Chem 111, Exam II, Summer 2002

Name: ______________________ ID: ________ - ____ - __________

The Periodic Table

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB	VIIIB	VIIIB	IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
H 1 1.01																	He 2 4.00
Li 3 6.94	Be 4 9.01											B 5 10.81	C 6 12.01	N 7 14.01	O 8 16.00	F 9 19.00	Ne 10 20.18
Na 11 22.99	Mg 12 24.31											Al 13 26.98	Si 14 28.09	P 15 30.97	S 16 32.07	Cl 17 35.45	Ar 18 39.95
K 19 39.10	Ca 20 40.08	Sc 21 44.96	Ti 22 47.88	V 23 50.94	Cr 24 52.00	Mn 25 54.94	Fe 26 55.85	Co 27 58.93	Ni 28 58.69	Cu 29 63.55	Zn 30 65.39	Ga 31 69.72	Ge 32 72.61	As 33 74.92	Se 34 78.96	Br 35 79.90	Kr 36 83.80
Rb 37 85.47	Sr 38 87.62	Y 39 88.91	Zr 40 91.22	Nb 41 92.91	Mo 42 95.94	Tc 43 (97.9)	Ru 44 101.07	Rh 45 102.91	Pd 46 106.42	Ag 47 107.87	Cd 48 112.41	In 49 114.82	Sn 50 118.71	Sb 51 121.76	Te 52 127.60	I 53 126.90	Xe 54 131.29
Cs 55 132.91	Ba 56 137.33	La 57 138.91	Hf 72 178.49	Ta 73 180.95	W 74 183.85	Re 75 186.21	Os 76 190.2	Ir 77 192.22	Pt 78 195.08	Au 79 197.97	Hg 80 200.59	Tl 81 204.38	Pb 82 207.2	Bi 83 208.98	Po 84 (209)	At 85 (210)	Rn 86 (222)
Fr 87 223.02	Ra 88 226.03	Ac 89 227.03	Rf 104 (261)	Db 105 (262)	Sg 106 (263)	Bh 107 (262)	Hs 108 (265)	Mt 109 (266)									

Ce 58 140.12	Pr 59 140.91	Nd 60 144.24	Pm 61 (145)	Sm 62 150.36	Eu 63 152.97	Gd 64 157.25	Tb 65 158.93	Dy 66 162.50	Ho 67 164.93	Er 68 167.26	Tm 69 168.93	Yb 70 173.04	Lu 71 174.97
Th 90 232.04	Pa 91 231.04	U 92 238.03	Np 93 237.05	Pu 94 (240)	Am 95 243.06	Cm 96 (247)	Bk 97 (248)	Cf 98 (251)	Es 99 252.08	Fm 100 257.10	Md 101 (257)	No 102 259.10	Lr 103 262.11

Useful Information

- $N = 6.02 \times 10^{23}$ mol^{-1}
- $h = 6.626 \times 10^{-34}$ J.s
- $c = 2.998 \times 10^{8}$ m/s
- $\lambda\nu = c$
- $E = h\nu$
- Density = m/v

Question 1
10 Points

Give the complete electronic configuration (spectroscopic notation) for the following:

1. Sodium $1s^2 2s^2 2p^6 3s^1$
2. Chlorine $1s^2 2s^2 2p^6 3s^2 3p^5$

Give the noble gas electronic configuration for the following

3. Mn $[Ar]4s^2 3d^5$
4. Fe^{3+} $[Ar]3d^5$
5. Cu $[Ar]4s^1 3d^{10}$

Question 2
6 Points

For the elements 1-20 inclusive (includes element 1 and element 20) give the symbol for those that are diamagnetic.

He, Be, Ne, Mg, Ar, Ca

Question 3
8 Points

Consider the following elements:

Ge, Si, Sn, C

Which element would you expect:

1. to have the smallest atomic radius? C
2. to be most metallic Sn
3. to have the largest ionization energy C
4. to be least electronegative Sn

Question 4
6 Points

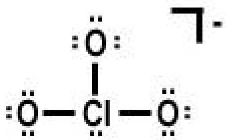
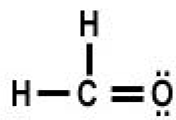
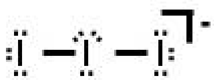
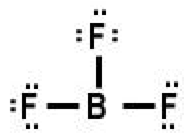
Consider the following elements:

phosphorus, silicon, aluminum, sulfur

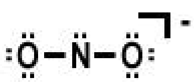
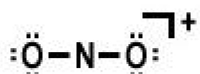
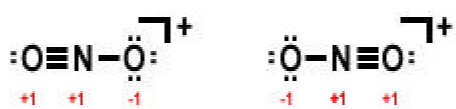
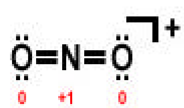
Which element would you expect:

5. to be most metallic Al
6. to have the largest ionization energy S
7. to be least electronegative Al

Question 5 Draw the Lewis dot structures for the following:
12 Points

ClO_3^- (Cl = Chlorine) 26 Valence Electrons 	H_2CO 12 Valence Electrons 
I_3^- 22 Valence Electrons 	BF_3 24 Valence Electrons 

Question 6 Draw the Lewis dot structures of NO_2^- and NO_2^+ showing any resonance structures where applicable.
10 Points

NO_2^- 18 Valence electrons  	NO_2^+ 18 Valence electrons   

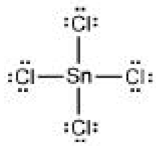
1. What is the N to O bond order in:

   NO_2^+: 2 NO_2^-: 1.5

2. Which molecule has the shortest N to O bond length? NO_2^+

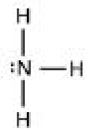
Question 7 (16 Points)

Give the Electron Pair Geometry and the Molecular Geometry for each of the following 'Lewis Dot Structures'.



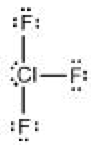
Electron Pair Geometry: Tetrahedron

Molecular Geometry: Tetrahedron



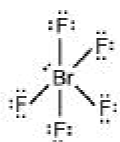
Electron Pair Geometry: Tetrahedron

Molecular Geometry: Trigonal Pyramid



Electron Pair Geometry: Trigonal Bipyramidal

Molecular Geometry: T-Shaped

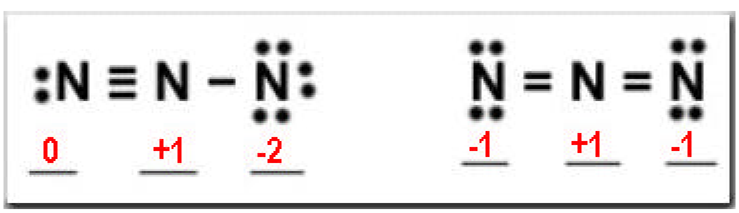


Electron Pair Geometry: Octahedron

Molecular Geometry: Square Pyramidal

Question 8 (7 Points)

Give the formal charge of each atom in each of the two resonance structures for the azide ion shown below.



What is the charge on an azide ion? -1

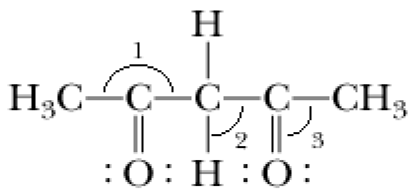
Question 9 (6 Points)

Give the correct formula for each of the following ionic compounds?

1. Ammonium carbonate $(NH_4)_2CO_3$
2. Iron(III) oxide Fe_2O_3
3. Aluminum sulfite $Al_2(SO_3)_3$
4. Magnesium nitrite $Mg(NO_2)_2$
5. Calcium sulfate $CaSO_4$
6. Potassium permanganate $KMnO_4$

Question 10
6 Points

For the molecule depicted below what are the expected bond angles for 1, 2 and 3.



1. 120

2. 109

3. 120

Question 11
8 Points

In the laboratory a student combines **47.5** mL of a **0.304** M $Ba(NO_3)_2$ nitrate solution with **29.2** mL of a **0.379** M $Ba(OH)_2$ solution.

What is the final concentration of **barium** cation ?

0.304 x 0.0475 = 0.01444 mol $Ba(NO_3)_2$
0.01444 mol $Ba(NO_3)_2$ x [1 Ba^{2+}/1 $Ba(NO_3)_2$] = 0.01444 mol Ba^{2+}

0.379 x 0.0292 = 0.01106 mol $Ba(OH)_2$
0.01106 mol $Ba(OH)_2$x [1 Ba^{2+}/1 $Ba(OH)_2$] = 0.01106 mol Ba^{2+}

Total Ba^{2+} = 0.01444 + 0.01106 = 0.0255 mol
New Volume = 47.5 + 29.2 = 76.7 mL = 0.0767 L

[Ba^{2+}] = 0.0255/0.0767 = 0.332 M

Question 12
5 Points

According to the following reaction, how many grams of potassium hydroxide are necessary to form 0.628 moles potassium carbonate?

CO_2(g) + 2 KOH(aq) = K_2CO_3(aq) + H_2O(l)

0.628 mol K_2CO_3 x [2 KOH/1 K_2CO_3] = 1.256 mol KOH

1.256 mol KOH x (56.11 g/ 1 mol) = 70.5g