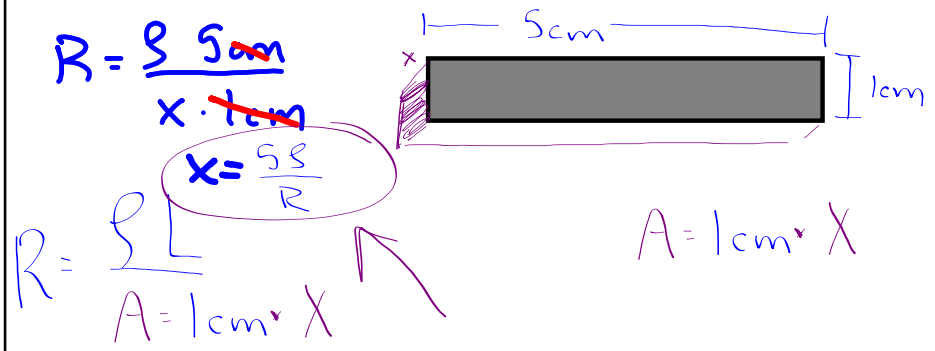


Resistance in an Electric Circuit

Variable:	V	I	R
Quantity:	Pot. Diff	Current	Resistance
Units:	[V]	[A]	[Ω]
Type:	Scalar	Scalar	Scalar

Electrical resistance: ratio of applied potential difference to current

Formula: $R = V/I$

$V = E/q$ $[J/C] = [V]$

$I = q/t$ $[C/s] = [A]$

$R = V/I$ $[V/A] = [\Omega]$

$R = \rho L/A$

Resistance in an Electric Circuit

3. What is the resistance of a small appliance that draws 3.00 A
at 120 Volts?

$R = V/I = \frac{120V}{3A} = 40\Omega$

Georg Simon Ohm
(1787 – 1854)

Ohm's Law

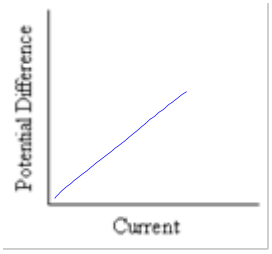
Ohm's Law: For a conductor at constant temperature, potential difference is proportional to current over a wide range of potential
differences

$V = IR$

This means that . . . the resistance of these materials is constant over a wide range of applied voltages

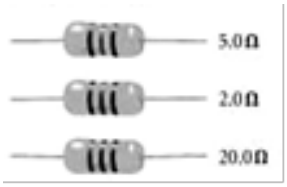
Resistance in an Electric Circuit

I. Ohmic device: device whose resistance remains constant – obeys Ohm's law



Slope: $V/I = R$

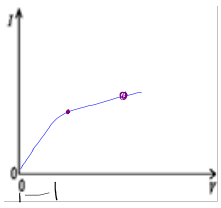
Example:



Slope: $\frac{I}{V} = \frac{1}{R}$

Resistance in an Electric Circuit

II. Non-Ohmic device: device whose resistance changes – doesn't't follow Ohm's law

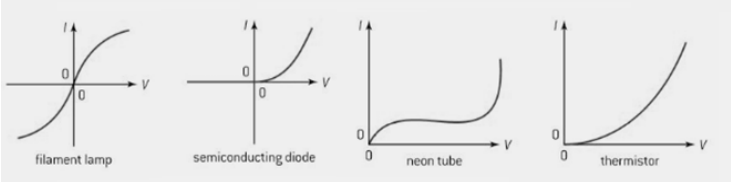


Relationship

voltage increases faster than current

Example:

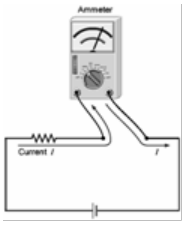
4. Why is a filament lamp non - ohmic?



I-V characteristics for various non-ohmic conductors

Types of Meters

Ammeter: device to measure current



Placement:

Must be placed in series to allow current to flow through it

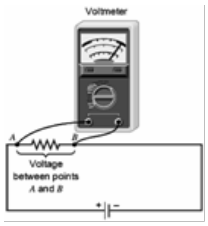
Circuit must be broken to insert ammeter

Ideal ammeter:

Has zero resistance so it will not affect current flowing through it

Types of Meters

Voltmeter: device to measure potential difference



Placement:

Must be placed in parallel to measure potential difference between two points

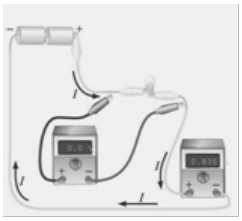
Placed outside circuit – no need to break circuit

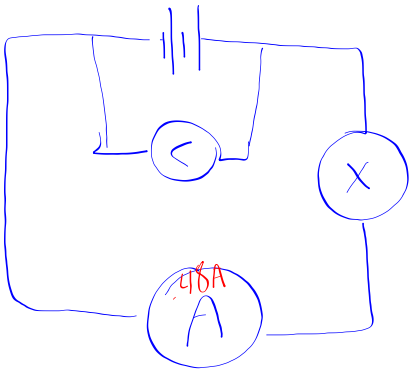
Ideal voltmeter:

Has infinite resistance so it will not allow any current to flow through it and disrupt circuit

Simple Circuits and Schematics

5. Draw a circuit diagram to include a 6.0 V battery hooked to a 12.5 Ω resistor. Include an ammeter reading the current in the circuit and a voltmeter to measure the potential difference across the resistor. Determine the reading on each meter.





$I = V/R = 6v/12.5\Omega$

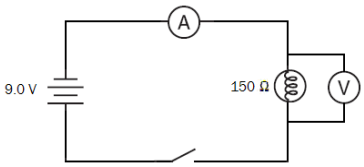
$= .48A$

6v

A

Simple Circuits and Schematics

6. Determine the readings on the meters when the switch is open and when it is closed.



Meter	Reading when Open	Reading when Closed
V	0	
A	0	

Open circuit: incomplete pathway for current – break in circuit – infinite resistance

Closed circuit: complete pathway for current

Short circuit: circuit with little to no resistance – extremely high current - overheating

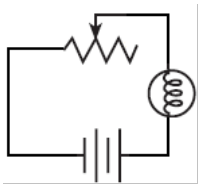
Simple Circuits and Schematics

Variable Resistor : a resistor whose resistance can be deliberately controlled/changed (rheostat). If there are 3 terminals, it is called a potentiometer (pot).

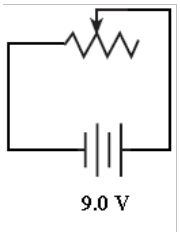
Also called: potentiometer – rheostat

7. What are some common uses for a variable resistor?

8. If the resistance in the circuit is increased, what will happen to the brightness of the lamp? Why?



9. If the resistor is set to 100 ohms, what is the current in the circuit?



Electrical Power and Energy

Power: rate at which work is done – rate at which energy is used/dissipated

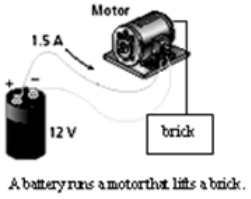
Mechanical	Electrical

Electrical Power

P = Units:

Electrical Energy

W = Units:



A battery runs a motor that lifts a brick.

Electrical Power and Energy

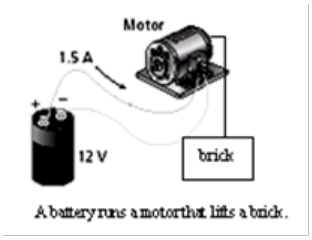
1. A mini light bulb is connected to a 1.5 volt battery and draws a current of 28 mA.

a) How much power does it dissipate?

b) How much energy does the light bulb use in 1.0 minute?

Electrical Power and Energy

2. Refer to the drawing above of a motor lifting a brick.



A battery runs a motor that lifts a brick.

a) How fast can the motor raise a 2.0 kg brick?

b) How much energy will the motor use in 10.0 seconds?