Exam Five **CHM 203 (Dr. Mattson)** **14 NOVEMBER 2007**	***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.* *Signature:*

Instructions: Show all work whenever a calculation is required! You will receive credit for <u>how</u> you worked each problem as well as for the correct answer. If you need more space, you may use the back of your periodic table — Write: "See PT" in box and then attach the periodic table. BOX YOUR ANSWERS! Write legibly.

1. (4 pts) Use the periodic trend for electronegativity to predict which bond in each group is the most polar. Circle your choice.

   (a) B — C B — N B — O

   (b) N — P N — S C — S

   (c) Br — F Cl — F B — B

   (d) S — N S — O S — F

2. (4 pts) Show the direction of polarity in each of the choices you circled in the previous problem by writing δ^+ and δ^- by each end, as appropriate.

(a)	(b)
(c)	(d)

3. (24 pts) Sketch Lewis dot structures for each of the following molecules or ions. Then complete the table.

	Lewis dot structure (2 pts)	ABE (1 pt)	3-D sketch (1 pt)
PCl_3			
SO_2			
SO_3			
SO_4^{-2}			
CO_2			
IF_3			

4. (18 pts) Complete the table.

ABE	Geometry name	Hybrid -ization	Angles
AB_2			
AB_3			
AB_2E			
AB_4			
AB_3E			
AB_2E_2			

5. (6 pts) The cyanate ion, NCO^-, has carbon in the middle. There are three resonance forms for cyanate, two of which are pretty good. Sketch the two good ones, for which the formal charges never exceed +/-1. Assign formal charges.

6 (6 pts) How much heat is evolved or absorbed in the reaction of 3.2 g sodium with excess water?

$2\ Na(s) + 2\ H_2O(l) \rightarrow 2\ NaOH(aq) + H_2(g)\ \Delta H = -368\ kJ$

7. Specific heat and molar heat capacity are similar measures and are related to one another. Specific heat has units of J/g deg and molar heat capacity has units of J/ mol deg.

(a) (4 pts) Given water's specific heat of 4.178 J/g deg, calculate the molar heat capacity for water.

(b) (4 pts) The heat, q, can be calculated knowing the specific heat, the mass of the solution and the change in temperature. Write a formula, starting with "q = " that allows one to calculate q from the molar heat capacity and whatever else is necessary according to your formula.

8. (8 pts) Consider the acid-base reaction:

$HCl(aq) + CsOH(aq) \rightarrow CsCl(aq) + H_2O(g)$ $\Delta H = ?$

When 100.0 mL of 0.200 M HCl and 50.0 mL 0.400 M CsOH are mixed, the temperature increases from 22.50 to 24.28 ^oC. The densities of the solutions are 1.00 g/mL and the specific heat of the solution is 4.2 J/g deg. What is ΔH for the reaction as shown above?

9. (5 pts) Given the two reactions:

$N_2(g) + O_2(g) \rightarrow 2\ NO(g)$ $\Delta H^o = +180$ kJ

$2\ CO(g) + O_2(g) \rightarrow 2\ CO_2(g)$ $\Delta H^o = -566$ kJ

Use Hess's law to calculate ΔH^o for the reaction:

$2\ NO(g) + 2\ CO(g) \rightarrow N_2(g) + 2\ CO_2(g)$ $\Delta H^o = ?$

10. (5 pts) Use the heat of formation data provided below in order to calculate ΔH^o_{rxn} for the reaction:

$4\ CO(g) + 2\ NO_2(g) \rightarrow 4\ CO_2(g) + N_2(g)$ $\Delta H^o_{rxn} = ?$

	ΔH^o_f (kJ/mol)
$CO(g)$	-111
$NO_2(g)$	+33
$CO_2(g)$	-394
$N_2(g)$	0

11. (6 pts) Use bond energies in order to estimate ΔH^o for the reaction:

$CH_4(g) + 2\ F_2(g) \rightarrow CH_2F_2(g) + 2\ HF(g)$ $\Delta H^o = ?$

D (kJ/mol)	H	C	F
H	436	410	570
C	410	350	450
F	570	450	159

12. (5 pts) Predict the sign for ΔS for each of these processes:

	ΔS
liquid water freezing	**+ or -**
liquid water boiling	**+ or -**
$2\ CH_4(g) + 2\ F_2(g) \rightarrow CH_2F_2(g) + 2\ HF(g)$	**+ or -**
$4\ CO(g) + 2\ NO_2(g) \rightarrow 4\ CO_2(g) + N_2(g)$	**+ or -**
the growth of a plant from seed	**+ or -**

(1 pt) Sign the Academic Integrity pledge *and* print your name here:

Your exam score (100 possible): _____

Determine your grade:

A+ ≥ 95; A ≥ 90; B+ ≥ 85; B ≥ 80; C+ ≥ 75; C ≥ 70; D ≥ 60

Answers

1. (a) B — O; (b) C — S; (c) Br — F; (d) S — F

2.

(a) δ^+ B — O δ^-	(b) δ^+ C — S δ^-
(c) δ^+ Br — F δ^-	(d) δ^+ S — F δ^-

3.

PCl_3 AB_3E
SO_2 AB_2E
SO_3 AB_3
SO_4^{-2} AB_4
CO_2 AB_2
IF_3 AB_3E_2

4.

ABE	Geometry name	Hybrid -ization	Angles
AB_2	Linear	sp	180 º
AB_3	Trigonal plane	sp^2	120 º
AB_2E	Bent	sp^2	~ < 120 º
AB_4	Tetrahedral	sp^3	109 º
AB_3E	Trigonal pyramid	sp^3	~ < 109 º
AB_2E_2	Bent	sp^3	~ < 109 º

5. N double bonded to C double bonded to O with the FC = -1 for N and FC = 0 for C and O. N triple bonded to C single bonded to O with the FC = 0 for N and C and FC = -1 and O.

6. q_{rxn} = –25.6 kJ or you could say 25.6 kJ of heat was evolved.

7. 75.2 J/ mol deg

(b) q = heat capacity x moles x ΔT

8. ΔH = –56.1 kJ

9. ΔH = –746 kJ

10. ΔH = –1198 kJ

11. ΔH = –902 kJ

12.

	ΔS
liquid water freezing	-
liquid water boiling	+
$2\ CH_4(g) + 2\ F_2(g) \rightarrow CH_2F_2(g) + 2\ HF(g)$	-
$4\ CO(g) + 2\ NO_2(g) \rightarrow 4\ CO_2(g) + N_2(g)$	-
the growth of a plant from seed	-