

Chemistry 113 – Chemistry and the Environment
Exam 2 (February 22, 2002)

TABLE 8.4 Average Bond Enthalpies (kJ/mol)

Single Bonds							
C—H	413	N—H	391	O—H	463	F—F	155
C—C	348	N—N	163	O—O	146		
C—N	293	N—O	201	O—F	190	Cl—F	253
C—O	358	N—F	272	O—Cl	203	Cl—Cl	242
C—F	485	N—Cl	200	O—I	234		
C—Cl	328	N—Br	243			Br—F	237
C—Br	276			S—H	339	Br—Cl	218
C—I	240	H—H	436	S—F	327	Br—Br	193
C—S	259	H—F	567	S—Cl	253		
		H—Cl	431	S—Br	218	I—Cl	208
Si—H	323	H—Br	366	S—S	266	I—Br	175
Si—Si	226	H—I	299			I—I	151
Si—C	301						
Si—O	368						

Multiple Bonds					
C=C	614	N=N	418	O ₂	495
C≡C	839	N≡N	941		
C=N	615	N=O	607	S=O	523
C≡N	891			S=S	418
C=O	799				
C≡O	1072				

SOLUBILITY RULES

1. Nitrates
2. Group I and NH₄⁺
3. All acetates (C₂H₃O₂⁻) are soluble
4. All chlorides are soluble except AgCl, Hg₂Cl₂, and PbCl₂
5. Most sulfates are soluble - except SrSO₄, BaSO₄, PbSO₄, and Hg₂SO₄ and ...
6. All carbonates are insoluble - except...
7. All hydroxides are insoluble - except...
8. All sulfides are insoluble – except Ca²⁺, Sr²⁺, Ba²⁺, and ...

IA											0							
1 H 1.008											2 He 4.003							
3 Li 6.941	IIA												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	IIIB	IVB	VB	VIB	VII B	VIII B			IB	IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95	
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80	
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	
55 Cs 132.9	56 Ba 137.3	57* La 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra (226.0)	89** Ac (227)	104 Rf	105 Ha	106 Unh	107 Uns	108	109 Uue										

* 58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
** 90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (244)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

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Name: _____

Questions 1 - 4 (18 points) are multiple choice questions. There will be no partial credit given for these problems. Problems 5 - 14 (82 points) should be worked out on the exam. Partial credit will be given for work shown. The answer by itself is not satisfactory for full credit.

Academic Honesty Policy: Intentionally using or attempting to use unauthorized materials, information or study aids in any academic exercise, OR intentionally or knowingly helping or attempting to help someone else to commit an act of academic dishonesty, such as knowingly allowing another to copy information during an examination or other academic exercise constitutes Academic Dishonesty and is **punishable with a possible grade of F** in this course!!!

There is a blank page at the end of this examination for use as scratch paper.

1. (4) How should water be classified with respect to its electrical conductivity properties?
 - a. weak electrolyte
 - b. nonconductor
 - c. strong electrolyte
 - d. good conductor

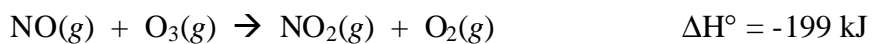
2. (4) Which of the following properties of water is NOT due to hydrogen bonding?
 - a. Water's specific heat = 1.00 cal/g °C.
 - b. Water is colorless.
 - c. The solid form is less dense than the liquid form.
 - d. Water boils at 100°C.

3. (5) Which of the following would you expect would NOT dissolve in water?
 - a. NaOH
 - b. HCl
 - c. C₈H₁₈
 - d. CaCl₂
 - e. NH₃

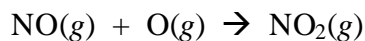
4. (5) Which has the greatest electronegativity?
 - a. Sodium
 - b. Aluminum
 - c. Phosphorus
 - d. Nitrogen
 - e. Iodine

Show your work on all problems!

5. (8) Given the following data:



Calculate ΔH° for the reaction



6. (6) When 1.00 mole of methane (CH_4) is burned, 890. kJ of energy is released as heat. Calculate ΔH_{rxn} for a process in which a 5.8 g sample of methane is burned.

7. (8) Estimate the $\Delta H_{\text{rxn}}^\circ$ for the formation of gaseous phosgene ($\text{Cl}_2\text{C}=\text{O}$) from $\text{CO}(g)$ and $\text{Cl}_2(g)$

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8. (6) Write a molecular and net ionic equation for the reaction of ammonium sulfate and barium nitrate.
9. (6) Place the atoms and / or ions in order of decreasing size and explain your rationale
Ar, Cl, K^+ , Ca^{2+} , and S^{2-}
10. (4) Write a balanced chemical equation to describe what occurs when hard water is heated.
11. (12) Aqua regia is an acid solution capable of dissolving gold. A dilute solution of it is made by adding 50.0 mL of 0.050 M HCl to 150.0 mL of 0.10 M HNO_3 . Calculate the concentrations of all ionic species in this solution.

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12. (10) For most organisms, maintaining a stable pH is crucial to survival. If this pH is changed by 1 pH unit from physiological conditions (average pH of 7.4), most biological systems will no longer function.
- a. What is the concentration of H^+ when the pH is 6.4? (2 points)

 - b. How does this compare to the H^+ concentration in most physiological conditions? (3 points)

 - c. Most biological systems can function if the concentration of H^+ remains within 150% of the average value of H^+ concentration. Find the upper and lower range of pH so that most biological systems can still function. (5 points)
13. (10) Trichloroacetic acid (CCl_3CO_2H) is a corrosive acid that is used to precipitate proteins. The pH of a 0.050 M solution of the trichloroacetic acid is 1.34. Calculate K_a .
14. (10) Calculate the pH of a 0.2 M triethylamine [$(C_2H_5)_3N$, $K_b = 4.0 \times 10^{-4}$].