Review Session: Sunday 2/9
Moore 100: 2-5pm

Chem 14B Pizza Rolls Review Packet W2020

NOTE: I created this packet using past exam questions, course outlines, and my own questions. This does ***not*** cover everything you need to know. Course outlines on Lavelle's website will be your best guide for what to know!

1. The following questions refer to the reaction below.

$$Pb(NO_3)_2(aq) + 2KCl(aq) \rightleftharpoons PbCl_2(s) + 2KNO_3(aq)$$

A) Write the equilibrium constant expression for the above reaction.

B) Describe what will happen to the reaction if KCl is removed and why.

C) Describe what will happen to the reaction if a small amount of $PbCl_2$ is added and why.

D) If K_c is x at 400K, what is K_c if the stoichiometric coefficients are halved?

2. The following questions refer to the reaction below.

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g) \qquad K_c = 1.6 \times 10^{-4}$$

A) Describe and explain in detail what will happen to the reaction if the system is compressed.

B) Describe and explain in detail what will happen when a small amount of argon gas is added.

C) Describe and explain in detail what will happen if the system is cooled.

D) What is the initial reaction quotient when 3.2g of NH_4HS is placed in a 2.0L vessel along with 1.47 mol of NH_3 and 2.85 mol H_2S?

E) From the setup in part D), what direction will the reaction proceed in and why?

3A) Dr. Lavelle has just bought Thrifty's cotton candy ice cream (Lyndon's favorite so buy me some from like CVS or something pls ty). He scoops out 125g and adds 9.3 kJ of heat into it. The temperature of the ice cream rises from -10.2 ^{o}C to -2.8 ^{o}C. Assuming the ice cream is in its solid state (Melting point is 0 ^{o}C), what is the specific heat capacity of it?

3B) Dr. Lavelle picks up the ice cream that he has just heated up (-2.8 ^{o}C) and accidentally drops it on the ground and can't eat it. Tears streaming down his face, he watches as half of it melts away when he realizes that from the moment he dropped the ice cream until now, it has received exactly 234kJ of heat. After performing quick calculations, he realizes that the enthalpy of fusion (kJ/g) for the ice cream is?

3C) True/False: Heat capacity is an intensive property.

3D) True/False: The enthalpy of fusion is positive, so the process is endothermic.

3E) True/False: Removing heat from a system is exothermic, so temperature must decrease.

3F) True/False Heat Capacities can be negative for simple molecules.

3G) True/False A material with a lower specific heat capacity is easier to heat up (requires less energy).

3H) Which of the following are **not** state functions?

a) Heat b) Heat Capacity c) Entropy d)Enthalpy e) Work

4A) Gordon Ramsay realizes the success of butterbeer from Harry Potter and wants to concoct his own magical drink. He needs to know the ΔH^o to report it to the FDA. His overall recipe is:

$$2\ \text{GingerAle(l)} + 5\ \text{RootBeer(l)} \rightarrow 2\ \text{Vodka(l)}$$

What is the ΔH^o for the reaction if,

GingerAle(l) + 3 RootBeer(l) + Dandruff(s)→ 2 Honey(l) $\Delta H^o = -345$ kJ

Vodka(l) + Sweat (l) → 2 Honey(l) $\Delta H^o = -21$ kJ

2 Dandruff(s) + RootBeer (l) → 2 Sweat (l) $\Delta H^o = -150$ kJ

4B) What is the above method called, and what property of enthalpy allows it to be used?

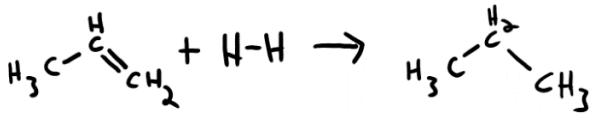
4C) Glucose is broken down via catabolism to release energy. Calculate ΔH^o_{rxn} for the the reaction of one mole of glucose given the following unbalanced reaction and information.

$$C_6H_{12}O_6\ (s) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (l)$$

Molecule	**ΔH^o_f (kJ/mol)**
$C_6H_{12}O_6$	-1271
CO_2	-393.5
H_2O	-283.8

4D) Calculate ΔH^o_{rxn} for the following reaction using the information in the table.

Bond Type	**Bond Enthalpy (kJ/mol)**
C=C	612
C-C	348
C-H	413
H-H	436



5. Lex Luthor is trying to design a gaseous mixture of Krypton gas and Helium gas to make Superman weak and have a high voice at the same time! But first, he wants to quickly review entropy. He finds a sealed box that has two compartments. He puts 9.00 g of Helium gas in the first compartment, and 125g of Krypton gas in the second compartment. The compartment with Krypton is 3 times the size of the compartment with Helium (triple the volume). He then removes the separating divider, allowing the gases to mix, and sees that temperature then increases from 50.0 to 75.0 ^{o}C.

A) Assuming the gases are ideal monatomic gases throughout the process, what is the total change in entropy of the system?

B) If the sealed box holds a total of 11.0 L, what is the final pressure?

C) True/False: One cannot calculate the entropy of vaporization for water at room temperature because water has a boiling point of 373K.

D) True/False: $S = k_B \ln W$ is used to calculate positional/residual entropy using statistics.

E) True/False: Molecules at exactly 0 degrees Kelvin have no entropy.

F) Under what conditions would $\Delta S_{system} = -\Delta S_{surroundings}$?

G) What is the residual entropy of a crystal of 3 identical molecules that can have 6 equal possible energy states?

H) Which has higher molar entropy, Lead (^{82}Pb) or Carbon (^{6}C)? Why?

6. You have a system consisting of 0.40 moles of an ideal gas contained in a 100.0L container at 1.0 atm. You just love chemistry to a fault, so you perform a series of steps to the system. First, you perform an isobaric compression of the container to 10.0L. Then, you pressurize the system to 10.0 atm using an isochoric method. Finally, you perform a reversible, isothermal expansion on your system back to a 100.0L volume at 1.0 atm. Now, to apply your knowledge, you must calculate ΔU, q, w, and ΔS of the system specifically over the entire process. Much fun!

7. Lyndon farts out a pink gas (PG) and Dr. Lavelle farts out a blue gas (BG). They react to somehow produce water vapor and carbon dioxide (very little smell) via the reaction below.

$$2PG\ (g) + BG\ (g) \rightarrow 4CO2\ (g) + H2O\ (g) \qquad \Delta H = -245kJ$$

Determine the change in internal energy when 1.00 mol of CO2 is produced by the above reaction at room temperature.

8) True/False: We can expect an endothermic reaction to be favorable at a very high temp.

9) True/False: For the same heat input, we expect a higher entropy change for a system at a lower temperature.

10. Matt asks me for water with no ice at a dining hall. Just to spite him, I measure 25.0 g of ice at 0.00 ^{o}C and drop it into 265 mL of water at 25.0 ^{o}C. What is the final temperature of the water?

11. One day, a Costco hotdog is found to contain a small vial of acid in the sausage. The irritated consumer decides to determine what acid it is. The consumer finds that its pK_b is 9.80. What is the pH of a 1.00×10^{-2} M solution of the acid?

12. Use the following table related to the reaction below.

Compound	$S_m°$ ($J.K^{-1}.mol^{-1}$) at 25.0 °C	$C_{P,m}$ ($J.K^{-1}.mol^{-1}$)
Glucose ($C_6H_{12}O_6$(s))	209.2	219.2
O_2(g)	205.1	29.4
CO_2(g)	213.7	37.1
H_2O(l)	69.9	75.3

$$C_6H_{12}O_6\ (s) + 6O_2\ (g) \rightarrow 6CO_2\ (g) + 6H_2O\ (l)$$

A) Calculate ΔS^o_{rxn} at 25°C for the metabolism of glucose as written above.

B) Suppose a researcher finds that ΔH^o_{rxn} = -2756 kJ for the reaction at 200. °C. Assuming all heat capacities are constant, calculate ΔH^o_{rxn} at the temperature of the human body, 37 °C. Hint: Since enthalpy is a state function, the process can be divided into three steps.

Leaving space here in case we add anything like Gibbs Free Energy or more acid/base stuff.

Final Note: Remember that this does not cover everything you need to know. Using the course outlines to guide you is the best way to not miss anything. Focus on understanding concepts of how and why we solve problems the way we do, rather than on how to solve the problem. This way, you can actually apply what you learned to new problems that you may see on the midterm. Good luck!!!!!