

Exam I

Chem 112 - General Chemistry II

Spring 2022

Instructions:

1. Read the instructions for each question carefully.
2. Work on the questions, then as a group we will go over each question.
3. If you have extra time, feel free to work ahead.
4. You are free to use a calculator and periodic table to answer the following questions.

Necessary constants and other information are provided in each question.

Good Luck!

This material was distributed by the Austin College Academic Skills Center in the General

Chemistry Tutorial Series

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1. Determine the effect of the following factors on solubility.
 - a. An increase in temperature on the solubility of (1) solids, (2) liquids, and (3) gasses.
 - b. An increase in pressure on the solubility of gasses.
2. Define what a spontaneous and non-spontaneous process is in terms of thermochemistry. Give an example of each process.
3. Calculate the entropy change in a system that has 2.5 moles of an ideal gas that is confined to 2.6 L of a 5.0 L container when the gas is allowed to expand and fill the entire container at constant temperature.
4. A solution is made by dissolving 105.2 g of naphthalene ($C_{10}H_8$) in 0.900 L of benzene (C_6H_6 , 0.8765 g/mL). Express the concentration of the solution in (a) molarity, (b) molality, and (c) percent by mass.

5. Calculate the freezing and boiling points of the solutions below:

[K_b of water is $0.52\text{ }^\circ\text{C/m}$] [K_f of water is $1.86\text{ }^\circ\text{C/m}$]

a. 19.8 g NaCl in 133 g water

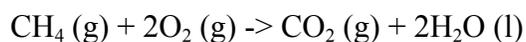
b. 13.7 g urea ($\text{CH}_4\text{N}_2\text{O}$) in 64.2 mL water

6. Using the second law of thermodynamics, determine if the reaction is spontaneous or nonspontaneous.

a. $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightarrow 2\text{HI}(\text{g})$ at 0°C ($S^\circ \text{H}_2(\text{g}) = 130.0\text{ J/K}\cdot\text{mol}$, $\Delta H^\circ_f \text{H}_2(\text{g}) = 0\text{ kJ/mol}$)
($S^\circ \text{I}_2(\text{g}) = 260.57\text{ J/K}\cdot\text{mol}$, $\Delta H^\circ_f \text{I}_2(\text{g}) = 62.25\text{ kJ/mol}$) ($S^\circ \text{HI}(\text{g}) = 206.3\text{ J/K}\cdot\text{mol}$,
 $\Delta H^\circ_f \text{HI}(\text{g}) = 25.9\text{ kJ/mol}$)

- b. **Na (s) \rightarrow Na(l) at 98°C** ($S^\circ \text{Na(s)} = 51.05 \text{ J/K}\cdot\text{mol}$, $\Delta H^\circ_f \text{(s)} = 0 \text{ kJ/mol}$), ($S^\circ \text{Na(l)} = 57.56 \text{ J/K}\cdot\text{mol}$, $\Delta H^\circ_f \text{Na(l)} = 2.41 \text{ kJ/mol}$)

7. Calculate the standard free energy change for the following reaction at 25°C with $\Delta G^\circ_f \text{CH}_4 \text{(g)} = -50.8 \text{ kJ/mol}$, $\Delta G^\circ_f \text{CO}_2 \text{(g)} = -394.4 \text{ kJ/mol}$, and $\Delta G^\circ_f \text{H}_2\text{O (l)} = -237.2 \text{ kJ/mol}$



8. Calculate the entropy changes for benzene in the solid-liquid and liquid-vapor transition. The molar heat for vaporization of benzene is 31.0 kJ/mol and the molar heat of fusion is 10.9 kJ/mol. At 1 atm, the melting point of benzene is 5.5°C and the boiling point is 80.1°C.

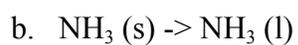
9. (a) Calculate the vapor pressure of an ideal solution containing 184.4 g ethanol (C_2H_5OH) and 30.0 g methanol (CH_3OH) at $20^\circ C$ if, at the same temperature, ethanol has a vapor pressure of 44 mmHg and methanol has a vapor pressure of 94 mmHg.

(b) Calculate the mole fraction of ethanol and methanol in the vapor of this solution at $20^\circ C$.

10. Fill in the table for the relationship between spontaneity signs and thermodynamic properties

$\Delta S_{univ} > 0$	ΔG _____	Spontaneous
ΔS_{univ} _____	$\Delta G > 0$	
ΔS_{univ} _____	$\Delta G = 0$	

11. Predict the sign of ΔS and justify your reasoning



12. Label each of the following as an (a) aerosol, (b) foam, (c) emulsion, (d) sol, or (e) gel and fill in the blanks on the chart.

- a. Salad dressing
- b. Blood
- c. Beaten egg whites
- d. Smoke
- e. Jell-O

Colloid name	Dispersed phase	Dispersion medium
Aerosol		Gas
Foam	Gas	
	Liquid	Liquid
Sol	Solid	
	Liquid	Solid