Chem 111 Evening Exam #3 Name: _____ Answer Key – Exam Version E

** 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								

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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 central nitrogen atom in nitrite ion, NO_2^-?
   a. *sp* b. sp^2 c. sp^3 d. sp^3d e. sp^3d^2

   ANS: B TOP: 9.2 Valence Bond Theory

2. For which of the following molecules does the central carbon atom have sp^2 hybridization?
   a. Cl_2CO b. $CHCl_3$ c. CS_2 d. CH_2Cl_2 e. HCN

   ANS: A TOP: 9.2 Valence Bond Theory

3. What is the molecular geometry around a central atom that is sp^2 hybridized, has three sigma bonds, and one pi bond?
   a. trigonal-planar
   b. trigonal-pyramidal
   c. bent
   d. T-shaped
   e. tetrahedral

   ANS: A 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

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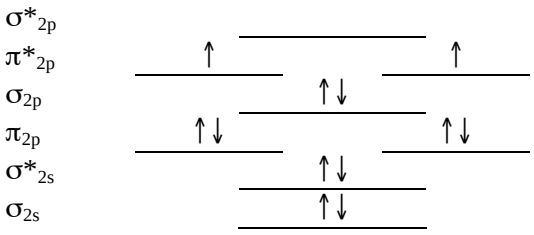
5. A molecular orbital that decreases the electron density between two nuclei is said to be .
   a. hybridized
   b. bonding
   c. antibonding
   d. pi-bonding
   e. nonpolar

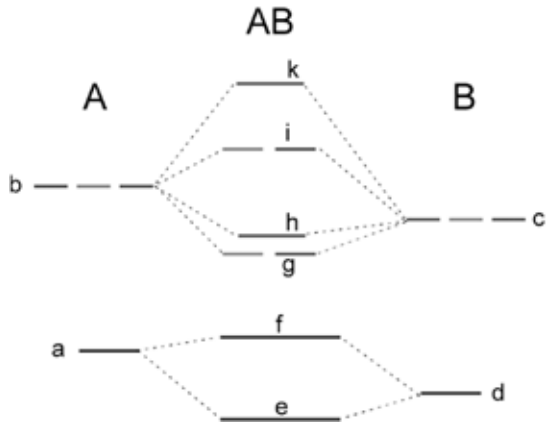
   ANS: C TOP: 9.3 Molecular Orbital Theory

6. The following valence molecular orbital energy level diagram is appropriate for which one of the listed species?



   a. B_2^{2-} b. C_2^{2-} c. N_2^{2-} d. O_2^{2-} e. F_2^{2-}

   ANS: C TOP: 9.3 Molecular Orbital Theory

7. 

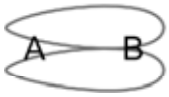
   Which picture best represents the electronic distribution in orbital "g"?

   a. 

   c. 

   e. 

   b. 

   d. 

   ANS: D

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

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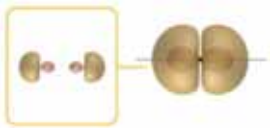
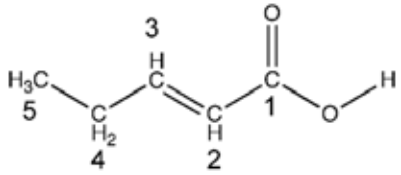


9. The picture at right depicts which type of orbital hybridization?
   a. sp
   b. sp^2
   c. sp^3
   d. sp^3d
   e. sp^3d^2

   ANS: A

10. In the molecule 2-pentenoic acid, which most closely measures the C_3-C_4-H angle?



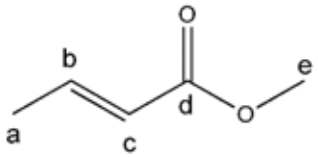
   a. 90°
   b. 109°
   c. 120°
   d. 145°
   e. 180°

   ANS: B

11. Each carbon atom in CH_3CH_3 requires what type of orbital hybridization?
   a. sp
   b. sp^2
   c. sp^3
   d. sp^4
   e. no hybridization

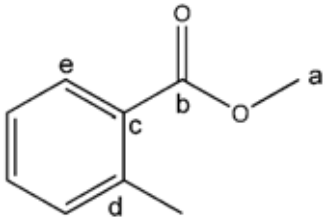
   ANS: C

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: B

14. Which of the following statements is/are correct?
    1. Water soluble ionic compounds, such as NaCl, are strong electrolytes.
    2. Some molecular compounds, such as HCl, are strong electrolytes.
    3. Some molecular compounds, such as acetic acid, are weak electrolytes.

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

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

15. Which one of the following compounds is a nonelectrolyte when dissolved in water?
    a. KI
    b. $MgBr_2$
    c. $MgCl_2$
    d. $Zn(NO_3)_2$
    e. F_2

    ANS: E 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. $NaNO_3$
    c. $NaCH_3CO_2$
    d. $Ca(ClO_4)_2$
    e. $CaBr_2$

    ANS: E TOP: 3.6 Precipitation Reactions

17. Formic acid, HCO_2H, is a weak acid. Write a net ionic equation for the reaction of aqueous formic acid and aqueous potassium hydroxide.
    a. $HCO_2H(aq) + KOH(aq) \rightarrow K^+(aq) + HCO_2^-(aq) + H_2O(ℓ)$
    b. $HCO_2H(aq) + H_2O(aq) \rightarrow HCO_2^-(aq) + H_3O^+(ℓ)$
    c. $H^+(aq) + OH^-(aq) \rightarrow H_2O(ℓ)$
    d. $HCO_2H(aq) + OH^-(aq) \rightarrow HCO_2^-(aq) + H_2O(ℓ)$
    e. $H^+(aq) + KOH(aq) \rightarrow K^+(aq) + H_2O(ℓ)$

    ANS: D TOP: 3.7 Acids and Bases

18. Write a balanced chemical equation for the reaction of aqueous solutions of potassium sulfide and nitric acid.
    a. $K_2S(aq) + 2\ HNO_3(aq) \rightarrow 2\ KH(aq) + S(NO_3)_2(g)$
    b. $K_2S(aq) + HNO_3(aq) \rightarrow HS(g) + K_2NO_3(aq)$
    c. $K_2S(aq) + 2\ HNO_3(aq) \rightarrow S(s) + H_2(g) + 2\ KNO_3(aq)$
    d. $K_2S(aq) + 2\ HNO_3(aq) \rightarrow 2\ K(s) + H_2(g) + S(NO_3)_2(g)$
    e. $K_2S(aq) + 2\ HNO_3(aq) \rightarrow H_2S(g) + 2\ KNO_3(aq)$

    ANS: E TOP: 3.8 Gas-Forming Reactions

19. Which species is oxidized in the reaction below?
    $I^-(aq) + ClO^-(aq) \rightarrow IO^-(aq) + Cl^-(aq)$
    a. ClO^-
    b. H_2O
    c. I^-
    d. IO^-
    e. none

    ANS: C TOP: 3.9 Oxidation-Reduction Reactions

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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

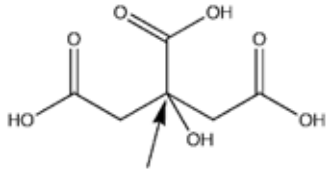
21. Consider the reaction

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

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. 4 b. 3 c. 2 d. 1 e. 0

ANS: D

23. Mixing **Na_2S** with **$BaCl_2$** in water leads to precipitation of
a. a Cl^- salt
b. a Ba^{2+} salt
c. a Na^+ salt
d. nothing precipitates
e. everything precipitates

ANS: D

24. What is the oxidation number of chromium in $Cr_2O_7^{2-}$?
a. +2 c. +5 e. +7
b. +4 d. +6

ANS: D

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

ANS: E