FPS – Atoms Chapter 4-5 - Unit 9 Review

Name____________________________ Period__________

A. ***History of Atomic Theory***

1. Summarize the following people's discoveries and ideas. Dates/drawings will not be required on the test.
    a. Democritus
    Greek philosopher, coined the term atomos, philosophized that the atom made up all things and could change shape and size.
    b. *Atomos*
    term coined by Democritus to mean "indivisible" which described the smallest piece of matter that could no longer be divided further
    c. Dalton
    Conducted experiments and found data to support a theory of matter that stated atoms were the smallest piece of matter that could not be divided, created or destroyed; atoms of same elements were the same and atoms of different elements were different.
    d. Thomson
    Scientist who used a cathode ray for experiments and discovered the electron
    e. Plum-pudding model
    Thomson's model that described the atom as a mass of positive "goo" with negatively charged particles randomly distributed throughout
    f. Rutherford
    Student of Thomson who disproved the plum-pudding model and discovered the nucleus
    g. Gold-foil experiment
    Experimental design by Rutherford that shot positively charged particles at gold foil. Most passed through, while few were deflected by the centers of atoms, which suggested the centers of atoms were dense and positive
    h. Bohr's model
    Model of the atom which suggested that electrons traveled in circular orbits of different energy levels around the nucleus.
    i. Electron-cloud model
    Modern theory that suggests the electrons are found in regions of high probability around the nucleus.

2. What were some differences between Dalton and Democritus's ideas?
Dalton had scientific evidence from many experiments to support his ideas. He also stated that atoms of different substances were different, not just different shapes/sizes as Democritus believed. Democritus also had no scientific evidence to support his ideas.

3. Who described the Billiard ball model? Why was it called such?
Dalton suggested the Billiard ball model. He imagined the atom as an indestructible sphere composed of the same material all the way through.

4. Rutherford, who was Thomson's student, refuted the plum-pudding model. Describe how his experiment did this.
Using the gold-foil experiment, Rutherford found that the atom was not mostly positive mass as Thomson said, but mostly empty space (since most the alpha particles passed through) with a small dense nucleus.

5. How is Bohr's model different than previous models?

Focuses on electron location and energy levels.

6. How is the electron-cloud model different than previous models?
States electrons are in regions of high probability called clouds or orbitals.

7. What were Dalton's three parts of his Atomic Theory of matter?
1- All things are made of atoms that cannot be divided, created, or destroyed.
2- All atoms of the same element are the same and all atoms of different elements are different.
3- Atoms can be chemically combined to formed new substances.

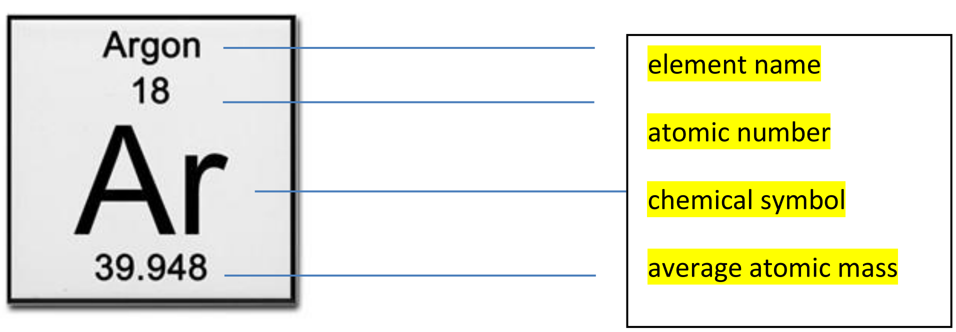
8. According to Bohr's model of the atom, where are the electrons? What can happen for them to change location?
Circular orbits around the nucleus of different energy levels. To move to a higher energy level, energy must be absorbed. To fall down to a lower energy level, energy must be released, often as a photon of light.

B. The Periodic Table & Atomic Structure

9. How is the modern periodic table of element arranged?
Increasing atomic number

10. Assuming the atom is neutral, what does the atomic number tell you?
Number of protons and (if neutral) number of electrons

11. Label the following periodic table square for argon.



12. What is a period? What does a period on the periodic table indicate about an element?
Period = row (horizontal). Tells us the number of energy levels

13. What is a group/family? What does a group/family on the periodic table indicate about an element?
Group/family = column (vertical) Tells the number of valence electrons (excluding the transition metals)

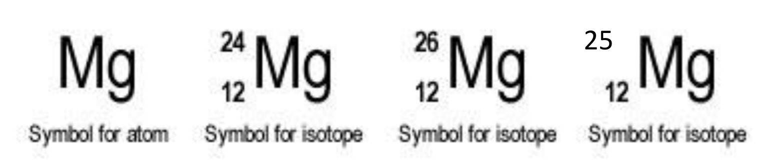
14. What do valence electrons indicate about an element?
Properties, Reactivity and Bonding

15. What is an ion? What do we call a positive and negative ion?
An ion is an atom that has become charged due to a transfer of valence electrons to become stable. Cation = "paws"itive and anion= negative

16. What is the octet rule? What are the exceptions?
States that in order to most stable, an atom must have 8 valence electrons in the outer shell. Hydrogen and helium are the exceptions.

17. What does the mass number tell you? What are isotopes?
Mass number = number of protons + number of neutrons
Isotopes are atoms that has differing number of neutrons

18. In nuclear notation, write the isotopes magnesium-24, magnesium-25, and magnesium-26.



19. What is the average atomic mass of Boron if it exists as 19.90% ^{10}B and 80.10% ^{11}B?

$$average\ atomic\ mass = \left(isotope\ mass\ x\ \frac{\%}{100}\right) + \left(isotope\ mass\ x\ \frac{\%}{100}\right) + \cdots$$
$$average\ atomic\ mass = \left(10\ x\ \frac{19.90\%}{100}\right) + \left(11\ x\ \frac{80.10\%}{100}\right)$$

= 10.801 amu

20. Magnesium has three naturally occurring isotopes. 78.70% of Magnesium atoms exist as Magnesium-24, 10.03% exist as Magnesium-25 and 11.17% exist as Magnesium-26. What is the average atomic mass of Magnesium?

$$average\ atomic\ mass = \left(24\ x\ \frac{78.70\%}{100}\right) + \left(25\ x\ \frac{10.03\%}{100}\right) + \left(26\ x\ \frac{11.17\%}{100}\right)$$

=24.2997 amu

C. Element Categories

21. Describe properties of the alkali metals and give an example.
Highly reactive, do not occur in nature, one valence electron. Ex: Li, Na

22. Describe properties of the alkaline-earth metals and give an example.
Highly reactive, do not occur in nature, two valence electrons Ex: Mg, Be

23. Describe properties of the transition metals and give an example.
Metallic properties (shiny, malleable) and do not fill inner shells consistently Ex: Cu, Co, Au

24. Describe properties of the metalloids and give an example.
Sometimes conductive at very high temperatures due to some metallic and nonmetallic properties. Ex: Si, B

25. Describe properties of the halogens and give an example.
Highly reactive, vary in state of matter, 7 valence electrons Ex: F, Cl

26. Describe properties of the noble gases and give an example.
Very unreactive (inert) with 8 valence electrons. all in gaseous states Ex.: Ne, He, Ar

27. What happens to metallic properties as you move from left to right on the periodic table?

Become less metallic, solid to gas

28. What happens to reactivity as you down a group on the periodic table?
Typically increases

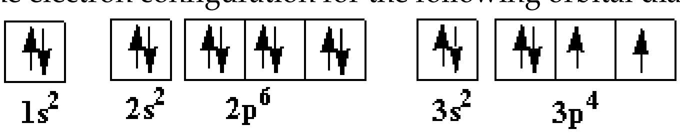
29. WHY do the alkali metals become more reactive down the group?
valence electron becomes further away due to atomic size and can be lost easier

30. WHY do the halogens become more reactive up the group?
Valence electrons are closer to the nucleus at the top of the group (ex.: F) and therefore can more easily and violently attract another electron. Due to the Law of Charges

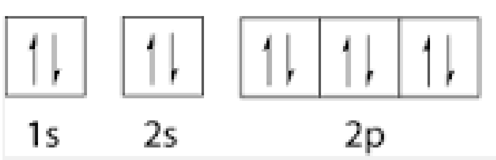
D. *Electron Configurations*

31. What are the 4 types of orbitals? How many electrons can each of them hold?
s, p, d, f
s = 2 electrons p= with 3 at each energy level, holds 6 electrons total
d= with 5 at each energy level, holds 10 electrons total
f= with 7 at each energy level, holds 14 electrons total

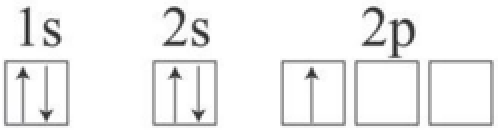
32. Write the complete electron configuration for the following elements:
    a. Potassium ____$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
    b. Lithium ________$1s^2 2s^1$____________
    c. Aluminum _______$1s^2 2s^2 2p^6 3s^2 3p^1$____________
    d. Carbon ________$1s^2 2s^2 2p^2$_______
    e. Nitrogen ________$1s^2 2s^2 2p^3$___________
    f. Argon __________$1s^2 2s^2 2p^6 3s^2 3p^6$______________
33. Write the electron configurations for the following ***ions.*** Remember, if an ion is positive, it has lost electrons. If an ion is negative, it has gained electrons.
    a. Be^{2+} ________$1s^2$__________
    b. B^{3+} ________$1s^2$___________________
    c. Cl^{1-} _______$1s^2 2s^2 2p^6 3s^2 3p^6$________________
    d. O^{2-} ____$1s^2 2s^2 2p^6$____________________
34. Identify the errors in the following electron configurations. If there is no error, write "none".
    a. $1s^2 2s^3 2p^2$ _s orbitals only hold 2 electrons
    b. $1s^2 2s^2 2p^6 3s^2 4s^1$ ______3p orbitals were not filled before moving to 4s________
    c. $1s^2 2s^2 2p^8 3s^1$ _______p orbitals only hold 6 electrons_________
35. Write the electron configuration for the following orbital diagrams. Then, identify the element.

a. 

$1s^2 2s^2 2p^6 3s^2 3p^4$; sulfur

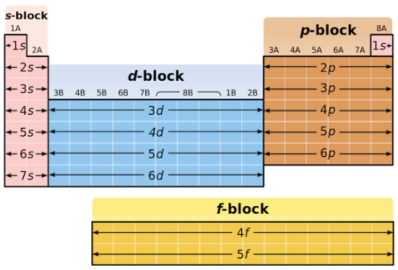
b. 

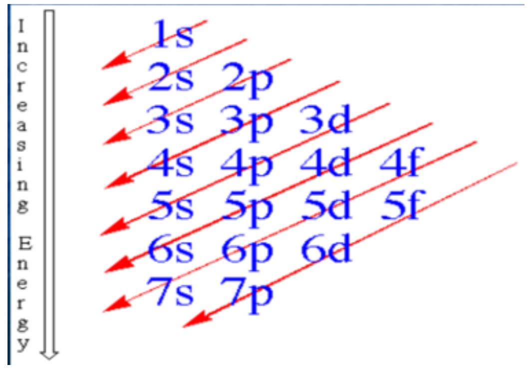
$1s^2 2s^2 2p^6$; neon

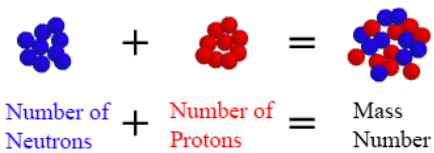
c. 

$1s^2 2s^2 2p^1$; Boron

Use your periodic table and the images and formulas below as reference.







$$average\ atomic\ mass = \left(isotope\ mass\ x\ \frac{\%}{100}\right) + \left(isotope\ mass\ x\ \frac{\%}{100}\right) + \cdots$$