

Exam Five
CHM 203 (Dr. Mattson)
10 November 2006

Academic Integrity Pledge:

In keeping with Creighton University's ideals and with the Academic Integrity Code adopted by the College of Arts and Sciences, I pledge that this work is my own and that I have neither given nor received inappropriate assistance in preparing it.

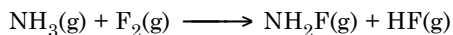
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Instructions: Show all work whenever a calculation is required! You will receive credit for how you worked each problem as well as for the correct answer. This exam is worth 100 points. **BOX YOUR ANSWERS!**

1. (6 pts) Evaluate each of the following steps as endothermic (ΔH is +) or exothermic (ΔH is -) in the formation of NaCl from its elements. Circle + or -.

Steps:	ΔH
$\text{Na(s)} \longrightarrow \text{Na(g)}$	+ -
$\text{Na(g)} \longrightarrow \text{Na}^+(\text{g}) + \text{e}^-$	+ -
$\frac{1}{2} \text{Cl}_2(\text{g}) \longrightarrow \text{Cl}(\text{g})$	+ -
$\text{Cl}(\text{g}) + \text{e}^- \longrightarrow \text{Cl}^-(\text{g})$	+ -
$\text{Na}^+(\text{g}) + \text{Cl}^-(\text{g}) \longrightarrow \text{NaCl(s)}$	+ -
Overall:	
$\text{Na(s)} + \frac{1}{2} \text{Cl}_2(\text{g}) \longrightarrow \text{NaCl(s)}$	+ -

2. (6 pts) Use bond dissociation energies to estimate ΔH for the following reaction:



Bond dissociation energies, kJ/mol

	H	N	F
H	436	390	570
N	390	240	270
F	570	270	159

3. (10 pts) True/False. Regarding the comparisons between ionic and covalent molecular substances:

- T F Ionic substances generally have high melting and boiling points.
T F Covalent substances can be solids, liquids or gases.
T F Lewis dot structures are used to understand the bonding in ionic compounds.
T F Hybridization descriptions (e.g. sp^3) are useful when explaining molecular shape.
T F Lattice energy refers to the overall energy content of a covalent molecule.
T F Forming a covalent bond from two atoms is always enthalpy favored (exothermic).
T F Forming an ionic lattice from ions in the gas phase is always enthalpy favored.
T F Lewis dot structures can be used to predict formulas of compounds.

T F Ammonium nitrate is an example of an ionic substance that is made up of only non-metallic atoms.

T F Covalent molecules are formed from atoms with large differences in their electronegativities.

4. (7 pts) Circle all of the following bonds that are non-polar. Draw a box around the most polar bond in the list.

F-F N-O P-N Cl-Cl B-F N-Br P-Cl

5. Sketch the Lewis dot structures of these five species (2 pts ea). Complete the information requested (1 pt per item).

(a) BrO_2^-	ABE formula:
	Shape name:
	Hybridization:

(b) SiO_4^{-4}	ABE formula:
	Shape name:
	Hybridization:

(c) HCN (C is central)	ABE formula:
	Shape name:
	Hybridization:

(d) SeO_3	ABE formula:
	Shape name:
	Hybridization:

(e) ClO_2	ABE formula:
	Shape name:
	Hybridization:

- (f) (5 points) Which of these species is/are paramagnetic? Circle your choice(s).

BrO_2^- SiO_4^{-4} HCN SeO_3 ClO_2

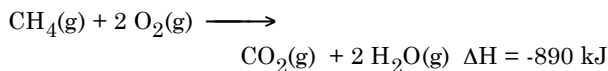
- (g) (5 points) Which of these species has/have resonance structures? Circle your choice(s).

BrO_2^- SiO_4^{-4} HCN SeO_3 ClO_2

6. (3 pts) Sketch again the Lewis structure of SeO_3 .

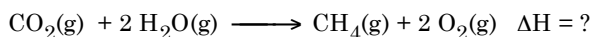
Assign formal charges to each atom.

7. (5 pts) In class we saw Kelsey and Beth create fireballs from balloons of methane. The heat of combustion for methane, CH_4 , is -890 kJ/mol :

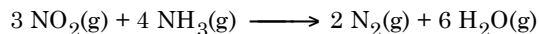


How much heat, q , is produced from a balloon containing 3.5 L methane, given that the molar volume of methane is 24.4 L/mol under these conditions?

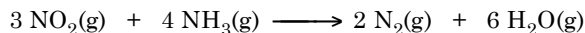
- (b) (2 pts) What is ΔH for the reverse reaction?



8. (6 pts) Using the ΔH_f data below to calculate ΔH for the reaction:



	ΔH_f (kJ/mol)
$\text{NO}_2(\text{g})$	+33
$\text{NH}_3(\text{g})$	-46
$\text{N}_2(\text{g})$	0
$\text{H}_2\text{O}(\text{g})$	-242

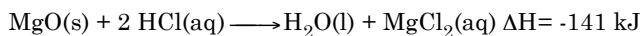
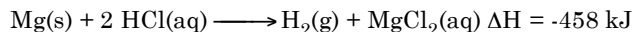


- 8(b) (2 pts) Is the reaction exothermic or endothermic?

Circle: EXOTHERMIC or ENDOTHERMIC

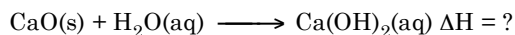
9. (3 pts) Write the chemical equation that corresponds to ΔH_f for ammonium carbonate.

10. (6 pts) In lab this week, you reacted magnesium metal and magnesium oxide with hydrochloric acid:



Use these equations along with the heat of formation of water, $\Delta H_f = -286 \text{ kJ/mol}$ to calculate ΔH_f for MgO .

11. (6 pts) When 1.045 g CaO is added to 50.0 mL water at 25°C in a calorimeter, the temperature of the water increases to 32.3°C . Assuming that the specific heat of the solution is 4.184 J/(g deg) , and the calorimeter absorbs a negligible amount of heat, calculate ΔH (in kJ) for the reaction:



12. (3 pts) Convert the specific heat of ice, 2.03 J/(g deg) , into the molar heat capacity in units of J/(mol deg)

If you have read and signed the Academic Integrity statement, please print your name here:

Your exam score (100 possible): _____

Determine your grade:

$A+ \geq 95$; $A \geq 90$; $B+ \geq 85$; $B \geq 80$; $C+ \geq 75$; $C \geq 70$; $D \geq 60$

Answers:

1. + + + - - -

2. $\Delta H = -291 \text{ kJ}$

3. T T F T F T T T T F

4. (7 pts) Circle F-F and Cl-Cl. Draw a box around B-F.

5. (a) AB_2E_2 ; bent; sp^3 ; (b) AB_4 ; tetrahedral; sp^3 ; (c)

AB_2 ; linear; sp; (d) AB_3 ; trigonal planer; sp^2 ; (e)

AB_2E_2 ; bent; sp^3 ; (f) ClO_2 ; (g) SeO_3

6. The Se atom is +2, the single bonded Os are -1 and the double-bonded O is 0.

7. $q = -128 \text{ kJ}$

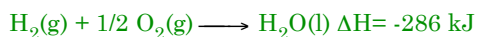
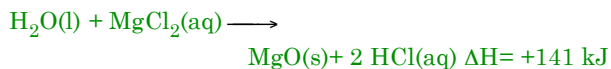
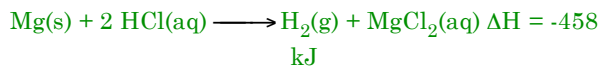
(b) $\Delta H = +890 \text{ kJ}$

8. $\Delta H = -1367 \text{ kJ}$

8(b) EXOTHERMIC

9. $\text{N}_2(\text{g}) + 4 \text{H}_2(\text{g}) + \text{C}(\text{s}) + 3/2 \text{O}_2(\text{g}) \longrightarrow (\text{NH}_4)_2\text{CO}_3(\text{s})$

10.



Sum:



11. $\Delta H = -83.7 \text{ kJ}$

12. 36.5 J/mol deg ,