

* 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

$E = hv = \frac{hc}{\lambda}$ $E_n^{H-atom} = -\frac{R_H hc}{n^2}$ $1 \text{ mL} = 1 \text{ cm}^3$	Some common ions: PO_4^{3-} CN^- CH_3CO_2^- NO_2^- NO_3^- CO_3^{2-} SO_3^{2-} SO_4^{2-}	$h = 6.626 \times 10^{-34} \text{ J s}$ $c = 2.9998 \times 10^8 \text{ m s}^{-1}$ $N = 6.022 \times 10^{23} \text{ mol}^{-1}$ $R_H = 1.097 \times 10^7 \text{ m}^{-1}$
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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

Solubility Rules for some ionic compounds in water**Soluble Ionic Compounds**

- All sodium (Na^+), potassium (K^+), and ammonium (NH_4^+) salts are SOLUBLE.
- All nitrate (NO_3^-), acetate (CH_3CO_2^-), chlorate (ClO_3^-), and perchlorate (ClO_4^-) salts are SOLUBLE.
- 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.
- 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

- 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.
- 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.
- 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 chlorine atom in the perchlorate ion, ClO_4^- ?
- 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 c. I_3^- only e. I_3^- and NO_2^+
 b. O_3 only d. O_3 and I_3^-

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 d. T-shaped
 b. trigonal-pyramidal e. tetrahedral
 c. bent

ANS: A TOP: 9.2 Valence Bond Theory

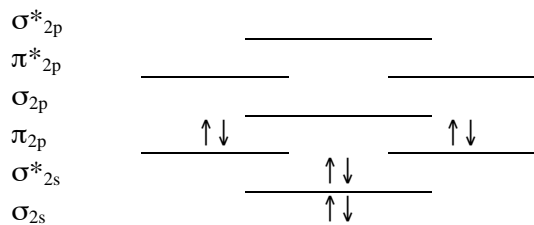
4. Which of the following characteristics apply to SO_2 ?
- polar bonds
 - nonpolar molecule
 - linear molecular shape
 - sp hybridized
- a. 1 only d. 1, 2, and 3
 b. 1 and 2 e. 1, 2, 3, and 4
 c. 3 and 4

ANS: A TOP: 9.2 Valence Bond Theory

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

ANS: C TOP: 9.3 Molecular Orbital Theory

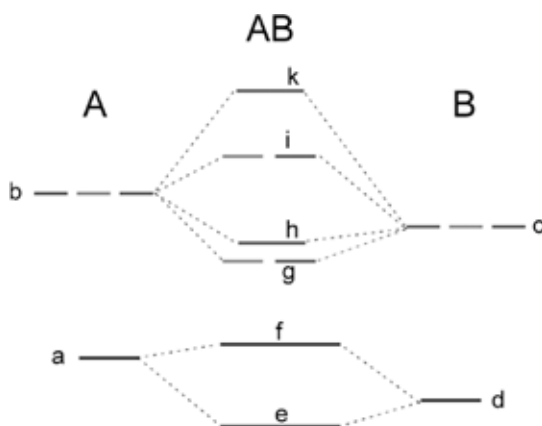
6. Which molecule will have the following valence molecular orbital energy level diagram?



- Li₂
- Be₂
- B₂
- C₂
- F₂

ANS: D TOP: 9.3 Molecular Orbital Theory

7.



Which picture best represents the electronic distribution in orbital “g”?

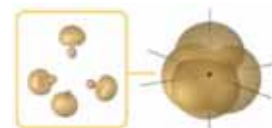
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-
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ANS: D

8. The diatomic AB above is NO⁻. What is the overall bond order?

- 1.0
- 1.5
- 2.0
- 2.5
- 3.0

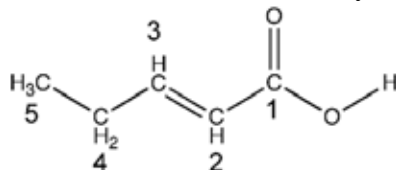
ANS: C



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

ANS: C

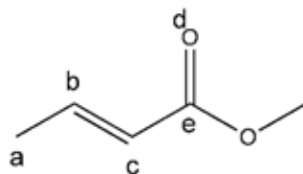
10. In the molecule 2-pentenoic acid, which most closely measures the C_3-C_4-H angle?



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

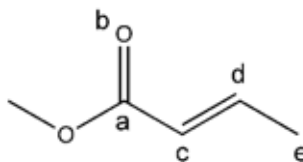
ANS: B

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



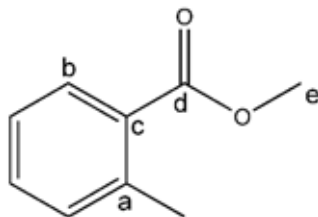
ANS: E

12. An alcohol will initially react with the molecule below at which position? **Whoops Duplicate!**



ANS: A

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

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. KI c. MgCl₂ e. F₂
b. MgBr₂ d. Zn(NO₃)₂

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

16. A precipitate will form when aqueous nickel(II) chloride is added to an aqueous solution of

- a. SrI₂ c. KOH e. NaF
b. Cu(NO₃)₂ d. Na₂SO₄

ANS: C TOP: 3.6 Precipitation Reactions

17. What is the net ionic equation for the reaction of aqueous sodium hydroxide and aqueous iron(II) chloride?

- a. Na⁺(aq) + OH⁻(aq) → NaOH(s)
b. Na⁺(aq) + Cl⁻(aq) → NaCl(s)
c. Fe²⁺(aq) + 2 OH⁻(aq) → Fe(OH)₂(s)
d. Fe²⁺(aq) + OH⁻(aq) → FeOH⁺(s)
e. Fe²⁺(aq) + 2 Cl⁻(aq) → FeCl₂(s)

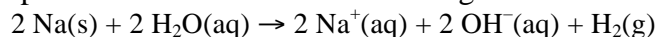
ANS: C TOP: 3.6 Precipitation Reactions

18. Write a balanced net ionic equation for the reaction of aqueous solutions of baking soda (NaHCO₃) and acetic acid.

- a. HCO₃⁻(aq) + CH₃CO₂H(aq) → CH₃CO₂⁻(aq) + H₂O(l) + CO₂(g)
b. 2 NaHCO₃(aq) + CH₃CO₂H(aq) → 2 Na₂CO₃(aq) + CH₄(aq) + 2H₂O(l) + CO₂(g)
c. NaHCO₃(aq) + H⁺(aq) → H₂CO₃(s) + Na⁺(aq)
d. HCO₃⁻(aq) + H⁺(aq) → H₂O(l) + CO₂(g)
e. HCO₃⁻(aq) + H⁺(aq) → H₂CO₃(aq)

ANS: A TOP: 3.8 Gas-Forming Reactions

19. Which species in the reaction below undergoes reduction?



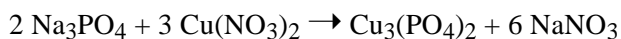
- a. Na c. H₂ e. none
b. H₂O d. OH⁻

ANS: B TOP: 3.9 Oxidation-Reduction Reactions

20. What is the oxidation number of sulfur in SCl_2 ?
 a. -2 b. 0 c. +2 d. +4 e. +6

ANS: C TOP: 3.9 Oxidation-Reduction Reactions

21. Consider the reaction

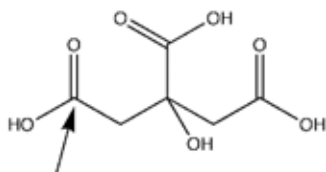


This reaction is best classified as

- a. oxidation-reduction d. acid-base
 b. gas-evolving e. gas-evolving and acid-base
 c. precipitation

ANS: C

22. Alka seltzer is a combination of citric acid, $\text{C}_6\text{H}_8\text{O}_7$, and NaHCO_3^- . They react in your glass to form $\text{C}_6\text{H}_7\text{O}_7^-$, H_2O , and CO_2 .



What is the oxidation number of the carbon pointed to by the arrow?

- a. -2 b. 0 c. 1 d. 2 e. 3

ANS: E

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

ANS: D

24. What is the oxidation number of manganese in MnO_4^- ?
 a. +2 c. +6 e. +7
 b. +4 d. -4

ANS: E

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

ANS: C