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

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 $cm^3$

Hz = $s^{-1}$

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

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

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

## 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.

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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

2. $\mathbf{XeF_4}$ is:

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

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

   1) square planar  2) octahedral  3) trigonal bipyramidal

   4) square pyramidal  5) trigonal planar

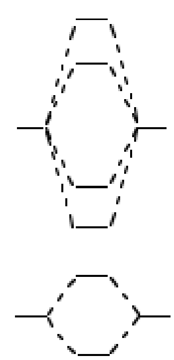
4. $\mathbf{ClF_3}$ is:

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

5. Using the simplified molecular orbital diagram at right, predict the true bond order in $\mathbf{CN^+}$.

   1) single  2) double  3) triple

   4) 1.5  5) 2.5



6. Using the simplified molecular orbital diagram above, predict the true bond order in $\mathbf{O_2^+}$.

   1) single  2) double  3) triple

   4) 1.5  5) 2.5

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

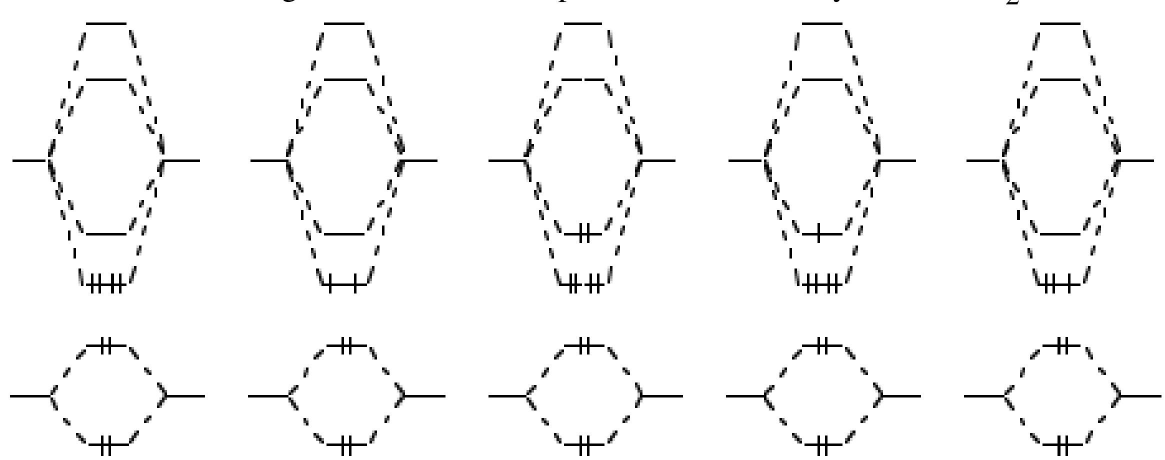
   1) $sp^4$  2) $sp^3$  3) $sp^2$  4) sp

   5) none of the above

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

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



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

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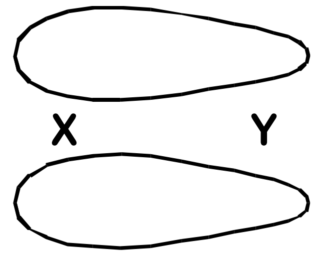
10. For the diatomic molecule XY, the diagram at right depicts:




1) one $\pi$ bonding orbital
2) two $\pi$ bonding orbitals
3) one sigma bonding orbital
4) two sigma bonding orbitals
5) one 2p atomic orbital

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

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

13. Mixing $\mathbf{Ba(NO_3)_2}$ with $\mathbf{CaCl_2}$ 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

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) $H^+$

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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

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

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

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

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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)

20. Which reaction below is a redox reaction?

1) $NaOH$ (aq) + $HNO_3$ (aq) → $NaNO_3$ (aq) + $H_2O$ (l)

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

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

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

5) None of the above

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

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

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

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

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

5) No *net* reaction occurs

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22. Dissolving BaO in water leads to:

1) a resulting acidic solution

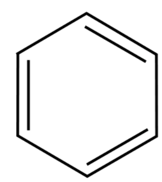
2) a resulting basic solution

3) no change in pH of the solution

23. Which of the following is the strongest acid?

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

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

25. The correct designator for this course is:

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