Chem 111 9:05a section Evening Exam #2v4

This exam is composed of **25** questions. 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 on 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 $E = hv = \frac{hc}{\lambda}$
 $1 \text{ mL} = 1 \text{ cm}^3$
 $\text{Hz} = \text{s}^{-1}$ $h = 6.626 x 10^{-34} J s$
 $c = 2.998 x 10^8 m s^{-1}$
 $N = 6.022 x 10^{23} mol^{-1}$

- 1. How many valence electrons are in the S atom?
 - 1) 2 2) 3 3) 8 4) 6 5) 4 (4) $1s^2s^2p^23s^2p^4$ n=2 is the valence level. It has 6 electrons
- 2. Which atom(s) has/have completely filled 3s, 3p, and 3d orbitals?
 - 1) Ar 2) Zn 3) Kr 4) Kr & Zn 5) Ar & Zn (4) Ar: $1s^{2}2s^{2}2p^{6}3s^{2}3p^{6}$ Zn: $1s^{2}2s^{2}2p^{6}3s^{2}3p^{6}3d^{1}4s^{2}$ Kr: $1s^{2}2s^{2}2p^{6}3s^{2}3p^{6}3d^{1}4s^{2}4p^{6}$

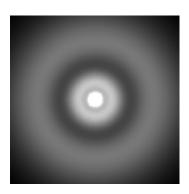
3. Which element is represented by: $1s^22s^22p^63s^23p^63d^{10}4s^24p^64d^{10}5s^25p^4$

1) As 2) Se 3) Br 4) Sb 5) Te

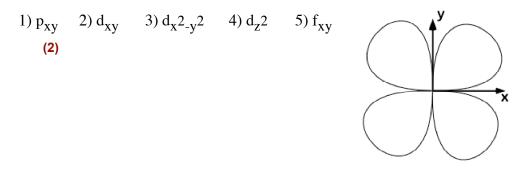
(5) See p297 to check, but you can read this off the organization of the periodic table.

4. The orbital depicted at right is:

1) 1s 2) 2p 3) 3s 4) 3p 5) 4p (3) 3s - 2 spherical nodes, 0 planar nodes



5. The orbital depicted at right is:



6. Which of the following quantum number sets is *not* allowed?

1) n=+3 l=+2 m_l = -1 m_s = +1/2 2) n=+2 l=+2 m_l = -1 m_s = +1/2 3) n=+3 l=+1 m_l = -1 m_s = -1/2 4) n=+2 l=0 m_l = 0 m_s = +1/2 5) n=+3 l=0 m_l = 0 m_s = -1/2 (2) l=0 ... n-1 therefore, with n=2, l cannot be 2

- 7. What is the maximum number of orbitals that can be identified by the set of quantum numbers n=+3 l=+1?
 - 1) 2
 2) 3
 3) 5
 4) 6
 5) 7

(2) for l = 1, one can have $m_l = -1, 0, +1$ (3 orbitals, with 6 electrons)

- 8. Which of the following has the shortest bond length?
 - 1) H_2O 2) NH_3 3) HF 4) CH_4

(3) F is smallest of F, O, N, and C. This allows H and F to approach closest, given that all are *single* bonds.

- 9. Which of the following has the highest bond energy?
 - 1) N_2 2) C_2 3) B_2 4) O_2 5) F_2 (1) N_2 – triple bond OWL 9-xx
- 10. The CO bond in the molecule CH_3O^- is best described as a:

| 1) ionic bond | 2) double bond |
|----------------|----------------|
| 3) triple bond | 4) single bond |

5) the molecule doesn't exist

(4) From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T. This and the following 3 questions are basic exercises in drawing Lewis structures.

- 11. Consider the molecule SO₃^x, where x is the charge on the molecule. All three bonds are single bonds. Which value of x yields the stable molecule? (Hint: draw Lewis structures to figure this one out)
 - 1) +2 2) +1 3) 0 4) -1 5) -2 (5)
- 12. For the SO₃^x molecule above, how many equal-energy resonance structures can you draw?
 - 1) 1 2) 2 3) 3 4) 4 5) 6 (1)
- 13. The NO bond in HNO is a:
 - single bond
 double bond
 triple bond
 ionic bond
 From OWL units 9-1d and 9-2b. See Study Questions 13-14, Chapter 9 of K&T
- 14. If an element with the valence configuration $4s^23d^7$ loses 2 electron(s), these electron(s) would be removed from the following subshell(s).

1) 4s 2) 3d 3) 4s and 3d 4) 3p 5) 4p (1) From OWL Unit 8-7d

15. Which molecule below does not exist?

- 16. Draw a stable Lewis structure for the symmetrical molecule **hydrogen peroxide** O_2H_2 . In this structure, how many *lone pair electrons* are on *each* O?
 - 1) 1 2) 2 3) 6 4) 3 5) 4 H - O - H
- 17. Draw a stable Lewis structure for the molecule **OCS**. In this structure (with C at the center), what is the bond order between C and S?

 1) 1
 2) 2
 3) 3
 4) 0.5
 5) 1.5

(2) This is isoelectronic with CO₂

18. Draw the best Lewis structure for NF₂⁻. How many lone pair electrons are located on N?

1) 1 2) 2 3) 3 4) 4 5) 6 (5) $F - \ddot{N} - F$

19. For the molecule NF_2^{-} , what is the electron group geometry of N?

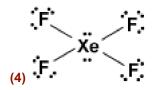
| 1) linear | 2) tetrahedral | 3) trigonal planar |
|-------------------------|----------------|--------------------|
| 4) trigonal bipyramidal | 5) octahedral | |
| (2) | | |

- 20. In the molecule NO_2^+ , the actual bond order for each NO bond is:
 - 1) 1 2) 2 3) 3 4) 1.5
 - 5) 1 for one bond and 2 for the other

(2) see above OWL 9-4

- 21. Draw the Lewis structure for XeF_4 . The electron group geometry is:
 - 1) square planar2) square pyramidal3) trigonal bipyramidal
 - 4) octahedral

5) none of the above



OWL 9-xx

| | Bon |) (gas phase) | | |
|------|-----|---------------|------|-----|
| Bond | D | Bond D | Bond | D |
| H-H | 436 | C-C 346 | N-N | 163 |
| C-H | 413 | C=C 610 | N=N | 418 |
| N-H | 391 | O-O 146 | C-O | 358 |
| O-H | 463 | O=O 498 | C=O | 745 |

22. Consider the reaction: $H_2NNH_2(g) + H_2(g) \rightarrow 2 NH_3(g)$

What is the energy $(\Delta H^{\circ}, \text{ in kJ mol}^{-1})$ for this reaction?

1) -183 2) +183 3) -163 4) +163 5) -273

5) -1 for one O and 0 for the other O

(Questions 23-24) Consider the following resonance forms for the ion ONC⁻

$$\dot{O} = N = \dot{C} \leftrightarrow :O \equiv N - \ddot{C} \leftrightarrow :\ddot{O} = N \equiv C$$

(a) (b) (c)

23. In resonance structure **c**, what is the formal charge on C?

1)
$$-3$$
 2) -2 3) -1 4) 0 5) $+1$
(3)

24. Which resonance structure is lower in energy, b or c?
1) c
2) b
3) neither, they have the same energy
(1)

25. The correct designator for this course is:

1) Chem 363 2) Sports 99 3) Econ 3.33 4) Chem 111 (4)

Name: _____

| PERIODIC TABLE OF THE ELEMENTS | | | | | | | | | | | | | | | | | |
|--------------------------------|---------------------|----------|------------|---------------------|------------|---------------------|------------|------------|---------------------|----------|---------------------|------------|------------|----------|----------|----------|---------------------|
| 1A | 2A | 3B | 4B | 5B | 6B | 7B | 8B | 8B | 8B | 1B | 2B | 3 A | 4 A | 5A | 6A | 7A | 8A |
| 1 H | | | | | | | | | | | | | | | | | 2 He |
| 1.008 | | - | | | | | | | | | | | | | | | 4.003 |
| 3 Li | 4 Be | | | | | | | | | | | 5 B | 6 C | 7 N | 8 0 | 9 F | 10 Ne |
| 6.939 | 9.012 | | | | | | | | | | | 10.81 | 12.01 | 14.01 | 16.00 | 19.00 | 20.18 |
| 11 Na | 12 Mg | | | | | | | | | | | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| 22.99 | 24.31 | | - | r | n | 1 | 1 | r | 1 | 1 | - | 26.98 | 28.09 | 30.97 | 32.07 | 35.45 | 39.95 |
| 19 K | ²⁰ Ca | 21 Sc | 22 Ti | 23 V | 24 Cr | ²⁵ Mn | 26 Fe | 27 Co | 28 Ni | 29 Cu | ³⁰ Zn | 31 Ga | 32 Ge | 33 As | 34 Se | 35 Br | 36 Kr |
| 39.10 | 40.08 | 44.96 | 47.90 | 50.94 | 52.00 | 54.94 | 55.85 | 58.93 | 58.71 | 63.55 | 65.39 | 69.72 | 72.61 | 74.92 | 78.96 | 79.90 | 83.80 |
| 37 Rb | 38 Sr | 39 Y | 40 Zr | 41 Nb | 42 Mo | 43 Tc | 44 Ru | 45 Rh | 46 Pd | 47 Ag | 48 Cd | 49 In | 50 Sn | 51 Sb | 52 Te | 53 I | 54 Xe |
| 85.47 | 87.62 | 88.91 | 91.22 | 92.91 | 95.94 | (99) | 101.1 | 102.9 | 106.4 | 107.9 | 112.4 | 114.8 | 118.7 | 121.8 | 127.6 | 126.9 | 131.3 |
| 55 Cs | 56 Ba | 57 La | 72 Hf | ⁷³ Ta | 74 W | 75 Re | 76 Os | 77 Ir | ⁷⁸ Pt | 79 Au | 80 Hg | 81 Tl | 82 Pb | 83 Bi | 84 Po | 85 At | ⁸⁶ Rn |
| 132.9 | 137.3 | 138.9 | 178.5 | 181.0 | 183.8 | 186.2 | 190.2 | 192.2 | 195.1 | 197.0 | 200.6 | 204.4 | 207.2 | 209.0 | (209) | (210) | (222) |
| ⁸⁷ Fr | ⁸⁸ Ra | 89 Ac | 104 Unq | 105 Unp | 106 Unh | 107 Uns | 108 Uno | 109 Une | | | | | | | | | |
| (223) | 226.0 | 227.0 | (261) | (262) | (263) | (262) | (265) | (266) | | | | | | | | | |