

# Chemistry 142

## Winter 2007

### Exam 2a

Name: \_\_\_\_\_

Take a deep breath, and relax! First, answer the questions you know how to do and then work on the more difficult problems. Don't forget to show all your work, so I can give you as much partial credit as possible.

Good Luck!

*Andy*



### Short Response.

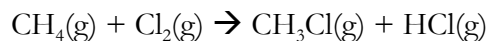
Q1. Ammonia is a compound with the chemical formula,  $\text{NH}_3$ . It is a gas at normal temperatures and pressures.

The addition of ammonia to cigarettes causes a proton to be transferred from nicotine to ammonia, increasing the physiological impact of the nicotine they contain up to a hundred-fold. The process is called 'free basing', and is similar to the process used to heighten the effects of cocaine.

**SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, And May Complicate Pregnancy.**

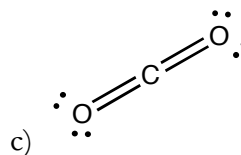
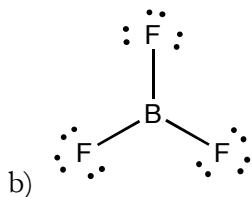
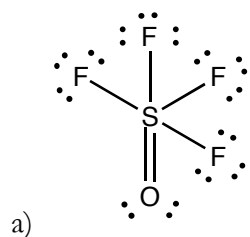
Sketch a valid Lewis structure for the  $\text{NH}_3$  molecule. (8 pts.)

Q2. Using the following bond energies, predict  $\Delta H^\circ$  for the following reaction: (8 pts.)



<i>Bond</i>	<i>Bond Energy (kJ/mol)</i>
C—H	414
C—Cl	350
Cl—Cl	243
H—H	436
C—Cl	432
C—C	347

Q3. What type of hybrid orbitals are used on the central atom of each of the following molecules? (6 pts.)



Q4. Bromochlorodifluoromethane (also known as Halon 1211) is an effective gaseous fire suppression agent used around highly valuable materials in places such as museums and telecommunication switching centers. It was originally developed in World War Two for use as a fire extinguisher for tanks and aircraft. Its chemical formula is  $\text{CF}_2\text{ClBr}$ .

- Sketch a valid Lewis structure for this molecule. (5 pts.)
- Using VSEPR, predict the shape of the molecule. Be sure to give the name of the molecular geometry, as well as approximate bond angles. (15 pts.)
- Explain which *bond* in the molecule is the *most polar*. (3 pts.)

Q5. Calculate the formal charge of each atom in the ozone molecule:  $\text{O}_3$ . (7 pts.)

Q6. Given that the bond length of each sulfur to oxygen bond in the molecule  $\text{SO}_3$  is identical, then write an acceptable set of resonance Lewis structures. (8 pts.)

Q7. Predict the *molecular* geometry of  $\text{PBr}_3$  using VSEPR theory. Be sure to include a valid Lewis structure, and an approximate set of angles as part of your answer. (14 pts.)

Q8. Is  $\text{CO}_2$  polar or non-polar? Explain using words and sketches. (8 pts.)

Q9. Describe the bonding inside ethylene,  $\text{CH}_2=\text{CH}_2$  using valence-bond theory. (15 pts.)

Q10. What is the difference between a sigma and a pi bond? Explain using both words and sketches. (6 pts.)

***Bonus Question:***

Sketch out the electron geometries and names of the shapes for the repulsion of two, three, four, five, and six electron pairs around a central atom.

## Useful Information

# Periodic Table of the Elements

I												IIIA		IVA	VA	VIA	VIIA	VIIIA						
1 H 1.01		2																						18 He 4.00
3 Li 6.94		4 Be 9.01																						10 Ne 20.18
11 Na 22.99		12 Mg 24.31																						18 Ar 39.95
19 K 39.10		20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	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 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.76	52 Te 127.60	53 I 126.90	54 Xe 131.29						
55 Cs 132.91		56 Ba* 137.33	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.84	75 Re 186.21	76 Os 190.23	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po [210]	85 At [210]	86 Rn [222]						
87 Fr [223]		88 Ra** [226]	103 Lr [262]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [264]	108 Hs [265]	109 Mt [268]	110 [269]	111 [272]	112 [277]	113 [285]	114 [285]	115 [289]	116 [289]	117 [293]	118 [293]						
		* 57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm [145]	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04									
		** 89 Ac [227]	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np [237]	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]									