Circuits

Electrical Circuit - An arrangement where ~~electrons~~ electric charges can flow in a closed path.

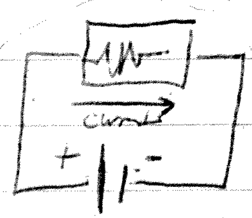
Simplest Circuit

A power source to provide potential difference, a resistor, wires

Symbol for resistor 

Symbol for Source of potential difference 

Circuit



X Electrons flow from the negative terminal to the positive terminal.

- Electrons use up all the energy by the time the reach the positive terminal - Heat (overcome resistance)

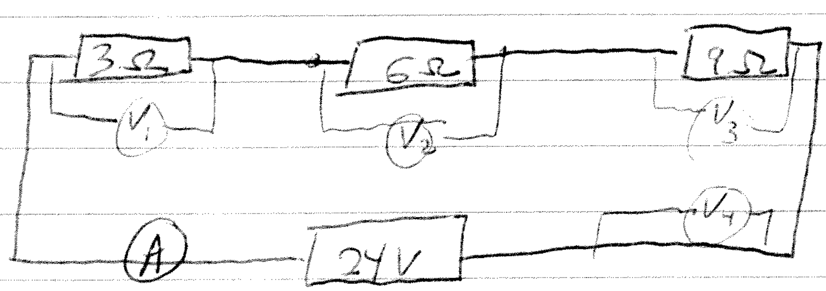
* Power Source needed to provide new energy

* Therefore, current (I) must be moving in the opposite direct.

~~Ohms Law V=IR~~ Series Circuits

Example - Christmas lights - When 1 bulb burns out, they all go out

Series Circuit - Current has only 1 path. If the path is interrupted, then entire circuit ceases to work.



-(V)- Voltmeter - High resistance device - measures potential difference across 2 points in a circuit

Ammeter -(A)- Low resistance device that measures current through any part of the circuit.

Series Circuit -

~~[scribbled out]~~ Since circuit has only 1 path, the current throughout the circuit is constant

- If use an ammeter you would get the same value

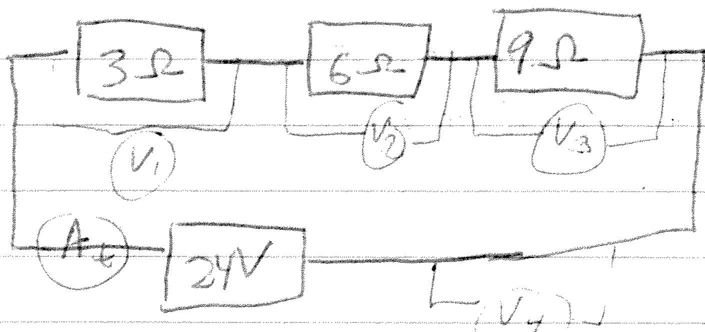
Series Circuit Concept

$I_{Total} = I_1 = I_2 = I_3$ $\quad I_{Total} = \frac{V_T}{R_T}$

$V_{Total} = V_1 + V_2 + V_3$

$R_{Total} = R_1 + R_2 + R_3$ ...

- Potential Difference Supplied by the power Source is equal to the ^(sum of) potential difference across ~~all~~ resistors



$R_T = R_1 + R_2 + R_3$

$= 3\Omega + 6\Omega + 9\Omega = 18\Omega$

~~$V_T = I_T R_T$~~

$V_T = I_T R_T$

$24V = I_T (18\Omega)$

$I = 1.33A$

(Show same accross all pts)

$V_1 = (1.33A)(3\Omega) = 4V$

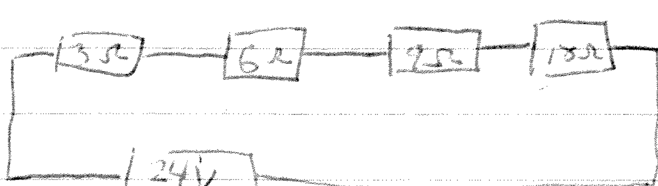
$V_2 = (1.33A)(6\Omega) = 8V$

$V_3 = (1.33A)(9\Omega) = 12V$

Since we ignore the resistance of the wire, 0Ω, No work needed to overcome R

$V_4 = 0V$

Ex2



$R_{Total} = 3\Omega + 6\Omega + 9\Omega + 18\Omega = 36\Omega$

$V_T = I_T R_T$

$24V = I_T \, 36\Omega$ $\quad I_T = 0.67$ (A)

* When resistance in a series circuit increases, the current decreases

Ex. Think of the wire as a road & resistors as an circuit, Traffic lights → b current of

We know about Series

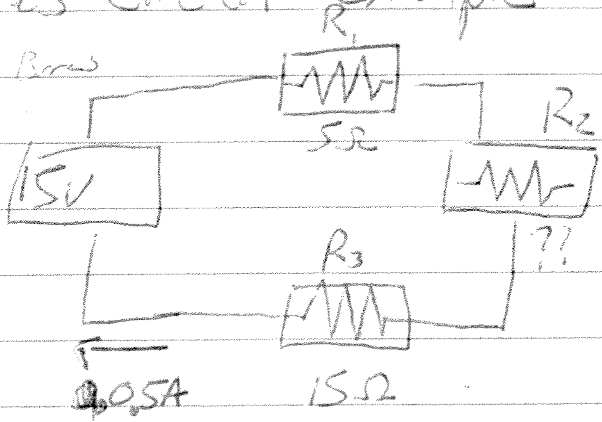
$R_T = R_1 + R_2 + R_3$

$V_T = V_1 + V_2 + V_3$

$I_T = I_1 = I_2 = I_3$

$I_T = \frac{V_T}{R_T}$

Series Circuit Example



1) What is the equivalent resistance in the circuit

$V_T = I_T R_T \qquad R_T = \frac{15V}{0.5A} = 30\,\Omega$

$R = \frac{V}{I}$

2) What is the potential Difference across R_2?

$V = IR \qquad V_1 = 0.5A(5\,\Omega) \qquad V_3 = .5A(15\,\Omega)$

$V_1 = 2.5V \qquad V_3 = 7.5V$

$V_T = V_1 + V_2 + V_3$

$15V = 2.5V + V_2 + 7.5V$

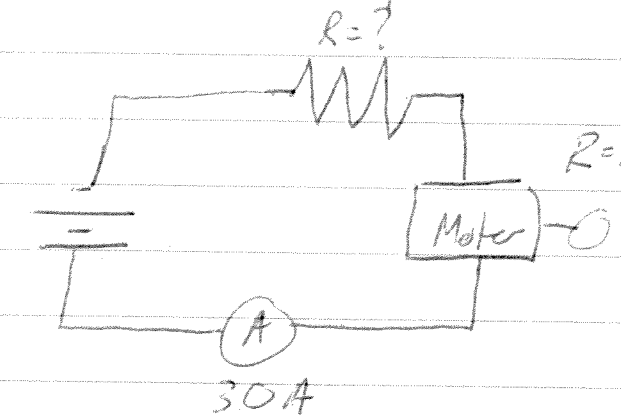
$V_2 = 5V$

$R = \frac{V}{I} = \frac{5V}{.5A}$

3) What is the total power developed in the circuit

$P_T = I_T V_T = .5A(15V) = 7.5W$

Series Circuit Example



① What is the resistance in the ~~motor~~ Resistor?

$$\frac{V_T}{I_T} = \frac{I_T R_T}{I_T} \qquad R_T = \frac{V_T}{I_T}$$

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

R_T = -ww- (R) + [Motor]

$4\Omega = 2\Omega + 2\Omega$

~~② What is the voltage in the Motor~~

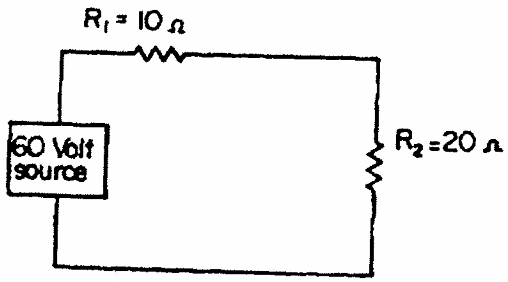
~~$V_{Mot} = \frac{I}{R_{Motor}}$ (Motor) $V_{Mot} = \frac{3A}{2\Omega} = 1.5V$~~

Name: Key

Date: ____________________

Physics: Series Circuits

Base your answers to questions **1** through **4** on the diagram below.



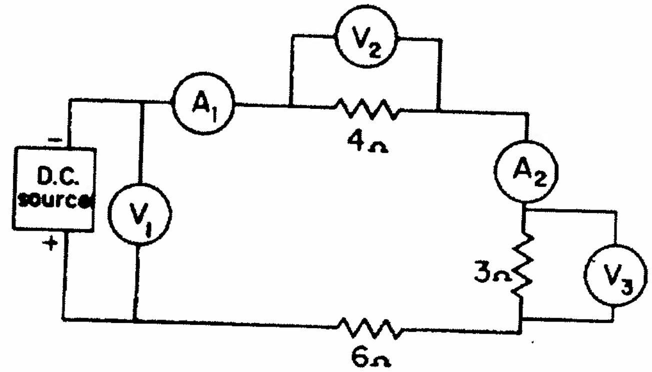
1. What is the total resistance of the circuit?
   (1) 6.6 Ω (3) 20 Ω
   (2) 10 Ω **(4) 30 Ω** 4

2. If the potential difference across R_1 is V volts, the potential difference across R_2 would equal
   (1) *V* volts **(3) (60 – *V*) volts**
   (2) 1/2 (60 – *V*) volts (4) (60 + *V*) volts 3

3. If the potential difference of the source were decreased, the total heat developed in the circuit would
   (1) decrease (3) remain the same
   (2) increase
   1 v...

4. Compared to the current in R_1, the current in R_2 is
   (1) less **(3) the same**
   (2) greater
   3

Base your answers to questions **5** through **8** on the diagram below. The reading of voltmeter V_1 is 26 volts, and the reading of ammeter A_1 is 2 amperes.



5. What is the reading of voltmeter V_2?
   (1) 52 V (3) 13 V
   (2) 26 V **(4) 8 V**
   4

6. What is the total resistance of the circuit?
   (1) ¾ Ω (3) 10 Ω
   (2) 4/3 Ω **(4) 13 Ω**
   4

7. The reading of ammeter A_2 is
   (1) 6 A (3) 3 A
   (2) 2 A (4) 52 A
   2

8. If additional resistances are added in series and the applied voltage is kept constant, the reading of voltmeter V_3 will
   (1) decrease (3) remain the same
   (2) increase
   1

9. Base your answers to parts a though c on the information and data table below.

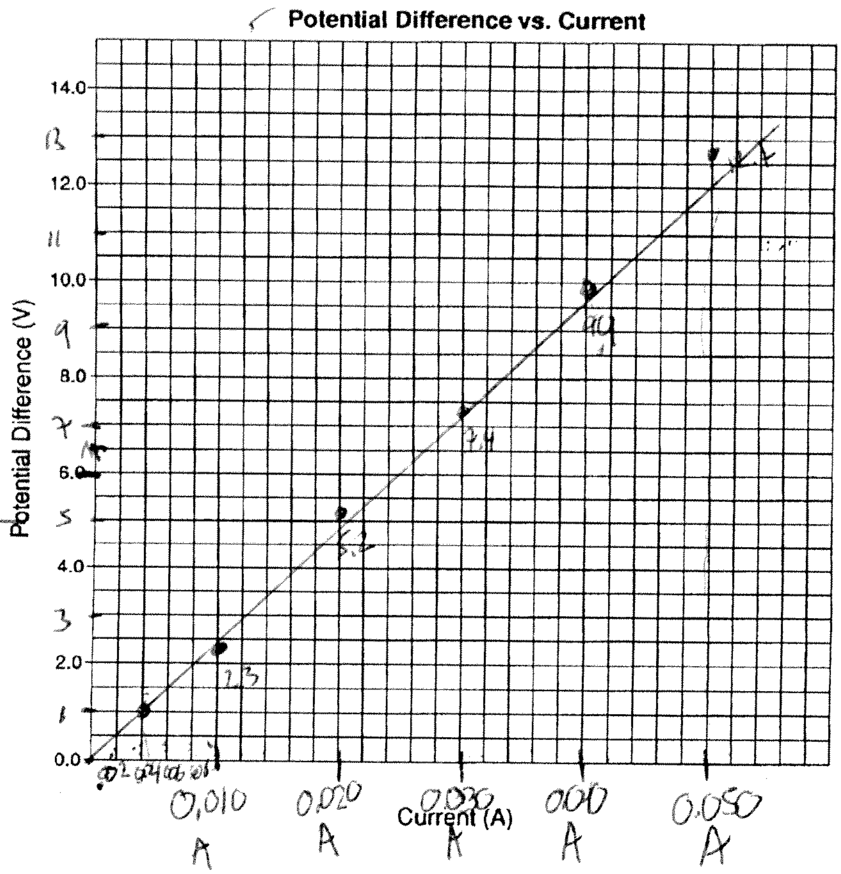
A resistor was held at constant temperature in an operating electric circuit. A student measured the current through the resistor and the potential difference across it. The measurements are shown in the data table below.

Data Table

Current (A)	Potential Difference (V)
0.010	2.3
0.020	5.2
0.030	7.4
0.040	9.9
0.050	12.7

Slope $\frac{\Delta Y}{\Delta X} = \frac{1V - 0V}{.004A - 0A} = 250\Omega$

$\frac{1V}{.004A}$



a Using the information in the data table, construct a graph on the grid provided following the directions below.
(1) Mark an appropriate scale on the axis labeled "Current (A)"
(2)Plot the data points for potential difference versus current.
(3)Draw the best-fit line.

b Using your graph, find the slope of the best-fit line. [Show all calculations, including the equation and substitution with units.]

c What physical quantity does the slope of the graph represent?

Resistance