CHEM 1314
Exam IV
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December 14, 1992

Name _____
TA Name _____

Lab Section _____

INSTRUCTIONS:

1. This examination consists of a total of 9 different pages. The last three pages includes a periodic table and some useful information, a solubility table, a table of vapor pressures and a table of standard heats of formation. All work should be done in this booklet.

2. PRINT your name, teaching assistant's name and lab section 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, 2, and 5 - 7.

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	_____	_____	_____	_____	_____
	(30)	(16)	(40)	(14)	(100)

(15) 1. The volume of a weather balloon containing He gas at 25.0 ˚C and 1.04 atm is 244 L. After released the balloon ascends to an altitude where the pressure falls to 0.120 atm and the temperature is –53.0 ˚C. Assuming no gas is lost as the balloon ascends, calculate the volume of the balloon under these new conditions.

(15) 2. A common laboratory preparation of O_2, involves the decomposition of potassium chlorate, $KClO_3$, according to the equation

$$2KClO_{3(s)} \rightarrow 2KCl_{(s)} + 3O_{2(g)}$$

Typically the oxygen gas is collected by displacing water. Calculate the maximum volume of dry O_2 collected when 0.869 g of $KClO_3$ decomposes at a temperature of 25.0 ˚C and an external pressure of 755 mm Hg?

(8) 3. Explain, in terms of the kinetic molecular model, why increasing the temperature of a sample of an ideal gas increases the pressure of the gas. Assume the volume and number of moles of gas are held constant.

(15) 4. Complete the following equations to describe the indicated compound's behavior when added to water. If the compound will not dissolve in water, write WND. For those compounds which dissolve, indicate whether the substances behaves as a non-, weak or strong electrolyte.

a) $C_6H_{12}O_{6(s)} \xrightarrow{H_2O}$

b) $C_4H_{8(l)} \xrightarrow{H_2O}$

c) $PbI_{2(aq)} \xrightarrow{H_2O}$

d) $NaC_2H_3O_{2(aq)} \xrightarrow{H_2O}$

e) $NH_4Cl_{(aq)} \xrightarrow{H_2O}$

(9) 5. Predict whether the following pairs (solute:solvent) form a solution when mixed together. In each case explain why or why not.

a) $CH_3NH_{2(g)} : H_2O_{(l)}$

b) $CS_{2(l)} : H_2O_{(l)}$

c) $CCl_{4(l)} : C_7H_{8(l)}$ (toluene)

(10) 6. Indicate the type of attractive force(s) that occur in each of the following pure substances:

a) $CH_3CH_2OH_{(l)}$

b) $SO_{2(s)}$

c) $CaF_{2(s)}$

d) $HNO_{3(l)}$

e) $Bi_{(s)}$

(9) 7. A sample of water vapor in a flask of constant volume exerts a pressure of 290 mmHg at 90.0 ˚C. The flask containing the water vapor is cooled to 75 ˚C, then to 65 ˚C and finally to 40 ˚C. Determine the pressure exerted by the water vapor in the flask at each of the lower temperatures.

Multiple Choice:

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

8. _____ 9. _____ 10. _____ 11. _____

12. _____ 13. _____ 14. _____

ONLY THE ANSWERS IN THE AREA ABOVE WILL BE GRADED. Select the most correct answer for each question. Each question is worth 2 points.

8. If the pressure of an ideal gas is tripled and the temperature halved the new volume can be expressed as; (Note: assume the number moles of the ideal gas remain constant.)

A) $V_{new} = 0.06 \cdot V_{initial}$
B) $V_{new} = 0.167 \cdot V_{initial}$
C) $V_{new} = 0.667 \cdot V_{initial}$
D) $V_{new} = 1.5 \cdot V_{initial}$

9. Which of the following gas mixtures exerts the greater pressure? Assume each mixture is in the same size volume at the same temperature

A) 2.00 g of H_2, 4.00 g of He and 40.0 g of Ar
B) 2.00 g of H_2, 6.00 g of He and 40.0 g of Ar
C) 4.00 g of H_2, 4.00 g of He and 40.0 g of Ar
D) 2.00 g of H_2, 4.00 g of He and 50.0 g of Ar

10. Which of the following compounds is expected to have the lowest vapor pressure at 25.0 ˚C?

A) CH_3OCH_3
B) CH_3OH
C) $CH_3CH_2CH_2CH_3$
D) $CH_3CH_2CH_3$

11. Which of the following molecules exhibit hydrogen bonding in the pure liquid?

A) HBr
B) CH_4
C) PH_3
D) N_2H_4

12. 0.135 g of H_2O are introduced into a 500.00 mL flask at 50.0 ˚C. Which of the following statements is true?

A) only vapor is present in the flask.
B) only liquid is present in the flask.
C) both liquid and vapor are present in the flask.
D) not enough information to determine the phase(s).

Given the list of intermolecular attractive forces;

1. ion - dipole
2. dipole - dipole
3. London dispersion
4. Hydrogen bonding

Answer the Questions 13 and 14.

13. Which intermolecular attractive force(s) occur in a pure liquid sample of CO?

A) 2 only
B) 3 only
C) 4 only
D) 2 and 3
E) 3 and 4

14. Which of the following statements about an ideal gas is false?

A) The forces of attraction between gas particles are assumed to be negligible.
B) Nonreactive gases will mix in any proportion and behave independently of each other.
C) The volumes of the gas particles are assumed to be negligible compared to the volume of the container.
D) At a constant temperature, all the molecules are assumed to have the same speed.

15. Consider the following specific heats of metals

Metal	Specific Heat $\frac{J}{g \cdot °C}$
Copper	0.385
Cobalt	0.418
Chromium	0.447
Gold	0.129
Silver	0.237

If the same amount of heat is added to 100. g samples of each of the metals, which are all at the same temperature initially, which metal will reach the highest temperature

A) Copper
B) Cobalt
C) Chromium
D) Gold
E) Silver

16. Rank the pure substances N_2, CH_3OH, Ar and CaO in terms of increasing strength of attractive forces

A) $N_2 < CH_3OH < Ar < CaO$
B) $N_2 < Ar < CH_3OH < CaO$
C) $CaO < CH_3OH < Ar < N_2$
D) $CH_3OH < CaO < Ar < N_2$

17. Which of the following statements is true?

A) For liquids with strong intermolecular attractive forces, e.g. hydrogen-bonding, the equilibrium vapor pressure can decrease with increasing temperature.
B) As intermolecular attractive forces increase the vapor pressure decreases and the boiling point increases.
C) In a closed system, the vapor pressure of a liquid depends on the volume of vapor above the liquid, whether liquid is present in the system or not.
D) The vapor pressure of a liquid depends on the surface area of the liquid.

Useful Information

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)

specific heat of water is $4.184 \frac{J}{g \cdot °C}$

$PV = nRT$

$R = 0.08203 \frac{L \cdot atm}{mol \cdot K}$ or $R = 8.314 \frac{J}{mol \cdot K}$

Solubility Table

Ion	Solubility	Exceptions
NO_3^-	soluble	none
ClO_4^-	soluble	none
Cl^-	soluble	except Ag^+, Hg_2^{2+}, *Pb^{2+}
I^-	soluble	except Ag^+, Hg_2^{2+}, Pb^{2+}
SO_4^{2-}	soluble	except Ca^{2+}, Ba^{2+}, Sr^{2+}, Hg^{2+}, Pb^{2+}, Ag^+
CO_3^{2-}	insoluble	except Group IA and NH_4^+
PO_4^{3-}	insoluble	except Group IA and NH_4^+
^-OH	insoluble	except Group IA, *Ca^{2+}, Ba^{2+}, Sr^{2+}
S^{2-}	insoluble	except Group IA, IIA and NH_4^+
Na^+	soluble	none
NH_4^+	soluble	none
K^+	soluble	none

*slightly soluble

Temperature (°C)	Vapor Pressure(mmHg)	Temperature (°C)	Vapor Pressure(mmHg)
-5	3.2	50	92.5
0	4.6	55	118.0
5	6.52	60	149.4
10	9.20	65	187.5
15	12.8	70	233.7
20	17.5	75	289.1
25	23.8	80	355.1
30	31.8	85	433.6
35	42.1	90	525.8
40	55.3	95	633.9
45	71.9	100	760