Name Key Date _____ Period ____

Super Chemist

Unit 3 Sweet Sheet- Atomic History and the Atom

Part 1: Electrons and Light Wavelengths

1. Draw the Electromagnetic Spectrum

Radio Microwaves Infrared ROYGBIV UV X-rays Gamma

2. What is the frequency of a 2,800 cm wave?

$f = \frac{c}{\lambda}$ $\quad \frac{3.00\times10^{8}\,m}{s} \left| \frac{100\,cm}{1\,m} \right| \frac{}{2,800\,cm} = \boxed{1.07\times10^{7}/s}$

3. What is the wavelength of a $4.86 \times 10^{16} s^{-1}$ wave?

$f = \frac{c}{\lambda}$ $\quad \frac{3.00\times10^{8}\,m}{s} \left| \frac{s}{4.86\times10^{16}} \right. = \boxed{6.17\times10^{-9}\,m}$

$\lambda = \frac{c}{f}$ $\quad \frac{6.17\times10^{-9}\,m}{} \left| \frac{1\times10^{9}\,nm}{1\,m} \right. = \boxed{6.17\,nm}$

4. Put the following electromagnetic waves in order of increasing wavelengths: x-ray, yellow light, blue light, radio waves, gamma rays.

gamma, X-rays, blue light, yellow light, radio waves

Part 2: History of the Atom

5. Write down what each person contributed to the model of the atom, list the name of their model. Also make sure to know the order in which they made these discoveries.

Democritus, Aristotle, John Dalton, Soddy, Thomson, Millikan, Rutherford, Bohr, Schrodinger and Heisenberg

Democritus - atom indivisible

Aristotle - earth, air, fire, water (4 elements)

John Dalton - Atomic Theory, Billiard Ball Model

Thomson - electron, cathode ray tube, Plum Pudding / Chocolate Chip model

Soddy - isotopes

Rutherford - Nucleus, gold foil experiment, atom mostly space

Bohr - planetary model, shells

Part 3: Dimensional Analysis

6. If 6.02×10^{23} atoms of C = 1 mole of C, how many moles are in 2.45×10^{27} atoms of C?

$$\frac{2.45 \times 10^{27} \text{ atoms}}{6.02 \times 10^{23} \text{ atoms}} \left| \frac{1 \text{ mole C}}{} \right. = 4069.8 \text{ moles}$$

4.07×10^{3} moles C

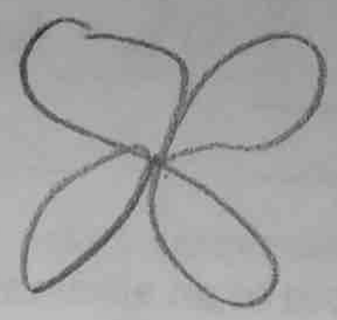
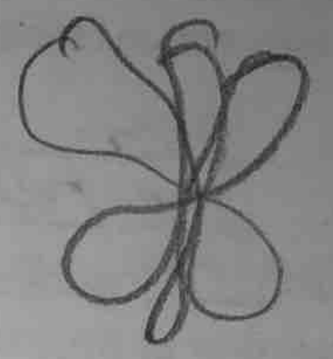
7. If the density of Katrinium is 5.67 g/mL, how many grams are in 97 mL of Katrinium?

$$\frac{97 \text{ mL}}{1 \text{ mL}} \left| \frac{5.67 \text{ g}}{} \right. = 550 \text{ g} \text{ or } 5.5 \times 10^{2} \text{ g}$$

Schrödinger + Heisenberg - Electron Cloud Model

Part 4: The Basic Model of the Atom

8. Draw an s, p, d, and f orbital. The f is extra credit. 😉

s	P	d	f
			

9. Draw the Valence Electron diagrams for the following atoms.

A. Li Li·

B. V V·

C. Se Se

D. Br :Br:

E. Xe :Xe:

10. Quantum Numbers: Describe what each quantum number tells you about an electron and list the possible values.

A. Principle Quantum Number – main energy level

n = 1-7

B. Orbital Quantum Number – type of orbital, orbital shape

s, p, d or f 0, 1, 2, 3

C. Magnetic Quantum Number – orientation of orbital

-3, -2, -1, 0, 1, 2, 3

D. Spin Quantum Number – up or down spin of electron

$\pm \frac{1}{2}$

Basic Atomic Structure Worksheet

1. The 3 particles of the atom are:
   a. proton (+)
   b. neutron (0)
   c. electron (-)

   Their respective charges are:
   a. pos.
   b. neutral
   c. negative

2. The number of protons in one atom of an element determines the atom's symbol (identity), and the number of electrons determines the charge of the element.

3. The atomic number tells you the number of protons in one atom of an element. It also tells you the number of electrons in a neutral atom of that element. The atomic number gives the "identity" of an element as well as its location on the periodic table. No two different elements will have the same atomic number.

4. The mass of an element is the average mass of an element's naturally occurring atom, or isotopes, taking into account the neutrons of each isotope.

5. The mass of an element is the total number of protons and neutrons in the nucleus of the atom.

6. The mass number is used to calculate the number of neutrons in one atom of an element. In order to calculate the number of neutrons you must subtract the number from the mass. (mass - number)

7. Give the symbol of and the number of protons in one atom of: p^+ = protons

   Lithium Li, 3 p^+
   Iron Fe, 26 pts
   Oxygen O, 8 p^+ pts
   Krypton Kr, 36 p^+
   Bromine Br, 35 p^+
   Copper Cu, 29 p^+
   Mercury Hg, 80 p^+.
   Helium He, 2 p^+.

8. Give the symbol of and the number of electrons in a neutral atom of: e^- = electrons

   Uranium U 92 e^-
   Boron B 5 e^-
   Chlorine Cl 17 e^-
   Iodine I 53 e^-
   Xenon Xe 54 e^-

9. Give the symbol of and the number of neutrons in one atom of:

   (Mass numbers are ALWAYS whole numbers...show your calculations) n° = neutrons

   Barium Ba 138-56 = 82 n°
   Carbon C 12-6 = 6 n°
   Fluorine F 19-9 = 10 n°
   Europium Eu 152-63 = 89 n°
   Bismuth Bi 209-83 = 126 n°
   Hydrogen H 1-1 = 0 n°
   Magnesium Mg 24-12 = 12 n°
   Mercury Hg 201-80 = 121 n°

10. Name the element which has the following numbers of particles:

a. 26 electrons, 29 neutrons, 26 protons Iron - 55

b. 53 protons, 74 neutrons Iodine - 127

c. 2 electrons (neutral atoms) Helium

d. 20 protons Calcium

e. 86 electrons, 125 neutrons, 82 protons Lead - 207

f. 0 neutrons Hydrogen

11. If you know ONLY the following information can you ALWAYS determine what the element is? (Yes/No)

a. Number of protons Yes

b. Number of neutrons No

c. Number of electrons in a neutral atom Yes

d. Number of electrons No

12. Fill in the missing items in the table below.

NAME	SYMBOL	Z	A	# PROTONS	# ELECTRONS	# NEUTRONS	ISOTOPIC SYMBOL
a. Sodium	Na	11	23	11	11	23-11=12	$^{23}_{11}Na$
b. Chlorine	Cl	17	35	17	~~18~~ 17	35-17=18	$^{35}_{17}Cl$
c. Potassium	K	19	39	19	19	20	$^{39}_{19}K$
d. Phosphorous	P	15	31	15	15	31-15=16	$^{31}_{15}P$
e. Iron	Fe	26	56	26	~~24~~ 26	30	$^{56}_{26}Fe$
f. Iodine	I	53	127	53	53	74	$^{127}_{53}I$
g. Silver	Ag	47	108	47	47	61	$^{108}_{47}Ag$
h. Krypton	Kr	36	84	36	36	48	$^{84}_{36}Kr$
i. Tungsten	W	74	184	74	74	110	$^{184}_{74}W$
j. Copper	Cu	29	64	29	29	35	$^{64}_{29}Cu$
k. Indium	In	49	115	49	49	66	$^{115}_{49}In$
l. Gold	Au	79	197	79	~~78~~ 79	118	$^{197}_{97}Au$
m. Sulfur	S	16	32	16	~~18~~ 16	16	$^{32}_{16}S$

Chemistry I Name: _____ Block: _____

Worksheet #3: Electron Configurations

Answer the following questions using your Unit 3 notes.

1. Write the ~~complete~~ Noble Gas electron configuration for each atom on the blank line.

a. Lithium [He] $2s^1$

b. Fluorine [He] $2s^2 2p^5$

c. Carbon [He] $2s^2 2p^2$

d. Argon [Ne] $3s^2 3p^6$

e. Sulfur [Ne] $3s^2 3p^4$

f. Nickel [Ar] $4s^2 3d^8$

g. Rubidium [Kr] $5s^1$

h. Xeon [Kr] $5s^2 4d^{10} 5p^6$

2. What elements are represented by each of the following electron configurations?

a. $1s^2 2s^2 2p^5$ F

b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ Ca

c. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^4$ Te

d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$ I

3. a. What are valence electrons? electrons in the outermost energy level

~~b. Explain how an atom's valence electron configuration determines its place on the periodic table.~~

c. List the number of valence electrons for the following atoms:

potassium = 1 magnesium = 2 carbon = 4 nitrogen = 5

4. Place the following orbitals in order of increasing energy:

1s, 3s, 4s, 6s, 3d, 4f, 3p, 7s, 5d, 5p

1s, 3s, 3p, 4s, 3d, 5p, 6s, 4f, 5d, 7

5. What two elements are exceptions to the way we normally write electron configurations? Write the expected and the actual configuration of each. What rules are followed? What rules are violated? → Aufbau up to 4s, Hund's, Pauli's

Cu

Ex. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$

Act. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

Cr

Ex. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$

Act. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$

Chemistry I Name: _____ Block: _____

Worksheet #3: Electron Configurations

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a. Lithium [He] $2s^1$

b. Fluorine [He] $2s^2 2p^5$

c. Carbon [He] $2s^2 2p^2$

d. Argon [Ne] $3s^2 3p^6$

e. Sulfur [Ne] $3s^2 3p^4$

f. Nickel [Ar] $4s^2 3d^8$

g. Rubidium [Kr] $5s^1$

h. Xeon [Kr] $5s^2 4d^{10} 5p^6$

2. What elements are represented by each of the following electron configurations?

a. $1s^2 2s^2 2p^5$ F

b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ Ca

c. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^4$ Te

d. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$ I

3. a. What are valence electrons? electrons in the outermost energy level

~~b. Explain how an atom's valence electron configuration determines its place on the periodic table.~~

c. List the number of valence electrons for the following atoms:

potassium = 1 magnesium = 2 carbon = 4 nitrogen = 5

4. Place the following orbitals in order of increasing energy:

1s, 3s, 4s, 6s, 3d, 4f, 3p, 7s, 5d, 5p

1s, 3s, 3p, 4s, 3d, 5p, 6s, 4f, 5d, 7s

5. What two elements are exceptions to the way we normally write electron configurations? Write the expected and the actual configuration of each. What rules are followed? What rules are violated? → Aufbau up to 4s, Hund's, Pauli's

Cu

Ex. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^9$

Act. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

Cr

Ex. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$

Act. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$

Chemistry I

Name: _____ Block: _____

Worksheet # 5: Check What Ya Know

Answer the following questions using your Unit 3 notes.

1. How many orbitals are in the following sublevels?

a) 3p sublevel = 3

b) 2s sublevel = 1

c) 4p sublevel = 3

d) 3d sublevel = 5

e) 4f sublevel = 7

2. Write the full electron configuration for each atom.

a) Phosphorus = $1s^2 2s^2 2p^6 3s^2 3p^3$

b) Gold = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^9$

c) Iodine = $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$

3. Give the symbol and names of the elements that correspond to these configurations of an atom. ~~Where does this element belong in the period table (e.g. noble gas, metalloid, etc.)~~

a) $1s^2 2s^2 2p^6 3s^1$ = Na

b) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$ = Ni

c) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$ = Se

4. Distinguish between the ground state and the excited state of an atom.

Excited state has higher energy and has jumped up energy levels. Ground is in most stable state.

~~5. Drew the orbital diagram for the element Manganese.~~

Question Number	Element	Electron Configuration	Non Core Orbital Notation [only the outermost orbitals are drawn]	Set of Quantum Numbers for the LAST Electron to Fill
1.	K	[Ar] $4s^1$	4s: ↑	4, 0, 0, +½
2.	Fe	[Ar] $4s^2 3d^6$	4s: ↑↓ ; 3d: ↑↓ ↑ ↑ ↑ ↑	3, 2, −2, −½
3.	N	$1s^2 2s^2 2p^3$	2p: ↑ ↑ ↑	2, 1, 1, +½
4.	Sn	[Kr] $5s^2\ 4d^{10} 5p^2$	5s: ↑↓ ; 4d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 5p: ↑ ↑ —	5, 1, 0, +½
5.	Br	[Ar] $4s^2\ 3d^{10}\ 4p^5$	4s: ↑↓ ; 3d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 4p: ↑↓ ↑↓ ↑	4, 1, 0, −½
6.	Ba	[Xe] $6s^2$	6s: ↑↓	6, 0, 0, −½
7.	Ni	[Ar] $4s^2 3d^8$	4s: ↑↓ ; 3d: ↑↓ ↑↓ ↑↓ ↑ ↑	3, 2, 0, −½
8.	P	[Ne] $3s^2\ 3p^3$	3s: ↑↓ ; 3p: ↑ ↑ ↑	3, 1, 1, +½
9.	Zr	[Kr] $5s^2\ 4d^2$	5s: ↑↓ ; 4d: ↑ ↑ — — —	4, 2, −1, +½
10.	U*	[Rn] $7s^2\ 5f^4$	7s: ↑↓ ; 5f: ↑ ↑ ↑ ↑ — — —	5, 3, 0, +½
11.	Ag**	[Kr] $5s^2\ 4d^9$	5s: ↑↓ ; 4d: ↑↓ ↑↓ ↑↓ ↑↓ ↑	4, 2, 1, −½
12.	Mg	$1s^2\ 2s^2 2p^6 3s^2$	3s: ↑↓	3, 0, 0, −½
13.	Kr	[Ar] $4s^2\ 3d^{10} 4p^6$	4s: ↑↓ ; 3d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 4p: ↑↓ ↑↓ ↑↓	4, 1, 1, −½
14.	As	[Ar] $4s^2\ 3d^{10} 4p^3$	4s: ↑↓ ; 3d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 4p: ↑ ↑ ↑	4, 1, 1, +½
15.	W	[Xe] $6s^2 4f^{14} 5d^4$	6s: ↑↓ ; 4f: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 5d: ↑ ↑ ↑ ↑ —	5, 2, 1, +½
16.	Fr	[Rn] $7s^1$	7s: ↑	7, 0, 0, +½
17.	*Pu	[Rn] $7s^2\ 5f^6$	7s: ↑↓ ; 5f: ↑ ↑ ↑ ↑ ↑ ↑ —	5, 3, 2, +½
18.	B	$1s^2 2s^2 2p^1$	2s: ↑↓ ; 2p: ↑ — —	2, 1, −1, +½
19.	Mn	[Ar] $4s^2\ 3d^5$	4s: ↑↓ ; 3d: ↑ ↑ ↑ ↑ ↑	3, 2, 2, +½
20.	I	[Kr] $5s^2\ 4d^{10}\ 5p^5$	5s: ↑↓ ; 4d: ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ; 5p: ↑↓ ↑↓ ↑	5, 1, 0, −½

ISOTOPES AND AVERAGE ATOMIC MASS

Name _____

Elements come in a variety of isotopes, meaning they are made up of atoms with the same atomic number but different atomic masses. These atoms differ in the number of neutrons.

The average atomic mass is the weighted average of all the isotopes of an element.

Example: A sample of cesium is 75% ^{133}Cs, 20% ^{132}Cs and 5% ^{134}Cs. What is its average atomic mass?

Answer: .75 x 133 = 99.75
.20 x 132 = 26.4
.05 x 134 = 6.7
Total = 132.85 amu = average atomic mass

Determine the average atomic mass of the following mixtures of isotopes.

1. 80% ^{127}I, 17% ^{126}I, 3% ^{128}I

(127)(.8) + (126)(.17) + (128)(.03) = 126.86 amu

2. 50% ^{197}Au, 50% ^{198}Au

_____

3. 15% ^{55}Fe, 85% ^{56}Fe

(.15)(55) + (.85)(56) = 55.85amu

4. 99% ^{1}H, 0.8% ^{2}H, 0.2% ^{3}H

_____

5. 95% ^{14}N, 3% ^{15}N, 2% ^{16}N

(.95)(14) + (.03)(15) + (.02)(16) 14.07 amu

6. 98% ^{12}C, 2% ^{14}C

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