 Name: _____

## *Chem 111* *10:10a section* *Evening Exam #3v2*

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 mL = 1 $cm^3$

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

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

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

1. Which of the following has the longest bond length?

   1) HF 2) HCl 3) HBr 4) HI

   **(4) I is the largest of F, Cl, Br, I OWL 9-xx**

2. Which of the following has the highest bond energy?

   1) HF 2) HCl 3) HBr 4) HI

   **(1) – shortest bond, strongest bond OWL 9-xx**

3. Which of the following has the shortest bond length?

   1) $F_2$ 2) $O_2$ 3) $N_2$ 4) $C_2$ 5) $B_2$

   **(3) $N_2$ – triple bond OWL 9-xx**

4. The CO bond in the molecule $CH_2O$ is best described as a:

   1) ionic bond
   2) single bond
   3) double bond
   4) triple bond
   5) the molecule doesn't exist

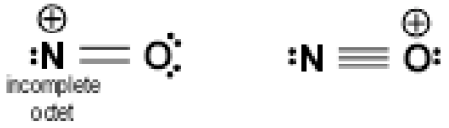
   **(3) From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T. This and the following 3 questions are basic exercises in drawing Lewis structures.**

 Name: _____

5. Draw the Lewis structure for **$NO^+$**. Draw a stable resonance structure that provides a full octet to each of N and O. In this resonance structure, what is the bond order for the NO bond?

   1) single 2) double 3) triple

   **(3) triple** **OWL 9-xx**




6. Using the simplified molecular orbital diagram at right, predict the true bond order in **$NO^+$**.

   1) single 2) double 3) triple

   4) 1.5 5) 2.5

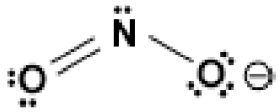
   **(3) triple** **OWL 9-xx**

7. Draw a stable resonance structure for **$NO_2^-$**. (one that provides a full octet to each atom). In this resonance structure, what are the bond orders for the NO bonds?

   1) two single 2) two double 3) two triple

   4) one single, one double 5) one double, one triple

**(4)**



**OWL 9-4**

8. In the molecule **$NO_2^-$**, the actual bond order for each NO bond is:

   1) 1 2) 2 3) 3 4) 1.5

   5) 1 for one bond and 2 for the other

   **(4) 1.5 (resonance structures)** **OWL 9-4**

9. In the molecule **$NO_2^-$**, the actual charge on each O is:

   1) 0 2) +1 3) –1 4) –0.5

   5) –1 for one O and 0 for the other O

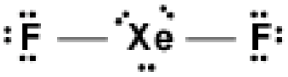
   **(4) 0.5 (resonance structures)** **OWL 9-4**

 Name: _____

10. Draw the Lewis structure for **$XeF_2$**. The molecular geometry is:

1) bent 2) linear 3) trigonal bipyramidal 4) octahedral

5) none of the above

(2) 

OWL 9-xx

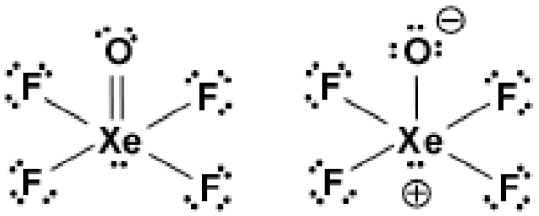
11. The molecule **$XeF_2$** is:

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

**(1) nonpolar – the individual dipoles cancel out.** OWL 9-10b

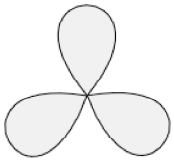
12. Draw the Lewis structure for **$XeOF_4$** (Xe is the central atom). What is the hybridization on **Xe**?

1) $sp^2$ 2) $sp^3$ 3) $sp^3d$ 4) $sp^3d^2$ 5) $sp^3d^3$

(4) 

OWL 9-xx

13. The picture at right depicts which type of orbital hybridization?



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

5) none of the above

**(3) from OWL 10-2b**

14. In the orbital hybridization ***above***, how many atomic orbitals were used to create the resulting molecular orbitals?

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

**(3) from OWL 10-2b**

15. A molecule has $sp^3d^2$ hybridization with one lone pair. The **molecular geometry** of this molecule is:

1) tetrahedral 2) octahedral 3) linear

4) square pyramidal 5) trigonal bipyramidal

**(4) from OWL 10-2b**

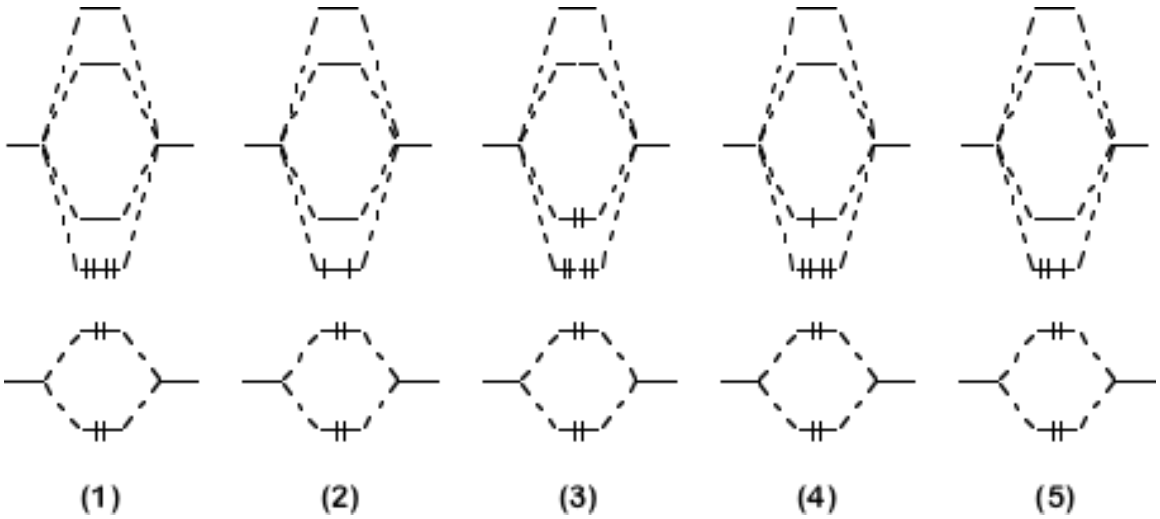
 Name: _____

16. What hybrid orbitals make up the sigma bond between **C2** and **C3** in propylene, **$CH_2CHCH_3$**?

1) sp & $sp^3$ 2) sp & $sp^2$ 3) $sp^2$ & $sp^3$ 4) $sp^2$ & $sp^2$ 5) $sp^3$ & $sp^3$

**(3) – from OWL 10-2c**

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




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

18. From molecular orbital theory, the bond order in $C_2^+$ is:

1) single 2) double 3) 0.5 4) 1.5 5) 3.5

**(4) 2.5 bonding, 1 antibonding – from OWL 10-5c**

19. Consider the molecular orbital diagram shown at right:
This energy diagram best describes:


1) $C_2$ 2) $CN^-$ 3) $CN^+$ 4) $N_2$

**(3) count electrons!! – from OWL 10-5c w/ a minor twist**

**Note that N is more electronegative, and therefore lower in energy, than C (N is on the right). OWL 10-xx**

 Name: _____

20. In the diagram at right, the π bonding orbitals are best described as:

1) all C 2) all N

3) more C than N 4) more N than C

5) equal mixture of C and N

**(4) N is more electronegative than C, therefore lower in energy. The bonding orbitals are closer in energy to the atomic N levels, therefore they have more "N" character. OWL 10-xx**

21. Using molecular orbital theory, what is the bond order in the anion $\mathbf{O_2^-}$?

1) 1 2) 1.5 3) 2 4) 2.5 5) 3

**(2) OWL 10-xx**

**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.

22. Mixing $\mathbf{Na_2CO_3}$ with $\mathbf{CaCl_2}$ in water leads to precipitation of:

1) a $CO_3^{2-}$ salt 2) a $Na^+$ salt 3) a $Cl^-$ salt

4) everything precipitates 5) no precipitation

**(1) inspired by OWL 5-2d**

 Name: _____

23. 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 **$Na^+$** (aq) is:

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

5) 0 ($Na^+$ doesn't occur in the net ionic equation)

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

**(5) Na+ cancels out of the net ionic equation** **OWL 10-xx**

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

$CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + NaCl$

In the net ionic equation, the coefficient in front of **$Ca^{2+}$** (aq) is:

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

5) 0 ($Ca^{2+}$ doesn't occur in the net ionic equation)

**(1) $Ca^{2+}$ (aq) + $CO_3^{2-}$ (aq) → $CaCO_3$ (s)** **OWL 10-xx**

25. The correct designator for this course is:

1) Chem 363 2) Chem 111 3) Econ 3.33 4) Sports 01

**(2)**

Name: _____

## 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) | | | | | | | | | |