

Name: _____ Period: _____ Date: _____

ATOMIC STRUCTURE NOTES ADVANCED CHEMISTRY

Directions: This packet will serve as your notes for this chapter. Follow along with the PowerPoint presentation and fill in the missing information. Important terms / ideas are in all capitals and bolded!

- **ATOM:**

- _____ are composed of only _____ type of atom

- _____ formed when _____ or more atoms are _____ bonded to form a new substance

- Atoms first suggested and named by _____... believed that atoms were _____ and indestructible

- His ideas were limited because they did not explain _____ and lacked _____ support

- _____ used experiments to explain Democritus' ideas over 2,000 years later...

- **Dalton's ATOMIC THEORY**

1) **ALL** elements are made of _____, _____ atoms

2) Atoms of the **SAME** element are _____... atoms of **DIFFERENT** elements are _____

3) Atoms can mix together or combine _____ in simple whole number ratios to form _____

4) Chemical _____ occur when atoms are separated, joined, or rearranged... but atoms are _____ changed into atoms of another _____ as a result

- **Subatomic Particles**

- Dalton was proved mostly right except... **ATOMS ARE** _____!

- Three Subatomic Particles

- **PROTONS:**

- **NEUTRONS:**

- **ELECTRONS:**

- Electrons

-Discovered by _____ in 1897

-Passed a _____ through gases at low pressure in a vacuum tube, producing a glowing beam or _____

- Cathode Ray Experiment

-The ray is a beam of _____ traveling from the cathode to the anode!

-When the _____ end of a magnet is applied, the beam is _____...
ELECTRONS MUST BE _____ CHARGED!!

-No matter what gas or metals were used, the charge-to-mass ratio remained the _____ ...
_____ ARE PART OF ALL ATOMS!!

- Oil Drop Experiment

- _____ calculated the charge and mass of the electron

-Charge: one unit of _____ charge (-1)

-Mass: 1/1840 the mass of a _____ atom (_____ subatomic particle)

- Protons and Neutrons

-**EUGENE GOLDSTEIN** discovered _____ (1,840 times _____ than an electron)

-**JAMES CHADWICK** confirmed the existence of _____ (about the same size as a proton)

- Gold Foil Experiment

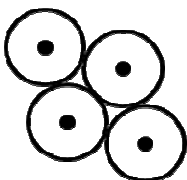
-**ERNEST RUTHERFORD** shot _____ particles (positively charged) at a thin sheet of _____ foil

-**HYPOTHESIS:** alpha particles will pass through the foil _____ changing direction because _____ charged particles spread out in the atoms of the foil will _____ stop or deflect the alpha particles

-**RESULTS:** most went straight _____, some _____, and some came straight _____

-**CONCLUSIONS:** most of the atom is _____ with a dense, positively charged _____ (protons and neutrons)!!!

-Use labels / lines to show what happened:



- **Models of the Atom**

-Various _____ contributed to our understanding of the atom

-Discoveries made between _____ shaped the current model

- **Dalton's Model**

-**1803**: Views atoms as _____ and _____ particles with _____ internal structure

-Draw it:

- **Thomson's Model**

-**1897**: Negatively charged particles (_____) are distributed throughout a _____ positive charge

- " _____ " Model

-Draw it:

- **Rutherford's Model**

-**1911**: Small, dense, positively charged _____ with the _____ moving around the nucleus (mostly _____)

-Did _____ explain the _____ of elements!!

-Draw it:

- **Bohr's Model**

-**1913**: Electrons move in a circular _____ at _____ distances from the nucleus (_____)

-Draw it:

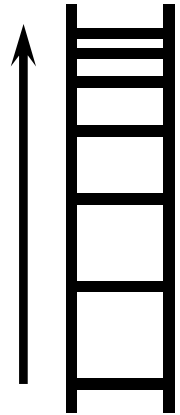
-**ENERGY LEVELS (n)**:

-Positive nucleus " _____ " the electrons so they stay in orbit

-Electrons absorb or emit energy as they _____ between levels:

- To an **EXCITED** (higher) orbit = _____ energy
- Return to **GROUND** (lower) orbit = _____ energy

-Imagine the fixed energy levels are like the _____: lowest rung is _____ in energy, can move rung to rung, you _____ stand between the rungs just like _____ can't be in between levels, and to climb you need the right amount of energy



-Levels are **NOT** _____ apart, so electrons gain or lose different amounts energy

-Higher energy levels are _____ together... it takes _____ energy to move from one to the next near the top!

*Ladder with _____ spaced rungs is actually a better representation of the model!!

- **Schrodinger's Model**

-**1926**: Development of a mathematical equation to determine _____ around the nucleus that would have a high _____ of containing an electron (_____)

-"_____ " or _____ (current)

-Draw it:

-Protons and neutrons found in the _____

-**ELECTRON CLOUD**:

DENSER regions = _____ probability of finding an electron

- Distinguishing Among Atoms

-Why are atoms of different elements different?

- They contain different number of _____
- _____ tell you which element is which

- **ATOMIC NUMBER:**

-Use the _____ to determine

-Ex: all Hydrogen atoms have _____ proton, so the atomic # of hydrogen is _____

-What is the Atomic Number for each: Li, Pb, Au, Br?:

- **Electrons**

***Since atoms are electrically _____, the # of protons must _____ the # of _____!!**

-Atoms with _____ numbers of protons and electrons are _____ (charged particles)

-Only the _____ can _____ or _____ to give ions, NOT the _____... **WHY?:**

-Positive (+) charge = _____ electrons, while Negative (-) charge = _____ electrons... number of charge indicates how many!

-Examples:

- **MASS NUMBER:**

Mass # =

of Neutrons =

-Example: If an element has an atomic number of _____ and a mass number of 78 what is the...

Number of protons?

Number of neutrons?

Number of electrons?

Symbol for this element?

- **Atomic Symbols**

X

Ex:

-Example: If an element has _____ protons and 140 neutrons what is the...

Atomic number?

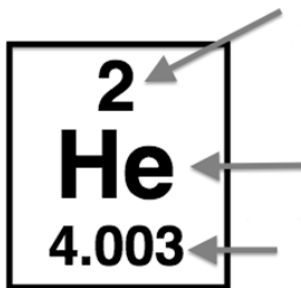
Mass number?

Number of electrons?

Atomic Symbol for this element?

- Reading the Periodic Table

-Round the _____ to get the MASS # of the most common isotope!!!



- Problems

-Determine the number of PROTONS, NEUTRONS, and ELECTRONS for each:

- _____:
- _____:
- _____:
- _____:

- **ISOTOPES:**

- _____ is different because there are more or less _____

- _____ is still the _____... otherwise the _____ would change!

-Naming: put the _____ after the element name

-Ex:

-Example: Determine the number of each subatomic particle for _____.

- **ATOMIC MASS:**

-Reflects both the _____ and relative _____ of the isotopes as they occur in nature

-**NOT** a _____ because it is an average

-Given on the _____

-Measured in _____ (amu)... 1 amu = 1/12 the mass of a _____ atom

- Calculating Avg. Atomic Mass

Average Atomic Mass =

-Example: Calculate the average atomic mass of copper if copper has two isotopes. 69.1% of copper has a mass of ____ amu and 30.9% has a mass of ____ amu.

-Example: Magnesium has three isotopes. 78.99% of Mg has a mass of ____ amu, 10.00% Mg has a mass of ____ amu, and the rest has a mass of 25 amu. What is the atomic mass of magnesium?

- Energy Levels

-Regions in space around the _____ that contain _____

-Tell you how _____ an electron is to the nucleus

-Numbered 1-7... with 1 being the _____ and _____ to the nucleus

-"N" stands for the Energy Level and is known as the _____

-**GROUND STATE** (_____ energy) is _____

-**EXCITED STATES** (_____ energy) are _____.

-Electrons in excited states are _____ from the nucleus, have _____ orbits, and _____ energy!

-_____ on the Periodic Table indicate the energy level!!!

- **SUBLEVELS:**

-Principal energy levels (n) can be _____ into energy sublevels

-Each energy level can have _____ sublevels with different _____ (showing where an electron is _____ to be found)

-Sublevels are denoted by letters: _____

- **ORBITALS:**

-Electrons are spinning in _____ directions... " _____ "

-Each sublevel has a different number of orbitals: s = ____, p = ____, d = ____, and f = ____

-Since each orbital can hold a max of ____ e-: s = ____ e-, p = ____ e-, d = ____ e-, and f = ____ e-

- Summary

ENERGY LEVEL (n)	# OF SUBS	# OF ORBS (n ²)	MAX # OF e ⁻ (2n ²)
1			
2			
3			
4			

- Electron Configurations: shows distribution of electrons among the orbitals of the atom

-Three Ways to do this:

- **Orbital Diagrams** (using _____ with electrons as _____)
- **SPDF Notation** (_____ and _____ showing levels and electrons)
- **Kernel Notation** (use _____ and simplified SPDF)

- Rules

- 1) **AUFBAU PRINCIPLE:** add electrons one at a time to the orbitals of _____ energy first
- 2) **PAULI EXCLUSION:** e- MUST have _____ spins and _____ of 2 e- per orbital (each e- has _____ different quantum #s)
- 3) **HUND'S RULE:** each orbital in the sublevel must have one e- _____ pairing begins

Ex:

- **Orbital Diagrams**

-How to draw:

- 1) Use a box to represent one _____ / Arrows represent _____
- 2) Find the # of _____
- 3) Start with the _____ energy level first (n = 1) and write down all _____ in each

4) Follow all _____ (max 2 e⁻ per orbital, correct # of orbitals for spdf, unpaired first, d is one row behind)

5) Use the _____ to help!

- Practice

-Example: Draw the orbital diagram for _____. Determine the number of unpaired electrons.

- _____:

- _____:

- _____:

- **SPDF Notation**

-The electron configuration for _____ using this notation is:

-**Large numbers** represent the _____

-**Letters** represent the energy _____

-**Superscript numbers** indicate the number of _____ in the sublevel

***USE THE _____ TO GUIDE YOU!!**

-Periods (_____) indicate an ENERGY LEVEL (___ sublevels are off by _____) ← WHY?

-Groups (_____) indicate SUBLEVELS

-Example: Write the electron configuration for _____.

- Practice

Write the electron configurations for _____, _____, _____, and _____ using spdf notation. How many electrons are in the last energy level?

- **Kernel (Shorthand) Notation**

-Write the symbol of the _____ (FARTHEST RIGHT column on the table) that _____ the element on the Periodic Table and put in []

-Then write the remaining electrons using spdf notation

-Example:

Aluminum:

Ne:

So... Al is:

-Try ___ and ___ on your own:

- Exceptions

-Some electron configurations will be _____ than what is expected from the rules

- _____ OR _____ **SUBLEVEL CONFIGURATIONS ARE MORE _____ !!!!**

-Examples: _____ and _____ (one electron is _____ for added stability)

_____:

_____:

- Light

-All light exhibits _____ properties

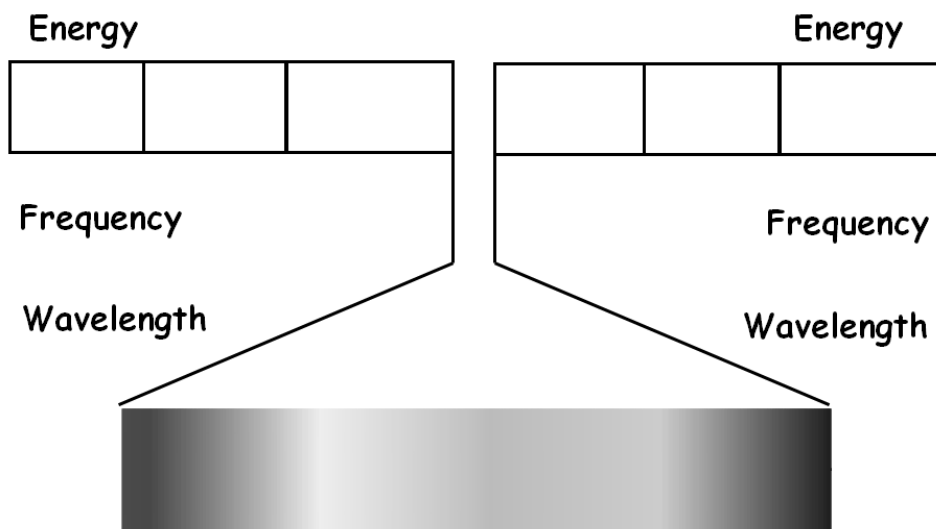
- **AMPLITUDE:**
- **WAVELENGTH (λ):**
- **FREQUENCY (ν):**

- Electromagnetic Spectrum

- ____ Regions

-Ranked with respect to their _____

-As the wavelengths become _____ the frequency decreases (_____ relationship)



- Visible Spectrum

-We are only able to see a very limited portion of the electromagnetic spectrum (_____)

-Visible light is an example of a **continuous spectrum** (_____)

-Ranges from _____ (long λ) to _____ (short λ)

- Prisms

-White light is made of _____ of the spectrum (**CONTINUOUS**)

-Colored light only gives _____ (**NOT CONTINUOUS**)...

- **ATOMIC EMISSION SPECTRUM:**

-Gives a pattern of color that is _____ for each element

-Adding energy _____ an atom's electrons... so they jump from the _____ (lowest energy) to an _____ (higher energy)

-When electrons move from a higher energy level back to a lower one, a quantum of energy (_____) is given off that has a frequency _____ to the energy change