8TH GRADE MATHEMATICS:

AIM: USING OHM'S LAW TO SOLVE MATH PROBLEMS

HOME WORK: HANDOUT BY MR. AKOMAH

ENCHANCING STUDENTS SKILLS IN INVERESE OPERATION USING OHMS LAW

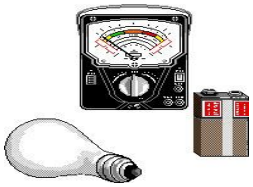
Learning Objectives : Students will…

1.Become aware of Ohm's Law, the relationship between current, voltage, and resistance in a series circuit.

2. To solve selected problems using Ohm's Law & Inverse operation and other math concepts.

3. To study Ohm's law and its application in simple series circuits; to determine current voltage and resistance

CONGITIVE DEMANDS ON THE LESSON



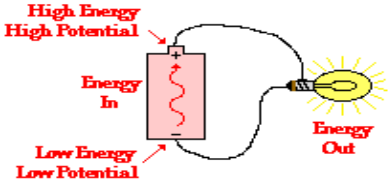
LEVEL I: MATHEMATICAL SKILL

LEVEL II: CONCEPTUAL UNDERSTANDING

LEVEL III: PROBLEM SOLVING

PREPARED

BY: MR. A. AKOMAH



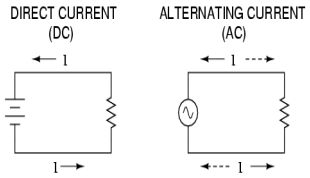
FOR:

Professor: Vikram Kapila

NYU - Polytechnic Institute

MOTIVATION: HAVE A STUDENT READ THE FOLLOWING:
Ohm's Law shows the relationship between ohms, volts and amps. This lesson will help us comprehend the daily use electricity in our homes.

LESSON INTRODUCTION: HOW THIS MATH CONNECTS:
TEACHER: Explain to students the daily use of mathematics in all aspects of our lives. Draw the schematics of a circuit and explain to students how Electricians use the formulas to install the correct gauge of wire to carry the load.



Materials needed per student:

- ☐ **Pencil**
- ☐ **Calculator with √ key & memory +/- functions**
- ☐ **Electricity and Ohm's Law Worksheets**
- ☐ **Electricity and Ohm's Law Example Problem handout**
- ☐ **Formulas, Equations, and Laws handout and two Ohm's Law handouts**

NOTE: Ohm's Law states that in a simple electrical circuit, the voltage equals the electrical current times the resistance.

$$V = IR$$

where:

- **V is the voltage in volts**
- **I is the current in amperes or amps**
- **R is the resistance in ohms**

Vocabulary: CURRENT, VOLTAGE, RESISTANCE

Current: Indicates the amount of electrons passing through the wire and is measured in amperes or amps for short. {I} is the unit symbol for Amps.

EXPLAIN: Current is what flows in a wire or conductor like water flowing down a pipe.

VOLTAGE: The force that drives electrical charges through a circuit is measured in volts. V = IR

RESISTANCE: Determines how much current will flow through a component. Resistors are used to control. $R = \frac{V}{I}$

Teacher used training aids:

- **9 volt battery**
- **18" lengths of insulated wire with clips**

- 10 ohm 0.25 watt resister
- 220 ohm 0.5 watt resister

Problem #1: GIVE STUDENTS TIME TO ANAYLIS THE PROBLEM (LEVEL III)

A 110 volt wall outlet supplies power to a strobe light with a resistance of 20 ohms. How much current is flowing through the strobe light?

SOLUTION:

V = 110 VOLTS R = 20 OHMS I = ?

V = IR REPLACE VARIABLE WITH VALUES

110 VOLTS = I (20) DIVIDE BOTH SIDES BY 20

$$\frac{110 \text{ VOLTS}}{20} = \frac{I(20)}{20}$$

ANSWER: I = 5.5 Amp.

Problem #2

A CD player with a resistance of 50 ohms has a current of 0.2 amps flowing through it. Sketch the circuit diagram and calculate how many volts supply the CD player.

SOLUTION:

V = ? R = 50 ohms I = 0.2

V = IR

V = 50 (0.2)

ANSWER: V = 5 Volt.

Problem #3

A 120-volt power source supplies a lamp with a resistance of 200 ohms. What is the current flow of the circuit?

V = 120 VOLTS R = 20 OHMS I = ?

V = IR REPLACE VARIABLE WITH VALUES

120 VOLTS = I (200) DIVIDE BOTH SIDES BY 20

$$\frac{120 \text{ VOLTS}}{200} = \frac{I(200)}{200}$$

ANSWER: I = 0.75 Amp

Problem #4

A source has a current of 0.2Amperes and a resistance R = 1000 ohms, Find the Voltage.

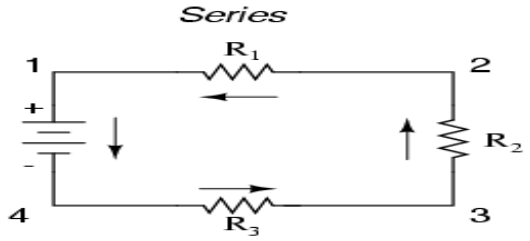
.Solution:

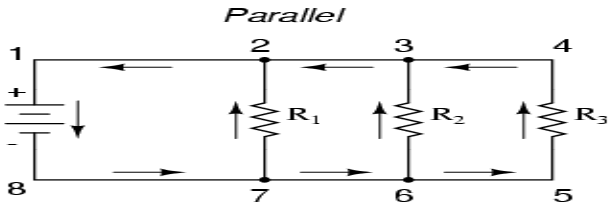
V = IR REPLACE VARIABLE WITH VALUES

V = 0.2A (1000 Ω) = 200V MULTIPLY

V = 200V

ANOTHER LESSON COMPONENT: DRAW ON BOARD AND EXPLAIN:
EXPLAIN TO STUDENTS: Most home are wired in Series or Parallel Circuit

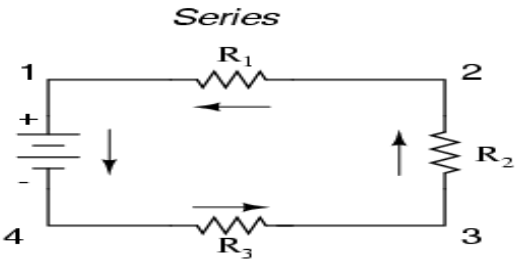




Resistances in Series

When resistances R_1, R_2, R_3, … are connected in series, the total resistance R_S is:

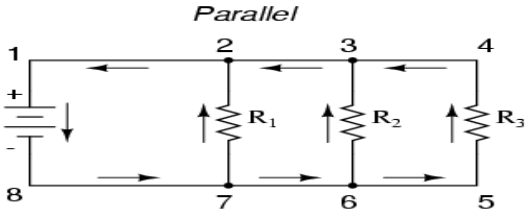
$$R_S = R_1 + R_2 + R_3 + \ldots R_S$$



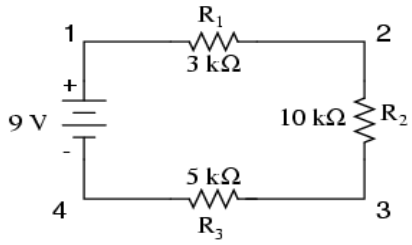
Resistances in Parallel

When resistances $\mathbf{R_1}$, $\mathbf{R_2}$, $\mathbf{R_3}$, ... are connected in parallel, the total resistance $\mathbf{R_P}$ is:

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots \frac{1}{R_N}$$



EXAMPLE: FIND THE TOTAL RESISTANCE, CURRENT, & VOLTAGE ACROSS EACH RESISTOR



Solution:

$R_S = R_1 + R_2 + R_3 + ...Rs$

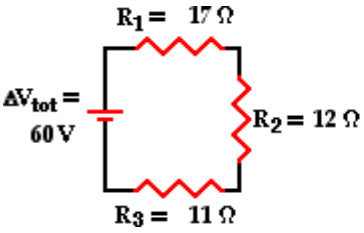
$R_S = 3 + 10 + 5 +$

$R_S = 18$ Ohms

$$I_{TOTAL} = \frac{E_{TOTAL}}{R_{TOTAL}} = \frac{9V\ .}{18}$$

$$I_{TOTAL} = \frac{9V\ .}{18K\Omega} = \frac{9\ .}{18{,}000} = 500\mu A$$

$E_{R1} = I(R1)$	$E_{R2} = I(R2)$	$E_{R3} = I(R_3)$
$E_{R1} = 500\mu A\ (3K\Omega)$	$E_{R2} = 500\mu A\ (10K\Omega)$	$E_{R3} = 500\mu A\ (5K\Omega)$
$E_{R1} = 500\mu A\ (3000)$	$E_{R2} = 500\mu A\ (1000\Omega)$	$ER3 = 500\mu A\ (5000\Omega)$
$E_{R1} = 1.5$ VOLTS	$E_{R2} = 5$VOLTS	$E_{R3} = 500\mu A\ (5000\Omega)$



FIND THE TOTAL RESISTOR, TOTAL CURRENT, EACH CURRENT, AND EACH VOLTAGE ACROSS EACH RESISTOR:

.SOLUTION: $R_{eq} = R_1 + R_2 + R_3 = 17\ \Omega + 12\ \Omega + 11\ \Omega = 40\ \Omega$

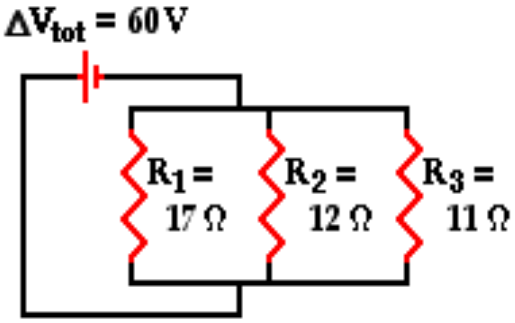
$I_{tot} = \Delta V_{battery} / R_{eq} = (60\ V) / (40\ \Omega) = 1.5$ amp

$I_{battery} = I_1 = I_2 = I_3 = 1.5$ amp

$\Delta V_1 = I_1 \cdot R_1$ $\quad \Delta V_2 = I_2 \cdot R_2$ $\quad \Delta V_3 = I_3 \cdot R_3$

$\Delta V_1 = (1.5\ A) \cdot (17\ \Omega)$ $\quad \Delta V_2 = (1.5\ A) \cdot (12\ \Omega)$ $\quad \Delta V_3 = (1.5\ A) \cdot (11\ \Omega)$

$\Delta V_1 = 25.5\ V$ $\quad \Delta V_2 = 18\ V$ $\quad \Delta V_3 = 16.5\ V$



FIND THE TOTAL RESISTOR, TOTAL CURRENT, EACH CURRENT, AND EACH VOLTAGE ACROSS EACH RESISTOR:

.SOLUTION

$$1 / R_{eq} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{17} + \frac{1}{12} + \frac{1}{11}.$$

$$I_{tot} = \frac{\Delta V_{battery}}{R_{eq}} = \frac{60\ V}{4.29063\ \Omega}.$$

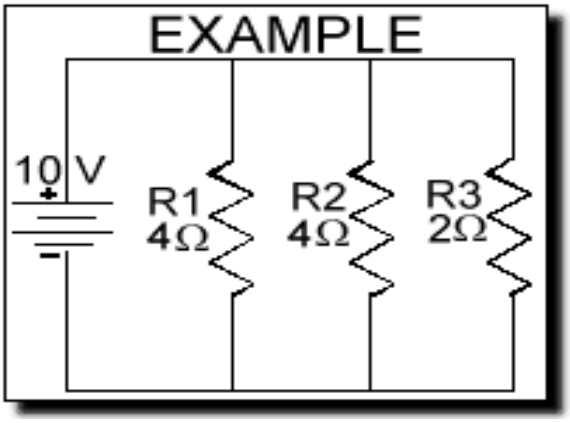
$$I_{tot} = 14.0\ amp$$

$$I_1 = \Delta V_1 / R_1 \qquad \Delta V_2 = \Delta V_2 / R_2 \qquad \Delta V_3 = \Delta V_3 / R_3$$

$$I_1 = (60\ V) / (17\ \Omega) \qquad I_2 = (60\ V) / (12\ \Omega) \qquad I_3 = (60\ V) / (11\ \Omega)$$

$$I_1 = 3.53\ amp \qquad I_2 = 5.00\ amp \qquad I_3 = 5.45\ amp$$

$$\Delta V_{battery} = \Delta V_1 = \Delta V_2 = \Delta V_3 = 60V$$



FIND THE TOTAL RESISTANCE OF THE CIRCUIT

SOLUTION:

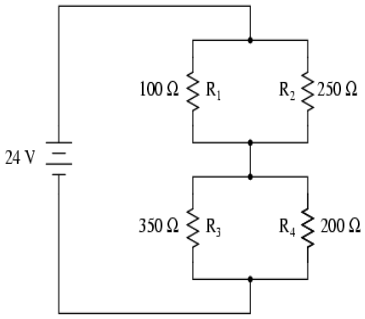
$$\frac{1}{R_T} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$$

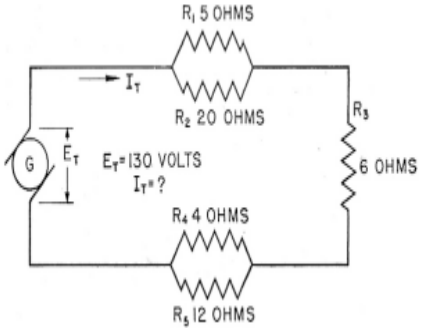
$$\frac{1}{R_T} = \frac{1}{4} + \frac{1}{4} + \frac{1}{2} = 1\ OHM$$

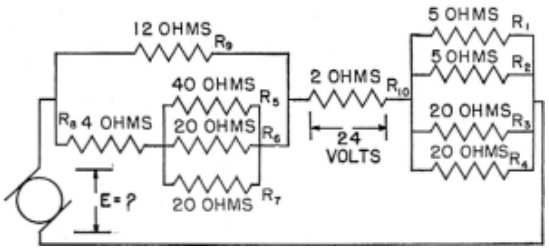
Extensions

Students will solve problems with circuits dealing with series and parallel circuits.

A series-parallel combination circuit





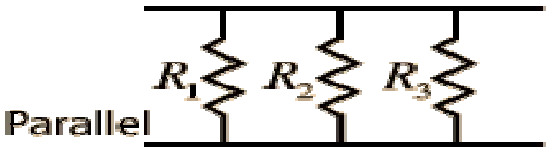


Summary: **Ohm's Law is the equation V = I R that shows the relationship between voltage, current and resistance in a simple electrical circuit. It applies both the AC and DC circuits.**

$$R_{equivalent} = R_1 + R_2 + R_3 + \dots$$

$$R_{equivalent} = \frac{V}{I} = \frac{V_1 + V_2 + V_3 + \dots}{I} = \frac{V_1}{I_1} + \frac{V_2}{I_2} + \frac{V_3}{I_3} + \dots = R_1 + R_2 + R_3 + \dots$$

Series key idea: The current is the same in each resistor by the current law.



$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

Parallel:

$$\frac{V}{R_{equivalent}} = I = I_1 + I_2 + I_2 + \dots = \frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_3}{R_3} + \dots$$

$$\frac{1}{R_{equivalent}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \dots$$

Parallel key idea: The voltage is the same across each resistor by the voltage law.

HANDOUT:

HOME WORK: BY MR. A. AKOMAH {PLEASE SHOW YOUR STEPS}

1. The unit of electrical pressure is the _____.

2. The unit of electrical current is the _____.

3. The unit of electrical resistance is the _____.

4. The current in a circuit is
(a) _____ proportional to the applied voltage.
(b) _____ proportional to the resistance.

5. The relation between current, voltage and resistance in a circuit is expressed by the equation
Amperes _____.

6. If a generator supplies 60 volts across a resistor and a current of 10 amperes flows through the circuit, what is the ohmic value of the resistor?

7. A generator is supplying 120 volts to a circuit which comprises two resistances, 6 ohms and 4 ohms, in series. What is the current flowing in the circuit?

8. What voltage must a generator have to produce a current of 6 amperes through resistances of 2 ohms, 3 ohms, and 5 ohms connected in series?

9. Four resistors, of 8 ohms, 6 ohms, 2 ohms and one of unknown resistance, are connected in series. A generator supplies 120 volts across this circuit. The IR-drop across the 6-ohm resistance is 36 volts. (a) What current is flowing in the circuit? (b) What is the total circuit resistance? (c) What ohmic value has the unknown resistor?

10. A generator supplies 100 volts to 3 resistors in series, whose resistances are 2 ohms, 3 ohms and 5 ohms. (a) What current flows in the circuit? (b) What is the current in each resistor?

ANSWERS : TO THE ABOVE

1. volt 2. Ampere 3. Ohm 4. (a) directly (b) inversely
5. volts/ohms 6. 6 ohms 7. 12 amperes 8. 60 volts 9. (a) I = 6 amperes (b)R_t=20 ohms (c)R_x= 20ohms 10. (a) I=10amperes (b) I=10 amperes

EXAMPLE :

Voltage = 10V
R1 = 4 Ohm
R2 = 4 Ohm
R3 = 2 Ohm

Remember that "Rt" means Total resistance of the circuit.
R1, R2, etc. are Resistor one, Resistor two, etc.

Now we will apply the formula above to this example:

1 1 1 1
-- = -- + -- + --
Rt R1 R2 R3

Therefore:
1 1 1 1
-- = -- + -- + --
Rt 4 4 2

It is easiest to change the fractions into decimal numbers (example 1 divide by 4 equals .25):
1/Rt = .25 + .25 + .5
1/Rt = 1

Now you have to get rid of the 1 on the left side so...
Rt = 1/1
Rt = 1 Ohm

NOW, Let's try a more complex one:

Voltage = 120 Volts
R1 = 100 Ohms
R2 = 200 Ohms
R3 = 1000 Ohms
R4 = 1 Ohms

1/Rt = 1/100 + 1/200 + 1/1000 + 1/1
1/Rt = .01 + .005 + .001 + 1
1/Rt = 1.016
Rt = 1/1.016 = .98 Ohms