CHEM 1014
Exam I
John I. Gelder
September 16, 1999

Name ____________________

TA's Name ____________________

Lab Section _______

Please sign your name below to give permission to post your course scores on homework, laboratories and exams. If you do not sign no scores will be posted. All scores will be posted by a random number assigned to you by Dr. Gelder.

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(signature)

INSTRUCTIONS:

1. This examination consists of a total of 6 different pages. The last page includes a periodic table and some useful information. 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. You will receive 2 points for knowing your TA's name AND laboratory section number in which you are officially enrolled.

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/discussion. You do not have to show your work for the multiple choice (if any) or short answer questions.

4. No credit will be awarded if your work is not shown in problems 3, 6b and 6c.

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.

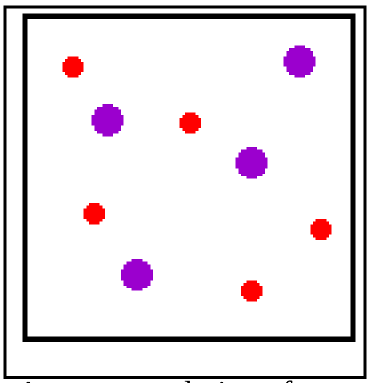
8. Relax and do well.

	Page 2	Page 3	Page 4	Page 5	TOTAL
SCORES	____ (39)	____ (23)	____ (23)	____ (13)	____ (100)

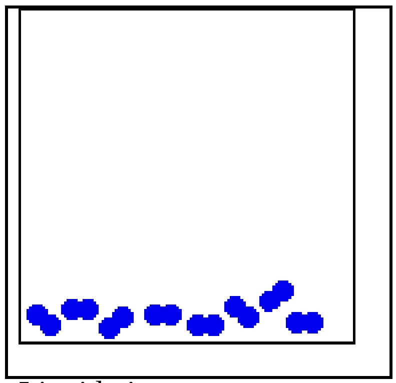
(15) 1. Complete the following table with the missing information.

Name	Formula	Symbol	Phase (25 ˚C)
phosphorus	P_4	P	**solid**
hydrogen	H_2	**H**	**gas**
gold	**Au**	Au	**solid**
fluorine	F_2	F	**gas**
lead	**Pb**	**Pb**	**solid**

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



A gaseous solution of two elements.



Liquid nitrogen.

(12) 3. Complete the following temperature conversions.

a) If a sample of silver melts at 1235 K, calculate the melting point in ˚F and ˚C.

K = 273.15 + ˚C   1235 K = 273.15 + ˚C   ˚C = 962

$$^\circ F = \frac{9}{5}(^\circ C) + 32 = \frac{9}{5}(962) + 32 = 1764\ ^\circ F$$

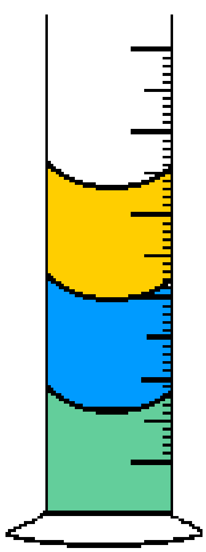
b) Liquid nitrogen boils at –321 ˚F. Calculate the boiling point of nitrogen in ˚C.

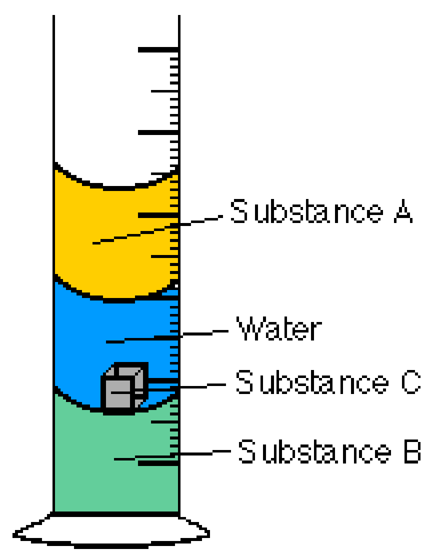
$$^\circ C = \frac{5}{9}(^\circ F - 32) = \frac{5}{9}(-321 - 32) = -196\ ^\circ C$$

(15) 4. Complete the following table. (For example, calculate the density for substance 'A' given the mass of substance 'A' and its volume.)

Substance	Mass (g)	Volume (mL)	Density (g mL^{-1})	Phase (25 ˚C)
A	37.5	56.8	$\frac{\mathbf{37.5\ grams}}{\mathbf{56.8\ mLs}}$ = **0.660** $\frac{\mathbf{g}}{\mathbf{mLs}}$	liquid
B	**1.59** $\frac{\mathbf{g}}{\mathbf{mLs}}$ **x 13.3 = 21.1 g**	13.3	1.59	liquid
C	1,225	**1,225 g / 1.35** $\frac{\mathbf{g}}{\mathbf{mLs}}$ **= 907 mLs**	1.35	solid

Assume you had 25 mL samples of the two liquids in the table above and a 25 mL sample of water. Describe the order (top to bottom) of the substances when placed into the same graduated cylinder. What would happen if a piece of the solid (from above) were dropped into the graduated cylinder? Draw and label a picture of a graduated cylinder before and after adding the solid.





(8) 5. Give an example of an element and of a compound. Describe the difference between an element and a compound.

Helium would be an example of an element and water would be an example of a compound. Both are pure substances. An element is composed of a single kind of atom. A compound is composed of two or more different elements combined together.

(15) 6a. In class we established and investigated the inverse relationship between pressure and volume for a gas. What is the relationship between pressure and temperature of a gas, direct or inverse? Why?

The relationship between pressure and temperature is a direct relationship. As the temperature of a sample of a gas increases so does the pressure.

b) The pressure exerted by a 15.0 mL sample of a gas in a syringe was 1.20 atm. Calculate the pressure exerted by the same sample when the volume is increased to 35.0 mLs.

$$\mathbf{PV = k \qquad 1.20\ atm \cdot 15.0\ mL = k = 18.0\ mL{\cdot}atm}$$

$$\mathbf{P = k \cdot \frac{1}{V} = 18.0\ mL{\cdot}atm \cdot \frac{1}{35\ mL} = 0.514\ atm}$$

c) A 2.50 L sample of carbon dioxide at 298 K is cooled to –50 ˚C. Calculate the volume of the sample of carbon dioxide.

$$\mathbf{V = kT \qquad k = \frac{V}{T} = \frac{2.50\ L}{298\ K} = 0.00839\ \frac{L}{K}}$$

$$\mathbf{K = 273.15 + {}^{\circ}C = 273.15 - 50\ {}^{\circ}C = 223\ K}$$

$$\mathbf{V = 0.00839\ \frac{L}{K} \cdot 223\ K = 1.87\ L}$$

(8) 7. In a container of a gas with a fixed volume no gas can escape or enter the container. If the gas in the container is cooled to a low enough temperature it condenses and forms a liquid. Briefly, explain what is happening as the gas is cooled, and why condensation occurs.

As a gas is cooled the energy of the gas particles decreases and their spped drops. For condensation to occur the particles must slow down enough that the attractions between particles cause the gas particles to form aggregates. When the aggregates become large enough they condense forming a liquid.

(8) 8. In one of the experiments/demonstrations I did in class I placed some water in an empty soda can (Coke Cola) and heated the can/water over a flame from a Bunsen burner. Describe the remainder of the experiment. Provide a brief explanation for what happened to the can.

Once the water is boiling in the can, the can was removed from the heat and inverted into a container of water. The can was immediately crushed.

All the air was purged from inside the can by the water vapor produced when the water was boiling. When the can was inverted and submerged in the beaker of water, the water vapor inside the can condensed leaving a vacuum inside the can. The pressure outside the can was much greater than the pressure inside the can crushing the can to try to equalize the pressure.

(5) 9. Explain why it is so easy to compress the volume of a sample of a gas, but very difficult to compress the volume of a liquid.

A gas is mostly empty space between the particles. In a liquid the particles are very close together, with little empty space between the particles. As an external force is applied (compression) the particles of a liquid can not get much closer together, while the particles of a gas can.

Periodic Table of the Elements

	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	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 **Rf** (261)	105 **Db** (262)	106 **Sg** (263)	107 **Bh** (262)	108 **Hs** (265)	109 **Mt** (266)									

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

$^{\circ}F = \frac{9}{5}\,^{\circ}C + 32$

density of water (liquid) = 1.0 g mL^{-1}

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

$P \cdot V = k$ (Boyle's Law)

1 atm = 14.7 lb in^{-2}

$V = k \cdot T$ (Charles' Law)