Gateway General Chemistry 125/126/130
Exam 2
October 31, 2006 (8:00-10:00pm)

Name_____

Section (*circle one*): 601 (Colin) 602 (Brannon) 603 (Mali) 604 (Xiaomu)

The exam has at total of 9 pages including the cover, and a table of heats of formation and a periodic table both of which you may remove. You do not need to turn the table of heats of formation or the periodic table in with your exam. Please neatly show all of your work.

Page	Questions	Possible points	Score
2	1-5	5	
3	6	8	
4	7-8	8	
5	9-11	12	
6	12-14	6	
7	15-16	6	

Total _____/45

Q1-5 *(1 point each) Please place the correct letter in the box*

1) Which of the following represents a non-polar covalent bond ?

a. O-O
b. C-O
c. NaCl
d. C-N
e. C=O

1)

2) Which statement concerning the interaction between two atoms is **incorrect**?

a. If two atoms are widely separated, there is very little attraction between them.
b. When two atoms are one bond length apart, the valence electrons on one atom are attracted to the nucleus of the other atom.
c. When two atoms are very close to one another (0.5 Å apart), repulsion occurs.
d. A covalent bond occurs when electrons are shared between two nuclei.
e. As atoms get closer together, their electrons attract each other.

2)

3) Which statement about the reaction below is incorrect?

$H_2O_{(l)} \rightarrow H_2O_{(g)}$ $\Delta H° = +44.0$ kJ

a. The same quantity of heat is needed for the solid to liquid transformation
b. The liquid must absorb heat from the surroundings to evaporate.
c. The reaction is endothermic.
d. The heat of vaporization is shown.
e. The ΔH for the gas to liquid transformation has the opposite sign.

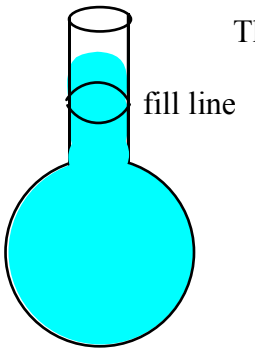
3)

4) If you need 300.0 mL of 0.500 M $K_2Cr_2O_7$, which method would you use to prepare this solution?

a) Dilute 250.0 mL of 0.600 M $K_2Cr_2O_7$ to 300.0 mL.
b) Add 50.0 mL of water to 250.0 mL of 0.250 M $K_2Cr_2O_7$
c) Dilute 125.0 mL of 1.00 M $K_2Cr_2O_7$ to 300.0 mL
d) Add 30.0 mL of 1.50 M $K_2Cr_2O_7$ to 270.0 mL of water
e) Dilute 150.0 mL of 0.250 M $K_2Cr_2O_7$ to 300.0 mL

4)

5) You prepared a NaCl solution by adding 58.44 g of NaCl to a 1-L volumetric flask and then adding water to dissolve it. When you were finished, the final volume in your flask looked like this:



1.00 L flask

The solution you prepared is:

a) Greater than 1M because you added more solvent than necessary.
b) Less than 1M because you added less solvent than necessary
c) Greater than 1 M because you added less solvent than necessary
d) Less than 1 M because you added more solvent than necessary.
e) 1M because the amount of solute, not solvent determines the concentration

5)

6) (*8 points*) The following is an excerpt from a question written into Car and Driver Magazine (May 2006, p20). "…you claim a 12mpg vehicle produces 20,000 pounds of cabon dioxide every 12,000 miles. How do 6200 pounds (1000 gallons at 6.2 pounds per gallon) of fuel excrete 20,000 pounds of pollutant? …."

Let's first rephrase the question to make it clearer. A car that gets 12 mpg (miles per gallon) drives 12,000 miles and thus uses 1000 gallons of gasoline. Gasoline weighs 6.2 pounds per gallon, so the car consumed 6200 pounds of gasoline. How did the consumption of 6200 pounds of gasoline result in the creation of 20,000 pounds of pollutant?

a) Write the balanced chemical equation for the burning of gasoline assuming that it is pure octane (C_8H_{18}).

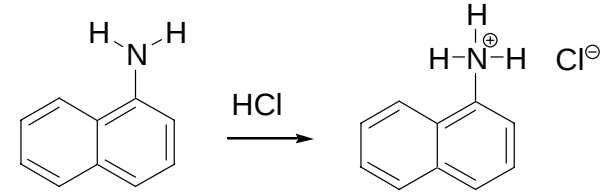
b) What is the ΔH of the reaction you wrote in a) assuming that all products are gases. (A table of heats of formations is available at the end of the exam.)

c) The pollutant referred to is CO_2. How much carbon dioxide in pounds is produced when 6200 pounds of gasoline is burned? (1 lb = 453.59 g)

d) How much energy is given off when 6200 pounds of fuel are burned?

7) (*2 points*) One of the reagents that you used to determine the nitrate concentration of the Muskov's well water was naphthylamine hydrochloride. Naphthylamine is not soluble in water. Hydrochloric acid is added to naphthylamine to form naphthylamine hydrochloride (as shown in Figure 1) which is soluble in water.

Figure 1: Naphthylamine to naphthylamine hydrochloride

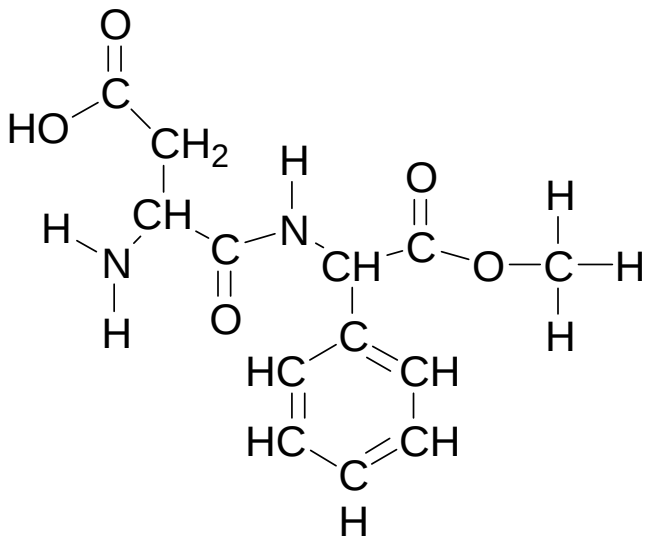


naphthylamine naphthylamine hydrochloride

Explain why HCl must be added to naphthylamine in order for it to dissolve in water.

8) (*6 points)*The structure of aspartame is shown below.

a. Circle five of the most polar bonds.
b. But a box □ around any hydrogen atom that can participate in hydrogen bonding.



Aspartame

c) Would you predict aspartame to be soluble in water or oil? Explain

9) (*5 points*) For the molecule SCO:

a) count the number of valence electrons:

b) Draw the Lewis structure; include any formal charges or resonance structures:

c) Draw an arrow indicating the net polarity of the molecule if any.

d) Name the electron pair geometry:	e) Name the molecular geometry:

10) (*5 points*) For the molecule ClF_3:

a) count the number of valence electrons:

b) Draw the Lewis structure; include any formal charges or resonance structures:

c) Draw an arrow indicating the net polarity of the molecule if any.

d) Name the electron pair geometry:	e) Name the molecular geometry:

11) (*2 points*) Write out the chemical reaction illustrating the heat of formation of ClF_3. What is the ΔH of this reaction?

12 (*4 points*) a) 50.0 mL of ethanol at 5.0°C was mixed with 50.0 mL of water at 75°C. What is the final temperature of the mixture?
Specific heat capacities: ethanol = 2.46 J/g°C; water = 4.184 J/g°C
Densities: ethanol: 0.789 g/mL; water 1.00 g/mL

T_f =

b) Which liquid underwent a greater temperature change? Why?

13 (*1 point*) Write out the chemical formulas for the following compounds:

a) sodium phosphate

b) magnesium chlorate

14) (*1 point*) A typical mug (250 mL) of coffee contains 125 mg of caffeine ($C_8H_{10}N_4O_2$). What is the molarity of caffeine in this solution?

15) (*4 points*) How many grams of salt (sodium chloride) are in your chicken soup? A student added excess $AgNO_{3(aq)}$ to a 1-cup (250 mL) serving of regular chicken soup and got 5.55 g of AgCl precipitate.

a) Write the net ionic equation for the reaction that took place. Include (s), (l), (g), (aq).

b) What was the concentration of chloride ions in the soup in ppm? You may assume that the soup has a density of 1.00 g/mL.

16) (*2 points*) Nitrogen makes up 78.08% of the atmosphere on earth. It is often liquefied and used as a coolant. How much energy does it take to heat 100.0 mL of liquid nitrogen from its boiling point of -195.9^{o}C to 20.0^{o}C. Nitrogen has a heat of fusion of 0.721 kJ/mol, a heat of vaporization of 5.56 kJ/mol, and a gaseous molar heat capacity of 0.02 kJ/mol^{o}C. The density of nitrogen is 0.807 g/mL.

Table 3: Heats of Formation[1]

Compound	ΔH_f (kJ/mol)	Compound	ΔH_f (kJ/mol)	Compound	ΔH_f (kJ/mol)
AgBr(s)	-99.5	$C_2H_5OH(l)$	-277.6	NaCl(s)	-411.0
AgCl(s)	-127.0	ClF_3 (g)	-163.2	NaF(s)	-569.0
AgI(s)	-62.4	$Cr_2O_3(s)$	-1128.4	NaOH(s)	-426.7
$Ag_2O(s)$	-30.6	CuO(s)	-155.2	$NH_3(g)$	-46.2
$Ag_2S(s)$	-31.8	$Cu_2O(s)$	-166.7	$NH_4Cl(s)$	-315.4
$Al_2O_3(s)$	-1669.8	CuS(s)	-48.5	$NH_4NO_3(s)$	-365.1
$BaCl_2(s)$	-860.1	$CuSO_4(s)$	-769.9	NO(g)	+90.4
$BaCO_3(s)$	-1218.8	$Fe_2O_3(s)$	-822.2	$NO_2(g)$	+33.9
BaO(s)	-558.1	$Fe_3O_4(s)$	-1120.9	NiO(s)	-244.3
$BaSO_4(s)$	-1465.2	HBr(g)	-36.2	$PbBr_2(s)$	-277.0
$CaCl_2(s)$	-795.0	HCl(g)	-92.3	$PbCl_2(s)$	-359.2
$CaCO_3$	-1207.0	HF(g)	-268.6	PbO(s)	-217.9
CaO(s)	-635.5	HI(g)	+25.9	$PbO_2(s)$	-276.6
$Ca(OH)_2(s)$	-986.6	$HNO_3(l)$	-173.2	$Pb_3O_4(s)$	-734.7
$CaSO_4(s)$	-1432.7	$H_2O(g)$	-241.8	$PCl_3(g)$	-306.4
$CCl_4(l)$	-139.5	$H_2O(l)$	-285.8	$PCl_5(g)$	-398.9
$CH_4(g)$	-74.8	$H_2O_2(l)$	-187.6	$SiO_2(s)$	-859.4
$CHCl_3(l)$	-131.8	$H_2S(g)$	-20.1	$SnCl_2(s)$	-349.8
$CH_3OH(l)$	-238.6	$H_2SO_4(l)$	-811.3	$SnCl_4(l)$	-545.2
CO(g)	-110.5	HgO(s)	-90.7	SnO(s)	-286.2
$CO_2(g)$	-393.5	HgS(s)	-58.2	$SnO_2(s)$	-580.7
$C_2H_2(g)$	+226.7	KBr(s)	-392.2	$SO_2(g)$	-296.1
$C_2H_4(g)$	+52.3	$Mg(OH)_2(s)$	-924.7	$SO_3(g)$	-395.2
$C_2H_6(g)$	-84.7	$MgSO_4(s)$	-1278.2	ZnO(s)	-348.0
$C_3H_8(g)$	-103.8	MnO(s)	-384.9	ZnS(s)	-202.9
n-$C_5H_{12}(l)$	-173.1	$MnO_2(s)$	-519.7		
C_8H_{18} (l)	-249.95				

[1] About chemistry. http://chemistry.about.com/library/weekly/blheatform.htm (accessed July 2006).

PERIODIC CHART OF THE ELEMENTS

1	1 H 1.00794																2 He 4.00260
2	3 Li 6.941	4 Be 9.01218											5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.998403	10 Ne 20.179
3	11 Na 22.98977	12 Mg 24.305											13 Al 26.98154	14 Si 28.0855	15 P 30.9376	16 S 32.06	17 Cl 35.453	18 Ar 39.948
4	19 K 39.0983	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.88	23 V 50.9415	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.69	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.904	36 Kr 83.80
5	37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.42	47 Ag 107.8682	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.29
6	55 Cs 132.9054	56 Ba 137.33	57 La 138.9055	58-71 LANTH-ANIDES	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.9665	80 Hg 200.59	81 Tl 204.383	82 Pb 207.2	83 Bi 208.9804	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226.0254	89 Ac 227.0278	90-103 ACTIN-IDES	104 Rf (261)	105 Db (262)	106 Sg (263)	107 Bh	108 Hs	109 Mt	110	111	112					

LANTHANIDE SERIES	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 158.9254	65 Tb 158.9	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
ACTANIDE SERIES	90 Th 232.0381	91 Pa 231.0359	92 U 238.0289	93 Np 237.0842	94 Pu (244)	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)