 Name: _____

Chem 111 *REVISED* 9:05a section Evening Exam #2v1

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 regulations.

$E = h\nu = \frac{hc}{\lambda}$

1 mL = 1 cm^3

Hz = s^{-1}

$h = 6.626x10^{-34}\ J\ s$

$c = 2.998x10^{8}\ m\ s^{-1}$

$N = 6.022x10^{23}\ mol^{-1}$

1. How many valence electrons are in the O atom?

   1) 4 2) 6 3) 8 4) 16 5) 0

   (2) $1s^2 2s^2 2p^4$ 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) Ar & Zn 5) Kr & Zn

   (5) **Ar:** $1s^2 2s^2 2p^6 3s^2 3p^6$ **Zn:** $1s^2 2s^2 2p^6 \mathbf{3s^2 3p^6 3d^{10}} 4s^2$

   Kr: $1s^2 2s^2 2p^6 \mathbf{3s^2 3p^6 3d^{10}} 4s^2 4p^6$

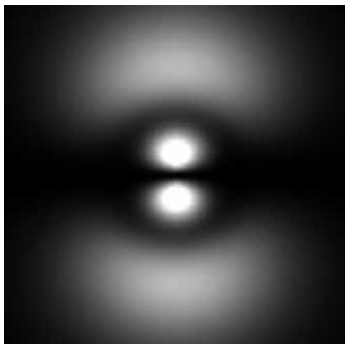
3. Which element is represented by: $\mathbf{1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3}$

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

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

 Name: _____

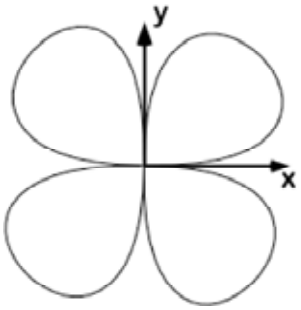
4. The orbital depicted at right is:



1) 1s 2) 2p 3) 3s 4) 3p 5) 4p

(4) 3p – 1 spherical node, 1 planar node

5. The orbital depicted at right is:



1) p_{xy} 2) d_{xy} 3) $d_{x^2-y^2}$ 4) d_{z^2} 5) f_{xy}

(2)

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=+1 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 = -1 m_s = +1/2

5) n=+3 l=0 m_l = 0 m_s = -1/2

(4) m_l = -l…0…l therefore, with l=0, m_l cannot be -1

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

1) 7 2) 2 3) 3 4) 5 5) 10

(4) for l = 2, one can have m_l = -2, -1, 0, +1, +2 (5 orbitals, with 10 electrons)

8. Which of the following has the shortest bond length?

1) H_2O 2) HF 3) NH_3 4) CH_4

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

 Name: _____

9. Which of the following has the highest bond energy?

1) B_2 2) C_2 3) N_2 4) O_2 5) F_2

(3) N_2 – triple bond OWL 9-xx

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

1) triple bond
2) double bond
3) single bond
4) ionic bond
5) the molecule doesn't exist

(3) 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 SO_3^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 SO_3^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:

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

(2) 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 **$4s^2 3d^7$** 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?

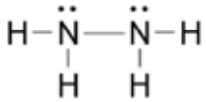
1) BeF_2 2) CaF_4 3) MgO 4) KCl 5) BCl_3

(2) See Study Question 33, Chapter 9 of K&T – think about ionization required to make ionic compounds (Chapt 9.3)

 Name: _____

16. Draw a stable Lewis structure for the symmetrical molecule **hydrazine** N_2H_4. In this structure, how many ***lone pair electrons*** are on ***each*** N?

1) 1 2) 2 3) 3 4) 4 5) 6



(2)

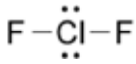
17. Draw a stable Lewis structure for the molecule **OCS**. In this structure (with C at the center), what is the bond order between C and O?

1) 1 2) 1.5 3) 2 4) 2.5 5) 3

(3) This is isoelectronic with CO_2

18. Draw the best Lewis structure for $\mathbf{ClF_2^+}$. How many **lone pair electrons** are located on Cl?

1) 1 2) 2 3) 3 4) 4 5) 6

(4) 

19. For the molecule $\mathbf{ClF_2^+}$, what is the electron group geometry of Cl?

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

(2)

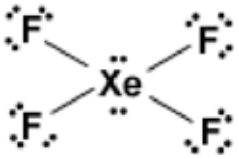
20. In the molecule $\mathbf{NO_2^+}$, the actual bond order for each NO bond is:

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 $\mathbf{XeF_4}$. The electron group geometry is:

1) square planar 2) square pyramidal 3) trigonal bipyramidal
4) octahedral 5) none of the above



(4) **OWL 9-xx**

 Name: _____

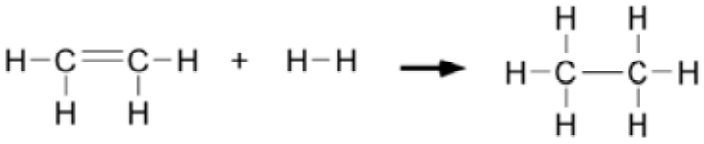
Bond Dissociation Energies (kJ mol^{-1}) (gas phase)

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_2CCH_2 (g) + H_2 (g) → CH_3CH_3 (g)

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

1) –126 2) +346 3) –44 4) +44 5) –480

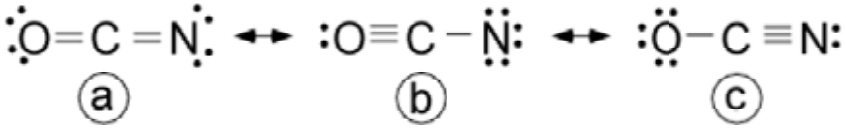


(1)

$\Delta H°$ = (Bonds Broken) – (Bonds Formed)

$\Delta H° = (D_{C=C} + D_{H-H}) - (2D_{C-H} + D_{C-C}) = (610 + 436) - [\ 2(413) + 346] = -126$ kJ mol^{-1}

(Questions 23-24) Consider the following resonance forms for the ion OCN^-



23. In resonance structure **b**, what is the formal charge on O?

1) –3 2) –2 3) –1 4) 0 5) +1

(5)

24. Which resonance structure is higher in energy, **b** or **c**?

1) b 2) c 3) neither, they have the same energy

(1)

25. The correct designator for this course is:

1) Chem 111 2) Chem 363 3) Econ 3.33 4) Sports 01

(1)

Name: _____

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)									