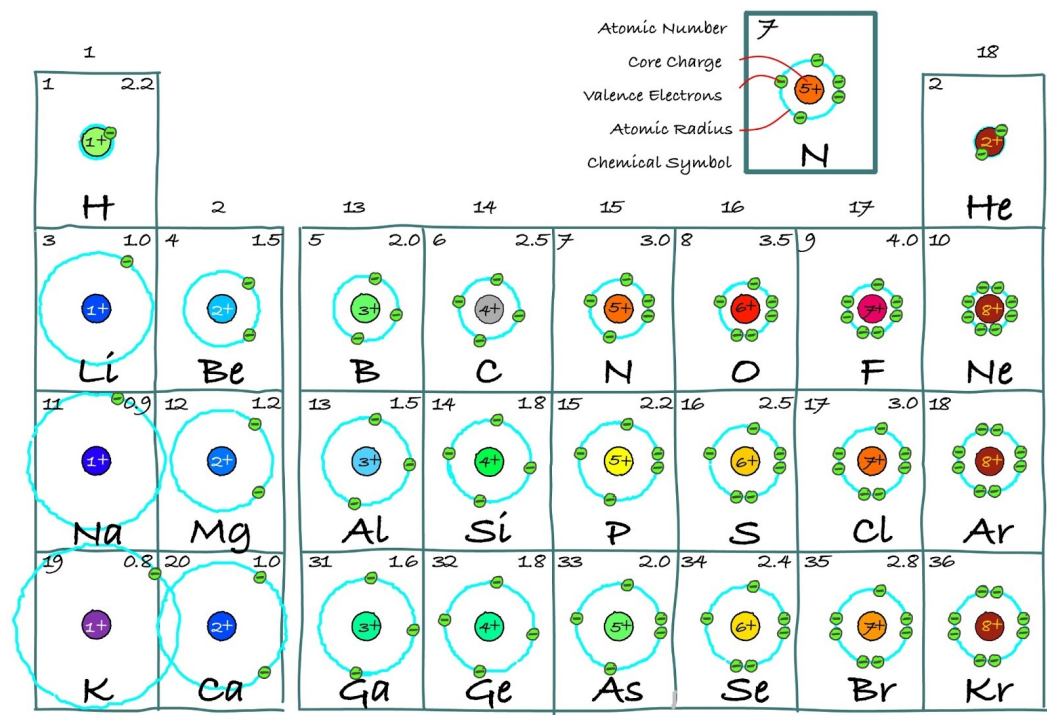


Science 9

Unit 2: Chemistry



BOOK 4: The Bohr Model & Periodic Trends

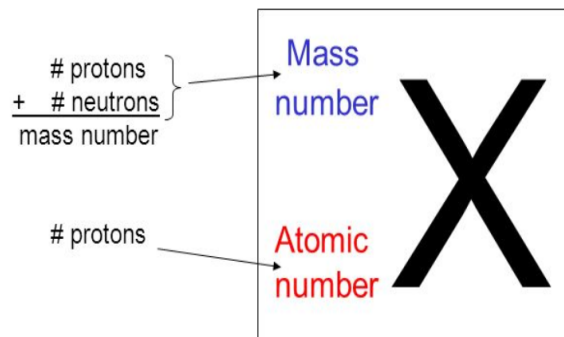
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PART A: THE BOHR MODEL

Using Standard Atomic Notation

- On the upper left of the element symbol is the **atomic** _____ (rounded to the nearest whole number)
- On the lower left of the element symbol is the **atomic** _____ (number of protons).



Ex. Consider the element gold. Its symbol is Au. Its mass number is 197 and its atomic number is 79.

Written in standard atomic notation it becomes: ${}^{197}_{79}\text{Au}$



Write the standard atomic notation for germanium, uranium, and cobalt.

Modeling Atoms with Bohr Diagrams

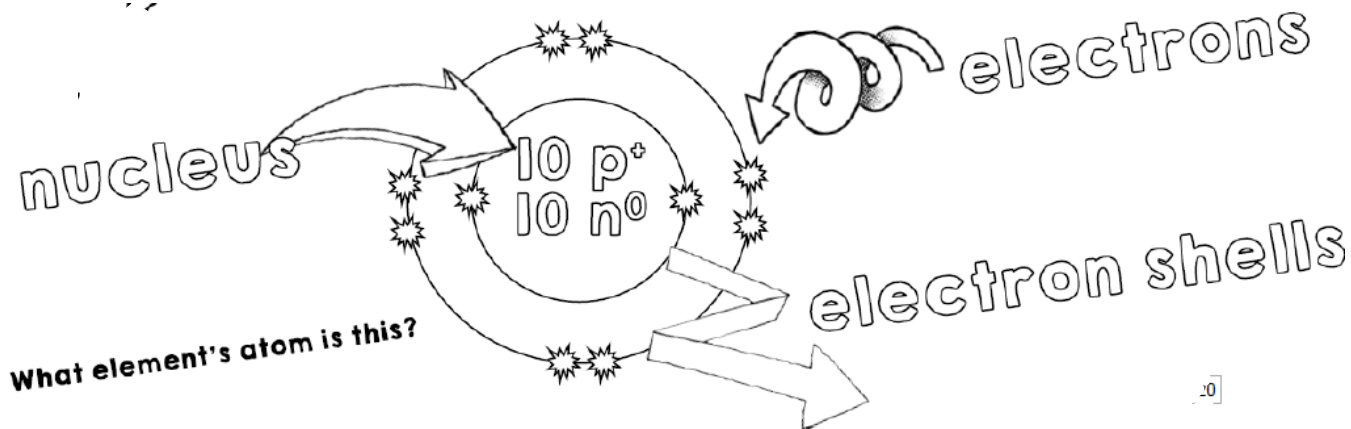
- Atoms are so _____ that in order to study them, we need to create _____
- The current atomic model is known as the _____
 - Electrons are always moving in 3D space around the _____
- The model that we will learn today represent the atom at _____
 - It's a way of representing the _____ of electrons in the "cloud"
- It's important to remember that an atomic model is a _____ version of an atom, and it's completely _____ in terms of _____

Bohr Diagrams

- A Bohr diagram is a diagram that shows how many _____ are in each shell surrounding the nucleus.
- Named in honour of _____, a Danish physicist who developed several models for showing the arrangement of electrons in atoms.
- There are three main background questions to explore before we start drawing Bohr diagrams.

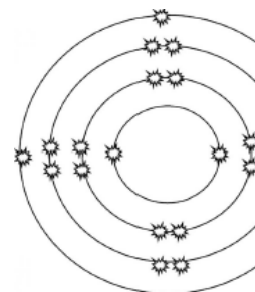


1. _____ of a Bohr Diagram



2. How does an Electron's _____ Correspond to its _____?

- Imagine climbing a _____. As you go up each rung, you gain more and more _____
 - This is similar to the way in which electrons have _____ energy as they orbit _____ from the nucleus
- The shells of an atom are named _____, _____, _____, and _____ going from _____ to furthest from the _____



3. How do _____ Fill the _____?

NOTE: Once the atoms get larger than Calcium (#20) things start to get more complicated!

Electrons fill the _____ shell (level 1) first. The K shell is full when it has **TWO** electrons.

Remaining electrons fill the _____ shell (level 2) next. The L shell is full when it has **EIGHT** _____.

Any _____ electrons fill the _____ shell (level 3) next. For the first _____ elements, the M shell is full when it has **EIGHT** electrons.

SHELL	LEVEL	# of electrons to be 'FULL'

DO Fill in the table above.

(After element #20, the M and N shell can actually hold 18 and 32 electrons...but for now we won't worry about that.)

If there are _____ remaining electrons, they fill the _____ shell (level 4). The N shell is full when it has **EIGHT** ²¹ electrons.

Drawing a Bohr Diagram

1. Write the element's _____ with the _____ at the TOP left and the _____ at the BOTTOM left
2. _____ the number of _____ in the atom. Write the number of protons (p^+) and neutrons (n^0) as the _____
3. _____: How many electrons does the _____ atom have?
4. _____ the K shell. Fill the K shell with the first _____ electrons. Make your electrons nice and _____!
5. Continue drawing each shell and _____ with electrons until you have accounted for all the atom's electrons.

LET'S TRY!

For _____:

Mass number _____

atomic number _____

_____ equals number of _____

F

— p^+

— n^0

(There are _____ electrons)

Draw one electron per side first, then double up. Move clockwise as you draw.

DO

Use the steps above and the sample to draw a Bohr Diagram for Aluminum.



In the diagram below, **identify the elements** by the Bohr model diagrams are shown. Write the symbols of the elements in the spaces provided.

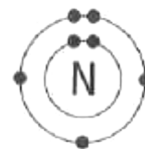
PART B: VALENCE ELECTRONS

- The electrons in the _____ shell. These are the electrons that participate in chemical _____.
- **Valence electrons** can be shared or _____ by another atom.
- Noble gases do not react unless under _____ conditions. This is because their valence shell is _____.
- An atom that has lost valence electrons is a _____ ion.
- An atom that has gained valence electrons is a _____ ion.

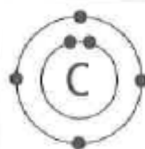


For the following Bohr diagrams, answer the following questions:

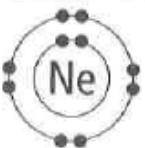
Number of protons _____ Number of electron shells _____
 Number of electrons _____ Number of valence electrons _____
 Ion or Atom _____



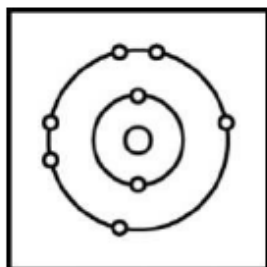
Number of protons _____ Number of electron shells _____
 Number of electrons _____ Number of valence electrons _____
 Ion or Atom _____



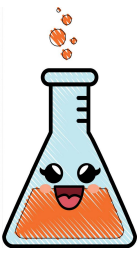
Number of protons _____ Number of electron shells _____
 Number of electrons _____ Number of valence electrons _____
 Ion or Atom _____



The following Bohr model diagram represents an oxygen atom.
 Examine the diagram, then answer the following questions:



- Why is this not a stable electron arrangement?
- What would make this atom stable?
- Use a different colored pen to adjust the diagram so that it shows a stable electron arrangement.

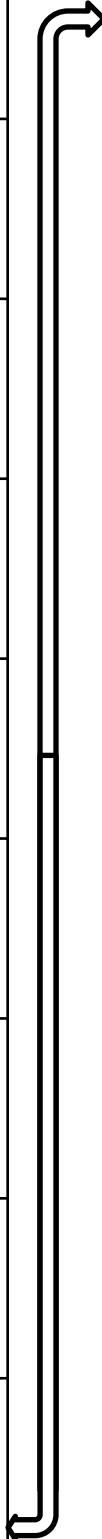


Bohr Model Scavenger Hunt Answer Sheet

For each problem, write the name of the Bohr model in the boxes below.

You may need to reference a periodic table to help you.

*start here!



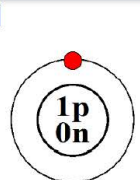
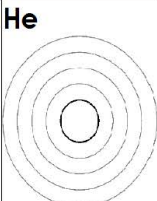
 *end here!

Homework

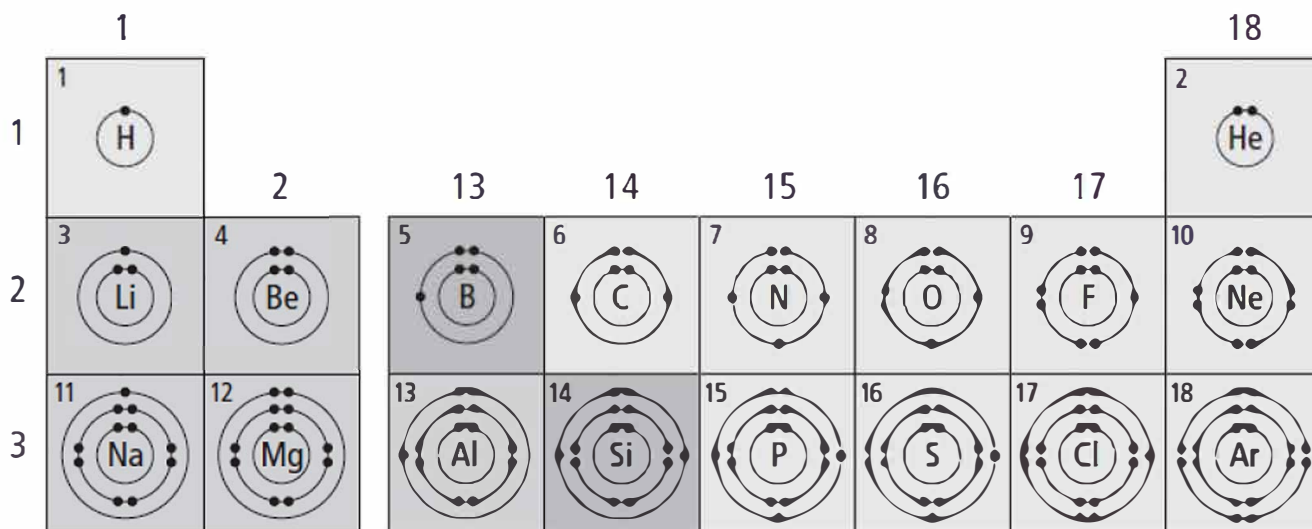
ASSIGNMENT #1: Bohr Model Practice, Worksheet pages 6-8
 This assignment is to be completed below in the space provided.

Use the innermost circle as the nucleus, and fill the electron shells with the correct number of electrons for each of the first 20 elements in the Periodic Table.
 eg. Hydrogen has been completed for you as an example.

Bohr Diagrams for the first 20 Elements

Group 1							Group 8	
Period 1	H 							He 
	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7		
Period 2	Li	Be	B	C	N	O	F	Ne
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar
Period 4	K	Ca						

1. What is the pattern between the number of **valence electrons** and the group number of the periodic table?
2. What is the pattern between the number of **electron shells** and the period number of the periodic table?



Drawing Bohr model diagrams

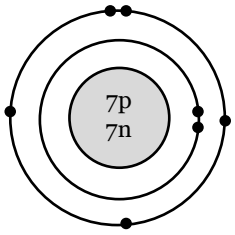
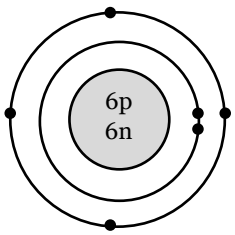
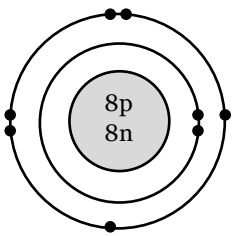
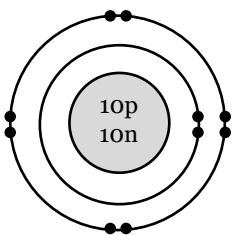
- Refer to the Bohr model chart **ABOVE** to help you complete the following table. Some answers are provided for you. (Hint: Remember that the maximum number of electrons in the first three shells is 2, 8, and 8.)

Atom/ion	Atomic number	Number of protons	Number of electrons	Number of electron shells
neon atom	10	10	10	2
fluorine atom	9			
sodium atom				
argon atom				
chlorine atom				
potassium atom				

- Use the table above to draw the Bohr model diagram for the following atoms and ions.

Argon atom	Chlorine atom	Potassium atom

Use your periodic table to answer the following.

	<p>a. number of protons _____</p> <p>b. number of electron shells _____</p> <p>c. number of electrons _____</p> <p>d. number of electrons in outer shell _____</p> <p>e. element _____</p>
	<p>a. number of protons _____</p> <p>b. number of electron shells _____</p> <p>c. number of electrons _____</p> <p>d. number of electrons in outer shell _____</p> <p>e. element _____</p>
	<p>a. number of protons _____</p> <p>b. number of electron shells _____</p> <p>c. number of electrons _____</p> <p>d. number of electrons in outer shell _____</p> <p>e. element _____</p>
	<p>a. number of protons _____</p> <p>b. number of electron shells _____</p> <p>c. number of electrons _____</p> <p>d. number of electrons in outer shell _____</p> <p>e. element _____</p>

These four elements are all in the same horizontal row (period) of the periodic table. What is the **same** about electron shells for elements in the same period?

What is **different** about the electrons in the outer shell for elements in the same period?

PART C: PERIODIC TABLE TRENDS

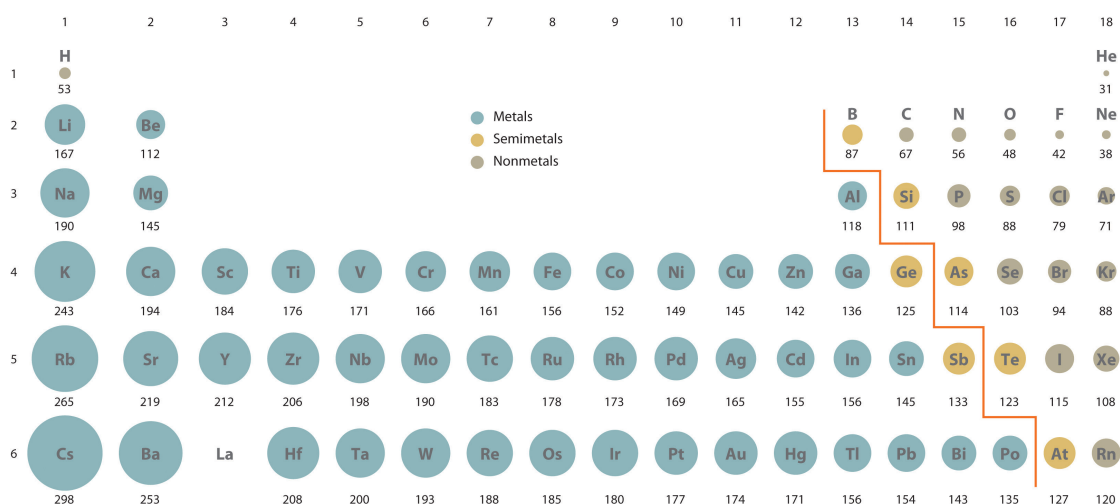
In chemistry the term _____ refers to a regular pattern in the properties of elements based on their atomic structure.

This is the pattern that Mendeleev predicted. When the pattern repeated, he began a new _____.

The periodic table is a powerful tool for analyzing trends in _____ and _____.

ATOMIC SIZE TRENDS:

Observe the sizes of the atoms in each group and period shown in the diagram below. Do you see a pattern?



1. Atomic size _____ moving DOWN a group/column.

- as you move **down** a _____, elements have atoms with _____ energy _____.
- the _____ the number of electron shells, the _____ away from the nucleus the **valence electrons** are _____.
- if the electrons are farther away, the atom is _____.

2. Atomic size _____ moving LEFT to RIGHT across a period/row.

- elements have _____ numbers of electrons in their _____ shells as you move LEFT to RIGHT.
- as the number of electrons increases, so does the number of _____ in the nucleus.
- the attraction between the n _____ valence electrons and the p _____ nucleus is **very strong**.
- with each electron added, the outer shell is pulled _____ to the nucleus and the atomic size _____.

REACTIVITY TRENDS:

Compare what happens when **potassium (A)** and **sodium (B)** are added to water:



You can see that the reaction is _____ vigorous and violent in 'A', water + potassium.

Why is this the case?

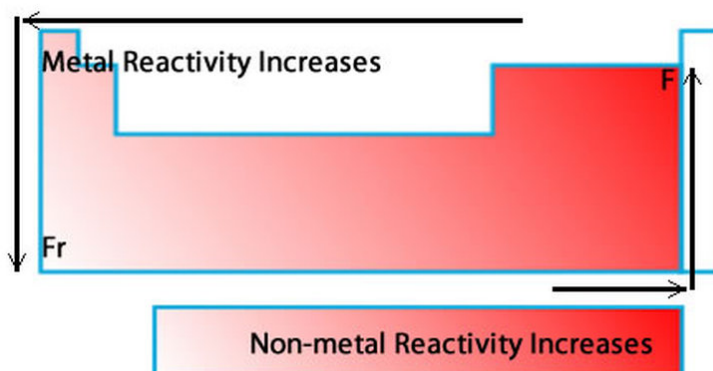
What is **similar** about potassium and sodium? _____

What is **different** about potassium and sodium? _____

- Because _____ valence electrons are farther away from the nucleus than the electrons in a _____ atom, the attraction to the nucleus is _____.
- Electrons further from the nucleus require _____ energy (*are easier*) to remove.
- The adding and removing of electrons is what is involved in c_____ r_____.
- This is why we would say that _____ is **more reactive** than _____.

This pattern repeats throughout the periodic table with the **exception of the noble gases**.

- the noble gases have a FULL valence shell, they are stable and _____



1. Explain why atoms get larger down a group on the periodic table:
2. Explain why atoms get smaller from LEFT to RIGHT across a periodic table:
3. Why is an alkali metal MORE reactive than an alkaline-earth metal in the same period?



LAB – REACTIVITY TRENDS IN THE PERIODIC TABLE

Periodic trends include both physical and chemical properties of elements. In this investigation, find out if (and how) the reactivity of metals relates to their position on the periodic table.

Question: Is there a relationship between the reactivity of a metal and its position in the periodic table?

Safety:

- Hydrochloric acid can burn skin. _____ is the chemical formula for hydrochloric acid.
- Do not handle _____ with your bare hands. Use the forceps instead.
- Clean up any spills and inform your teacher immediately.
- You must be wearing your goggles and apron until you have finished cleaning up your lab station.

Procedure:

1. **Read the procedures completely** and then design a table to record your observations below.
2. Using a spot plate place one piece of each type of metal (calcium _____, magnesium _____ and aluminum _____) into a separate well. Do not pick up the calcium with your hands, use the forceps.
3. Fill a beaker half full with water. Using the dropper add 3-5 drops of water into each well that contains a piece of metal. Record your observations.
4. When the reactions stop, dispose of the liquid as directed by your teacher. You will use the magnesium and aluminum metals again for the next step.
5. Add 3-5 drops of hydrochloric acid (HCl) to the remaining magnesium and aluminum samples. Record your observations and indicate the relative reactivity of each metal.
CAUTION: Be very careful when working with the hydrochloric acid. Acid can burn your skin. If you spill any acid solution on your hands, rinse it off immediately with cool water and inform your teacher.
6. Clean up your work area and dispose of materials as directed by your teacher.

Prediction: I think _____ metal will be the most reactive.

Conclude and Communicate

1. a) Draw Bohr diagrams for magnesium, calcium and aluminum.

b) Does your understanding of atomic structure support your observations from this investigation? Justify your response.

Apply and Innovate:

1. What other metals could you test this way? Suggest two or three additional metals that you could test.