CHEM 100 **Name**_____
Exam 1 **Summer 2010**

Part I. Multiple choice. Circle the correct answer for each problem. 3 points each

1. The observation that 20 g of hydrogen gas always combines with 160 g of oxygen gas to form 180 g of water, even when there is more than 160 g of oxygen present in the reaction container, illustrates the law of
   a. multiple proportions.
   c. ideal gases.
   b. definite proportions.
   d. excess reactants.

2. How many neutrons are in this isotope of tin represented by ^{106}Sn?
   a. 156
   c. 50
   b. 56
   d. 106

3. The proton has
   a. a smaller mass and same charge as the electron.
   b. a larger mass and opposite charge as the electron.
   c. a smaller mass and opposite charge as the electron.
   d. the same mass and charge as the electron.

4. In the quantum mechanical view of the atom, electrons are confined to charge clouds called
   a. energy levels.
   c. orbitals.
   b. orbits.
   d. ions.

5. The element with the ground state electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ is
   a. Ar.
   c. F.
   b. Br.
   d. Cl.

6. Elements in the same group have
   a. the same number of neutrons.
   b. the same number of electrons.
   c. the same atomic number.
   d. the same number of valence electrons.

7. Which of the following has a pyramidal molecular shape?
   a. CH_4
   c. BF_3
   b. NH_3
   d. H_2O

8. The formula of aluminum oxide is
   a. AlO.
   c. Al_2O_3.
   b. AlO_2.
   d. AlO_3.

9. Covalent bonds generally form between

a. non-metals.
c. ions.
b. metals and non-metals.
d. metals.

10. What is the formula of ammonium nitrate?

a. NH_4NO_3
c. $NH_4(NO_3)_2$
b. NH_4N
d. $(NH_4)_2NO_3$

Part II Short Answer. Complete each of the following. Point values are noted by each question.

11. Convert the following formulas to names or names to formulas: (3 points each)

a. N_2O_5

dinitrogen pentoxide

b. boron trifluoride

BF_3

c. $Fe(OH)_3$

iron (III) hydroxide

12. Complete the following table: (1 point per blank, 9 total)

Name	Symbol	# Protons	# Neutrons	# Electrons	Atomic #	Mass #
calcium ion	Ca^{2+}	20	20	18	20	40
phosphorous	P	15	16	15	15	31

13. Write the electron configuration showing the filling of sublevels for: (3 points each)

a. aluminum atoms

$1s^2 2s^2 2p^6 3s^2 3p^1$

b. arsenic atoms

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

c. chloride ions

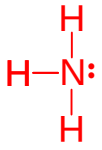
$1s^2 2s^2 2p^6 3s^2 3p^6$

14. Metallic mercury is a liquid at room temperature, with 6.02×10^{23} atoms of mercury occupying 14.83 mL. Using a balance, you determine that 10.0 mL of liquid mercury has a mass of 135.3 g. What is the mass of a single mercury atom? (5 points)

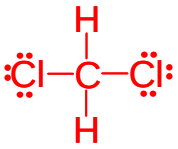
$$\frac{135.3\ \text{g}}{10.0\ \cancel{\text{mL}}} \times \frac{14.83\ \cancel{\text{mL}}}{6.02 \times 10^{23}\ \text{atoms}} = \frac{\mathbf{3.33 \times 10^{-22}\ g}}{\mathbf{atom}}$$

15. Draw Lewis structures for the following compounds (4 points each)

a. ammonia (NH_3)



b. dichloromethane (CH_2Cl_2)



Part III. Complete 3 of the following 4 problems. Clearly mark the problem you do not want graded. Each problem is worth ten (10) points. You must show you work on calculations to receive partial credit. Report numerical results to the correct number of significant figures and with the appropriate units.

16. Explain briefly how the electron pair geometry and molecular geometry for a compound can be different. Use an example molecule, to support your explanation.

The molecular geometry refers to the locations of the atoms in a compound, but the electron pair geometry considers both the atoms and unshared pairs on the central atom. Unshared pairs occupy space and restrict the position of atoms in space, therefore influencing shape. Consider ammonia, whose Lewis structure is shown in problem 15a. It has four "things" around the central atom, leading to tetrahedral electron pair geometry. One of those things, however, is an unshared pair. Therefore, the molecular geometry or "shape" is pyramidal.

17. Perform the following conversions:
    a. Express 3.6×10^{-10} m, the diameter of a gold atom, in decimal notation. (2 points)

$$0.00000000036 \text{ m}$$

    b. Convert 32.5 μg to mg. (4 points)

$$32.5 \cancel{\mu g} \times \frac{10^{-6} \cancel{g}}{1 \cancel{\mu g}} \times \frac{1 \text{ mg}}{10^{-3} \cancel{g}} = \mathbf{0.0325 \text{ mg}}$$

    c. Convert 3.2×10^{5} nm to mm. (4 points)

$$3.25 \times 10^{5} \cancel{nm} \times \frac{10^{-9} \cancel{m}}{1 \cancel{nm}} \times \frac{1 \text{ mm}}{10^{-3} \cancel{m}} = \mathbf{0.32 \text{ mm}}$$

18. You have been asked back to your high school to present a brief description to a junior chemistry class on the structure of the atom. Outline the important points that you would tell the students.

    Your discussion should address the following:
    - The size, mass and charge of the proton, neutron and electron
    - Protons and neutrons are in the nucleus where the bulk of the mass of the atom exists.
    - The electrons occupy orbitals around the nucleus (not orbits)
    - The number of protons determines the identity of the atoms. A neutral atom has the same number of protons and neutrons.

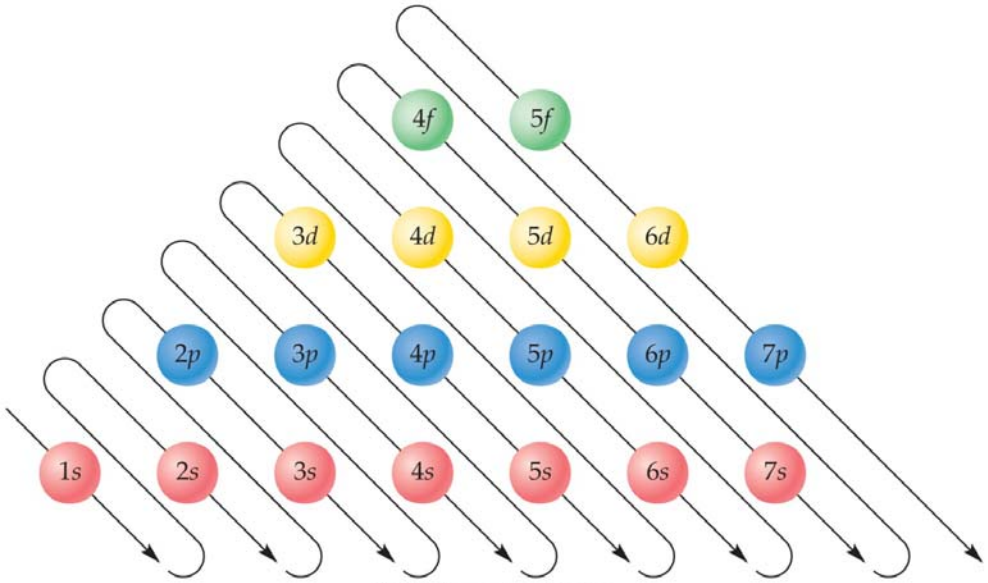
19. The terms “noble gas configuration” and “octet” appear regularly in the discussion of ionic and covalent chemical bonding. Briefly describe the significance of these terms in the context of compound formation. Consider both ionic and covalent compounds.

    In forming ions or compounds, atoms attempt to fill their outermost shell (valence shell) with electrons. For main group atoms, the valence shell can hold eight electrons, hence the “octet” In their normal state, the noble gases have filled valence shells (or octets).

    In forming ionic compounds, atoms either gain or lose electrons to produce a filled valence shell.

    In covalent compounds, atoms share electrons in order to fill these orbitals

Possibly Useful Information



PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES
1 H 1.00797																1 H 1.00797	2 He 4.0026
3 Li 6.939	4 Be 9.0122											5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312											13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	‡89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

*Lanthanide Series

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97

‡Actinide Series

90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)