EXAM 4 CH101.004 (Blackstock) November 30, 2006

*Student name (print):*_____ honor pledge: _____

1. Which of these choices is the general electron configuration for the outermost electrons of elements in the alkaline earth group?
A. ns^1
B. ns^2
C. ns^2np^4
D. ns^2np^5
E. $ns^2np^6(n-1)d^6$

2. Consider the element with the electron configuration $[Xe]6s^24f^7$. This element is
A. a representative element.
B. a lanthanide element.
C. a nonmetal.
D. an actinide element .
E. a noble gas.

3. The representative elements are those with unfilled energy levels in which the "last electron" was added to
A. an *s* orbital.
B. an *s* or *p* orbital.
C. a *d* orbital.
D. a *p* or *d* orbital.
E. an *f* orbital.

4. Which of these species make an *isoelectronic pair*: Cl^-, O^{2-}, F, Ca^{2+}, Fe^{3+}?
A. Ca^{2+} and Fe^{3+}
B. O^{2-} and F
C. F and Cl^-
D. Cl^- and Ca^{2+}
E. none of these

5. Which one of these ions has the largest radius?
A. Cl^-
B. K^+
C. S^{2-}
D. Na^+
E. O^{2-}

6. Which of these elements has the greatest electron affinity (largest positive value)?
A. Mg
B. Al
C. Si
D. P
E. S

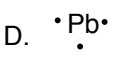
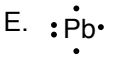
7. The first ionization energy of sodium is 495.9 kJ/mol. The energy change for the reaction $Na(s) \text{ ----> } Na^+(g) + e^-$ is therefore
A. 495.9 kJ/mol.
B. less than 495.9 kJ/mol.
C. greater than 495.9 kJ/mol.
D. equal to the electron affinity of sodium.
E. equal to the 2nd ionization energy of sodium.

8. Which of these compounds is most likely to be ionic?
A. KF
B. CCl_4
C. CS_2
D. CO_2
E. ICl

9. Which of these compounds is most likely to be ionic?
A. NCl_3
B. $BaCl_2$
C. CO
D. SO_2
E. SF_4

10. Which of these compounds is most likely to be covalent?
A. Rb_2S
B. $SrCl_2$
C. CS_2
D. CaO
E. MgI_2

11. The Lewis dot symbol for the a lead atom is

A. 
B. 
C. 
D. 
E. 

12. Calculate the energy change for the reaction

$$K(g) + Br(g) \text{ -----> } K^+(g) + Br^-(g)$$

given the following ionization energy (IE) and electron affinity (EA) values

	IE (kJ/mol)	EA (kJ/mol)
K:	419	48
Br:	1140	324

A. -1,092 kJ/mol
B. -95 kJ/mol
C. 95 kJ/mol
D. 1,092 kJ/mol
E. 1,187 kJ/mol

13. Which of these elements has the *greatest* electronegativity?
A. Mg
B. Ga
C. Si
D. Ba
E. Pb

14. Which of these bonds would have the *greatest* polarity (i.e., highest percent ionic character)?
A. S-P
B. Si-S
C. Si-Se
D. Si-Cl
E. Si-I

15. The total number of bonding electrons in a molecule of formaldehyde (H_2CO) is
A. 3.
B. 4.
C. 6.
D. 8.
E. 18.

16. The total number of lone pairs in NCl_3 is
A. 6.
B. 8.
C. 9.
D. 10.
E. 13.

17. The number of resonance structures for the nitrate ion needed to illustrate that all three NO bonds are equivalent is:
A. 1.
B. 2.
C. 3.
D. 4.
E. none of these.

18. How many covalent bonds will a neutral nitrogen atom usually form in a stable molecule?
A. 1
B. 2
C. 3
D. 5
E. 8

19. What is the formal charge on the central nitrogen atom in N_2O (the atomic order is N-N-O)?
A. 0
B. +1
C. -1
D. -2
E. +2

20. What is the formal charge on the singly bonded oxygens in the Lewis structure for the carbonate ion?
A. -2
B. -1
C. 0
D. +1
E. +2

21. Each of the three resonance structures of NO_3^- has how many lone pairs of electrons?

A. 7
B. 8
C. 9
D. 10
E. 13

22. Which of these molecules has an atom with an incomplete octet?
A. NF_3
B. H_2O
C. $AsCl_3$
D. GeH_4
E. BF_3

23. Which of these molecules has an atom with an expanded octet?
A. HCl
B. $AsCl_5$
C. ICl
D. NCl_3
E. Cl_2

24. Use bond energies to estimate the enthalpy change for the reaction of one mole of CH_4 with chlorine gas to give CH_3Cl and hydrogen chloride.

BE(C-H) = 414 kJ/mol
BE(C-Cl) = 326 kJ/mol
BE(H-Cl) = 432 kJ/mol
BE(Cl-Cl) = 243 kJ/mol

A. -101 kJ/mol
B. -106 kJ/mol
C. +331 kJ/mol
D. +106 kJ/mol
E. +101 kJ/mol

25. According to the VSEPR theory, the shape of the SO_3 molecule is
A. pyramidal.
B. tetrahedral.
C. trigonal planar.
D. distorted tetrahedron (seesaw).
E. square planar.

26. The shape of the SF_4 molecule is
A. tetrahedral.
B. trigonal pyramidal.
C. trigonal planar.
D. square planar.
E. distorted tetrahedron (seesaw).

27. According to VSEPR theory, the shape of the PH_3 molecule is best described as
A. linear.
B. trigonal planar.
C. tetrahedral.
D. bent.
E. trigonal pyramidal.

28. The shape of the ClF_3 molecule is best described as
A. distorted tetrahedron.
B. trigonal planar.
C. tetrahedral.
D. T-shaped.
E. trigonal pyramidal.

29. According to the VSEPR theory, the molecular shape of the carbonate ion, CO_3^{2-}, is
A. square planar.
B. tetrahedral.
C. pyramidal.
D. trigonal planar.
E. octahedral.

30. According to the VSEPR theory, which one of the following species should be *linear*?
A. H_2S
B. HCN
C. BF_3
D. H_2CO
E. SO_2

31. According to VSEPR theory, which one of the following molecules has tetrahedral geometry?
A. NH_3
B. CCl_4
C. CO_2
D. SF_4
E. PCl_5

32. Which of the following substances is/are *bent*?
(i) H_2S (ii). CO_2 (iii) ClNO (iv) NH_2^- (v) O_3

A. only (iii)
B. only (i) and (v)
C. only (i), (iii), and (v)
D. all are bent except for (iv)
E. all are bent except for (ii)

33. The bond angle in Cl_2O is expected to be approximately
A. 90.
B. 109.5.
C. 120.
D. 145.
E. 180.

34. The F-S-F bond angles in SF_6 are
A. 90 and 180.
B. 109.5.
C. 120.
D. 180.
E. 90 and 120.

35. The C-N-O bond angle in nitromethane, CH_3NO_2, is expected to by approximately
A. 60.
B. 90.
C. 109.5.
D. 120.
E. 180.

36. Complete this sentence: The PCl_5 molecule has
A. nonpolar bonds, and is a nonpolar molecule.
B. nonpolar bonds, but is a polar molecule.
C. polar bonds, and is a polar molecule.
D. polar bonds, but is a nonpolar molecule.

37. Predict the molecular geometry and polarity of the SO_2 molecule.
A. linear, polar
B. linear, nonpolar
C. bent, polar
D. bent, nonpolar
E. none of these

name: _____

Multiple choice score (74 pts) _____, Short answer score (31 pts) _____, total _____

Short Answer:

1. (18 pts) Write proper Lewis structures for the following "stable" molecules. Be sure to include any formal charges on atoms and all valence electrons in your structures. Accurate molecule geometries are not required here (but are welcome!).

XeF_4	$(CH_3CO_2)^-$	CH_2CCH_2
zenon tetrafluoride	acetate anion (two resonance structures)	allene

$CH_3CO_2CH_3$	C_5H_8O	CH_3CH_2OH
methylacetate	cyclopentanone (ring of 5 C's)	ethanol

CH_3NO_2
nitromethane (provide two resonance structures here)

2. (7 pts) Of the above, which would have a dipole moment (name them here).

3. (6 pts) Write Lewis structures for the following stable compounds and then draw a picture of the molecule with accurate geometries at the atoms (also indicate the geometry at each atom in words). Be sure to show all valence electrons and any formal charges.

CH_3CCH
propyne

(NH_4) (HCO_3)
ammonium bicarbonate salt
(draw separate structure/picture for each ion)

PERIODIC TABLE

PERIOD	GROUP I A	II A	III A	IV A	V A	VI A	VII A	←VIII A→	I B	II B	III B	IV B	V B	VI B	VII B	VIII B
																2 He 4.0026
	3 Li 6.941	4 Be 9.012									5 B 10.811	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.180
	11 Na 22.99	12 Mg 24.305									13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.066	17 Cl 35.453	18 Ar 39.948
	19 K 39.098	20 Ca 40.078	21 Sc 44.955	22 Ti 47.88	23 V 50.941	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.39	31 Ga 69.723	32 Ge 72.610	33 As 74.921	34 Se 78.960	35 Br 79.904	36 Kr 83.80
	37 Rb 85.468	38 Sr 87.620	39 Y 88.906	40 Zr 91.224	41 Nb 92.906	42 Mo 95.940	43 Tc (97.907)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.29
	55 Cs 132.91	56 Ba 137.33	57 La* 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.20	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.20	83 Bi 208.98	84 Po (208.99)	85 At (209.99)	86 Rn (222.02)
	87 Fr (223.02)	88 Ra (226.03)	89 Ac** (227.03)	104 Unq (261.11)	105 Unp (262.11)	106 Uns (262.12)												

Metals | Nonmetals

d Transition Elements

Gas — Liquid — 34 Se 78.96 — Atomic number — Atomic mass (g mol^{-1})

f Transition Elements

***Lanthanides (Rare Earths)**	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (144.92)	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.94	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
****Actinides**	90 Th 232.04	91 Pa (231.04)	92 U (238.05)	93 Np (237.05)	94 Pu (244.06)	95 Am (243.06)	96 Cm (247.07)	97 Bk (247.07)	98 Cf (242.06)	99 Es (252.08)	100 Fm (257.10)	101 Md (258.10)	102 No (259.10)	103 Lr (260.11)

From *Principles of Electronic Materials and Devices, Second Edition*, S.O. Kasap (© McGraw-Hill, 2002)
http://Materials.Usask.Ca

exam 4 Key

1.B

2.B

3.B

4.D

5.C

6.E

7.C

8.A

9.B

10.C

11.C

12.C

13.C

14.D

15.D

16.D

17.C

18.C

19.B

20.B

21.B

22.E

23.B

24.A

25.C

26.E

27.E

28.D

29.D

30.B

31.B

32.E

33.B

34.A

35.D

36.D

37.C