Chemistry Unit 3 – Atoms

Name:

Period:

Matter has definite structure that determines characteristic physical and chemical properties: Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical reactions.

Chemistry Daily Journal

|  |  |  |
| --- | --- | --- |
| Today’s Date | What did I accomplish yesterday? | What are my goals today? What sections, activities, and labs do I want to get done today? |
|  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Objective** | **Learning Opportunities** | **Suggested Due Date** | **Date Completed** |
| 3.1 Describe the number and type of subatomic particles in an atom | Podcast 3.1 Basic Atomic Structure* Read p. 101-112, answer p. 112, 17-18
* Drawing and making atom-The M&M Lab
 | 09/21/11 |  |
| 3.2 Recognize contributions various scientists have made to the development of modern atomic theory  | * Podcast 3.2 History of Chemistry
* Historical Figures in Chemistry
* History of Chemistry Quiz
* Models of the Hydrogen Atom-PhET Simulation
 | 09/26/11 |  |
| 3.3 Calculate mass number and average atomic mass  | * Podcast 3.3 Mass of Atoms
* Read p. 112 – 117, answer p. 113, 19-20; p. 117, 23-24
* Atomic Structure
* Isotopes and Average Atomic Mass
* Quiz on Atomic Structure and Isotopes
 | 09/28/11 |  |
| 3.4 Sketch an atom’s Bohr Diagram  | Podcast 3.4 Locating Electrons* Read 127-132, answer p. 132 #2,3,5,6
 | 09/30/11 |  |
| 3.5 Sketch an Aufbau Diagram for any atom  | Podcast 3.4 Locating Electrons* Read page 133-136
* Bohr Model and Aufbau Diagrams
 | 10/04/11 |  |
| 3.6 Write the complete electron configuration for an atom in long-hand or short-hand | Podcast 3.4 Locating Electrons* Answer p. 135 , 8-9
* Bohr Model, Aufbau Diagrams and E-Configuration Practice
* Quiz on Bohr, Aufbau and E-Configuration
 | 10/04/11 |  |
| 3.7 Evaluate the energy stored in atoms and electrons | Podcast 3.5 Electrons, Energy, and Light* Read pages 138-146, answer p. 140. 14-15; p. 146, 16-17, 21
* KABOOM! Video
* Physics and Quantum Mechanical Model
* Flame Test for Metals
* Unit 3 Review Questions
 | 10/06/11 |  |

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Per: \_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Historical Figures in Chemistry**

|  |  |  |  |
| --- | --- | --- | --- |
| **Who** | **What** | **Where** | **When** |
| Democritus |   |   |   |
| Aristotle |   |   |   |
| Johann Beecher |   |   |   |
| Joseph Priestly |   |   |   |
| Antoine Lavoisier |   |   |   |
| John Dalton |   |   |   |
| Heinrich Geissler |   |   |   |
| Sir William Crookes |   |   |   |
| JJ Thompson |   |   |   |
| Robert Millikan |   |   |   |
| Eugene Goldstein |   |   |   |
| Marie Curie |   |   |   |
| Ernest Rutherford |   |   |   |
| Henry Moseley |   |   |   |
| James Chadwick |   |   |   |
| Niels Bohr |  |  |  |
| Louis DeBroglie |  |  |  |
| Werner Heisenberg |  |  |  |
| Max Planck |  |  |  |

Alchemist Article Questions

1. What is Alchemy?
2. How did Alchemy impact chemistry?

1. Why is Alchemy a false science?
2. What did scientists create by mistake through experiments with Alchemy?

 Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Per: \_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_

Drawing and Making Atoms – The M&M Lab

**Purpose:** To use information from the periodic table to draw box and Bohr representations of atoms.

**Materials:** Periodic Table, pencil, paper, candy

**Procedure:**

1. Use your periodic table to determine the name of the element.
2. The atomic number indicates the # of protons in the nucleus. It also gives the number of electrons in a neutral atom.
3. The atomic mass gives the # of protons plus the average # of neutrons in the nucleus. (Ex: Round atomic mass to nearest number, then subtract that by the atomic number to get the number of neutrons in the nucleus)
4. Remember that electrons exist in energy levels around the nucleus. The 1st energy level holds 2 electrons, 2nd level holds 8, and 3rd level holds 8.

Box Diagram example of Argon:

18 2

8

8

# Ar

39.95

Represents atomic #

Represents atomic mass

Represents electron energy levels

Represents atomic symbol

Ar

39.948

From the information in the periodic table you can create a 2-D model of what an atom looks like called the Bohr model. This model shows the nucleus with the protons and neutrons, and it shows energy levels with electrons.

\_\_ \_\_

\_\_

# \_\_\_

\_\_\_\_

+

+

+

+

+

+

+

\_

\_

\_

\_

\_

\_

\_

What element is this?

Fill in the box with the

correct information.

Oxygen: Drawing:

\_\_ \_\_

\_\_

# \_\_\_

\_\_\_\_

Carbon:

\_\_ \_\_

\_\_

# \_\_\_

\_\_\_\_

Hydrogen:

\_\_ \_\_

\_\_

# \_\_\_

\_\_\_\_

Nitrogen:

\_\_ \_\_

\_\_

# \_\_\_

\_\_\_\_

Chlorine:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

Magnesium: Drawing:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

Sulfur:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

Sodium:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

Extra Credit:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

Extra Credit:

\_\_ \_\_

\_\_

\_\_

# \_\_\_

\_\_\_\_

**PhET Simulation Exploration – Models of the Hydrogen Atom**

[*http://phet.colorado.edu/simulations/sims.php?sim=Models\_of\_the\_Hydrogen\_Atom*](http://phet.colorado.edu/simulations/sims.php?sim=Models_of_the_Hydrogen_Atom)

**Overview**

One of the most tantalizing puzzles at the beginning of the 1900s for scientists was to describe the make-up of the atom. As explained in the podcast, light was used to investigate the make-up of the atom.

In this activity, you will first observe a simulated light spectrum of hydrogen gas. This is the same spectrum that you observed in class. You will then look at spectra predicted by different models of the atom. The models you will test include:

* John Dalton’s Billiard Ball model
* J.J. Thomson’s Plum Pudding model
* Ernest Rutherford’s Classical Solar System model
* Niels Bohr’s Shell model
* Louis deBroglie’s Electron Wave model
* Erwin Schrodinger’s Quantum Mechanical model

You will need a stopwatch to complete this exercise.



**Procedure and questions**

1. Access the PhET website.
2. Search for **Models of the Hydrogen Atom** and run it.
3. Click on the *Expand* box in the top right corner of the simulation so that the simulation completely fills the screen.
4. Turn on the *White l*ight gun. The white light is shining into a transparent box containing hydrogen gas molecules.
	1. Explain why, with white light, the light photons passing up through the box have different colors.
5. Check the **Show Spectrometer** box. Notice that the color of the photons passing up through the box corresponds to a wavelength of UV, visible, or IR radiation.
6. In the **Light Controls**, click on *Monochromatic*. Notice that the incoming photons are now all the same color. A spectrum slider appears that allows you to change the energy of the incoming photons. Move the slider across the spectrum from ultraviolet (UV) down to the infra-red (IR). Notice the color of the lamp and the photons moving up the screen. Decide how you can distinguish between UV and IR photons. Record that information below.
7. Switch **the Light Controls** back to *White* light
8. Move the *Slow…Fast* slider all the way over to *Slow*
9. Watch the photons carefully. Most of the light gun photons pass through the box of hydrogen unaffected. Occasionally a photon is absorbed by something in the ? box and a new photon of the same energy (color) leaves the box.
10. Describe what is going on in the ? box.
11. Move the *Slow…Fast* slider all the way over to *Fast*, **Reset** the **Spectrometer**, and let the simulation run for 1 minute.
12. After 1 minutes, click on the **Spectrometer camera** to take a snapshot of **the Experiment**.
13. Describe what is happening to the spectrum below. Include in your description the *colors*, estimated *wavelengths*, and *relative numbers* of stacked colored balls. These colored balls correspond to photons emitted by the ? box.
14. Slide the snapshot off to the right of the screen for later comparison with the models.
15. Close the **Show Spectrometer** box
16. Remember that John Dalton proposed that an atom was simply a very tiny hard ball. To see this simulated, in the top left corner, switch from **Experiment** to **Predict** and highlight the **Billiard Ball model**.
17. Move the *Slow…Fast* slider all the way over to Slow and describe what is happening below.
18. Below, sketch your idea of what the spectrum will look like for Dalton’s model.
19. Move the *Slow…Fast* slider all the way over to *Fast*, reset the **Spectrometer**, and let the simulation run for 1 minute.
20. Click on the **Spectrometer** camera to take a snapshot of the **Billiard Ball**. Compare it to the **Experiment**. Slide these snapshots off to the right for later comparisons.
21. Does the spectrum for the **Billiard Ball** model match that of the **experimental (**real) hydrogen spectrum?
22. Switch to Thomson’s **Plum Pudding model**, close **Show Spectrometer**, and move the *Slow…Fast* slider all the way over *to Slow*. (your snapshot will disappear as well. Don’t worry, it will come back when you open Show Spectrometer again). Describe what is happening within the atom below.
23. Move the *Slow…Fast* slider all the way over to *Fas*t, reset the **Spectrometer**, and let the simulation run for 1 minute.
24. Click on the **Spectrometer** camera to take a snapshot of the **Plum Pudding** model. Compare it to the **Experiment**. Slide the snapshot off to the right for later comparisons.
25. Does the spectrum for the **Plum Pudding** model match that of the real hydrogen spectrum?
26. Just for fun, switch to the **Classical Solar System** model. This was Rutherford’s model that assumes the atom is like our solar system. Describe what happens below.
27. Switch to the **Bohr model**, click on **Show electron energy level** in the upper right hand corner, and set the speed to *Slow*.

*NOTE: These three next steps are critical to you understanding the Bohr atom model*

* 1. Describe what you see in the atom diagram.
	2. Describe what you see in the energy level diagram
	3. Describe how the atom diagram and energy level diagrams are related.
1. Move the *Slow…Fast* slider all the way over to *Fast*, reset the **Spectrometer**, and let the simulation run for 1 minutes.
2. Click on **the Spectrometer** camera to take a snapshot of the **Bohr model**. Compare it to the **Experiment**. Slide the snapshot off to the right for later comparisons.
3. How well does the **Bohr Shell model** spectrum match the experimental (real) hydrogen spectrum*? Explain in detail.*

*In the* ***Bohr Shell model****, electrons can exist only at certain energy levels (also called shells), not at any energy levels between them. Shells in this energy diagram go from 1 to 6. An increase in energy level (say from 1 🡪 6) can only occur if a photon of incoming light is absorbed. A decrease in energy level (say from 2 🡪1) is accompanied by the emission of a photon as the excited electron releases its excess energy.*

1. In *the Help* menu, select *Transitions* to see all possible transitions.
2. Move the *Slow…Fast* slider all the way over to *Slow.*
3. Set the **Light Controls** to **Monochromatic.**
4. Set the monochromatic light source to 122 nm by clicking on the slider box and type in “122.” This provides photons of just the right energy to raise (excite) the electron from n=1 to n=2 shell (1🡪 2 transition). Describe the atom diagram and the energy level diagrams. Notice that the electron decays are colored. What is the meaning of the colors?
5. Set the light source to 103 nm. This provides photons of just the right energy to raise (excite) the electron from n=1 to n=3 shell (1🡪 3 transition). Describe the atom diagram and the energy level diagrams. How do the transitions differ from 1🡪2?
6. Just to make sure you understand this model, set the light source to 97 nm. This provides photons of just the right energy to raise (excite) the electron from n=1 to n=4 shell (1🡪 4 transition). Describe the atom diagram and the energy level diagrams. How do the transitions differ from 1🡪2 and 1🡪3 ?
7. Set the light source to 656 nm. This corresponds to a transition from 2🡪3. What happens? *Explain*.

*Louis de Broglie was the first atomic theorist to incorporate the ideas of Planck and Einstein that electrons can be both waves and particles. He developed the de Broglie hypothesis stating that any moving particle or object had an associated wave (wave-particle duality). De Broglie thus created a new field in physics called wave mechanics, uniting the physics of light and matter. For this he won the Nobel Prize in Physics in 1929. Among the applications of this work has been the development of electron microscopes.*

1. Set the **Light Controls** back to **White**. Switch to the **de Broglie Electron Wave** model. Describe what is the same and different about the de Broglie and Bohr models of the hydrogen atom.
2. Move the *Slow…Fast* slider all the way over to *Fast*, reset the **Spectrometer**, set **Light Controls** to **White**, and let the simulation run for 1 minutes.
3. Click on the **Spectrometer** camera to take a snapshot of the **de Broglie model**. Compare it to the **Experiment**. Slide the snapshot off to the right for later comparison with other models.
4. How well does the **de Broglie Electron Wave model** spectrum match the real hydrogen spectrum?
5. In the top left corner of the atomic view, change the radial view to 3-D view. Describe what you see.

*Erwin Schrödinger began thinking about wave mechanics in 1925. His interest was sparked by a footnote in a paper by Albert Einstein. Like de Broglie, he began to think about explaining the movement of an electron in an atom as a wave. By 1926 he published his work, providing a theoretical basis for the atomic model that Niels Bohr had proposed based on laboratory evidence. The equation at the heart of his publication became known as Schrödinger's wave equation.*

1. Switch to the **Schrödinger model** with **White light** and speed set to *Fast*. Describe what you see in the atom diagram and the energy level diagram. Don’t worry about all the details. Just capture the big picture ideas.
2. Move the *Slow…Fast* slider all the way over to *Fast*, reset the **Spectrometer**, set **Light Controls** to **White**, and let the simulation run for 1 minutes.
3. Click on the **Spectrometer** camera to take a snapshot of the **Schrödinger model**. Compare it to the **Experiment.** Slide the snapshot off to the right for later comparison with other models.
4. How well does the **Schrödinger Electron Wave** model spectrum match the real hydrogen spectrum?
5. Spread **the Experimental snapshot** and the **model snapshots** across the screen. Push the “**Print Screen**” key at the top of the keyboard. This puts a snapshot of the screen on the computer’s clipboard. Paste it into a **Word document** and print out two copies to printer FAH-522DBH1 (one for each partner). Set the Page Layout to print two copies on one page.







Bohr Models and Aufbau Diagrams

Use a periodic table and the information on pages 133-135 to complete the following activity. For each element given, draw a Bohr Model and an aufbau diagram.

**Bohr Model** – Include the number of protons and neutrons (round the atomic mass to the nearest whole number) in the nucleus, and the correct number of electrons in each energy level.

**Aufbau Diagram** – Create a aufbau diagram following the three rules (fill in the blank information found on pages 133-135:

7s \_\_

7p \_\_ \_\_ \_\_

5f \_\_ \_\_ \_\_ \_\_ \_\_

6d \_\_ \_\_ \_\_ \_\_

6s \_\_

6p \_\_ \_\_ \_\_

5d \_\_ \_\_ \_\_ \_\_

4f \_\_ \_\_ \_\_ \_\_ \_\_

5s \_\_

5p \_\_ \_\_ \_\_

4d \_\_ \_\_ \_\_ \_\_

4s \_\_

4p \_\_ \_\_ \_\_

3d \_\_ \_\_ \_\_ \_\_

3s \_\_

3p \_\_ \_\_ \_\_

2s \_\_

2p \_\_ \_\_ \_\_

1s \_\_

*Use the full aufbau diagram below to help you complete the aufbau diagrams you will need to draw.*

1. Aufbau Principle – \_\_\_\_\_\_\_\_\_\_\_\_\_ occupy the orbitals of \_\_\_\_\_\_\_\_\_\_\_\_ energy first.
2. Pauli Exclusion Principle – each orbital can only hold \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ at a time and they must have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
3. Hund’s Rule – electrons occupy orbitals of the \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ in a way that makes the number of electrons with the same \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ as \_\_\_\_\_\_\_\_\_\_\_\_\_ as possible.

Example:

Nitrogen

 Bohr Model Aufbau Diagram

p+ = 7

n0 = 7

2 e-

5 e-

1s \_\_

2s \_\_

2p \_\_ \_\_ \_\_

|  |  |  |
| --- | --- | --- |
| **Element** | **Bohr Model** | **Aufbau Diagram** |
| Oxygen |  |  |
| Sodium |  |  |
| Aluminum |  |  |
| Iron |  |  |
| Calcium |  |  |
|  Iodine |  |  |

Bohr Model, Aufbau Diagrams, and Electron Configuration Practice

*For each group of four elements, pick one element and draw a Bohr model. Pick another (different) element and draw an aufbau diagram. Then pick another (different) element and write a full electron configuration. For the last of the four elements write a short hand electron configuration.*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Helium, Beryllium, Nitrogen, Fluorine

 Bohr Model: Aufbau Diagram:

 Full Electron Configuration: Short Hand Electron Configuration:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Silicon, Potassium, Tin, Strontium

 Bohr Model: Aufbau Diagram:

 Full Electron Configuration: Short Hand Electron Configuration:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Gold, Silver, Platinum, Uranium

 Bohr Model: Aufbau Diagram:

Short Hand Electron Configuration:

KABOOM!

Watch this video in class and then answer the following questions. There is a companion web site for this video at <http://www.pbs.org/wgbh/nova/kaboom/elemental/>

1. How were explosions discovered ? By whom?
2. Honey and sulfur can combine to make a bomb. How?
3. How is Alchemy related to Chemistry?
4. Name some exciting fireworks displays that you have seen.
5. Would you like to be a pyrotechnician, why or why not?
6. How did gunpowder get to Europe?
7. How did weapons control society in Medieval times?
8. Name the Chemical that can explode on contact.
9. Chemical energy is stored in what part of the compounds ?
10. Why are high explosives unpredictable ?
11. What is an inert powder?
12. What was Nobel's great invention?
13. What is centex? And why is it a great explosive ?
14. Who is Nobel? Why did he create the Nobel peace prize?
15. Do you agree with the destruction or Nuclear warheads why or why not?

Physics and the Quantum Mechanical Model

*Read page 138-139 in your textbook to answer the following questions.*

1. Define the following:
* Amplitude
* Wavelength
* Frequency
* Hertz
* Electromagnetic radiation
* Spectrum
1. What do the product of frequency and wavelength always equal? What is that equation?
2. What would the equation be if you were solving for frequency? (not in the book)
3. What would the equation be if you were solving for wavelength? (not in the book)
4. How are the wavelength and frequency of light related?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

*Use the diagram below and the diagram on page 139 to answer the following 8 questions.*



1. Which color of light has the lowest frequency? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which color of light has the highest frequency? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Which color of light has the longest wavelength? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Which color of light has the shortest wavelength? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. List the types of radiation in the Electromagnetic spectrum in the correct order from Longest Wavelength to Shortest Wavelength.
6. Why do you think that UV rays are so harmful to your skin?

Flame Test for Metals

**Purpose**: To observe and identify metallic ions using flame tests.

**Background**: Have you ever wondered why a candle flame is yellow? The characteristics yellow of a candle flame comes from the glow of burning carbon fragments. The carbon fragments are produced by the incomplete combustion reaction of the wick and candle wax. When elements, such as carbon, are heated to high temperatures, some of their electrons are excited to higher energy levels. When these excited electrons fall back to lower energy levels, they release excess energy in packages of light called ***photons***, or light quanta. The color of the light emitted depends on its energy. Blue light is more energetic than red light, for example. When heated, each element emits a characteristic pattern of light energies, which is useful for identifying the element. The characteristic colors of light produced when substances are heated in the flame of a gas burner are the basis of flame tests for several elements. In this experiment, you will perform the flame tests used to identify several metallic elements.

**Problems Statement:** Write your problems statement in the form of a question.

**Hypothesis:** Read through the materials used for this lab and predict what color each metal ion will emit. This should not be in an if…then…because statement. Just list the metal ions and put what color you think they will be.

**Materials** : safety goggles, 1 platinum wire or nichrome wire loop, 1 50 ml beaker, 8 small test tubes, 1 test-tube rack, scoopulas, tongs, 1 gas burner, paper towels, 6M hydrochloric acid, potassium chloride (KCl), calcium chloride (CaCl2), strontium chloride (SrCl2), lithium chloride (LiCl), copper (II)chloride (CuCl2), sodium chloride (NaCl), barium chloride (BaCl2), magnesium strip, 2 unknown samples.

**Procedure**:

1. Copy down the data table in your data section of the lab.
2. Determine what the dependent and independent variables are as well as the constants and the control.
3. Dip your wire loop into the 6M HCL and then heat it in the hot flame of a Bunsen burner until no color comes from the wire when it is put into the flame.
4. Dip the clean wire loop into the sample of metal salt and heat the sample in the burner flame. Record the color of the flame in the data table.
	* For the sample of magnesium, hold a piece of magnesium with tongs in the flame approximately 10-15 seconds. Once the reaction begins, take the piece of magnesium out of the flame. Look at the sample for a second or two and then turn your head away.
5. Record your observations. Record the color and how quickly the sample burned and if there was any change in color. Be very descriptive in your observations so you have good data to compare to your unknowns.
6. Turn off your Bunsen burner and make sure your lab station area is clean and in order.
7. When directed by your teacher, move to the next station.
8. Repeat steps 3-7 at each station. Be sure to clean your wire loop each time.
9. Perform a flame test on the unknown salts. Record your observations.
	* The solutions are in the labeled spray bottles.
	* Before testing the unknown, spray water on the black paper in the hood so the paper does not catch on fire!
	* Spray the solution into the flame. Make sure that you are holding the spray bottle approximately 2 feet away from the flame.
	* When finished, repeat the process with the second solution.
10. Dispose of the unused portions of your samples as directed by the teacher.
11. Complete all of the required sections of the formal lab write up.

**Data Table:**

**NEAT AND ORGANIZED -- use a ruler!**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sample** | **Color**  | **Observations** | **Wavelength** | **Frequency** |
| **Potassium** |  |  |  |  |
| **Calcium** |  |  |  |  |
| **Strontium** |  |  |  |  |
| **Lithium** |  |  |  |  |
| **Copper** |  |  |  |  |
| **Barium** |  |  |  |  |
| **Sodium** |  |  |  |  |
| **Magnesium** |  |  |  |  |
| **Unknown****#1** |  |  |  |  |
| **Unknown****#2** |  |  |  |  |

**Calculations:** Show all your calculations used to determine the frequency of each sample.

**Questions:**

1. What elements produced the most easily identified colors?
2. What elements were not easily identified?
3. List the elements in order of increasing frequency, does this correlate with the visible light spectrum?
4. Draw a Bohr Model and electron configuration for each of the known elements.

**Flame Test Lab Report Rubric**

|  |  |  |
| --- | --- | --- |
| **Table of Contents** | **Points Earned** | **Points Possible** |
| * Includes the title, page numbers, and date of experiment
 |  | 1 |
| **Title** |  |  |
| * Creative, relates to the experiments, underlined at the top of the lab report
 |  | 1 |
| **Purpose Statement** |  |  |
| * Applies to the overall goal of the experiment.
 |  | 1 |
| **Variables**  |  |  |
| * Includes independent, dependents, constant (at least 3), and control.
 |  | 1 |
| **Question** |  |  |
| * Testable and clearly stated, correct punctuation
 |  | 1 |
| **Hypothesis** |  |  |
| * States what you are doing, what you predict will happen, and why you think that will happen. If…Then…Because
 |  | 1 |
| **Materials** |  |  |
| * A list of all materials used in the experiment
 |  | 1 |
| **Procedure** |  |  |
| * Write a complete, **DETAILED** procedure. If necessary, include a sketch of the lab setup.
 |  | 1 |
| **Data** |  |  |
| * Organized table that shows the data you have collected during the experiment
	+ - Include an appropriate titles (sample, element observation, color, wavelength, frequency)
		- Clearly organize and label data columns and rows
		- Units are clearly identified
		- Accuracy of data is appropriate to measuring equipment or instruments
		- Data and table lines are neat and presentable (USE A RULER)
 |  | 5 |
| **Analysis** |  |  |
| * Unknown Identification
	+ - Unknown is correctly identified
		- Data is used to support reasoning
 | 1pt per unknown | 2 |
| **Questions** |  |  |
| * Questions are answered clearly and explanation is provided (restate question).
1. What elements produced the most easily identified colors?
2. What elements were not easily identified?
3. List the elements in order of increasing frequency, does this correlate with the visible light spectrum?
4. Draw a Bohr Model for each of the known elements. (2 points each)
 | 2pts per question | 16 |
| **Conclusion** |  |  |
| * In the first few sentences, describe the identity of your unknown #1 and #2 . Be sure to use your data to support your reasoning.
 |  | 4 |

|  |  |  |
| --- | --- | --- |
| Error Analysis: Discuss how the 4 types of errors may have influenced the outcome of your experiment. Be sure to tell what direction the error skewed your data ( wavelength is too high or too low)  |  | 4 |
| * Discuss how to change the design to fix the errors. What further questions or investigations do this lead to? Suggest relevant changes and other experiments to improve understanding of the subject.
 |  | 2 |
| **Discussion/Reflection** |  |  |
| * Discuss what you learned from this experiment and how it relates to what we are learning in class and applications in the real world (your world). Examples: Medicine, Pharmacy, Industry, Technology, Mining
 |  | 2 |
| * Explain how the theoretical concepts we are learning in class directly apply to the lab experience. What Theories/ Laws are involved? How did this lab verify or deviate from them?
 |  | 2 |
| **Total Score** |  | **45** |

Unit Three Review Questions

**Chapter 4**

1. Match the following historical figures with what they did (some are from chapter 5):

|  |  |  |
| --- | --- | --- |
| \_\_\_ Democritus | A. | Discovered that oxygen is used in burning materials. |
| \_\_\_ Aristotle | B. | Discovered the nucleus in a gold foil experiment. |
| \_\_\_ Alchemists | C. | Discovered oxygen. |
| \_\_\_ Beecher | D. | Created the vacuum tube later used by chemists. |
| \_\_\_ Priestly | E. | Discovered the electron and proposed the plum-pudding model. |
| \_\_\_ Lavoisier | F. | Discovered that electrons have a negative charge. |
| \_\_\_ Dalton | G. | Discovered protons. |
| \_\_\_ Geissler  | H. | Used X-rays to determine the number of proton in the nucleus. |
| \_\_\_ Goldstein | I. | Proved the existence of neutrons. |
| \_\_\_ Crookes | J. | Discovered the cathode ray. |
| \_\_\_ Curie | K. | Created gunpowder by mistake. |
| \_\_\_ Thompson | L. | Determined that electrons were located in energy levels. |
| \_\_\_ Millikan | M. | Proposed the quantum mechanic model of the atom (electron cloud). |
| \_\_\_ Rutherford | N. | Proposed four elements and their properties: Fire, water, air, and earth. |
| \_\_\_ Bohr  | O. | Proposed the first idea of the atom in the 4th century BC. |
| \_\_\_ Moseley | P. | Proposed first version of the atomic theory; spherical model of the atom. |
| \_\_\_ Schrodinger | Q. | Discovered radioactive elements. |
| \_\_\_ Chadwick | R. | Developed the phogiston theory. |

1. What is the atomic theory?
2. Complete the table for the following elements.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Element** | **# of Protons** | **# of Electrons** | **# of Neutrons** | **Atomic #** | **Atomic Mass** |
| Manganese (Mn) | 25 |  | 30 |  |  |
| Sodium (Na) |  | 11 | 12 |  |  |
| Bromine (Br) | 35 |  | 45 |  |  |
| Yttrium (Y) |  |  |  | 39 | 89 |
| Arsenic (As) |  | 33 |  |  | 75 |
| Actinium (Ac) | 89 |  |  |  | 227 |

1. A sample of hydrogen is 99% 1H, 0.8% 2H, and 0.2% 3H. What is its average atomic mass?

**Chapter 5**

1. Draw a Bohr model for the following elements: (you must use numbers…NO DOTS!)
	1. Osmium (Os) C. Nitrogen (N)

* 1. Mendelevium (Md) D. Boron (B)
1. Draw an Aufbau Diagram for Technetium (Tc).
2. Write the full electron configurations for the following elements:
	1. Lead (Pb)
	2. Molybdenum (Mo)
	3. Potassium (K)
	4. Samarium (Sm)
3. Write shorthand electron configurations for the following elements:
	1. Barium (Ba)
	2. Francium (Fr)
	3. Silicon (Si)
	4. Tin (Sn)
4. What did Aufbau, Pauli, and Hund state in relation to electron configuration and Aufbau diagrams?
5. Where is the s- block located on the periodic table?

Where is the p- block?

d- block?

f- block?

1. What is the shape (general) and how many electrons can fit in into the following orbitals?
	1. s – shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ # of electrons \_\_\_\_\_\_\_
	2. p – shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ # of electrons \_\_\_\_\_\_\_
	3. d – shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ # of electrons \_\_\_\_\_\_\_
	4. f – shape \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ # of electrons \_\_\_\_\_\_\_
2. What is de Broglie’s equation?
3. What is Heisenberg’s Uncertainty Principle?
4. What is the correct order of the Electromagnetic Spectrum from longest wavelength to shortest wavelength?
5. What is the correct order of the visible light spectrum?
6. What is the wavelength of the radiation whose frequency is 5.00×1015 1/s?
	1. In what region of the electromagnetic spectrum is this radiation?
7. An inexpensive laser that is available to the public emits light that has a wavelength of 670 nm. What are the color and frequency of the radiation? (be careful of your units)