Chem 111 Evening Exam #2 Name: Updated 10/26 _____

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

This exam is composed of **25 questions** on 4 pages (in addition to this cover page).

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)									

d

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

1. Which element is represented by: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^4$
   a) Se b) Ge c) As d) Sb e) Te

2. The correct spectroscopic notation for phosphorous (P) is:
   a) $1s^2 2s^2 2p^6 3s^2 3p^2$
   b) $1s^2 2s^2 2p^6 3s^2 3p^6$
   c) $1s^2 2s^2 2p^6 3s^2 3p^3$
   d) $1s^2 2s^2 2p^6 3s^2 3p^5$
   e) $1s^2 2s^2 2p^6 3s^2 3p^4$

3. How many valence electrons are in the S atom?
   a) 2 b) 5 c) 4 d) 6 e) 0

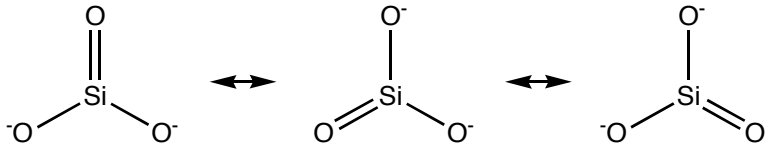
   $1s^2 2s^2 2p^2 3s^2 3p^4$ n=3 is the valence level. It has 6 valence electrons

4. Which of the following has the shortest bond length?
   a) CH_4 b) BH_3 c) NH_3 d) H_2O e) HF

   F is the smallest of B, C, N, O, and F

5. Consider the molecule $SiO_3^{\ x}$, where x is the charge on the molecule. Which value of x (the net charge on the molecule) yields the stable molecule? (Hint: draw Lewis structures to figure this one out)
   a) -3 b) +2 c) 0 d) -2 e) -1

6. For the $SiO_3^{\ x}$ molecule, how many equal-energy resonance structures can you draw?
   a) 6 b) 1 c) 4 d) 2 e) 3



   This question was a bit ambiguous on another version of the exam. Everyone got full credit.

7. Consider the molecule ClF_2^- How many lone **pairs** are on the central atom?
   a) 0 b) 1 c) 2 d) 4 e) 3

8. Consider the molecule ClF_2^- What is the **electron pair geometry**?
   a) octahedral
   b) tetrahedral
   c) linear
   d) trigonal bipyramidal
   e) trigonal planar

9. Consider the molecule ClF_2^- What is the **molecular geometry**?
   a) trigonal bipyramidal
   b) linear
   c) octahedral
   d) trigonal planar
   e) tetrahedral

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10. The CO bond in the molecule CH_2O is best described as a:

a) triple bond
b) ionic bond
c) single bond
d) double bond
e) the molecule doesn't exist

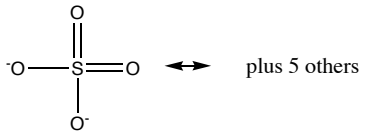
11. Which of the following has the lowest effective nuclear charge as seen by its outermost valence electrons?
a) F b) S c) O d) Si e) N

12. Which of the following has the highest electron affinity?
a) N b) F c) O d) Si e) S

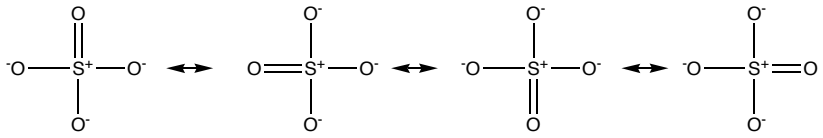
13. For the SO_4^{2-} molecule, how many equal-energy resonance structures can you draw?

a) 6 b) 1 c) 0 d) 2 e) 4

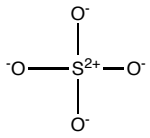
1)



2)



3)



The top set of 6 resonance structures is lowest in energy, in that charge separation is minimized and the negative charges are localized on O, which can stabilize charge the most. The second set of structures is higher in energy in that there is a positive charge on S, with more charge separation. The third structure is another valid resonance structure, but is still higher in energy, as there is more (unnecessary) separation of charge..

This question is harder than I intended. Consequently I gave full credit for any answer (but note that I may try to dissect the concepts here and come up with a better question in the future!)

14. Which of the following correctly compares atomic radii?
a) Ne < O < N < C < Be
b) Ne < Li < B < C < N
c) O < N < C < Be < Ne
d) Li < B < C < N < Ne
e) none of the above

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15. Which compound below does not exist?

a) BCl_3 b) KCl c) MgO d) CaF_4 e) BeF_2

16. Draw the Lewis structure for $\mathbf{NO_2^+}$ Your resulting molecule has a total of:
a) two triple bonds
b) one double and one triple bond
c) two single bonds
d) two double bonds
e) one single and one double bond

17. Draw the Lewis structure for $\mathbf{NO_2^+}$ In this structure, the formal charge on N is
a) -2 b) -1 c) 0 d) +1 e) +2

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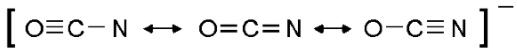
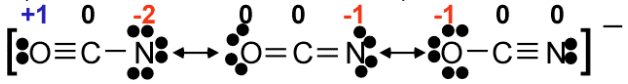
18. The molecule boron trifluoride BF_3 has what molecular structure?
    a) bent
    b) tetrahedral
    c) trigonal planar
    d) trigonal bipyramidal
    e) octahedral



19. (A) (B) (C)

    Which resonance form of OCN^- contributes most to the real molecule?
    a) A
    b) B
    c) C
    d) A and C same
    e) all same

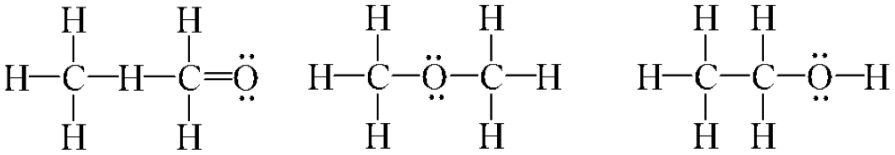


(A) (B) (C)

Choice A is higher in energy in that it places a double negative charge on N and a positive charge on O. This distribution is the opposite of what we'd want based on electronegativity.

20. How many lone pairs of electrons are assigned to the sulfur atom in H_2S?
    a) 0 b) 1 c) 2 d) 3 e) 4

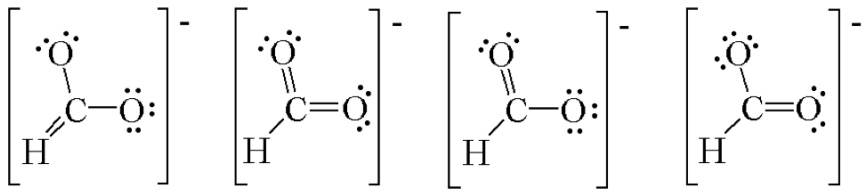
21. Which of the following are possible Lewis structures for C_2H_6O?



(1) (2) (3)

    a) 1
    b) 2
    c) 3
    d) 2 and 3
    e) 1, 2, and 3

22. Which of the following are resonance structures for formate ion, HCO_2^-?



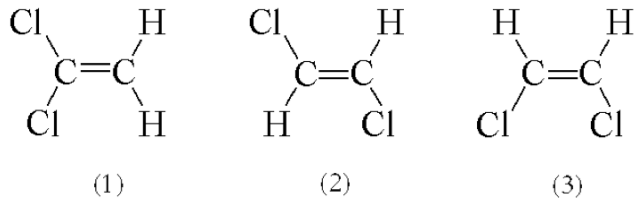
1 2 3 4

    a) 1 and 2
    b) 2 and 3
    c) 3 and 4
    d) 1, 3, and 4
    e) 2, 3, and 4

23. Electronegativity is a measure of
    a) the ability of an atom in a molecule to attract electrons to itself.

b) the oxidation number of an atom in a molecule or polyatomic anion.
c) the charge on an polyatomic anion.
d) the charge on a polyatomic cation.
e) the ability of a substance to conduct electricity.

24. Three possible structures of $C_2H_2Cl_2$ are shown below. Which of these molecules are polar?



(1) (2) (3)

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

We talked about this in class, and its presented in the text

25. What course is this?
a) Sports 01
b) Math 3.14159
c) Spy 007
d) Chem 111
e) Bio 152

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Answer Section

MULTIPLE CHOICE

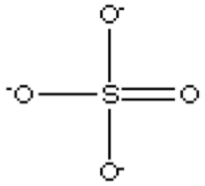
1. ANS: A PTS: 1
2. ANS: C PTS: 1
3. ANS: D

   $1s^2 2s^2 2p^2 3s^2 3p^4$ n=3 is the valence level. It has 6 valence electrons

   PTS: 1
4. ANS: E PTS: 1
5. ANS: D PTS: 1
6. ANS: E PTS: 1
7. ANS: E PTS: 1
8. ANS: D PTS: 1
9. ANS: B PTS: 1
10. ANS: D

    From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T.

    PTS: 1
11. ANS: D PTS: 1
12. ANS: B PTS: 1
13. ANS: E



    PTS: 1
14. ANS: A PTS: 1
15. ANS: D PTS: 1
16. ANS: D PTS: 1
17. ANS: D PTS: 1
18. ANS: C PTS: 1
19. ANS: C PTS: 1
20. ANS: C PTS: 1 TOP: 8.2 Covalent Bonding and Lewis Structures
21. ANS: D PTS: 1 TOP: 8.2 Covalent Bonding and Lewis Structures
22. ANS: C PTS: 1 TOP: 8.4 Resonance
23. ANS: A PTS: 1 TOP: 8.7 Bond Polarity and Electronegativity
24. ANS: C PTS: 1 TOP: 8.8 Bond and Molecular Polarity

25. ANS: D