2
8V
6Ω