5. What is the resistance of a copper wire 2.0 meters long with a cross-sectional area of 6.4×10^{-8} m^2?

6. a) What is the resistance of a nichrome wire 12 meters long with a diameter of 2.7×10^{-4} meter?

b) if the diameter of the wire above is doubled, what is its resistance?

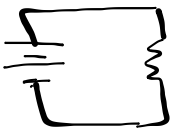
Simple Circuits and Schematics

Schematic: diagram using symbols to represent circuit elements

For each circuit shown below, draw a corresponding schematic diagram using appropriate Circuit Symbols

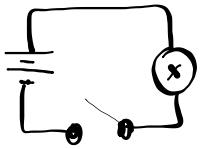
1. Actual Circuit

Schematic Diagram of Circuit

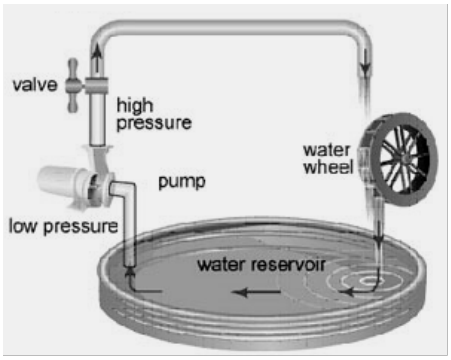


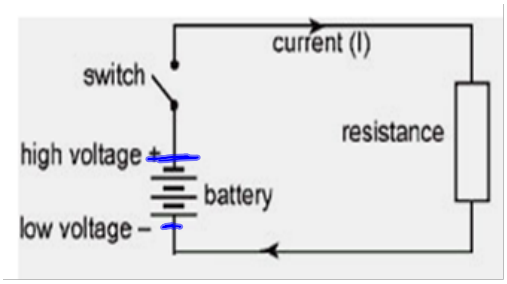
2. Actual Circuit

Schematic Diagram of Circuit



Water Analogy for a Simple Circuit

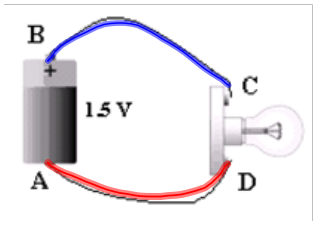




Electric Circuits

1. For the electric circuit shown, what is the potential (voltage) at:

Point A	Point B	Point C	Point D
0v	+1.5v	+1.5v	0v



2. For the electric circuit shown, what is the potential difference from:

A→B	B→C	C→D	D→A
+1.5v	0	-1.5v	0

Electromotive Force (emf): conversion from some other form of energy into electrical energy voltage rise, potential increase

Potential difference (pd): conversion from electrical energy into some other form of energy voltage drop, potential decrease

Device					pd or emf?
Cell	converts energy from	chemical	into	electrical	emf
Resistor		electrical		internal	pd
Microphone		sound		electrical	emf
Loudspeaker		electrical		sound	pd
Lamp		electrical		light (and internal)	pd
Photovoltaic cell		light		electrical	emf
Dynamo		kinetic		electrical	emf
Electric motor		electrical		kinetic	pd

Resistance in an Electric Circuit

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

Electrical resistance: ratio of applied potential difference to current

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

Resistance in an Electric Circuit

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

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

$$V = IR$$

Georg Simon Ohm
(1787 – 1854)

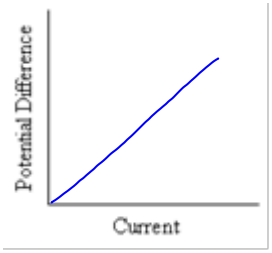
Ohm's Law

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

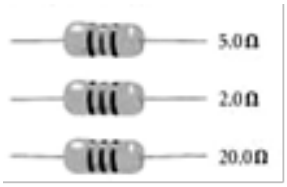
This means that . . . the resistance of these materials is constant over a wide range of applied voltages

Resistance in an Electric Circuit

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



Example:

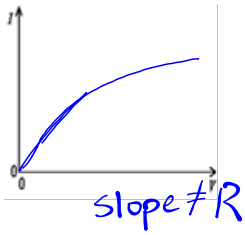


Slope: $\frac{V}{I} = R$

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

Resistance in an Electric Circuit

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



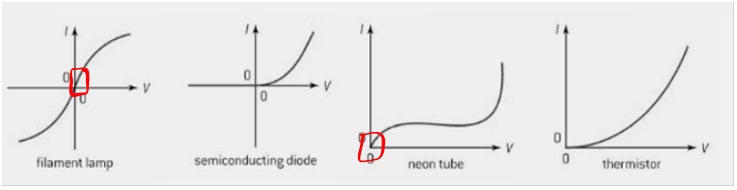
Relationship

current increases w/voltage, but at slower (decreasing) rate

Example:

4. Why is a filament lamp non - ohmic?

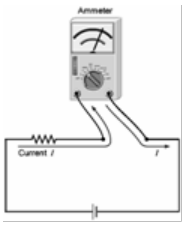
as more current flows, more collisions w/lattice ions, filament heats up, lattice ions moce more -> higher R



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

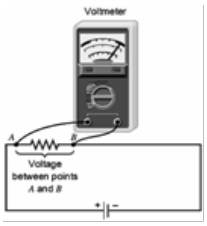
Circuit must be broken to insert ammeter

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

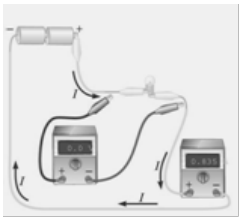
Ideal voltmeter:

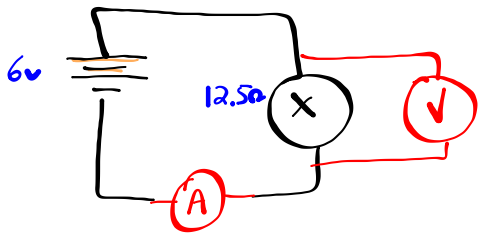
Has infinite resistance so it will not allow any current to flow through it and disrupt circuit

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.

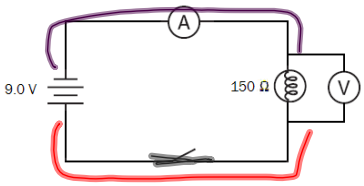
$I = V/R = 6v/12.5\Omega$
$= .48 A$





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)—	0v	9v
—(A)—	0A	.06A

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