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)									

c

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

1. Which element is represented by: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$
   a) I b) Po c) Te d) At e) Br

2. The correct spectroscopic notation for phosphorous ion (P^{2-}) is:
   a) $1s^2 2s^2 2p^6 3s^2 3p^6$
   b) $1s^2 2s^2 2p^6 3s^2 3p^2$
   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 P atom?
   a) 4 b) 6 c) 5 d) 10 e) 0

   $1s^2 2s^2 2p^2 3s^2 3p^3$ n=3 is the valence level. It has 5 valence electrons

4. Which of the following has the shortest bond length?
   a) SiH_4 b) PH_3 c) HCl d) AlH_3 e) H_2S

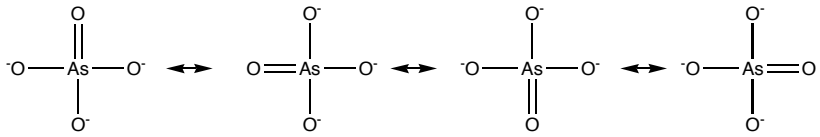
   Cl is the smallest of Al, Si, P, S, and Cl

5. Consider the molecule AsO_4^x, where x is the charge on the molecule. Which value of x (the net charge on the molecule) yields the most stable molecule? (Hint: draw Lewis structures to figure this one out)
   a) 0 b) -1 c) -2 d) +2 e) -3

6. For the AsO_4^x molecule, how many equal-energy resonance structures can you draw?
   a) 3 b) 6 c) 4 d) 1 e) 2

   One can construct at least 3 different views of this molecule

1)



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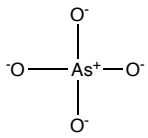
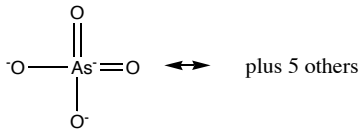


3)



The top set of 4 resonance structures is best, in that the negative charges are localized on O, which can stabilize charge the most. The second structure is another valid resonance structure, but is higher in energy than the first, as there is more (unnecessary) separation of charge. The last set of structures is still higher in energy in that negative charge is localized on As, which has lower electronegativity than O. So set (1) is the lowest energy set of equal energy resonance structures. Everyone got full credit for any answer.

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7. Consider the molecule ClF_5 How many lone **pairs** are on the central atom?
   a) 0 b) 1 c) 2 d) 3 e) 4

8. Consider the molecule ClF_5 What is the **electron pair geometry**?
   a) octahedral c) trigonal planar e) tetrahedral
   b) linear d) trigonal bipyramidal

9. Consider the molecule ClF_5 What is the **molecular geometry**?
   a) trigonal planar c) ~~trigonal bipyramidal~~ e) tetrahedral
   b) trigonal bipyramidal d) square pyramidal

10. The CO bond in the molecule CH_3OH is best described as a:

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

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

12. Which of the following has the lowest electron affinity?
    a) S b) Si c) Al d) Cl e) P

13. For the SO_3^{2-} molecule, how many equal-energy resonance structures can you draw?

    a) 6 b) 1 c) 3 d) 0 e) 2

    There are 3 equal energy resonance structures for structure 1, while there is only one resonance structure for structure 2. Structure one should be lower in energy, based on the fact that charge is minimally separated.

    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) O < N < C < Be < Ne
    b) Li < B < C < N < Ne
    c) Ne < Li < B < C < N
    d) Ne < O < N < C < Be
    e) none of the above

15. Which compound below does not exist?

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

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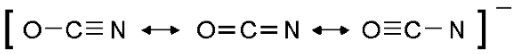
16. Draw the Lewis structure for $\mathbf{NO_2^-}$ For any **one** of the most stable resonace forms, your resulting molecule has a total of:
    a) one double and one triple bond
    b) one single and one double bond
    c) two double bonds
    d) two single bonds
    e) two triple bonds

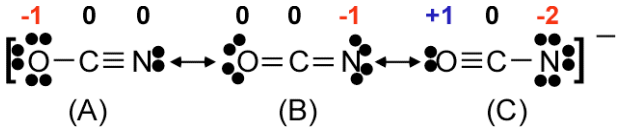
17. Draw a lowest energy Lewis structure for $\mathbf{NO_2^-}$ In this structure, the formal charge on N is
    a) -2 b) -1 c) 0 d) +1 e) +2

18. The molecule carbon tetrachloride CCl_4 has what molecular structure?
    a) tetrahedral
    b) trigonal planar
    c) bent
    d) octahedral
    e) trigonal bipyramidal



19. (A) (B) (C)

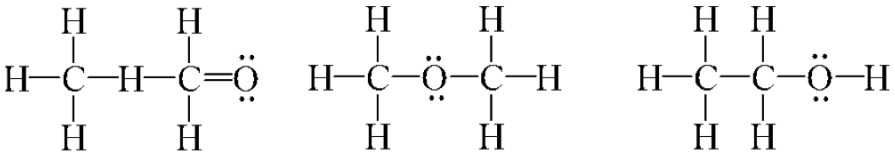
    Which resonance form of OCN^- contributes most to the real molecule?
    a) A
    b) B
    c) C
    d) A and C same
    e) all same



Choice C is bad 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

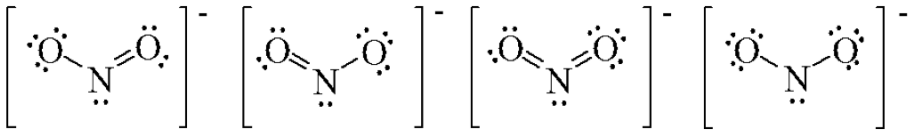
21. Which of the following are possible Lewis structures for C_2H_6O?



(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 nitrite ion, NO_2^-?

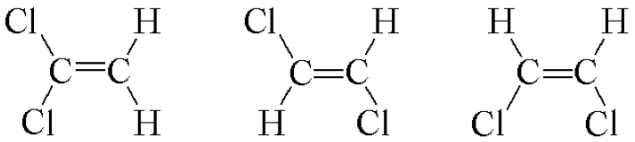


(1) (2) (3) (4)

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

23. Electronegativity is a measure of
a) the charge on a polyatomic cation.
b) the charge on an polyatomic anion.
c) the ability of a substance to conduct electricity.
d) the oxidation number of an atom in a molecule or polyatomic anion.
e) the ability of an atom in a molecule to attract electrons to itself.

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
d) 3 only
e) 2 and 3

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

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Evening Exam 2
Answer Section

MULTIPLE CHOICE

1. ANS: E PTS: 1
2. ANS: D PTS: 1
3. ANS: C
   $1s^2 2s^2 2p^2 3s^2 3p^3$ n=3 is the valence level. It has 5 valence electrons

   PTS: 1
4. ANS: C PTS: 1
5. ANS: E PTS: 1
6. ANS: C PTS: 1
7. ANS: B PTS: 1
8. ANS: A PTS: 1
9. ANS: D PTS: 1
10. ANS: A
    From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T.

    PTS: 1
11. ANS: E PTS: 1
12. ANS: C PTS: 1
13. ANS: B PTS: 1
14. ANS: D PTS: 1
15. ANS: A PTS: 1
16. ANS: B PTS: 1
17. ANS: C PTS: 1
18. ANS: A PTS: 1
19. ANS: A 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: A PTS: 1 TOP: 8.4 Resonance
23. ANS: E PTS: 1 TOP: 8.7 Bond Polarity and Electronegativity
24. ANS: C PTS: 1 TOP: 8.8 Bond and Molecular Polarity
25. ANS: C PTS: 1