2426 (1) Phys 2426 2015-09-17 Lec 7

HW 2 - Work on it!
- Use "Ask Your Teacher"

Want to transfer energy quickly.
Usual phone charger = 5.0 V.

Rate of Energy Flow = $P = I V$

For small wires, $I = 2.0 A$ max.

$P = (5V)(2A) = 10 W$

Qualcomm Quick Charge

$V = 5V, 9V, 12V$

Then $P = (12V)(2A) = 24 W$

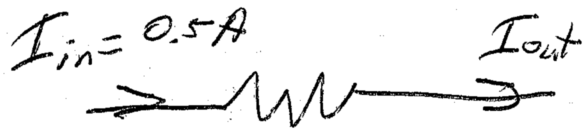
2426 (2)

Circuit Analysis Principles

* Cons. Charge
* Cons. Energy per charge

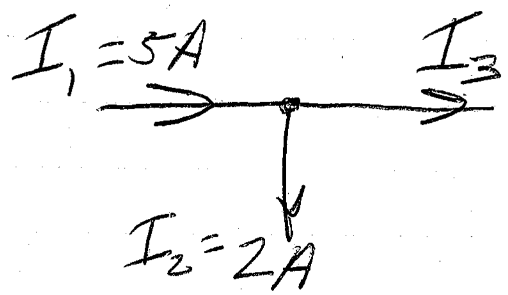
Cons. Charge

Must account for all current.
What goes in must come out.
Current flows <u>through</u> components.



We know $I_{out} = 0.5\ A$

At a junction, current "splits".



We know $I_3 = 3A$

$$I_1 = I_2 + I_3$$

In general: $\sum I_{in} = \sum I_{out}$

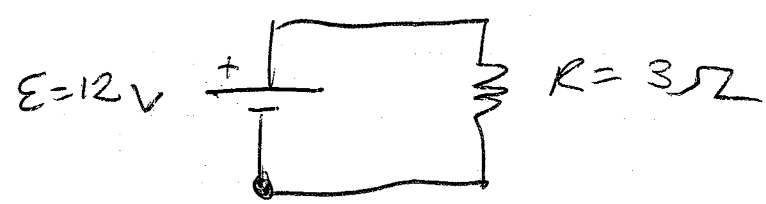
2426 (3)

Cons. Energy per charge

- When a charge completes any loop, its total energy gain must equal its total energy loss.

For any loop:

$$\sum V_{gain} - \sum V_{loss} = 0$$
$$\sum \Delta V = 0$$



My Loop: start @ lower left, go CW.

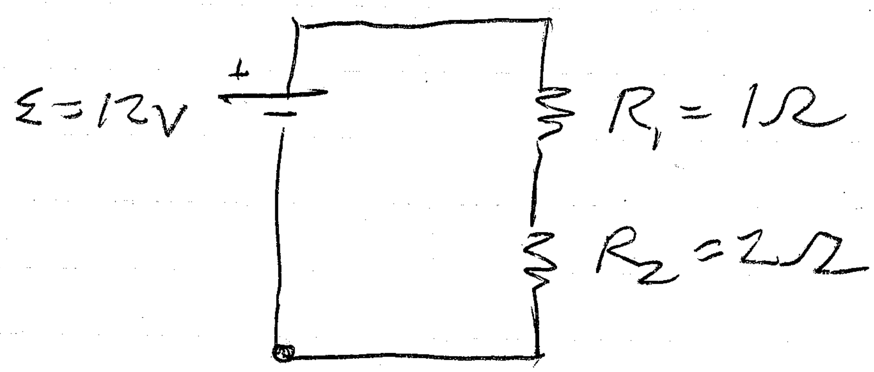
Battery $V_{gain} = 12V$ $\Delta V = +12V$

Resistor $V_{loss} = IR$ $\Delta V = -IR$

$$12V - IR = 0$$
$$12V = I(3\Omega)$$
$$I = 4A$$

Loop eqn says $V_{batt} = V_R$

<u>Series Circuit</u> - current passes thru one component after another.



Charge: There is only one current.

$$I_{batt} = I_1 = I_2 = I$$

Voltage: Loop from Lower-Left, CW

Batt: $V_{gain} = 12\,V$

R_1: $V_{loss} = I\,(1\Omega)$

R_2: $V_{loss} = I\,(2\Omega)$

$$(12v) - I(1\Omega) - I(2\Omega) = 0$$

$$(12v) - I(1\Omega + 2\Omega) = 0$$

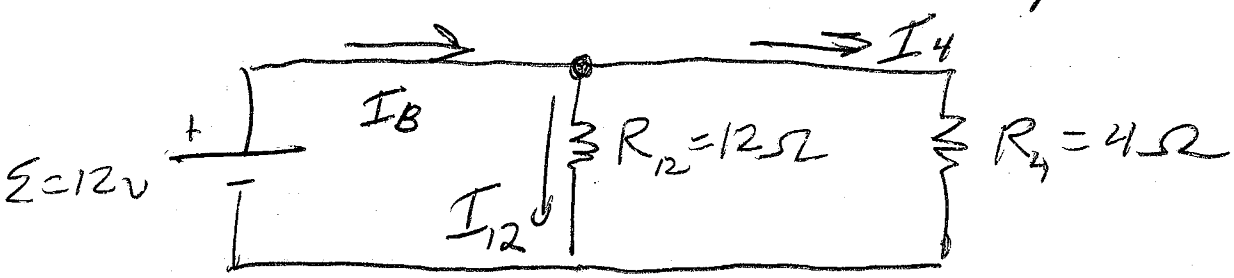
$$(12v) = I\,(1\Omega + 2\Omega)$$

$$V = I \quad R$$

Series: $R_{eq} = R_1 + R_2 + \cdots$

2426 (5)

Parallel Circuit - current has options



Current: At top junction
I_{batt} is inward
I_4 is outward
I_{12} is outward

$$I_B = I_4 + I_{12}$$

Voltage: Can follow different loops

<u>Batt - R_{12}</u>

$$12V - I_{12} R_{12} = 0$$

$$I_{12} = \frac{12V}{12\Omega} = 1A$$

<u>Batt - R_4</u>

$$12V - I_4 R_4 = 0$$

$$I_4 = \frac{12V}{4\Omega} = 3A$$

$$I_B = 3A + 1A = 4A$$

Batt "sees": $\mathcal{E} = 12V$ $I = 4A$ $R_{eq} = 3\Omega$

R_4 "sees": $R_4 = 4\Omega$ $I = 3A$ $V_4 = 12V$

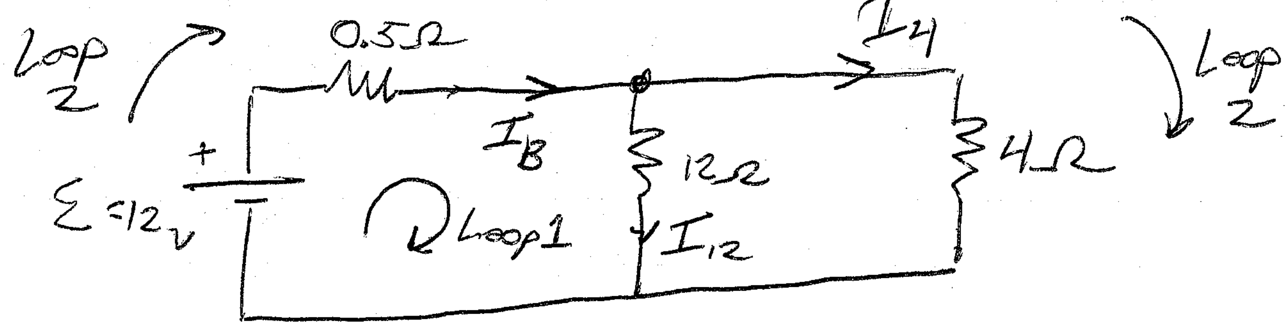
R_{12} "sees": $V_{12} = 12V$

2426 (6)

	Series	Parallel
Current	$I = I_1 = I_2 = I_3 = \cdots$	$I_T = I_1 + I_2 + \cdots$
Voltage	$V_T = V_1 + V_2 + \cdots$	$V = V_1 = V_2 = \cdots$
Resistance	$R_{eq} = R_1 + R_2 + \cdots$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$
Power	$P_T = P_1 + P_2 + \cdots$	$P_T = P_1 + P_2 + \cdots$

For any circuit: $\Sigma P_{gen} = \Sigma P_{used}$

2426 (7) Combination Circuit



Method 1:

$$I_B = I_4 + I_{12}$$

$$(12\,V) - 0.5\,I_B - 12\,I_{12} = 0$$

$$(12\,V) - 0.5\,I_B - 4\,I_4 = 0$$

Method 2: