Chem 111 Evening Exam #3 Name: _____Answer Key – Exam Version A

** Enter your answers on the bubble sheet. Turn in all sheets. **

This exam is composed of **25 questions** on 7 pages total.

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

$E = h\nu = \frac{hc}{\lambda}$ $E_n^{H-atom} = -\frac{R_H hc}{n^2}$ 1 mL = 1 cm^3	**Some common ions:** PO_4^{3-} CN^- $CH_3CO_2^-$ NO_2^- NO_3^- CO_3^{2-} SO_3^{2-} SO_4^{2-}	$h = 6.626x10^{-34}\ J\ s$ $c = 2.9998x10^8\ m\ s^{-1}$ $N = 6.022x10^{23}\ mol^{-1}$ $R_H = 1.097x10^7\ m^{-1}$

a

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)									

a

Chem 111 Evening Exam #3 Name: _____Answer Key – Exam Version A

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+}) 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^+, NH_4^+, 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.

Identify the choice that best completes the statement or answers the question.

1. What is the hybridization of the nitrogen atom in NCl_3?
   a. *sp* b. sp^2 c. sp^3 d. sp^3d e. sp^3d^2

   ANS: C TOP: 9.2 Valence Bond Theory

2. For which of the following molecules and ions does the central atom have *sp* hybridization: NO_2^+, O_3, and I_3^-?
   a. NO_2^+ only
   b. O_3 only
   c. I_3^- only
   d. O_3 and I_3^-
   e. I_3^- and NO_2^+

   ANS: A TOP: 9.2 Valence Bond Theory

3. What is the molecular geometry around a central atom that is sp^3d^2 hybridized and has one lone pair of electrons?
   a. tetrahedral
   b. trigonal-bipyramidal
   c. square-planar
   d. square-pyramidal
   e. see-saw

   ANS: D TOP: 9.2 Valence Bond Theory

4. Which of the following characteristics apply to SO_2?
   1. polar bonds
   2. nonpolar molecule
   3. linear molecular shape
   4. *sp* hybridized

   a. 1 only
   b. 1 and 2
   c. 3 and 4
   d. 1, 2, and 3
   e. 1, 2, 3, and 4

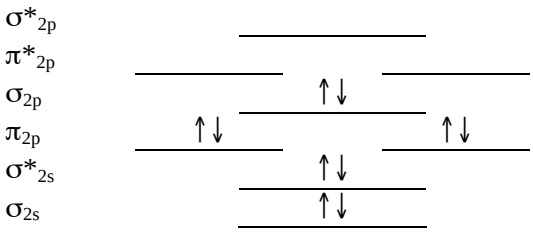
   ANS: A TOP: 9.2 Valence Bond Theory

Chem 111 Evening Exam #3 Name: _____Answer Key – Exam Version A

5. A molecular orbital that decreases the electron density between two nuclei is said to be .
   a. hybridized
   b. bonding
   c. antibonding
   d. pi-bonding
   e. nonpolar

   ANS: C TOP: 9.3 Molecular Orbital Theory

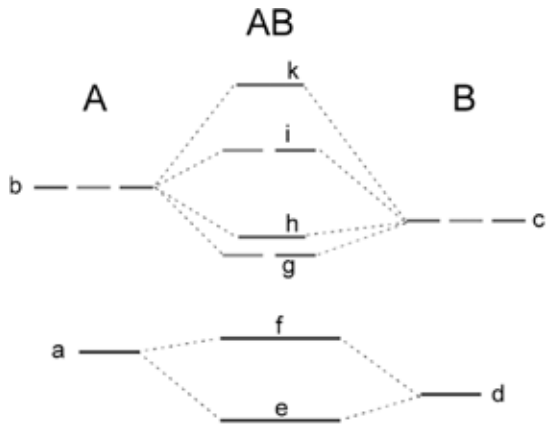
6. Which molecule will have the following valence molecular orbital level energy diagram?



   a. Li_2 b. Be_2 c. B_2 d. C_2 e. N_2

   ANS: E TOP: 9.3 Molecular Orbital Theory

7.



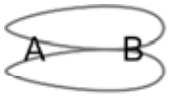
   Which picture best represents the electronic distribution in orbital "h"?

   a. 

   c. 

   e. 

   b. 

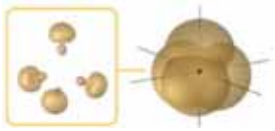
   d. 

   ANS: B

8. The diatomic AB above is CN^-. What is the overall bond order?
   a. 1.0 b. 1.5 c. 2.0 d. 2.5 e. 3.0

   ANS: E

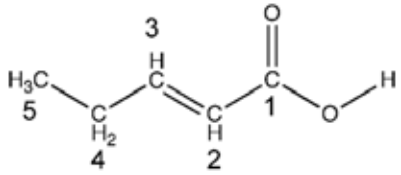
Chem 111 Evening Exam #3 Name: _____Answer Key – Exam Version A



9. The picture at right depicts which type of orbital hybridization?
   a. sp
   b. sp^2
   c. sp^3
   d. sp^3d
   e. sp^3d^2

   ANS: C

10. In the molecule 2-pentenoic acid, which most closely measures the C_2-C_1-OH angle?



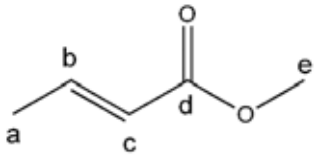
   a. 90°
   b. 109°
   c. 120°
   d. 145°
   e. 180°

   ANS: C

11. A central atom in a molecule has a trigonal bipyramidal electron pair geometry. What is the orbital hybridization on that atom?
   a. sp
   b. sp^2
   c. sp^3
   d. sp^4
   e. sp^3d

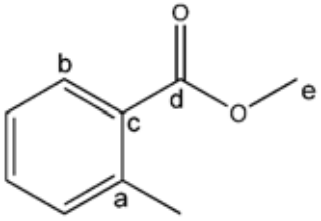
   ANS: E

12. An alcohol will initially react with the molecule below at which position?



   ANS: D

13. Which carbon center below is most deficient in electrons?



   ANS: D

14. Which of the following statements is/are correct?
    1. All ionic compounds that are soluble in water are electrolytes.
    2. All ionic compounds dissolve in water.
    3. Molecular compounds are never soluble in water.

    a. 1 only
    b. 2 only
    c. 3 only
    d. 1 and 2
    e. 2 and 3

    ANS: A TOP: 3.5 Ions and Molecules in Aqueous Solutions

15. Which one of the following compounds is a nonelectrolyte when dissolved in water?
    a. HCl
    b. $MgBr_2$
    c. Cl_2
    d. $Zn(NO_3)_2$
    e. KI

    ANS: C TOP: 3.5 Ions and Molecules in Aqueous Solutions

16. A precipitate will form when aqueous $Pb(NO_3)_2$ is added to an aqueous solution of
    a. $Cu(NO_3)_2$
    b. $CaBr_2$
    c. $NaCH_3CO_2$
    d. $Ca(ClO_4)_2$
    e. $NaNO_3$

    ANS: B TOP: 3.6 Precipitation Reactions

17. What is the net ionic equation for the reaction of aqueous calcium acetate and aqueous sodium carbonate?
    a. $Ca^{2+}(aq) + 2\ CH_3CO_2^-(aq) \rightarrow Ca(CH_3CO_2)_2(s)$
    b. $Na^+(aq) + CH_3CO_2^-(aq) \rightarrow NaCH_3CO_2(aq)$
    c. $Na^+(aq) + CH_3CO_2^-(aq) \rightarrow NaCH_3CO_2(s)$
    d. $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$
    e. $Ca^{2+}(aq) + 2\ Na^+(aq) \rightarrow CaNa_2(s)$

    ANS: D TOP: 3.6 Precipitation Reactions

18. Write a balanced net ionic equation for the reaction of barium carbonate and aqueous hydrochloric acid.
    a. $BaCO_3(s) + 2\ H^+(aq) \rightarrow Ba^{2+}(aq) + CO_3^{2-}(aq) + H_2(g)$
    b. $BaCO_3(s) + 2\ H^+(aq) \rightarrow Ba^{2+}(aq) + CO_2(g) + H_2O(™)$
    c. $BaCO_3(s) + 2\ HCl(aq) \rightarrow BaCl_2(aq) + H_2CO_3(aq)$
    d. $BaCO_3(s) + 2\ H^+(aq) \rightarrow Ba^{2+}(aq) + H_2CO_3(s)$
    e. $BaCO_3(s) + 2\ H^+(aq) \rightarrow BaO(s) + CO_2(g) + H_2(g)$

    ANS: B TOP: 3.8 Gas-Forming Reactions

19. Which molecule in the reaction below is the reducing agent?

    $2\ C_2H_6(g) + 7\ O_2(g) \rightarrow 4\ CO_2(g) + 6\ H_2O(g)$

    a. C_2H_6
    b. O_2
    c. O_2 and CO_2
    d. CO_2
    e. None

    ANS: A TOP: 3.9 Oxidation-Reduction Reactions

Chem 111 Evening Exam #3 Name: _____Answer Key – Exam Version A

20. What is the oxidation number of iodine in potassium periodate, KIO_4?
a. –1 b. 0 c. +3 d. +5 e. +7

ANS: E TOP: 3.9 Oxidation-Reduction Reactions

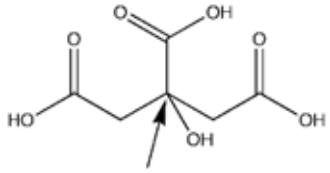
21. Consider the reaction

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

This reaction is best classified as
a. oxidation-reduction
b. gas-evolving
c. precipitation
d. acid-base
e. gas-evolving and acid-base

ANS: E

22. 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 CO2.



What is the oxidation number of the carbon pointed to by the arrow?
a. -2 b. 0 c. 1 d. 2 e. 4

ANS: C

23. Mixing **$Ba(NO_3)_2$** with **$CaCl_2$** in water leads to precipitation of
a. a NO_3^- salt
b. A Cl^- salt
c. a Ca^{2+} salt
d. nothing precipitates
e. everything precipitates

ANS: D

24. What is the oxidation number of antimony in Sb_2O_5?
a. +2 c. +5 e. 0
b. -2 d. -5

ANS: C

25. What course is this?
a) Chem 111 c) Bio 152 e) Election 08
b) Sports 01 d) Math 3.14159

ANS: A