Chemistry 115 Name Key
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Exam 2B October 15, 2008

	Points Earned	Points Possible
Page 1 multiple choice		12
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Total		101

Note: All work must be shown to receive credit. On calculation problems show answer with the correct number of significant figures using scientific notation if necessary.

Avogadro's number 6.022×10^{23}/mol

PERIODIC CHART

IA												IIIA	IVA	VA	VIA	VIIA	NOBLE GASES
1 **H** 1.008	IIA															1 **H** 1.008	2 **He** 4.002
3 **Li** 6.941	4 **Be** 9.012	Transition Metals»										5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 23.00	12 **Mg** 24.30	IIIB	IVB	VB	VIB	VIIB	ÉÍÍÍVIIIBÍÍÍÍ»			IB	IIB	13 **Al** 27.00	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.70	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (99)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (268)	110 **??** (???)								

Lanthanide series	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (147)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
Actinide series	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Part 1 - Multiple Choice (12 points)

1. Which is not part of Dalton's atomic model?
   a. Elements are composed of minute, indivisible particles called atoms.
   b. Atoms of the same element are alike in mass.
   c. Atoms of the same element can be different in size.
   d. Chemical compounds are composed of two or more atoms of different elements.
   e. All of the above are part of Dalton's atomic model

2. What charge does a cation possess?
   a. It is not possible to determine the charge
   b. Positive
   c. Negative
   d. Neutral

3. The nucleus of an atom usually contains
   a. Protons
   b. Neutrons
   c. Electrons
   d. Both choices A and B
   e. Neither, choices A, B, nor C

4. The number of protons in an atom is known as its
   a. Atomic Mass
   b. Atomic number
   c. Mass number
   d. Molecular mass
   e. None of the above

5. Different isotopes of an element are atoms of that element which have
   a. The same atomic number and the same mass number
   b. Different atomic number and the same mass number
   c. The same atomic number and different mass number
   d. Different atomic number and different mass number
   e. None of the above

6. The atomic mass of an element is
   a. The mass of the most abundant isotope of that element
   b. The weighted average of the masses of the naturally occurring isotopes of that element
   c. The arithmetic average of the masses of the isotopes of that element
   d. The ratio of the mass of one atom of an isotope of that element to the mass of hydrogen
   e. None of the above

Part 2 – Nomenclature (8 points) Fill in the following table with the correct IUPAC name or formula

IUPAC Name	Chemical Formula
Magnesium nitrate	Mg(NO3)2
Cupric bromide	CuBr2
Trinitrogen pentoxide	N3O5
Ammonium sulfide	(NH4)2S
Potassium phosphate	K_3PO_4
Nickel(III) oxide	Ni_2O_3
Calcium hydroxide	$Ca(OH)_2$
Pentaphosphorus tetrachloride	P_5Cl_4

Part 3 – Problems (80 points)

1. (6 points) Fill in the chart below

species	protons	neutrons	electrons
^{34}P	15	19	15
$^{82}Br^{-1}$	35	47	36

2. (5 points) Explain how an empirical and a molecular formula differ.

An empirical formula is the simplest ratio of the atoms in a compound. A molecular formula tells the actual number of each type of atom in a compound.

3. (6 points) Balance the equations below

a. 2 Al + $N_2 \rightarrow$ 2 AlN

b. $BaCl_2$ + $(NH_4)_2SO_4 \rightarrow$ $BaSO_4$ + 2 NH_4Cl

4. (8 points) Complete and balance the equations below. (Both reactions will occur.)
   a. Cu + $AgNO_3$ (single replacement reaction)

Cu + 2 AgNO3 → Cu(NO3)2 + 2 Ag

   b. $FeSO_4$ + KOH (double displacement reaction)

FeSO4 + 2 KOH → Fe(OH)2 + K2SO4

5. (20 points) Given a 5.96 g sample of the amino acid phenylalanine, $C_9H_{10}NO_2$,.calculate the following:
   a. molar mass of phenylalanine

9(C) + 10(H) + N + 2(O)
= 9(12.01 amu) + 10(1.008 amu) + 14.01amu + 2(16.00 amu)
= 108.09 amu + 10.08 amu + 14.01 amu + 32.00 amu
=164.18 amu

   b. moles of phenylalanine

$$?\,mol\ C_9H_{10}NO_2 = 5.96\ g\ C_9H_{10}NO_2 \times \frac{1\ mol\ C_9H_{10}NO_2}{164.2\ g\ C_9H_{10}NO_2} = 0.0363\ mol\ C_9H_{10}NO_2$$

   c. moles of carbon atoms

$$0.0363\ mol\ C_9H_{10}NO_2 \times \frac{9\ mol\ C}{1\ mol\ C_9H_{10}NO_2} = 0.327\ mol\ C$$

   d. molecules of phenylalanine

$$0.0363\ mol\ C_9H_{10}NO_2 \times \frac{6.022 \times 10^{23} molec\ C_9H_{10}NO_2}{1\ mol\ C_9H_{10}NO_2} = 2.18 \times 10^{22}\ molec\ C_9H_{10}NO_2$$

   e. number of oxygen atoms

$$2.18 \times 10^{22}\ molec\ C_9H_{10}NO_2 \times \frac{2\ oxygen\ atoms}{molec\ C_9H_{10}NO_2} = 4.36 \times 10^{22}\ oxygen\ atoms$$

6. (24 points) Butane, C_4H_{10}, is a common fuel for heating homes in areas not serviced by natural gas. The equation for its combustion is

$$2\ C_4H_{10} + 13\ O_2 \longrightarrow 8\ CO_2 + 10\ H_2O$$

a. How many moles of oxygen are required to react with 7.44 mol C_4H_{10}?

$$?\ mol\ O_2 = 7.44\ mol\ C_4H_{10} \times \frac{13\ mol\ O_2}{2\ mol\ C_4H_{10}} = 48.4\ mol\ O_2$$

b. How many grams of carbon dioxide will be produced when 5.19 mol of C_4H_{10} are burned?

$$?\ g\ CO_2 = 5.19\ mol\ C_4H_{10} \times \frac{8\ mol\ CO_2}{2\ mol\ C_4H_{10}} \times \frac{44.01\ g\ CO_2}{1\ mol\ CO_2} = 913\ g\ CO_2$$

c. If 855 grams of CO_2 are produced in part b, what is the percent yield of the reaction?

$$?\ \%\ yield = \left(\frac{actual}{expected}\right) \times 100(\%) = \left(\frac{855}{913}\right) \times 100(\%) = 93.6\%\ yield$$

d. How many molecules of butane will react with 39 molecules of oxygen gas?

$$?\ molec\ C_4H_{10} = 39\ molec\ O_2 \times \frac{2\ molec\ C_4H_{10}}{13\ molec\ O_2} = 6\ molec\ C_4H_{10}$$

e. How many molecules of water will be produced by the combustion of 5.00 g of butane?

$$?\ molec\ H_2O = 5.00\ g\ C_4H_{10} \times \frac{1\ mol\ C_4H_{10}}{58.12g\ C_4H_{10}} \times \frac{10\ mol\ H_2O}{2\ mol\ C_4H_{10}} \times \frac{6.022 \times 10^{23} molec\ H_2O}{1\ mol\ H_2O}$$
$$= 2.59 \times 10^{23} molec\ H_2O$$

f. How many moles of CO_2 will be produced by the reaction of 5.00 moles of butane with 40.0 moles of oxygen gas?

$$?\ mol\ CO_2 = 5.00\ mol\ C_4H_{10} \times \frac{8\ mol\ CO_2}{2\ mol\ C_4H_{10}} = \boxed{20.0\ mol\ CO_2}$$

$$?\ mol\ CO_2 = 40.0\ mol\ O_2 \times \frac{8\ mol\ CO_2}{13\ mol\ O_2} = 24.6\ mol\ CO_2$$

7. (7 points) Calculate the empirical formula of a compound which is composed of 38.76% Cl and 61.24% O

$$38.76\ g\ Cl \times \frac{1\ mol\ Cl}{35.45\ g\ Cl} = 1.093\ mol\ Cl$$

$$61.24\ g\ O \times \frac{1\ mol\ O}{16.00\ g\ O} = 3.828\ mol\ O$$

$$Cl_{\frac{1.093}{1.093}} O_{\frac{3.828}{1.093}} = Cl_1 O_{3.50} = Cl_2 O_7$$

8. (5 points) A compound with empirical formula SO_2F_2 has a molar mass of 306 g. Determine the molecular formula for the compound.

SO_2F_2 -- Molar mass = 32 + 2(16) + 2 (19) = 102

You need 3 units of SO_2F_2 to get a molar mass of 306

So the molecular formula is $S_3O_6F_6$