

PRINT NAME \_\_\_\_\_

SIGN NAME \_\_\_\_\_

CIRCLE your recitation section in the list below.

A:	M	9:00	HM 210	B:	M	10:00	DA 208B
C:	T	11:00	NS 317	D:	W	8:00	LF 130
E:	W	12:00	SK 209	F:	Th	4:00	HM 108

SCORED GRADE: \_\_\_\_\_

All answers should be with the correct significant figures.

Atomic weights are provided in the Periodic Table. These values must be used. The Periodic Table will not be collected. It may be used as scratch paper or as cover paper. Do not turn it in.

Be certain your answers are clear. If an answer is not clear, it can be considered wrong.

Problems marked with \*\* in the margin are from the assigned homework. These total 30 points.

Place your name in the space provided at the top of each question page. This helps to identify the pages if they are accidentally separated during grading and processing. Note the extra information needed at the top of page 4.

Work promptly. Use your time effectively.

## SOME THINGS WHICH MAY OR MAY NOT BE USEFUL

$$T(\text{K}) = T(^{\circ}\text{C}) + 273$$

$$R = 0.08206 \text{ atm} \cdot \text{L}/(\text{mol} \cdot \text{K})$$

Heat and Heat Capacity  $q = \Delta T \times \text{mass} \times c$ Freezing point depression  $\Delta T_f = K_f \times m$ Osmotic pressure  $\Pi = M \times R \times T$ 

H <sub>2</sub> O(l) EVP	0. °C	10. °C	20. °C	30. °C	40. °C
Torr:	4.59	9.21	17.5	31.8	55.4

Standard Enthalpies of Formation (in kJ or kJ/mol)

Ca<sup>2+</sup>(aq) -542.83Ca<sup>2+</sup>(g) 1,925.90CaCl<sub>2</sub>(s) -795.80Cl<sup>-</sup>(aq) -167.16Cl<sup>-</sup>(g) -233.95

**\*\*KEEP YOUR WORK AND ANSWERS COVERED.\*\***

1. (30 pts) Indicate whether each statement is true (T) or false (F). Be certain T or F is clearly indicated.

- \_\_\_\_\_ For every substance, its  $\Delta H_{\text{vap}}^{\circ}$  is greater than its  $\Delta H_{\text{fus}}^{\circ}$ .
- \_\_\_\_\_ At 10 atm, the boiling point of a liquid is higher than its normal boiling point.
- \_\_\_\_\_  $\text{CO}_2$  is the most used supercritical fluid worldwide.
- \_\_\_\_\_ Each  $\text{H}_2\text{O}$  molecule in ice uses two hydrogen bond donor interactions and two hydrogen bond acceptor interactions.
- \_\_\_\_\_ Neon atoms cannot have a temporary dipole.
- \_\_\_\_\_ Diamond is a two-dimensional network of  $sp^2$  carbon atoms.
- \_\_\_\_\_ Every enthalpy of hydration is negative.
- \_\_\_\_\_ All soluble ionic compounds dissolve in water exothermically.
- \_\_\_\_\_ A chloride ion has a higher charge density than a fluoride ion.
- \_\_\_\_\_ Gases with a larger value of  $k_{\text{H}}$  have a greater solubility in water.

2. (8 pts) List the primary intermolecular forces for each of the following (pure) compounds. If more than one IF is operating for a compound, CIRCLE the strongest IF for that compound.

BrCN \_\_\_\_\_

$\text{Cl}_3\text{PO}$  \_\_\_\_\_

- \*\* 3. (6 pts) Consider the following physical properties for benzene,  $\text{C}_6\text{H}_6$ .

melting point =  $5.5\text{ }^{\circ}\text{C}$

$\Delta H_{\text{fus}}^{\circ} = 9.87\text{ kJ}$

boiling point =  $80.1\text{ }^{\circ}\text{C}$

$\Delta H_{\text{vap}}^{\circ} = 30.72\text{ kJ}$

$c$  of solid =  $1.5\text{ J}/(\text{g}\cdot^{\circ}\text{C})$

$c$  of liquid =  $1.8\text{ J}/(\text{g}\cdot^{\circ}\text{C})$

A 14.0 g sample of solid benzene at  $-12.7\text{ }^{\circ}\text{C}$  was heated until finally reaching gas phase at its boiling point. Consider just part of this overall process: start with the solid at  $-12.7\text{ }^{\circ}\text{C}$ , and heat the sample until you have liquid at  $5.5\text{ }^{\circ}\text{C}$ . Circle the number of kJ's which would be required.

- |      |      |      |      |      |      |
|------|------|------|------|------|------|
| 1.26 | 1.51 | 1.83 | 2.15 | 2.49 | 2.72 |
| 3.08 | 3.31 | 3.66 | 3.95 | 4.22 | 4.52 |

last name: \_\_\_\_\_

4. (6 pts) A solution of 5.78 mol% potassium carbonate has a density of 1.32 g/mL. Circle the mass% of the solute.

21.6%      23.7%      26.0%      28.1%      30.8%      32.0%  
36.9%      38.1%      40.5%      43.9%      45.5%      47.1%

- \*\* 5. (5 pts) What chemical type of solid is formed by each of the following substances?

silicon dioxide \_\_\_\_\_

gold \_\_\_\_\_

- \*\* 6. (6 pts) Consider  $\text{CaCl}_2(s)$  dissolving into water. Using enthalpies of formation, calculate  $\Delta H_{\text{soln}}^\circ$  (in kJ) and enter it on the line at right. (Only the answer, and not the calculation, will be graded for this question.) \_\_\_\_\_

7. (5 pts) A solution contains 0.562 g of tetraphosphorus trisulfide in 25.0 g benzene,  $\text{C}_6\text{H}_6$ . Circle the freezing point (in  $^\circ\text{C}$ ) of the solution. For  $\text{C}_6\text{H}_6$ ,  $K_f = 5.07^\circ\text{C}/\text{m}$  and  $\text{mp} = 5.49^\circ\text{C}$ .

4.73      4.79      4.84      4.87      4.90      4.97  
5.03      5.08      5.11      5.15      5.20      5.26

- \*\* 8. (7 pts) For each compound below in water, list the primary intermolecular forces which are operating between the compound and the water.

$\text{H}_3\text{CNH}_2$  \_\_\_\_\_

$\text{SiF}_4$  \_\_\_\_\_

NAME: \_\_\_\_\_

SECTION: \_\_\_\_\_

9. (6 pts) Consider a closed, 50.0 L container of air with 55.0% RH at 30. °C (86 °F). If that volume of air cools down to 10. °C (50. °F), how much dew is present at equilibrium? Circle the answer in g.

0.168	0.209	0.364	0.470	0.508	0.661
0.727	0.813	0.954	1.05	1.13	1.22

10. (9 pts) Consider CH<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> (H<sub>3</sub>CCH<sub>3</sub>) for dissolving into water. Both are gases in their native phase. Of the two compounds, which has weaker total IFs with water and which has stronger total IFs with water?

weaker IFs \_\_\_\_\_ stronger IFs \_\_\_\_\_

Explain your answer. You must include which specific IFs are involved.

Of the two compounds, which is less opposed by entropy to dissolve and which is more opposed?

less opposed by S \_\_\_\_\_ more opposed by S \_\_\_\_\_

Explain your ranking.

11. (6 pts) Consider the following pure compounds.

H<sub>3</sub>SiCl      Cl<sub>3</sub>PO      BCl<sub>3</sub>      H<sub>2</sub>O      ClF<sub>3</sub>      CH<sub>3</sub>CH<sub>2</sub>F

Which has the strongest dispersion? \_\_\_\_\_

Which has the weakest dispersion? \_\_\_\_\_

- \*\* 12. (6 pts) A solution contains 9.19 g water and 29.6 g CH<sub>3</sub>OH. Circle the mole fraction of water in the solution.

0.317	0.330	0.356	0.378	0.391	0.419
0.436	0.450	0.477	0.496	0.511	0.532