 Name: _____

Chem 111 *9:05a section* *Evening Exam #3v2*

Updated 4/28/04 10:15am

This exam is composed of **25** questions. Go initially through the exam and answer the questions you can answer *quickly*. Then go back and try the ones that are more challenging to you and/or that require calculations.

As discussed on the course syllabus, honesty and integrity are absolute essentials for this class. In fairness to others, dishonest behavior will be dealt with to the full extent of University regulations.

$E = h\nu = \frac{hc}{\lambda}$

$1\ \text{mL} = 1\ \text{cm}^3$

$\text{Hz} = \text{s}^{-1}$

$h = 6.626x10^{-34}\ J\ s$

$c = 2.998x10^{8}\ m\ s^{-1}$

$N = 6.022x10^{23}\ mol^{-1}$

PERIODIC TABLE OF THE ELEMENTS

1A	2A	3B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3A	4A	5A	6A	7A	8A
1 H 1.008																	2 He 4.003
3 Li 6.939	4 Be 9.012											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											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	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 58.71	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 (99)	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 181.0	74 W 183.8	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 227.0	104 Unq (261)	105 Unp (262)	106 Unh (263)	107 Uns (262)	108 Uno (265)	109 Une (266)									

Solubility Rules for some ionic compounds in water

Soluble Ionic Compounds

1. All sodium (Na^+), potassium (K^+), and ammonium (NH_4^+) salts are SOLUBLE.
2. All nitrate (NO_3^-), acetate ($CH_3CO_2^-$), chlorate (ClO_3^-), and perchlorate (ClO_4^-) salts are SOLUBLE.
3. All chloride (Cl^-), bromide (Br^-), and iodide (I^-) salts are SOLUBLE -- EXCEPT those also containing: lead, silver, or mercury (I) (Pb^{2+},Ag^+, Hg_2^{2+}) which are NOT soluble.
4. All sulfate (SO_4^{2-}) salts are SOLUBLE - - EXCEPT those also containing: calcium, silver, mercury (I), strontium, barium, or lead (Ca^{2+}, Ag^+, Hg_2^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}) which are NOT soluble.

Not Soluble Ionic Compounds

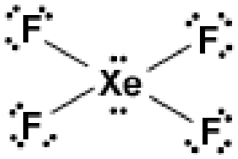
5. Hydroxide (OH^-) and oxide (O^{2-}) compounds are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or barium (Na^+, K^+, Ba^{2+}) which are soluble.
6. Sulfide (S^{2-}) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, ammonium, or barium (Na^+, K^+, NH4$^+$, Ba^{2+}) which are soluble.
7. Carbonate (CO_3^{2-}) and phosphate (PO_4^{3-}) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or ammonium (Na^+, K^+, NH_4^+), which are soluble.

 Name: _____

1. What is the molecular geometry of $\mathbf{XeF_4}$?

   1) square planar 2) octahedral 3) trigonal bipyramidal

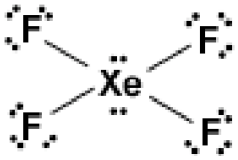
   4) square pyramidal 5) none of the above



(1) OWL 9-xx

2. $\mathbf{XeF_4}$ is:

   1) polar 2) nonpolar 3) can't tell

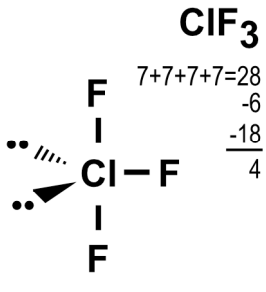


(2) OWL 9-xx

3. What is the molecular geometry of $\mathbf{ClF_3}$?

   1) square planar 2) octahedral 3) trigonal bipyramidal

   4) square pyramidal 5) T-shaped



(5) OWL 9-xx

Everyone will get full credit

There was an error on the exam here. "T-shaped" was not an option, thus no answers were correct. "T-shaped" is the correct answer.

Why? The lone pairs want be as far away as possible from each other and from other bonds. Putting them in plane achieves a separation of 120° See Fig 9.14

The analysis takes some thinking…

4. $\mathbf{ClF_3}$ is:

   1) polar 2) nonpolar 3) can't tell

   (1) polar ~~(2) nonpolar~~

   Everyone will get full credit

 Name: _____

5. Using the simplified molecular orbital diagram at right, predict the true bond order in **CN^+**.

1) single 2) double 3) triple

4) 1.5 5) 2.5

(2) double OWL 9-xx

6. Using the simplified molecular orbital diagram above, predict the true bond order in **O_2^+**.

1) single 2) double 3) triple

4) 1.5 5) 2.5

(4) 2.5 OWL 9-xx

7. Each carbon in CH_3CH_3 requires which type of orbital hybridization?

1) sp^4 2) sp^3 3) sp^2 4) sp

5) none of the above

(2) from OWL 10-2b

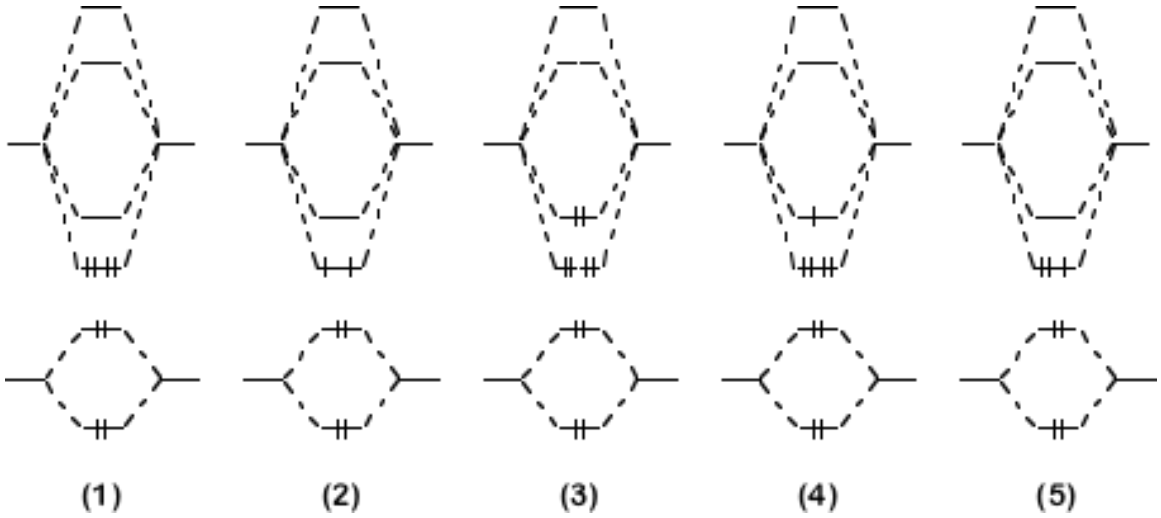
8. How many atomic orbitals were used to create each of the resulting hybrid orbitals above?

1) 1 2) 2 3) 3 4) 4 5) 5

(4) from OWL 10-2b

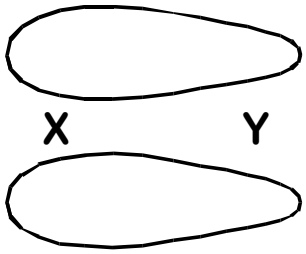
 Name: _____

9. Which of the following molecular orbital representations correctly describes C_2^+?



(5) – seven electrons – from OWL 10-5c

10. For the diatomic molecule XY, the diagram at right depicts:



1) one π bonding orbital
2) two π bonding orbitals
3) one sigma bonding orbital
4) two sigma bonding orbitals
5) one 2p atomic orbital

(1)

11. In the diatomic molecule XY, above, we can deduce that:

1) atom X has a higher electronegativity than atom Y
2) atom Y has a higher electronegativity than atom X
3) atoms X and Y have the same electronegativity
4) we have insufficient data to distinguish the relative electronegativities

(1)

12. In the diatomic molecule XY, above the orbital(s) is/are likely derived from:

1) one sp hybrid orbital on X and another sp hybrid orbital on Y
2) one s atomic orbital on X and another s atomic orbital on Y
3) one s atomic orbital on X and a p atomic orbital on Y
4) one p atomic orbital on X and an s atomic orbital on Y
5) one p atomic orbital on X and another p atomic orbital on Y

(5)

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13. Mixing **$Ba(NO_3)_2$** with **$CaCl_2$** in water leads to precipitation of:

1) a NO_3^- salt 2) a Ca^{2+} salt 3) a Cl^- salt

4) everything precipitates 5) no precipitation

(5) inspired by OWL 5-2d - Nothing below precipitates!

Ba^{2+} (aq) + $2NO_3^{2-}$ (aq) + Ca^{2+} (aq) + $2Cl^-$ (aq) → Ba^{2+} (aq) + $2Cl^-$ (aq) + Ca^{2+} (aq) + $2NO_3^{2-}$ (aq)

14. Gold can be dissolved from gold-bearing rock by treating the rock with sodium cyanide in the presence of oxygen.

$4Au\ (s) + 8NaCN\ (aq) + O_2\ (g) + 2H_2O\ (l) \rightarrow 4NaAu(CN)_2\ (aq) + 4NaOH\ (aq)$

For this reaction, what is the reducing agent?

1) Au 2) NaCN 3) O_2 4) H_2O 5) H^+

(1) Au K&T 5-122

15. Consider the reaction:

$2Na_3PO_4 + 3Cu(NO_3)_2 \rightarrow Cu_3(PO_4)_2 + 6NaNO_3$

This reaction is best classified as:

1) oxidation-reduction 2) precipitation 3) acid-base

4) gas-evolving 5) gas evolving and precipitation

(2) Precipitation K&T 5-46

$2Na_3PO_4$ (aq) + $3Cu(NO_3)_2$ (aq) → $Cu_3(PO_4)_2$ (s) + $6NaNO_3$ (aq)

16. Consider the reaction:

$FeCO_3\ (s) + 2HNO_3\ (aq) \rightarrow Fe(NO_3)_2 + CO_2 + H_2O$

This reaction is best classified as:

1) oxidation-reduction 2) precipitation 3) acid-base

4) gas-evolving 5) gas evolving and acid-base

(5) CO_2 is a gas. $2H^+$ from HNO_3 joins with O^{2-} from CO_3^{2-}

(the latter is really the same as H^+ plus OH^-)

17. CdSe finds many uses in electronics and the computer industry. What is theoxidation number of Cd in CdSe?

1) -1 2) 0 3) 1 4) 2 5) 4

(4) +2 Se wants to be –2

 Name: _____

18. Alka seltzer is a combination of citric acid, $C_6H_8O_7$, and $NaHCO_3^-$. They react in your glass to form $C_6H_7O_7^-$, H_2O, and CO_2

What is the oxidation number of C in $C_6H_7O_7^-$?

1) +1 2) +2 3) +3 4) +6 5) –6

(1) +1 –1 = 6x + 7(+1) + 7(-2)

19. Write the balanced, ***net ionic equation*** corresponding to the unbalanced equation:

$AlCl_3 + Na_3PO_4 \rightarrow AlPO_4 + NaCl$

The coefficient in front of $\mathbf{Al^{3+}}$ (aq) is:

1) 1 2) 2 3) 3 4) 4

5) 0 (Al^{3+} doesn't occur in the net ionic equation)

Al^{3+} (aq) + PO_4^{3-} (aq) → $AlPO_4$ (s)

(1) OWL 10-xx

20. Which reaction below is a redox reaction?

1) $NaOH\ (aq) + HNO_3\ (aq) \rightarrow NaNO_3\ (aq) + H_2O\ (l)$

2) $Na_2CO_3\ (aq) + 2\ HClO_4\ (aq) \rightarrow CO_2\ (g) + H_2O\ (l) + 2NaClO_4$

3) $Si\ (s) + 2Cl_2\ (g) \rightarrow SiCl_4\ (l)$

4) $CdCl_2\ (aq) + Na_2S\ (aq) \rightarrow CdS\ (s) + 2\ NaCl\ (aq)$

5) None of the above

(3) Look at redox changes **Chapt 5 inspired by book**

21. The net ionic equation for the reaction of zinc sulfate and sodium hydroxide is:

1) $Zn^{2+}\ (aq) + 2\ OH^-\ (aq) \rightarrow Zn(OH)_2\ (s) + Na_2SO_4\ (aq)$

2) $ZnSO_4\ (aq) + 2\ NaOH\ (aq) \rightarrow Zn(OH)_2\ (aq) + Na_2SO_4\ (aq)$

3) $Zn^{2+}\ (aq) + 2\ OH^-\ (aq) \rightarrow Zn(OH)_2\ (aq)$

4) $Zn^{2+}\ (aq) + 2\ OH^-\ (aq) \rightarrow Zn(OH)_2\ (s)$

5) No *net* reaction occurs

(4) hydroxide salts are generally insoluble (OWL 5-2c)

 Name: _____

22. Dissolving BaO in water leads to:

1) a resulting acidic solution

2) a resulting basic solution

3) no change in pH of the solution

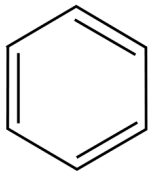
(2)

23. Which of the following is the strongest acid?

1) H_3PO_4 2) H_2CO_3 3) CH_3COOH 4) NH_3 5) HNO_3

(5) Nitric acid

24. In benzene, shown at right, there are 3 pi bonding and 3 pi antibonding molecular orbitals. How many carbon 2p orbitals are used in creating these molecular orbitals?



1) 1 2) 2 3) 3 4) 6 5) 12

(4) six -- six atomic orbitals yield six molecular orbitals

25. The correct designator for this course is:

1) Chem 262 2) Chem 111 3) Econ 3.33 4) Sports 01

(2)