Science 9

Chapter 8: Ohm's law describes the relationship of current, voltage, and resistance.
1. Chapter 8.1: Electric Potential Energy and Voltage (page 270)

When ____________________ charges are moved ____________________ apart, they gain electrical ____________________ energy. Electric potential ____________________ is the ____________________ in potential energy per ____________________ of charge. ____________________ is the common name for electric potential difference and is measured in ____________________ (___). Electrical energy depends on the ____________________ of charge and the ____________________.

2. Define the following terms (pages 270 -271)

a) Battery: ________________________________________________________________

b) Electrochemical cells: ____________________________________________________

c) Terminals: _____________________________________________________________

d) Energy: ________________________________________________________________

e) Kinetic energy: _________________________________________________________

f) Potential energy: _______________________________________________________

g) Electric potential energy: _______________________________________________

3. Answer the following questions:

a) How are a battery and a storm cloud similar? ________________________________

b) How are they different (name two ways)? ________________________________

c) Fill in the blanks: Battery ____________________ are the end points where we make connections. Extra ____________________ accumulate on one of the battery terminals, making it ____________________ charged. The other terminal has lost these electrons and therefore it is ____________________ charged.

Draw a AA battery to the right and show –ve and +ve terminals.

Total marks this page: 18
d) Electric potential energy can be transformed into different types of energy (three are mentioned on pages 270 and 271) using different electric devices. Complete the table below.

<table>
<thead>
<tr>
<th>Type of device</th>
<th>Electrical energy is transformed into what kind of energy?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD player</td>
<td></td>
</tr>
<tr>
<td>light bulb</td>
<td></td>
</tr>
<tr>
<td>fan</td>
<td></td>
</tr>
<tr>
<td>heater</td>
<td></td>
</tr>
<tr>
<td>battery charger</td>
<td></td>
</tr>
</tbody>
</table>


a) Potential difference (use glossary): ____________________________________________

b) Voltage: also called potential difference

c) Volt: ____________________________________________

d) Voltmeter: ____________________________________________

e) Electrodes: ____________________________________________

f) Electrolyte: ____________________________________________

Who is the scientist, and what did they do to help learn about electricity?

a) Galvani: ____________________________________________

b) Volta: ____________________________________________

Describe how Volta made a "voltaic pile": ____________________________________________

In the space to the right is a diagram of Volta's battery. Colour the zinc metal (Z) one colour and the copper (C) metal a different colour. F stands for fabric.
4. Read the section on Comparing Potential Energy and Potential Difference. Explain how the potential energy in a battery is like a set of stairs. What is the voltage compared to? What is the amount of charge that has been separated compared to?

Fill in the blanks: The potential energy in the battery is due to both the _______________ difference (_____________) and the amount of _______________ that has been separated (__________________). Even though ____, ____, _____, and _______ batteries all have a potential difference of ______ Volts, the battery that can separate the most charge would have the _______________ potential energy. The energy that charge possesses is dependent on the _______________ and the _______________.

5. Producing Voltage: Name 2 different groups of batteries: _______ cells and _______ cells.

Name 5 places dry cells are used (4 are given):

Name 4 places wet cells are used (3 are given):

Read page 273. Take notes in point form on how batteries produce voltage.

How does a car battery produce 12 volts.

<table>
<thead>
<tr>
<th>Source of Electricity</th>
<th>Device Examples or Situations</th>
<th>How it works</th>
</tr>
</thead>
<tbody>
<tr>
<td>Friction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piezoelectric Crystals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo-electro chemical cells</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermocouples</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generators</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total marks this page: 20
7. Label the diagram below. Refer to Figure 8.5 on page 273. Colour it.

8. THINK - A single dry cell or wet cell generates 1.5 volts. A single rechargeable battery generates 1.2 volts. Cells are arranged in series (we will learn about this later) to increase the voltage. Two dry cells in series makes 3 volts \((1.5 \times 2)\). Complete the table below.

<table>
<thead>
<tr>
<th>Number of batteries in series</th>
<th>Total voltage produced from dry or wet cells</th>
<th>Total voltage produced from rechargeables</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>(1.5 \times 2 = 3) volts</td>
<td>(1.2 \times 2 = \underline{______}) volts</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total marks this page: 30
If a number of batteries in series produced 12 volts, how many cells would there have to be?

a) of 1.5 volt wet or dry cells?
b) of 1.2 volt rechargeable cells?

9. Do Reading Check (page 275) Do numbers 3, 5, 8, 9  

Full Sentences!

10. Do Checking Concepts (page 279). Do numbers 1, 2, 4, 5, 7  

Full Sentences!

Total marks this page: 20
Section 8.2: Electric Current (page 280)

1. Current electricity is the __________ of ________________ particles in a ________________ circuit. The unit for measuring electric current is the ________________, which is defined as one ________________ of charge passing a given point per ________________. An ________________ is a device used to measure current. To have a continuous flow of charge, the circuit must have at least one source of ________________.

2. Define the following terms (pages 281 – 283):
   a) Electric circuit: ________________
   b) Electric load: ________________
   c) Circuit diagrams: ________________
   d) Source: ________________
   e) Conductor: ________________
   f) Load: ________________
   g) Switch: ________________
   h) Open circuit: ________________
   i) Closed circuit: ________________

3. Read page 281. Answer the following questions:
   a) Name 5 examples of an electric load (4 are given) ________________ ________________ ________________ ________________ ________________
   b) Explain how chemical energy can also be potential energy. ________________
   c) Do electrons move from positive to negative or negative to positive? ________________

Total marks this page: 17
4. Circuit symbols: Copy the different symbols into the table below from page 282.

<table>
<thead>
<tr>
<th>Component</th>
<th>Electric circuit symbol</th>
<th>Component</th>
<th>Electric circuit symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducting wire</td>
<td></td>
<td>Bulb</td>
<td></td>
</tr>
<tr>
<td>Voltmeter</td>
<td></td>
<td>Open switch</td>
<td></td>
</tr>
<tr>
<td>Cell</td>
<td></td>
<td>Closed switch</td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td></td>
<td>Ammeter (page 284)</td>
<td></td>
</tr>
<tr>
<td>Resistor (page 295)</td>
<td></td>
<td>Motor</td>
<td>M</td>
</tr>
</tbody>
</table>

5. What are the four criteria listed for drawing a neat circuit?

6. Examine figure 8.11 on page 282. Copy the circuit diagram down in the space below. Then draw the circuit diagrams for the three circuits shown on top of page 283.

Figure 8.11:

Circuit A (page 283)  
Circuit B (page 283)  
Circuit C (page 283)

Total marks this page: / 21
In the space below draw complete circuits with the following components:

a) a cell with an open switch and a resistor.
b) a battery with a closed switch and a motor

c) a cell with two resistors and two bulbs
d) a battery with an open switch, a closed switch, a motor and a bulb

THINK Questions:

a) What is the functional difference between a cell and a battery (hint: look at the symbols)?

b) Question d) above uses two switches. What circuit would have two switches like that?

7. Do Reading Check (page 282): Numbers 1, 3, 4

Full Sentences!
8. Read pages 283 and 284. Answer the following questions:
   a) Explain why a light goes on immediately after connecting a circuit instead of having to wait as you might for turning on a hose. ______________________________________________________________________
   
   b) Explain why electrons do not need to touch each other when flowing through a circuit the way that water does when flowing through a hose. ______________________________________________________________________
   
   c) How is a battery NOT an example of static electricity? ______________________________________________________________________
   
   d) Define the following terms:
      current electricity. ______________________________________________________________________
      electric current: ______________________________________________________________________
      amperes: ______________________________________________________________________
      ammeter: ______________________________________________________________________
   
   e) Think about a meter and a millimeter. There are _______ mm in 1 meter. How many milliamperes are in one ampere? _______________ How many millivolts are in one volt? _______________. Think again about a meter and a millimeter. One mm = .001 meter.
      1 mA = _______________ A. 1 mV = _______________ V.
   
   f) What did Andre-Marie Ampere study? ______________________________________________________________________
   
   g) How did Benjamin Franklin's ideas about electricity differ from what we understand today? ______________________________________________________________________

9. Do Reading Check on page 285. Do numbers 1, 4, 6, 7, 8 ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   ______________________________________________________________________
   
Total marks this page: 16
10. Do Checking Concepts on page 289. Do numbers 1, 2, 3, 4, 5, 6, 7, 13 (label the diagram)

13. Draw the circuit diagram below – label all the components.
Section 8.3: Resistance and Ohm’s Law (page 290)

1. ______________ slower the ______________ of electrons and ______________ electrical energy. Resistance is measured in ______________ (__)_.

   We calculate resistance by applying a ______________ and measuring the ______________. ______________ ______________ states that the relationship of voltage (___), current (___), and resistance (___) is given by: ______________.

   ______________ are electrical components used in circuits to ______________ current and convert electrical energy into other forms of energy.

2. Read pages 290 to 292. Answer the following questions:
   a) Define Resistance: ______________

   b) How is the wire that connects a battery to a load and the filament in a light different? ______________

   c) Explain how a light bulb works. ______________

   d) Copy figure 8.15B in the space to the right.

   e) Fill in the blanks:

   Voltage is the ______________ in potential energy per unit of charge between ______________ in the circuit and ______________ in the circuit. When you ______________ the voltage connected to the circuit, the ______________ will also increase. In other works, voltage is ______________ to current.

   If a battery is connected to an electric circuit that has a ______________ resistance, ______________ current will flow than if the same battery is connected to a ______________ resistance circuit.

   f) What did Ohm study? ______________

   g) Georg Ohm was born in ______________. He lived from ______________ to ______________.
3. Copy the **entire** paragraph at the top of the page on page 293 and both Ohm's law formulas.

4. When doing any questions involving formulas, always complete the question using this 4 step method:
   
   **Step 1:** Write the correct formula arrangement down
   
   **Step 2:** Substitute known values for variables
   
   **Step 3:** Solve and include units
   
   **Step 4:** Write a sentence answering the question.

   Each question will be worth 2 marks: You get ½ a mark per step.

Do Practice Problems (page 293) 1, 2, and 3 in the space below. **Show all 4 steps!**

1) 

2) 

3) 

4) A car battery (12 volts) requires 100 A to start a car. What is the resistance of the starter?
5. Read Converting Prefixes (page 293) Please note:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>symbol</th>
<th>convert from base unit</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>micro</td>
<td>μ</td>
<td>x 1,000,000 (x 10^6)</td>
<td>.0005 V = .0005 x 1000000 = 500 μV</td>
</tr>
<tr>
<td>milli</td>
<td>m</td>
<td>x 1,000 (x 10^3)</td>
<td>2 amperes = 2 x 1000 = 2000 mV</td>
</tr>
<tr>
<td>kilo</td>
<td>k</td>
<td>x 1,000 (x 10^3)</td>
<td>3000 volts = 3000 x 1000 = 3 kV</td>
</tr>
<tr>
<td>Mega</td>
<td>M</td>
<td>x 1,000,000 (x 10^6)</td>
<td>2000000 Ω = 2000000 x 1000000 = 2 MΩ</td>
</tr>
</tbody>
</table>

Some examples: 1 MV = 1,000 kV = 1,000,000 V = 1,000,000,000 mV = 1,000,000,000,000 μV

Do the following conversions:

a) 1000 mA = ______________________ A
b) .25 A = ______________________ mA

c) 5000 V = ______________________ MV
d) .45 kΩ = ______________________ Ω

e) 2 MV = ______________________ V
f) .1 MV = ______________________ V

g) 35000000 mΩ = ______________________ Ω
h) 50 A = ______________________ mA

i) 4000 A = ______________________ MA
j) 200000 Ω = ______________________ kΩ

k) 450000000 Ω = ______________________ MΩ
l) .09 A = ______________________ mA

m) 2 MV = ______________________ mV
n) 1.5 kΩ = ______________________ mΩ

o) .05 MA = ______________________ kA
p) 2000000000 mΩ = ______________________ MΩ

q) .00000001 kA = ______________________ mA
r) .25 MA = ______________________ kA

**NOTE:** it is important when doing math to convert all units into base units first!!! You have to do this to ensure that your final answer is in the correct units. You can convert the answer to a different unit after.

6. Do Practice Problems (page 294) 1, 2, and 3 in the space below. **Show all 4 steps!**

1) ______________________
2) ______________________

3) ______________________

4) A resistor is rated at 2 MΩ. .5 mA flows through it. What is the voltage? (hint – you have to convert numbers to base units)
7. Read pages 294 to 297. Answer the following questions:

Define resistor: 

What can resistors be used for? 

There are 3 ways to determine resistance across a load:
   - Method 1: measure the ______________ using a ______________ and measure the ______________ using an ______________ then use ______________ ______________ to calculate resistance.
   - Method 2: Use an ______________ (a device that measures ______________). You can find these in a ______________, which is an instrument that can measure voltage, current, and resistance.
   - Method 3: On a resistor you can read the ______________ bands (page 279).

8. Copy Table 8.2 – Colour Coding on Resistors – into the table below.

<table>
<thead>
<tr>
<th>Number</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The colour bands on the resistor means:

1st number: ______________
2nd number: ______________
3rd number: ______________
4th number: ______________ gold - ___% silver - ___% blank - ___%

Use the information from above to calculate the resistance of the colour bands below:

<table>
<thead>
<tr>
<th>1st colour</th>
<th>2nd colour</th>
<th>3rd colour</th>
<th>4th colour</th>
<th>Reading on Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>red</td>
<td>green</td>
<td>yellow</td>
<td>silver</td>
</tr>
<tr>
<td>2</td>
<td>blue</td>
<td>black</td>
<td>red</td>
<td>gold</td>
</tr>
<tr>
<td>3</td>
<td>violet</td>
<td>yellow</td>
<td>brown</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>grey</td>
<td>grey</td>
<td>grey</td>
<td>silver</td>
</tr>
<tr>
<td>5</td>
<td>white</td>
<td>blue</td>
<td>white</td>
<td>gold</td>
</tr>
<tr>
<td>6</td>
<td>brown</td>
<td>brown</td>
<td>red</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>grey</td>
<td>black</td>
<td>black</td>
<td>gold</td>
</tr>
<tr>
<td>8</td>
<td>yellow</td>
<td>grey</td>
<td>orange</td>
<td>silver</td>
</tr>
<tr>
<td>9</td>
<td>red</td>
<td>green</td>
<td>brown</td>
<td></td>
</tr>
</tbody>
</table>

Total marks this page: 28
Name: ____________________________  Block: __________  Date Due: _________________

<table>
<thead>
<tr>
<th>1st colour</th>
<th>2nd colour</th>
<th>3rd colour</th>
<th>4th colour</th>
<th>Reading on Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>55000000 Ω 5% accuracy</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>21000 Ω 10% accuracy</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>1800 Ω 20% accuracy</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>760 Ω 10% accuracy</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>45000000 Ω 20% accuracy</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td>36 kΩ 5% accuracy</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td>10 MΩ 20% accuracy</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td>66000 MΩ 10% accuracy</td>
</tr>
</tbody>
</table>

9. The first method to determine the value on a resistor was to calculate it by running a known voltage through it and measuring the amperage. Make a circuit diagram of Circuit A on top of page 296 to the right (follow the steps – do a neat job). Complete the table below using the data from Calculating Resistance (top of page 295) and calculate the resistance values.

<table>
<thead>
<tr>
<th>Voltage (V)</th>
<th>Current (A)</th>
<th>Resistance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

10. Do Reading Check (page 297). Do numbers 1, 2, 3, 5, 6

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

Total marks this page: 26
11. Do Checking Concepts (page 301). Do numbers 1, 2, 5, 8, 9, 10, 11

For numbers 8, 9, and 10 show all 4 steps!

12. Do Understanding Key Ideas (page 303). Do numbers 26, 27, 28, 29, 30

Total marks this page: 20