

CHEM 1515.001 - 006
Exam II
John II. Gelder
March 5, 2002

Name _____

TA's Name _____

Section _____

INSTRUCTIONS:

1. This examination consists of a total of 8 different pages. The last three pages include a periodic table, a table of vapor pressures for water, a solubility table and a table of thermodynamic values. 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 6 and 8.
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	Page 6	TOTAL
SCORES	<u> </u> (22)	<u> </u> (18)	<u> </u> (24)	<u> </u> (18)	<u> </u> (18)	<u> </u> (100)

(9) 1. Write the chemical formula(s) of the product(s) and balance the following reactions. Identify all products phases as either (g)as, (l)iquid, (s)olid or (aq)ueous. Soluble ionic compounds should be written in the form of their component ions.

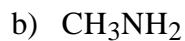


(4) 2a. Write the ionic and net ionic chemical equation for 1a), 1b) or 1c).

Ionic equation

Net Ionic equation

(9) 3. Identify the interparticle attractive force(s) present in the solids of the following substances. If more than one interparticle force, indicate which is the most important.

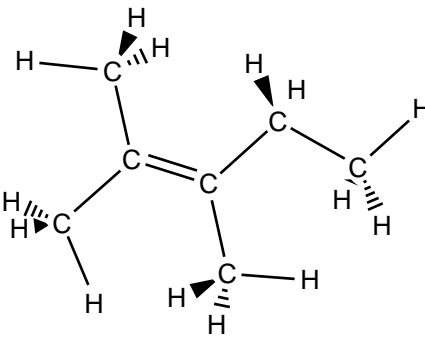


(12) 4. Account for each of the following observations about pairs of substances. In your answers, use appropriate principles of intermolecular forces. In each part, your answer must include references to both substances.

a) HF has normal boiling point = 20 °C where as HCl has a normal boiling point of -114 °C.

b) CCl₄ has normal boiling point = 76.7 °C where as CBr₄ has a normal boiling point of 189 °C.

(6) 5. Give the name or draw the complete Lewis structure (showing all C-H bonds) for each of the following compounds.

	4-ethyl- <i>trans</i> -2-heptene	3,3-dimethyl-1-butyne
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- (12) 6. Barium, Ba, crystallizes in one of the cubic unit cell systems. The edge length of its unit cell is 502 pm and the density of the metal is 3.50 g cm^{-3} . Determine the number of atoms in the cubic unit cell **and** identify the type of cubic cell.
- (12) 7a. Some solutions processes are exothermic while others are endothermic. Provide an explanation for this difference.
- b) A substance with the formula $\text{C}_2\text{H}_4\text{O}_2$ is very soluble in water, but insoluble in CS_2 . Suggest a structure for this substance that supports the solubility information. Indicate the intermolecular attractive force that explains the solubility.

(36) 8. An aqueous solution of Na_3PO_4 is prepared by mixing 16.4 g Na_3PO_4 with 500 g of water.

a) calculate the molality of the solution. (6)

b) calculate the ideal freezing point of the solution. (6)

c) the experimental freezing point was found to be $-1.32\text{ }^\circ\text{C}$. Explain why the experimental and ideal freezing point are different. (6)

8. (Continued)

d) a new aqueous solution of sodium phosphate, Na_3PO_4 , was prepared with a density of 1.05 g cm^{-3} . The molality of this solution was determined to be 0.320 molal .

i) calculate the weight percent of Na_3PO_4 in this solution. (6)

ii) calculate the molarity of the solution. (6)

iii) describe how to prepare 1200 g of a 0.320 molal solution beginning with a 0.500 molal Na_3PO_4 solution and distilled water. (6)

Periodic Table of the Elements

	IA																VIII A	
1	1 H 1.008																	2 He 4.00
		IIA										IIIA	IVA	VA	VIA	VIIA		
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	
			IIIB	IVB	VB	VIB	VIIB	VIII		IB	IIB							
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

$$1 \text{ pm} = 10^{-12} \text{ m}$$

$$R = 0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} = 8.314 \frac{\text{J}}{\text{mol}\cdot\text{K}} \quad 6.02 \times 10^{23}$$

$$P_{\text{solution}} = \chi_{\text{solvent}} P^{\circ}_{\text{solvent}}$$

$$\text{density of H}_2\text{O} = 1.00 \frac{\text{g}}{\text{cm}^3}$$

$$\Delta T = i k m \quad k_f(\text{H}_2\text{O}) = 1.86 \frac{^{\circ}\text{C}}{\text{m}} \quad k_b(\text{H}_2\text{O}) = 0.512 \frac{^{\circ}\text{C}}{\text{m}}$$

$$\text{edge length (l)} = 2r$$

$$\text{edge length (l)} = 2\sqrt{2} \cdot r$$

$$\text{edge length (l)} = \frac{4r}{\sqrt{3}}$$

$$\Delta G^{\circ} = \Delta H^{\circ} - T\Delta S^{\circ}$$

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

Solubility Table

<u>Ion</u>	<u>Solubility</u>	<u>Exceptions</u>
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