REFERENCE SHEET FOR CHEM 1 MIDTERM EXAMINATION
(Not all data on this sheet will be necessary for any given exam)

THIS EXAM HAS 9 PAGES (INCLUDING THE COVER)
MAKE SURE YOU HAVE THEM ALL

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)

PHYSICAL CONSTANTS

$c = 2.998 \times 10^8$ m/s (speed of light)

$e = 1.602 \times 10^{-19}$ C (charge of one electron)

$R = 8.3145$ J/(mol K) $= 0.08206$ L atm/(mol K)

$F = 96,485.$ C/mol

For $T = 298$K: $2.303RT/F = 0.0592$ V

$\ln(2) = 0.693$

1 atomic mass unit $= 1.66 \times 10^{-24}$ kg

YOU MAY TEAR THIS SHEET OFF AND USE IT FOR REFERENCE

PUT YOUR NAME ON THE THIRD PAGE, AND ALL FOLLOWING PAGES

CHEM 1   MIDTERM EXAM 1   SPRING 04

NAME_____   DATE:

INSTRUCTOR (circle): Islam Kazimierska   Zhao   Voloshchuk

SHOW ALL WORK   USE CORRECT UNITS AND SIGNIFICANT DIGITS
YOU MAY SHOW YOUR WORK ON THE BACK OF THE SHEET, BUT INDICATE
YOUR ANSWER ON THE FRONT

PERIODIC TABLE AND REFERENCE DATA MAY BE TORN OFF OF EXAM

16 QUESTIONS, 100 POINTS TOTAL (+2 EXTRA CREDIT AT END OF EXAM)

1. (10 points) Indicate whether each of the following statements is true or false:

T   F
__   __One mole of carbon-12 weighs <u>exactly</u> 12 grams.
__   __A solution containing a strong electrolyte conducts electricity.
__   __A liter is a volume equal to $100 \ cm^3$.
__   __The discovery of the nucleus assisted Dalton in his development of atomic
            theory.
__   __A free proton has a mass of <u>exactly</u> one atomic mass unit.
__   __Oxygen, sulfur and bromine are all nonmetallic elements.
__   __Isotopes of the same element <u>always</u> have the same number of protons.
__   __Elements in the same column (family) of the periodic table usually have
            similar chemical properties.
__   __An ion is formed when a neutral atom gains or loses electrons.
__   __Electrons account for most of the mass of an atom.

2. (15 points) Answer all of the following.
A. (4 points) Identify each of the following as a strong electrolyte, a weak electrolyte or a
     nonelectrolyte.

            ethanol

            hydrochloric acid

            sodium hydroxide

            silver nitrate

B. (4 point) Write the chemical formula of the following ions:

Ammonium ion: Iodide ion:

Sulfate ion: Hydrogen carbonate ion:

C. (4 points) Identify each of the following as an element, a compound, a homogeneous
     mixture or a heterogeneous mixture (no credit for "mixture" as whole answer):

            Iodine crystals: An iron bar:

            Salsa: Pure sodium chloride:

D. (3 points) Give the number of protons, neutrons and electrons in a $^{37}_{17}Cl^-$ ion.

Protons: Neutrons: Electrons:

Protons: Neutrons: Electrons:

NAME_____

3. (8 points) Answer each of the following:

A. (4 points) Name the following compounds:

$FeCl_3$: $SiBr_4$:
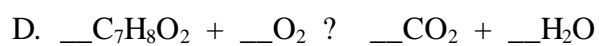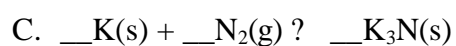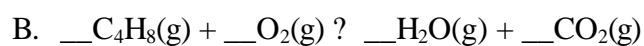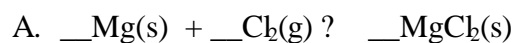
$HClO_2$: $KHCO_3$:

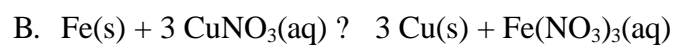B. (4 points) Write chemical formulas for the following compounds:
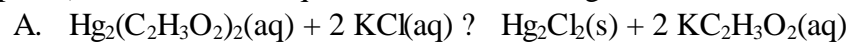
Dinitrogen tetroxide:

Hydroiodic acid:

Lithium hydroxide:

Ammonium sulfate:

4. (2 points) What did Rutherford's gold foil experiment prove about the structure of the atom? Answer in no more than 2 sentences.

5. (8 points) Balance the following equations. Do not leave spaces blank. Write "1" to indicate a single unit of a species.

A. __Mg(s) + __Cl_2(g) ?   __$MgCl_2$(s)

B. __C_4H_8(g) + __O_2(g) ? __H_2O(g) + __CO_2(g)

C. __K(s) + __N_2(g) ?   __K_3N(s)

D. __$C_7H_8O_2$ + __O_2 ?   __CO_2 + __H_2O

NAME_____

6. (4 points) Write net ionic equations for the following reactions:

   A. $Hg_2(C_2H_3O_2)_2(aq) + 2\ KCl(aq)\ ?\quad Hg_2Cl_2(s) + 2\ KC_2H_3O_2(aq)$

   B. $Fe(s) + 3\ CuNO_3(aq)\ ?\quad 3\ Cu(s) + Fe(NO_3)_3(aq)$

7. (4 points) Write the products of the following reactions. If no reaction takes place, indicate "N.R." You must write all the products, but you do not need to balance the reaction.

   A. $AgNO_3(aq) + NaCl(aq)\ ?$

   B. $Cu(s) + AgNO_3(aq)\ ?$

   C. $Au(s) + Zn(NO_3)_2(aq)\ ?$

   D. $CH_4(g) + O_2(g)\ ?$
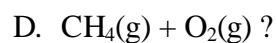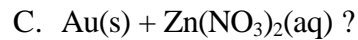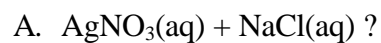
8. (6 points) How many nitrogen atoms are there in 30.0g of N_2O_4. Give your answer in individual atoms, not moles.

NAME_____

9. (6 points) The density of metallic lead is 11.35 g/cm³. Calculate the <u>volume</u> of metallic lead required to react with 50.0 mol of chlorine gas according to the equation:

$$Pb(s) + Cl_2(g) \rightarrow PbCl_2(s)$$
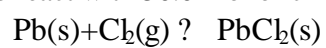
10. (6 points) What mass of NaCl is needed to precipitate all the silver ions from 7.5L of 0.0150M $AgNO_3$ solution?

NAME_____

11. (4 points) A compound is 74.4% gallium and 25.6% oxygen by weight. What is its empirical formula?

12. (4 points) 1.07g of solid $Ca(NO_3)_2$ are dissolved in enough water to make 452.1mL.
   A. (3 points) Calculate the molar concentration of $Ca(NO_3)_2$ in solution.

   B. (1 point) Calculate the molar concentration of the nitrate ion, NO_3^- in solution.

13. (4 points) A molecule has an empirical formula C_5H_4. Its molecular weight is 128.16 atomic mass units. Give the molecular formula.

NAME_____

14. (6 points) Consider the reaction:

$$4 \ NH_3(g) + 5 \ O_2(g) \ ? \quad 4 \ NO(g) + 6 \ H_2O(g)$$
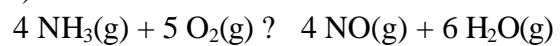
If 7.5×10^2 g of NH_3 are mixed with 7.5×10^2 g of O_2, identify the limiting reagent and calculate the number of grams of NO produced and calculate the number of grams of excess reagent remaining.

NAME:_____

15. (7 points) A solid powder is known to be a mixture of NaCl and Na_2CO_3, but the relative amounts of each compound in the sample are unknown. Sodium carbonate reacts with hydrochloric acid according to the equation:

$Na_2CO_3(aq) + 2 \; HCl(aq) \; ? \quad 2NaCl(aq) + H_2O(l) + CO_2(g)$
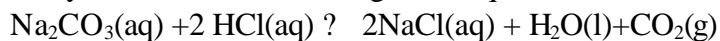
A solution of the mixture is prepared by adding 10.0g of the mixture to enough water to make 1.0L of solution. It is observed that the above reaction goes to completion (*i.e.* the solution is neutralized) after the addition of 83.15mL of 0.1174M hydrochloric acid to the 1.0L sample of the solution.

A.(4 points) What is the concentration of sodium carbonate in the solution before the addition of HCl?

B.(3 points) What is the mass of NaCl in the initial 10.0g sample?

NAME:_____

16. (6 points) Hydrogen cyanide, HCN, is a poisonous gas. The lethal dose is approximately 3.0×10^2 mg of HCN per kilogram of air. The density of air at room temperature is approximately $0.00118 g/cm^3$.

   If HCN gas is formed by the reaction

   $2 \, NaCN(s) + H_2SO_4(aq) \, ? \quad Na_2SO_4(aq) + 2 \, HCN(g)$
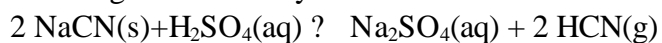
what mass of NaCN is required to produce a lethal dose of HCN in a sealed room that measures 4.0m x 3.0m x 2.0m. Neglect the volume of any objects in the room.

EXTRA CREDIT:

(1 point): Give the name of the cavity formed in a rock by the formation and subsequent dissolution of a crystal of a soluble material (Hint: Their presence was cited by NASA as evidence of water on Mars):

(1 point): Give the approximate distance from the North Pole to the equator in meters: