Chem 111 2:30p section Evening Exam #3

This exam is composed of 25 questions, 1 of which requires mathematics that *might* require a calculator. 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 in 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.

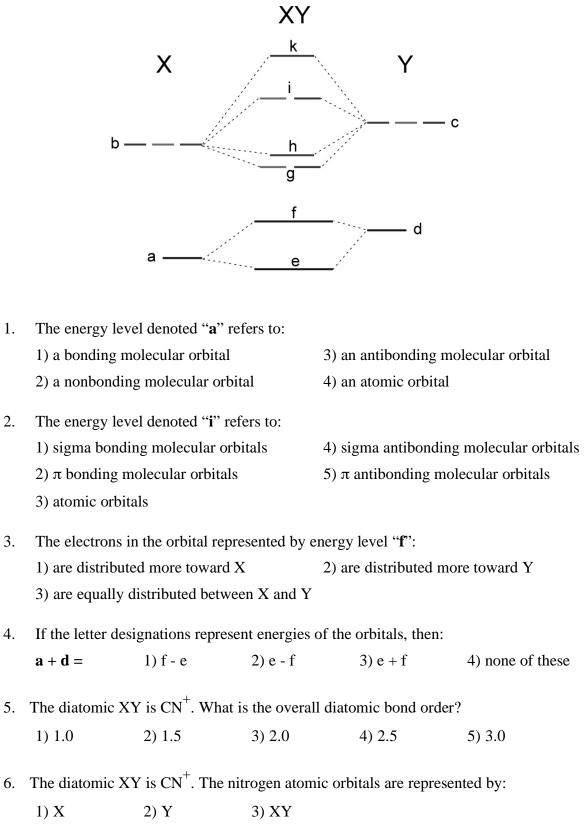
I hereby state that all answers on this exam are my own and that I have neither gained unfairly from others nor have I assisted others in obtaining an unfair advantage on this exam.

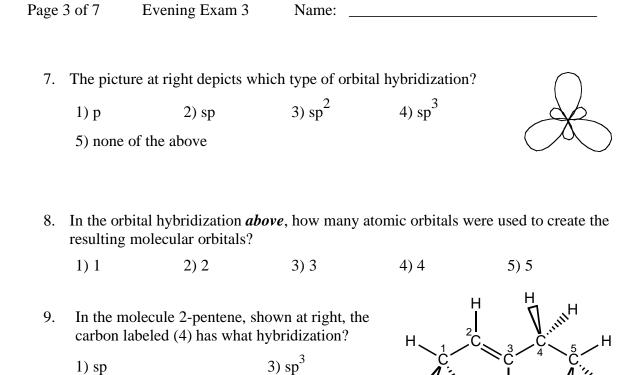
Signature						
$E = hv = \frac{hc}{\lambda}$	Some common ions:	$h = 6.626 x 10^{-34} J s$				
n n	PO_4^{3-} $CN^ CH_3CO_2^{-}$	$c = 2.9998 \times 10^8 m s^{-1}$				
$E_n^{H-atom} = -\frac{R_H hc}{n^2}$	NO_2^{-} NO_3^{-} CO_3^{2-}	$N = 6.022 x 10^{23} mol^{-1}$				
$1 \text{ mL} = 1 \text{ cm}^3$	SO ₃ ²⁻ SO ₄ ²⁻	$R_{H} = 1.097 \times 10^{7} m^{-1}$				

PERIODIC TABLE OF THE ELEMENTS

1A	2A	3 B	4B	5B	6B	7B	8B	8B	8B	1B	2B	3 A	4 A	5A	6A	7A	8A
1																	2
Н																	Не
1.008		-											1	1	1		4.003
3	4											5	6	7	8	9	10
Li	Be											В	С	Ν	0	\mathbf{F}	Ne
6.939	9.012											10.81	12.01	14.01	16.00	19.00	20.18
11	12											13	14	15	16	17	18
Na	Mg											Al	Si	Р	S	Cl	Ar
22.99	24.31		-	r	1	1	1	1	•	-		26.98	28.09	30.97	32.07	35.45	39.95
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Со	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Rb	Sr	Y	Zr	Nb	Мо	Тс	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Те	Ι	Xe
85.47	87.62	88.91	91.22	92.91	95.94	(99)	101.1	102.9	106.4	107.9	112.4	114.8	118.7	121.8	127.6	126.9	131.3
55	56	57	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
Cs	Ba	La	Hf	Та	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Ро	At	Rn
132.9	137.3	138.9	178.5	181.0	183.8	186.2	190.2	192.2	195.1	197.0	200.6	204.4	207.2	209.0	(209)	(210)	(222)
87	88	89	104	105	106	107	108	109									
Fr	Ra	Ac	Unq	Unp	Unh	Uns	Uno	Une									
(223)	226.0	227.0	(261)	(262)	(263)	(262)	(265)	(266)	J								

Questions 1 through 6 refer to the energy diagram below of a "first row" (n=2) diatomic:





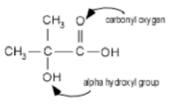
10. The angle describing $C_3-C_4-C_5$ (centered on carbon 4) is approximately:

4) sp^4

1) 109.5° 2) 120° 3) 180° 4) 90°

- 11. A central atom in a molecule has an octahedral electron pair geometry. What is the orbital hybridization on that atom?
 - 1) sp 2) sp² 3) sp³ 4) sp³d 5) sp³d²
- 12. Trendy anti-wrinkle creams advertise the presence of "alpha hydrox" as a key component. A structure of an alpha hydroxy acid is shown at right. In this molecule, what is the hybridization at the *carbonyl oxygen*? Hint: all C and O atoms have complete octets.

2) sp^{2}



1) sp 2) sp² 3) sp³ 4) sp³d 5) sp³d²

Solubility Rules for some ionic compounds in water

Soluble Ionic Compounds

- 1. All sodium (Na⁺), potassium (K⁺), and ammonium (NH₄⁺) salts are SOLUBLE.
- 2. All nitrate (NO₃⁻), acetate (CH₃CO₂⁻), chlorate (ClO₃⁻), and perchlorate (ClO₄⁻) salts are SOLUBLE.
- 3. All chloride (Cl⁻), bromide (Br⁻), and iodide (I⁻) salts are SOLUBLE -- EXCEPT those also containing: lead, silver, or mercury (I) (Pb²⁺,Ag⁺, Hg²⁺) which are NOT soluble.
- 4. All sulfate (SO₄²⁻) salts are SOLUBLE - EXCEPT those also containing: calcium, silver, mercury (I), strontium, barium, or lead (Ca²⁺, Ag⁺, Hg₂²⁺, Sr²⁺, Ba²⁺, Pb²⁺) which are NOT soluble.

Not Soluble Ionic Compounds

- 5. Hydroxide (OH⁻) and oxide (O²⁻) compounds are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or barium (Na⁺, K⁺, Ba²⁺) which are soluble.
- 6. Sulfide (S²⁻) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, ammonium, or barium (Na⁺, K⁺, NH4⁺, Ba²⁺) which are soluble.
- 7. Carbonate (CO₃²⁻) and phosphate (PO₄³⁻) salts are NOT SOLUBLE -- EXCEPT those also containing: sodium, potassium, or ammonium (Na⁺, K⁺, NH₄⁺), which are soluble.

13. Mixing $Ag(NO_3)_2$ with $MgCl_2$ in water leads to precipitation of:

- 1) a NO_3^- salt2) an Ag^{2+} salt3) a Mg^{2+} salt4) everything precipitates5) 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 oxidizing agent on the left side of the reaction?

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

15. Ammonium sulfide, $(NH_4)_2S$, reacts with $Hg(NO_3)_2$ to produce HgS and NH_4NO_3 This reaction is best classified as:

1) oxidation-reduction	2) acid-base	3) precipitation
4) gas evolving	5) gas evolving and precip	itation

16. Consider the unbalanced reaction:

 $Ca(OH)_2$ (s) + HNO₃ (aq) \rightarrow $Ca(NO_3)_2$ (aq) + H₂O (l)

In the balanced, net ionic equation for this reaction, the coefficient preceding NO_3^{-1} is:

4) $N0_3^{-}$ does not appear in the net ionic equation

17. Consider the unbalanced reaction:

 $Ca(OH)_2$ (s) + HNO₃ (aq) \rightarrow $Ca(NO_3)_2$ (aq) + H₂O (l)

This reaction is best classified as:

1) oxidation-reduction	2) gas evolving	3) precipitation
4) acid-base	5) gas evolving and precip	pitation

18. Consider the following reaction that occurs within rechargeable "lead storage" batteries:

Pb (s) + PbO₂ (s) + 2 H₂SO₄ (aq) \rightarrow 2 PbSO₄ (s) + 2H₂O (l)

The oxidation number of Pb in PbO_2 is:

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

19. In the above reaction, the reducing agent on the left side of the reaction is:

1) Pb (s) 2) PbO₂ (s) 3) H_2SO_4 4) this is not a redox reaction

- 20. Which reaction below is a redox reaction?
 - 1) NaOH (aq) + HNO₃ (aq) \rightarrow NaNO₃ (aq) + H₂O (l) 2) Na₂CO₃ (aq) + 2 HClO₄ (aq) \rightarrow CO₂ (g) + H₂O (l) + 2NaClO₄ 3) Si (s) + 2Cl₂ (g) \rightarrow SiCl₄ (l) 4) CdCl₂ (aq) + Na₂S (aq) \rightarrow 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) $Zn^{2+}(aq) + 2 OH^{-}(aq) \rightarrow Zn(OH)_{2}(s)$ 2) $Zn^{2+}(aq) + 2 OH^{-}(aq) \rightarrow Zn(OH)_{2}(aq)$ 3) $Zn^{2+}(aq) + 2 OH^{-}(aq) \rightarrow Zn(OH)_{2}(s) + Na_{2}SO_{4}(aq)$ 4) $ZnSO_{4}(aq) + 2 NaOH(aq) \rightarrow Zn(OH)_{2}(aq) + Na_{2}SO_{4}(aq)$ 5) No *net* reaction occurs

- 22. Even though it is only slightly soluble, dissolving MgO (assume that it does dissolve) in water leads to:
 - 1) no change in pH of the solution
 - 2) a resulting acidic solution
 - 3) a resulting basic solution
- 23. You add sufficient 1 M HCl to 1.0 L of water to yield a final pH=4.0. Which statement below is true regarding the resulting solution?

1) $[OH^{-}] = 10^{-14} M$	2) $[\text{H}^+] = 4.0 \text{ M}$	3) $[\text{H}^+] = 10^4 \text{ M}$
4) $[Cl^{-}] = 0.1 \text{ mM}$	5) none of the above	

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

 $AlCl_3 + Na_3PO_4 \rightarrow AlPO_4 + NaCl$

The numerical coefficient preceding PO_4^{3-} (aq) is:

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

- 5) 0 (Na⁺ doesn't occur in the net ionic equation)
- 25. What is the catalog number for this class?
 - 1) 1232) 3453) 8994) 3.141595) 111