CHEM 1314.02 and 1314.03
Exam I
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September 13, 2000

Name _____**KEY**_____

TA's Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 7 different pages. The last page include a periodic table and some useful equations. All work should be done in this booklet.

2. PRINT your name, TA's name and your lab section number now in the space at the top of this sheet. DO NOT SEPARATE THESE PAGES.

3. Answer all questions that you can and whenever called for show your work clearly. Your method of solving problems should pattern the approach used in lecture. You do not have to show your work for the multiple choice or short answer questions.

4. No credit will be awarded if your work is not shown in problems 1, 5 and 6.

5. Point values are shown next to the problem number.

6. Budget your time for each of the questions. Some problems may have a low point value yet be very challenging. If you do not recognize the solution to a question quickly, skip it, and return to the question after completing the easier problems.

7. Look through the exam before beginning; plan your work; then begin.

8. Relax and do well.

	Page 2	Page 3	Page 4	Page 5	TOTAL
SCORES	_____ (26)	_____ (24)	_____ (26)	_____ (24)	_____ (100)

(21) 1. Perform the following conversions.

a) 56.5 yards to kilometer (use at least 3 conversion factors)

$$\mathbf{56.5\ yards \left(\frac{3\ ft}{1\ yd}\right)\left(\frac{12\ in}{1\ ft}\right)\left(\frac{2.54\ cm}{1\ in}\right)\left(\frac{1\ m}{100\ cm}\right)\left(\frac{1\ km}{1000\ m}\right) = 5.17 \times 10^{-2}\ km}$$

b) marble has a density of 2.73 $\frac{g}{cm^3}$. Convert to $\frac{pounds}{foot^3}$.

$$\mathbf{2.73\ \frac{g}{cm^3}\left(\frac{2.54\ cm}{1\ inch}\right)^3\left(\frac{12\ in}{1\ foot}\right)^3\left(\frac{1\ pound}{454\ g}\right) = 170.\ \frac{pounds}{foot^3}}$$

c) What is 10.0 Kelvin on the Fahrenheit scale?

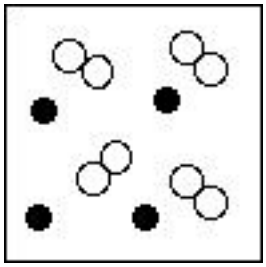
$$\mathbf{K = {}^\circ C + 273.15}$$

$$\mathbf{{}^\circ C = K - 273 = 10.0\ K - 273 = -263\ {}^\circ C}$$

$$\mathbf{{}^\circ C = \frac{5}{9}({}^\circ F - 32)}$$

$$\mathbf{{}^\circ F = \frac{9}{5}\,{}^\circ C + 32 = \frac{9}{5}\,-263 + 32 = -441\ {}^\circ F}$$

(5) 2. Diagram the following system as viewed at the atomic level in the space provided. Be sure to clearly label each of the substances in your diagram.



A homogeneous mixture of neon and oxygen at room temperature.

(6) 3. Predict a reasonable formula for the compound formed from each of the following combinations of elements or polyatomic ions.

a) aluminum and sulfur **Al_2S_3**

b) silver and carbonate **Ag_2CO_3**

c) nitrogen and oxygen **NO, or NO_2, or N_2O or N_2O_5**

(10) 4. Complete the following table

Formula	*M*, Molar Mass $\left(\frac{g}{mol}\right)$	*m*, mass of sample (gms)	*n*, moles of sample (mol)	*N*, number of atoms, molecules, or formula units
NaBr	**103**	**367 g**	3.56	**2.14×10^{24} f.u.**
CO_2	**44**	**0.216**	**4.92×10^{-3}**	2.96×10^{21}
XSO_4	**305**	552	1.82	**1.10×10^{24} f.u.**

NaBr: $3.56 \text{ mol} \left(\frac{103 \text{ g}}{1 \text{ mol}}\right) = 367 \text{ g}$ $3.56 \text{ mol} \left(\frac{6.02 \times 10^{23} \text{ f.u.}}{1 \text{ mol}}\right) = 2.14 \times 10^{24} \text{ f.u.}$

CO_2: $2.96 \times 10^{21} \text{ molecule} \left(\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecule}}\right) = 4.92 \times 10^{-3} \text{ mol}$

$4.92 \times 10^{-3} \text{ mol} \left(\frac{44 \text{ g}}{1 \text{ mol}}\right) = 0.216 \text{ g}$

XSO_4: $\left(\frac{552 \text{ g}}{1.82 \text{ mol}}\right) = 305 \frac{\text{g}}{\text{mol}}$ $1.82 \text{ mol} \left(\frac{6.02 \times 10^{23} \text{ f.u.}}{1 \text{ mol}}\right) = 1.10 \times 10^{24} \text{ f.u.}$

What is the symbol for the unknown element, X?

305 g – MM of S – 4 * MM of O = 305 g – 32 g – 64 g = 209 g Pb

(8) 5. Chlorine consists of two isotopes, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$. The relative atomic mass of each isotope is 34.96885 u and 36.96590 u. If the relative weighted average atomic mass for chlorine is 35.4527 u calculate the fractional abundance of each isotope.

Average atomic mass = Σ(mass$_{isotope}$ · fractional abundance$_{isotope}$)

1 = fractional abundance$_{isotope}$ + fractional abundance$_{isotope}$

let

x = fa of $^{35}_{17}$Cl and y = fa of $^{37}_{17}$Cl

therefore

1 = x + y and x = 1 – y

35.4527 u = 34.96885 u · x + 36.96590 u · y

35.4527 u = 34.96885 u · (1 – y) + 36.96590 u · y

solving for y

35.4527 u = 34.96885 u – 34.96885y + 36.96590 u · y

35.4527 u = 34.96885 u – 34.96885y + 36.96590 u · y

–1.997y = –0.4838

y = 0.2422 is the fa of $^{37}_{17}$Cl and 1 – y = 1 – 0.2422 = 0.7578 fa of $^{35}_{17}$Cl

(15) 6. Determine the empirical formula for a compound that is 18.34 % aluminum, 32.71 % sulfur and 48.95 % oxygen by weight.

Assume 100 g of sample,

$$\mathbf{18.34\ g\ Al \left(\frac{1\ mol\ al}{27.0\ g\ Al}\right) = 0.6793\ mol\ Al}$$

$$\mathbf{32.71\ g\ S \left(\frac{1\ mol\ S}{32.1\ g\ S}\right) = 1.019\ mol\ S}$$

$$\mathbf{48.95\ g\ O \left(\frac{1\ mol\ O}{16.00\ g}\right) = 3.060\ mol\ O}$$

$$\mathbf{\left(\frac{0.6793\ mol\ Al}{0.6793}\right) : \left(\frac{1.019\ mol\ S}{0.6793}\right) : \left(\frac{3.060\ mol\ O}{0.6793}\right)}$$

1.00 Al : 1.50 S : 4.50 O
multiply by 2 (1 Al : 1.5 S : 4.5 O) = 2 Al : 3 S : 9 O
$Al_2S_3O_9$

What is the name of the compound?

$Al_2(SO_3)_3$ aluminum sulfite

(11) 7. Complete the following table;

Name of the compound	Formula of the compound	Ionic or Covalent Compound
sodium phosphate	**Na_3PO_4**	**ionic**
sulfur trioxide	**SO_3**	**covalent**
iron(III) nitrate	$Fe(NO_3)_3$	**ionic**
Potassium peroxide	**K_2O_2**	**ionic**
sulfuric acid	$H_2SO_{4(aq)}$	
hexane	C_6H_{14}	**covalent**

Multiple Choice: (24 points)

Print the letter (A, B, C, D, E) which corresponds to the answer selected.

8.	**D**	9.	**B**	10.	**A**	11.	**D**	12.	**B**
13.	**D**	14.	**A**	15.	**C**				

ONLY THE ANSWERS IN THE AREA ABOVE WILL BE GRADED. Select the most correct answer for each question. Each question is worth 3 points.

8.Which of the following are physical properties of bromine?

I) reddish-brown
II) liquid
III) reacts with aluminum
IV) dissolves in hexane

A. I and II
B. I and IV
C. I, II and III
D. I, II and IV
E. III only

9.Which of the following isotopes has the number of protons, neutrons and electrons indicated below?

Protons	Neutrons	Electrons
38	50	36

A) $^{124}_{88}Ra^{2+}$

B) $^{88}_{38}Sr^{2+}$

C) $^{88}_{50}Sn^{2+}$

D) $^{88}_{36}Xe$

10. Which of the following metals reacts immediately with water?

A) sodium
B) aluminum
C) mercury
D) gold
E) copper

11. Which of the following does NOT happen when aluminum is added to a sample of bromine?

A) The aluminum burns brightly;
B) A dense white cloud is formed;
C) White solid is seen in the container after the reaction;
D) The aluminum and bromine react immediately on mixing;

12. The answer to the correct number of significant figures;

$$26.896 - (7.2 \cdot 0.125) =$$

A) 26
B) 26.0
C) 26.00
D) 25.99
E) 25.996

13. Given the four numbers;

$$0.003450,\ 9.00 \times 10^3,\ 100.0,\ 98{,}000$$

The correct number of significant figures;

A) 3, 3, 4, 2
B) 4, 3, 1, 2
C) 6, 3, 4, 5
D) 4, 3, 4, 2
E) 3, 1, 4, 5

14. What is the mass of one atom of gold?

A) 3.27×10^{-22} gms
B) 3.06×10^{21} gms
C) 1.79×10^{-21} gms
D) 1.31×10^{-22} gms

15. Concentrated ammonia, $NH_{3(aq)}$, is a mixture of pure NH_3 and water and is prepared by bubbling pure NH_3 gas into water. To prepare a solution of concentrated NH_3 157 g of NH_3 gas is added to 113. g of water. The final volume of the mixture is 300. mLs. Calculate the density of concentrated ammonia and the weight percent of pure NH_3 in concentrated ammonia.

	Density ($g \cdot mL^{-1}$)	Weight %
A)	0.523	72.0
B)	0.377	52.3
C)	0.900	58.1
D)	0.900	52.3
E)	0.523	37.7

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1 **H** 1.008																	2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	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
5	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** (98)	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
6	55 **Cs** 132.9	56 **Ba** 137.3	57 **La** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.8	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)
7	87 **Fr** (223)	88 **Ra** 226.0	89 **Ac** 227.0	104 (261)	105 (262)	106 (263)												

Lanthanides	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.2	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
Actinides	90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** 237.0	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)

Useful Information

1 pound (lb) = 453.59237 gram (gm)

1 liter (L) = 1.056718 quart (qt)

4 qt = 1 gallon (gal)

1 inch (in) = 2.54 centimeters (cm)

1 mile = 5280 feet (ft)

$^{\circ}C = \frac{5}{9}(^{\circ}F - 32)$

density of water = $1.00 \frac{g}{mL}$

$K = {}^{\circ}C + 273.15$

average atomic mass = Σ(isotopic mass $\cdot$ fractional abundance)

Avogadro's number = 6.022×10^{23}