

****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.

T A system with more options for the distribution of energy has more entropy.

T For every pure substance, $\Delta H_{\text{cond}}^{\circ} = -\Delta H_{\text{vap}}^{\circ}$.

F Decreasing the pressure on a liquid will increase its boiling point.

T Water can sublime below 0 °C.

F CO₂ is more polarizable than SO₂.

T Each carbon atom in diamond is sp^3 hybridized and bonded to four other carbon atoms.

T All $\Delta H_{\text{soln}}^{\circ}$ values for gas phase solutes are negative.

T Helium is insoluble in water.

F All salts increase in solubility in water as temperature increases.

F A solution of 0.1 m glucose (C₆H₁₂O₆) will have a higher equilibrium vapor pressure than a solution of 0.05 m sucrose (C₁₂H₂₂O₁₁).

- ** 2. (4 pts) Your 2 L bottle of carbonated water has gone flat. If the solution in the bottle at equilibrium at 25 °C contains [CO₂(aq)] = 0.0016 M, then calculate (and circle) the pressure (in atm) of the CO₂(g) in the gas space. For CO₂, $k_{\text{H}} = 0.034 \text{ M/atm}$.

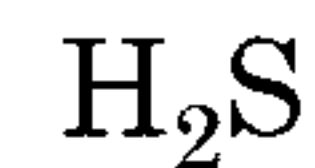
0.011	0.016	0.022	0.027	0.036	0.039
0.041	<u>0.047</u>	0.050	0.054	0.062	0.067

3. (5 pts) $\Delta H_{\text{sub}}^{\circ}$ for I₂ at 25 °C is 62.24 kJ. Circle the number of kJ required to sublime 36.0 g I₂.

6.01	6.82	7.34	7.91	8.13	<u>8.83</u>
9.51	9.72	10.8	15.9	20.6	23.3

last name: MW

- ** 4. (6 pts) Consider the (pure) compounds below.



Which compound(s) have hydrogen bonding?

H₃CNH₂, HF

Which one compound has the weakest dispersion?

HF

Which one compound has the strongest dispersion?

AsCl₃

5. (6 pts) Consider a solution of 1.490 M magnesium sulfate, which has a density of 1.165 g/mL. Circle the mole% of the solute.

2.13%

2.37%

2.65%

2.72%

3.08%

3.20%

3.69%

3.73%

4.15%

4.39%

4.45%

4.71%

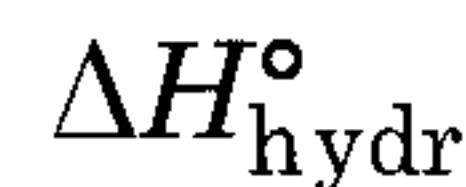
- ** 6. (9 pts) Which intermolecular forces are operating for each of the following (pure) compounds?

Cl₂SO dispersion, dipole-dipole

HCCH dispersion

NH₃ dispersion, dipole-dipole, H-bonding

7. (9 pts) Consider the following enthalpy terms.



Which term represents the energy required to separate the molecules of a liquid?

$\Delta H_{\text{vap}}^{\circ}$

Which term represents the change in energy upon dissolving a liquid into water?

$\Delta H_{\text{soln}}^{\circ}$

How many of the terms are ALWAYS negative (exothermic)?

1

last name: MW

8. (6 pts) For each compound below in water, list the primary intermolecular forces which are operating between the compound and the water.

CS₂ dispersion, dipole-induced dipole

PH₃ dispersion, dipole-dipole

- ** 9. (6 pts) Consider the following compounds, all of which are liquids by themselves.

C₈H₁₈ H₂O₂ CH₂Cl₂ HCO₂H (HCOH)

Two are miscible in water. Which are they?

H₂O₂, HCO₂H

One is soluble but not miscible. Which is it?

CH₂Cl₂

One is insoluble and immiscible. Which is it?

C₈H₁₈

- ** 10. (6 pts) A solution is composed of 5.11 g disulfur dichloride in 50.0 g carbon tetrachloride. What is the molality of the disulfur dichloride in this solution?

0.503	0.563	0.582	0.620	0.637	0.699
0.735	<u>0.757</u>	0.782	0.811	0.846	0.877

11. (5 pts) The structure of calcium fluoride is based on an fcc lattice of calcium ions. How many cations and anions are in one unit cell?

cations 4 anions 8

12. (2 pts) What is the strongest IF in (pure) Cl₃PS?

dispersion

(2 pts) Comparing Br⁻ and I⁻, which one has the greater charge density?

Br⁻

(2 pts) Comparing SiF₄ and CF₄, which one has the lower EVP at 25 °C?

SiF₄

(2 pts) Comparing SiO₂, NO₂ and SO₂, one is a solid at 25 °C. Which one is the solid?

SiO₂