Name _____ **Period**_____

Unit 3: Atomic Structure

Skills:

1. Interpreting Models of the Atom
2. Determining the number of subatomic particles
3. Determine P, e-, n for ions
4. Distinguish isotopes from other atoms/ions
5. Calculate WAAM!
6. Identify Valence Electrons and Electron configuration
7. Draw Bohr Diagrams
8. Apply excited State electron concept to e- configurations

Unit 3 Vocabulary……Due: Test Day

Word	Definition
Atom	
Proton	
Neutron	
Electron	
Gold Foil Experiment	
Valence Electron	
Atomic Mass Number	
Weighted Average Atomic Mass	
Isotope	
Ion	
Excited State	
Principle Energy Level	

Unit 3 Resources:

SCAN ME

Skill 1: Interpret the Evolution of the Models of the Atom through History

Travel through the stations as you travel in the time through the evolution of our scientific understanding of the atom!

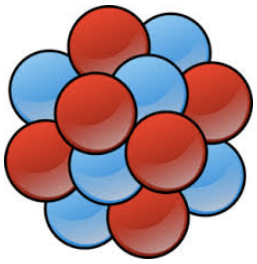
Station 1: The Greeks! An Atomic Philosophy

Watch and answer:

What did Democritus call the "tiny, indivisible particle" which he believed to be the basis of all substances? _____

Plato and Aristotle did not _____ with Democritus and so his theory was _____ _____ _____ centuries.

Station 2: Dalton (1803)



Read about Dalton's Four Main Ideas:

1. All matter consists of tiny particles called _____. He imagined them as tiny,_____ spheres in various stages of motion.

2. _____ are indestructible and _____

3. All atoms of the same elements are _____ by their weights—meaning all atoms of the same element are identical!

4. In chemical reactions, atoms _____ in _____, _____ number ratios.

Station 3: JJ Thomson (1897):

Watch link and complete:

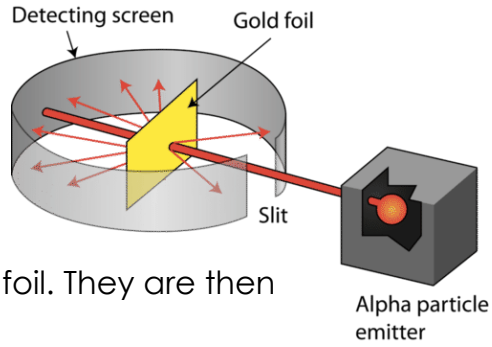
In 1896, JJ Thomson used a _____ accelerator. Thomson _____ the voltage across the plates and he measured the amount of bending.

That allowed him to deduce the mass of the particle in the beam. Thompson discovered the first _____ particle, the _____.

Thompson discovered that the atom is not the fundamental building block of matter, there are_____ object inside. Atoms are _____ _____ hard, indivisible spheres!

Answer: Compare JJ Thomson's Mode of the atom to Dalton's. What has changed?

Station 4: Rutherford (1909) Gold Foil Experiment!
Watch and Complete:



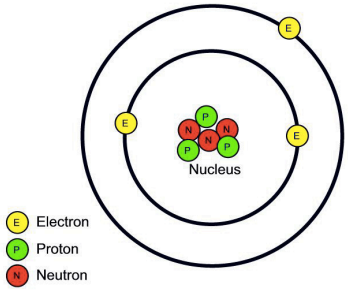
Earnest Rutherford discovered the _____ nucleus!

Rutherford set up an experiment to direct a beam of _____ particles…through a very thin, _____ foil. They are then detected by one of the two detectors.

Rutherford determined that most of the gold atom is _____ space, so the alpha particles go _____ through. Occasionally, one of the particles will be _____ by the positive nucleus.

The atom has a small _____nucleus, with mostly _____ space, with electrons distributed _____.

Station 5: The Bohr OR Planetary Model (1913)
Watch and Answer:



Negatively charged electrons are found in concentric _____ around the _____charged nucleus.

We sometimes refer to the Bohr model as the _____model.

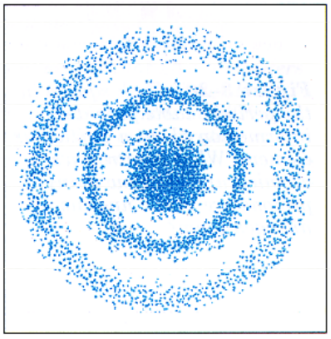
Electrons are found at fixed _____ _____ orbiting at _____ distances from the nucleus.

The path closest to the nucleus has the _____energy level and the energy level is _____ the farther the electron is from the nucleus

Station 6: Wave mechanical/ Quantum Model (Modern Model)
Read and answer:

Schrödinger used _____ _____ to describe the likelihood of finding an electron in a certain position.

This atomic model is known as the _____ model of the atom.



Unlike the Bohr model, the quantum mechanical model does not define the _____ of an electron, but rather, predicts the odds of the location of the electron—a cloud. This location is called an ORBITAL.

Where the cloud is most dense, the _____ of finding the electron is greatest.

Practice:

1) Which of the following did Rutherford's Gold Foil experiment prove?
   a. That the atom was a uniformly dense sphere.
   b. That the atom is mostly empty space with a dense, positive core.
   c. That most the atom consists of a uniform positive "pudding" with small negative particles called electrons embedded throughout.
   d. Thatelectronstravelaroundthenucleusinwell-definedpathscalledorbits.

2) J.J. Thomson's Cathode Ray Tube experiment led to the discovery of
   a. the positively charged subatomic particle called the electron
   b. the positively charged subatomic particle called the proton
   c. the positively charged subatomic particle called the electron
   d. the negatively charged subatomic particle called the electron

3) According to the Bohr Model,
   a. electrons are found in areas of high probability called orbitals
   b. electrons travel around the nucleus in circular paths called orbits
   c. electrons are found in areas of high probability called orbits
   d. electrons travel around the nucleus in random paths called orbitals

4) According to the Wave-Mechanical Model,
   a. electrons are found in areas of high probability called orbitals
   b. electrons travel around the nucleus in circular paths called orbits
   c. electrons are found in areas of high probability called orbits
   d. electrons travel around the nucleus in random paths called orbitals

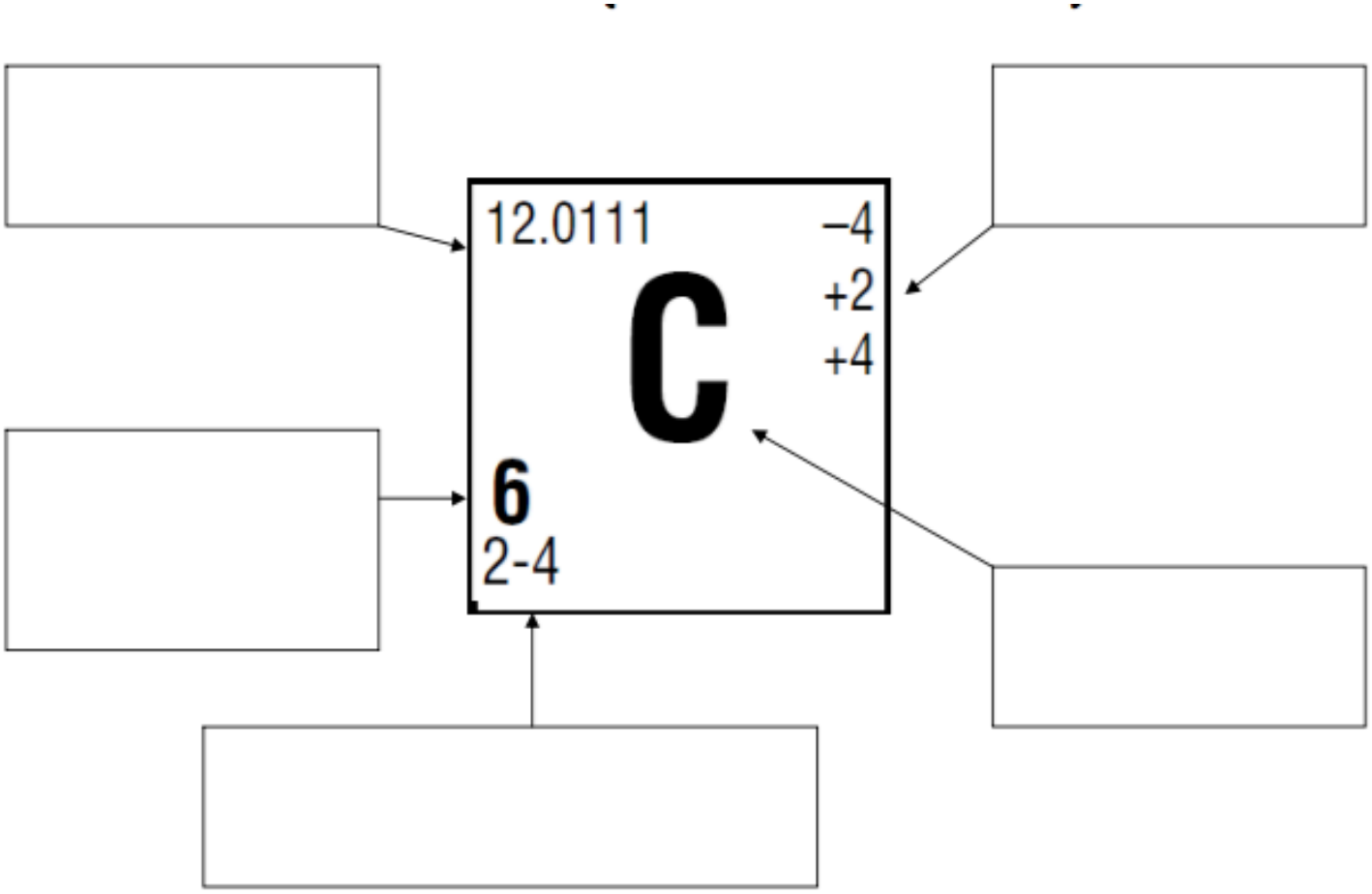
5) Write the charge on the following subatomic particles:
   a. Proton _____
   b. Neutron _____
   c. Electron _____

6) Draw a visual of the model:

Greek/Dalton	Thomson	Bohr	Wave Mechanical

Scientist	Model	Date	Discovered/Ideas	Model Description	Candy Model
Democritus	Greek Model	420 BC	Documented the idea of existence atoms	Solid sphere	
Dalton	Cannon Ball Model	1800	Proposed atomic theory Said that atoms make elements and elements combine to make _____	Solid sphere	
Thomson	Plum Pudding Model	1897	Discovered the electron	A sphere filled with a _____ charged fluid, and negatively charged particles	
Rutherford	Nuclear model/ Planetary Model	1911	Through the "_____ _____ experiment" discovered that atoms have to be made up of mostly _____, dense, positively charged region in the center.	A dense region in the center, called the _____orbited by electrons like the rings around the planet Saturn.	
Bohr	Planetary Model	1913	Proposed that the electrons orbit in distinct orbits, but electrons could jump between these orbitals by gaining or losing energy.	Electrons orbited the nucleus in concentric circles called _____.	
Schrodinger	Electron Cloud Model or Quantum Mechanical Model	1924	Instead of perfectly circular orbits, the electrons would be found in _____ of space around the nucleus.	Electrons are found in clouds of space around the nucleus called _____.	

Skill 2: Determining Number of Subatomic Particle in the Atom



**Nucleons = PROTONS and NEUTRONS; any subatomic particles found w/in the nucleus

Subatomic Particle	Charge	Relative Mass	Location	Symbol	How to Calculate
Proton				_____	
Neutron					
Electron					

Atomic Vocabulary:

1. **Atomic Mass Unit (_____)**
2. **Atomic Number:** number of _____ in an atom. Identifies the _____
3. **Nuclear Charge:** depends on the number of _____ in the nucleus.
4. **Atomic Charge:** The total _____ of an atom is ALWAYS _____ (# of protons _____ # of electrons)
5. **Mass Number:** Mass number = _____
6. **Average Atomic Mass:** The _____of all isotopes' atomic mass, found in the top_____ of the periodic table square.
7. **Ion:** Having a positive or _____ charge due to increased or _____ number of electrons.
8. _____: Two atoms with the same number of protons but a different number of neutrons!

Symbol	# Protons	# Neutrons	# Electrons	Atomic Number	Mass Number	Nuclear Charge	Nuclear Symbol
Cl-35	17	18	17	17	35	17	$^{35}_{17}Cl$
	15	16					
C-14		8					
			8				$^{16}_{8}O$
Ar-40		22					

Skill 3: Determine protons, electrons + neutrons for ions

Ions: An atom that has _____

(# of protons does _____ # of electrons)

ANion: A _____ charged ion, meaning that it has _____ a certain number of electrons. The atom gets _____.

Example:

Cation: A _____ charged ion, meaning that it has _____ a certain number of electrons. The atom gets _____.

Example:

$^{23}_{11}Na^{+1}$

Atomic Number: _____ # of protons: _____

Mass Number: _____ # of neutrons: _____

Ion Charge: _____ # of electrons: _____

Type of Ion: _____

Fill out the missing data below:

Question	Ion	Mass #	Atomic #	# of Nucleons	# of p	# of n	# of e-	Lost or Gained Electrons
1	$^{41}_{19}K^{+1}$							
2	$^{80}_{35}Br^{-1}$							
3	$^{25}_{12}Mg^{+2}$							
4			22			25	19	
5	$^{138}La^{+3}$							

Skill 4: Identify Isotopes

Isotope: Atoms of the same element, but different number of _____ and different _____.

Isotopes of Hydrogen				
Particle	**Protons**	**Neutrons**	**Mass Number**	**Symbol**
H-1 (Protium)				
H-2 (Deuterium)				
H-3 (Tritium)				

Mass notation: Shows the element symbol and the _____ of the atom only.

C – 14 **_____ p _____ n _____ e**

Isotopic Notation: shows the _____ of an atom long with _____

$^{9}_{4}$Be **_____ p _____ n _____ e^-**

Practice:

1. Se-79. Does its MASS exactly match the periodic table? _____....._____
   Find the number of neutrons in an atom of Se-79.

2. Find the number of neutrons in an atom of $^{52}_{24}$Cr

. Which symbols represent atoms that are isotopes of each other?

A) ^{14}C and ^{14}N B) ^{16}O and ^{18}O
C) ^{131}I and ^{131}I D) ^{222}Rn and ^{222}Ra

Isotope name	atomic #	mass #	# of protons	# of neutrons	# of electrons
5 boron-10					
5 boron-11					

Skill 5: Calculate the Weighted Average Atomic Mass (WAAM!) of an element

Atomic Mass: The mass number of a given nucleus must be a whole number because it is the sum of the number of _____ and _____ in the nucleus. So why isn't the mass of each a whole number…….

Weighted Average Atomic Mass: The _____ mass of the naturally occurring _____

HOW TO FIND THE WEIGHTED AVERAGE ATOMIC MASS (W.A.A.M.!)

$$\text{Avg. Atomic Mass} = \frac{(\text{mass})(\%) + (\text{mass})(\%) \ldots}{100}$$

1. Carbon has two naturally occurring stable isotopes. Most carbon atoms-98.89% are C-12, while the remaining 1.108% are C-13. What is the atomic mass of carbon?

2. 92.21% of Si is found to be 27.98 amu, 4.70% is found to be 28.98 amu, and the remaining 3.09% is found to be 29.97. Calculated the atomic mass of carbon

3. Calculate the Average Atomic Mass for the following:
   93.12% of K-39
   6.88% of K-41

4. A new element, Tyserium (Ty), has recently been discovered and consists of two isotopes. One isotope has a mass of 331 g/mol and is 35.0 % abundant. The other isotope is 337 g/mole and is 65.0 % abundant. What is the mass of Ty as it appears on the periodic table?

   A) 332 g/mol
   B) 333 g/mol
   C) 334 g/mol
   D) 335 g/mol

Average Atomic Mass Practice Station

1)	2)	3)
4)	5)	6)

Calculate the atomic mass of each of the following isotopes. SHOW ALL WORK.

	Element	Mass	Percent Abundanc
1)	copper-63	62.9396 amu	69.17%
	copper-65	64.9278 amu	30.83%
2)	uranium-235	235.0439 amu	0.72%
	uranium-238	238.0510 amu	99.28%
3)	hydrogen-1	1.0078 amu	99.985%
	hydrogen-2	2.0140 amu	0.015%
4)	element Q-8	8.0 amu	10.0%
	element Q-9	9.0 amu	20.0%
	element Q-10	10.0 amu	70.0%

Skill 6: Identify valence electrons and electron configurations

- ☐ What are Valence Electrons? _____
  _____ Involved in _____
- ☐ Where do we find how many there are for each atom? _____

Electron Configurations: (See Ref. Tabs) Shows how electrons are distributed in each atom

Examples:

Na: _____ = _____ kernel e- _____ valence e-

Ne: _____ = _____ kernel e- _____ valence e-

Al: _____ = _____ kernel e- _____ valence e-

Examples: 2 - 7 - 2: _____ 2 – 8 – 4: _____

2 – 8 – 17 - 2: _____ 2 – 8 – 10 - 2: _____

Skill 7: Drawing Bohr Diagrams:

Question	Ion Notation	Mass #	Atomic #	# of Nucleons	# of p	# of n	# of e-	Electron configuration
1					15	16	18	
2	^{32}S - 2							
3					34	45	36	
4	$^{135}_{55}Cs$ +1							
5			43			55	36	
6		92	41				36	

Skill 7: Draw Bohr Models to represent the Atom

Bohr Models: How we represent_____

_____

Drawing Atom with Principle Energy Levels

O (Oxygen)	**Valence e⁻:** **Kernel e⁻:**

O^{2-} (oxygen)	H (Hydrogen)	Al^{3+} (Aluminum)
C-14	Mg (Magnesium)	He (Helium)
N (Nitrogen)	Cl (Chlorine)	F (Fluorine)

Skill 8: Apply excited State electron concept to e- configurations

- ☐ Electron shells fill up in a particular order: 2 AND 8 ARE THE MAGIC NUMBERS indicating a full octet or full valence shell
- ☐ Principal energy level: _____
- ☐ The rule that guides # of electrons in a configuration is _____, where n= the number of shells (PEL)
- ☐ The electron configuration on the reference table is called a _____ state.

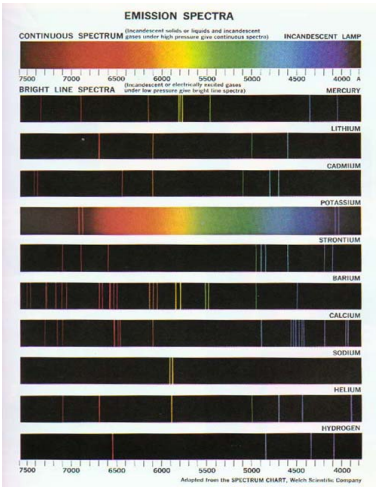
Ground State of Aluminum (Al):_____

But when we add energy…

- ☐ **Excited State Configurations:** if _____ gain/absorb _____, they can move to an EXCITED STATE (Higher PEL)! When they fall back down, they _____ _____.

Excited State of Aluminum (Al):_____

We can use this to identify elements!



- ☐ **Bright Line Spectra:** Light (energy) emitted when excited electrons_____ to the ground state.
  - Each spectrum is unique and can be used to determine the _____ of an element like a fingerprint!
- ☐ As the electron shell number increases, the amount of energy _____

Practice:
Which electron configuration could represent a strontium atom in the excited state?

1) 2-8-18-7-1
2) 2-8-18-7-3
3) 2-8-18-8-1
4) 2-8-18-8-2

Element	Ground State	Total # of Electrons	Excited State	Total # of Electrons
Boron				
Magnesium				