Sample Exam Questions from Previous CHEM 1515 Exams

(12) 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.

a) $Mg(OH)_{2(s)} + HCl_{(aq)} \rightarrow$

b) $(NH_4)_2CO_{3(aq)} + Cu(NO_3)_{2(aq)} \rightarrow$

c) $Pb(NO_3)_{2(aq)} + KBr_{(aq)} \rightarrow$

d) hydrochloric acid$_{(aq)} + Mg_{(s)} \rightarrow$

(6) 2. Write the ionic and net ionic chemical equations for 1a) and 1b).

1a)

Ionic equation:

Net Ionic equation:

1b)

Ionic equation:

Net Ionic equation:

(12) 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.

a) $HCl_{(aq)} + Pb(NO_3)_{2(aq)} \rightarrow$

b) $Na_2SO_{4(aq)} + Ba(NO_3)_{2(aq)} \rightarrow$

c) $K_{(s)} + Cl_{2(g)} \xrightarrow{H_2O}$

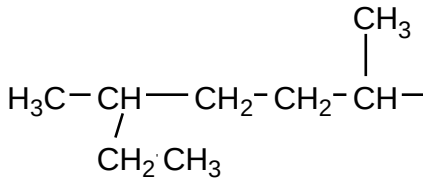
d) $Mg_{(s)} + CO_{2(g)} \xrightarrow{\Delta}$

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

Ionic equations

Net Ionic eduation

(6) 5. Give the name or draw the Lewis structure for each of the following compounds.

3-ethyl-1-pentyne	trans-3, 5-dimethyl-2-hexene	

(14) 6. Draw ALL of the structural isomers for C_4H_7Cl. Name at least four of these isomers.

(6) 6. Give the name or draw the Lewis structure for each of the following compounds.

Nothing here!	2,3,4,4-tetramethylheptane	1,2,3-trichloro-2-bromopro

(12) 7. Draw and name all of the structural isomers for C_6H_{14}.

(16) 8a. Acetone has a ΔH°_{vap} of 32.4 kJ·mol^{-1} and a normal boiling point of 56 ˚C. Calculate the (equilibrium) vapor pressure of acetone at 23 ˚C (room temperature).

b) A 1.00 gram sample of acetone is placed into an evacuated 1.00 L container at 56.0 ˚C. The container is then cooled to 23.0 ˚C. Describe the phase(s) present at 23.0 ˚C. (Show your work to justify your answer.)

(12) 4. Hydrazine, N_2H_4, is used in the manufacture of pesticides and foam plastics as well as rocket fuel. As evident from the formula hydrazine is closely related to ammonia, perhaps it can be made by the reaction;

$$2NH_{3(g)} \rightarrow N_2H_{4(g)} + H_{2(g)}$$

a) Is this reaction feasible at 298 K? Support your answer with a calculation.

b) Is the reaction favored at high temperature or low temperature? Support your answer with a calculation.

(12) 6. A reaction that could be used to prepare ethylene glycol (used in antifreeze) is

$$2CO_{(g)} + 3H_{2(g)} \rightarrow CH_2OHCH_2OH_{(l)}$$

Thermodynamic data for $CH_2OHCH_2OH_{(l)}$:

Substance	$\Delta H^\circ_f \left(\frac{kJ}{mol}\right)$	$\Delta G^\circ_f \left(\frac{kJ}{mol}\right)$	$S^\circ \left(\frac{J}{mol \cdot K}\right)$
$CH_2OHCH_2OH_{(l)}$	-387.1	-298.2	

Use this data and any data from the table on this exam to determine the value of the standard molar entropy of $CH_2OHCH_2OH_{(l)}$ at 25 ˚C.

(9) 5. 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.

(17)4a. The equilibrium vapor pressure for carbon disulfide, CS_2, at 10 ˚C is 192 mmHg. Predict the phase(s) present at 10 ˚C if 14.0 g of CS_2 are placed into a 10.00 L container (previously evacuated). Support your answer with an explanation, and any important calculations.

b. What phase(s) are present if the volume of the container were twice as large at the same temperature? (Assume no loss of CS_2)

(10)5a. The vapor pressure of cyclohexane at 20 ˚C is 78 mmHg and at 60 ˚C it is 390 mmHg. Calculate the heat of vaporization, ΔH°_{vap} for cyclohexane.

(13) 9a. Name the two phases involved in evaporation.

b) Write a chemical equation to symbolically represent evaporation for a substance of your choosing.

c) Is evaporation endothermic or exothermic?

d. From a particulate level (atomic level) how does evaporation occur?

(24) 6. Given the reaction

$$C_2H_{2(g)} + 2H_{2(g)} \rightarrow C_2H_{6(g)}$$

a) If the value for the standard entropy change, ΔS°, for the reaction above is $-232.7\ J\ K^{-1}$, calculate the standard entropy, S°, for $C_2H_{6(g)}$.

b) Calculate the value of the standard free energy change, ΔG°, for the reaction. What does the sign of ΔG° indicate about the reaction above.

c) What happens to the spontaneity of the reaction as the temperature is increased? Explain.

d) Calculate the temperature the spontaneity of the reaction changes.