

**Chem 127**  
**Prof. Mark Jensen**  
**Exam #3**  
**12/3/04**

Name \_\_\_\_\_

Pledge:

When you have completed this exam, please consider the following:

*I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this exam.*

Signed \_\_\_\_\_

Answer the questions on the following pages, paying strict attention to significant figures where applicable. Answers given without supporting work WILL NOT be given full credit.

Some potentially useful information:  $N = 6.022 \times 10^{23}$   $c = 3.00 \times 10^8$  m/s

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$C(\text{H}_2\text{O}) = 4.184 \text{ J/g}\cdot\text{K}$$

$$E_n = -\frac{2.18 \times 10^{-18} \text{ J}}{n^2}$$

1											18						
IA											VIIIA						
1 H 1.008	2 He 4.00											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
3 Li 6.94	4 Be 9.01											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	3 III B	4 IV B	5 V B	6 VI B	7 VII B	8 -	9 VIII B	10 -	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	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 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.91	36 Kr 83.30
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 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30
55 Cs 132.91	56 Ba 137.34	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.98	84 Po 210	85 At 210	86 Rn 222
87 Fr 223	88 Ra 226.03	103 Lr 262.1	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt									

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu 239.05	95 Am 241.06	96 Cm 247.07	97 Bk 249.08	98 Cf 251.08	99 Es 254.09	100 Fm 257.10	101 Md 258.10	102 No 255

1. (26 pts) Fill in the following table:

Bond Pairs	Lone Pairs	Total e <sup>-</sup> pairs	Name of Molecular Shape	Polar? (Yes or No) [Assume AX <sub>n</sub> where n = number of bond pairs, A and X are atoms with differing electronegativities]
2	0	2		
3	0	3		
2	1	3		
4	0	4		
3	1	4		
2	2	4		
5	0	5		
4	1	5		
3	2	5		
2	3	5		
6	0	6		
5	1	6		
4	2	6		

2. (8 pts) The human eye is a complex sensing device for visible light. The optic nerve needs a minimum of  $2.0 \times 10^{-17}$  J of energy to trigger a series of impulses that eventually reaches the brain. How many photons of blue light at 475 nm are needed?

3. (16 pts) Use noble gas cores to give the electron configuration for each of the following:

a) Cu

b)  $\text{Cd}^{2+}$

c) Bi

d)  $\text{Se}^{2-}$

4. (16 pts) Use orbital box notation to give the complete electron configuration for an atom of oxygen.

Label the electrons 1-8 in the orbital box diagram above, then fill in the table below with acceptable values for each quantum number:

electron #	n	$\ell$	$m_\ell$	$m_s$
1				
2				
3				
4				
5				
6				
7				
8				

5. (14 pts) Answer true (T) or false (F) to each of the following:

- \_\_\_\_\_ The Schrodinger equation treats the electron as both a particle and a wave.
- \_\_\_\_\_ The Schrodinger equation can only be solved for 1-electron species.
- \_\_\_\_\_ The de Broglie wavelength of a particle increases as the mass of the particle decreases.
- \_\_\_\_\_ A neon gas light is a good example of black body radiation.
- \_\_\_\_\_ The visible portion of the electromagnetic spectrum is generally considered to be 400-700 nm.
- \_\_\_\_\_ The Heisenberg Uncertainty Principle states that is impossible to simultaneously know both the position and the energy of an electron in an atom.
- \_\_\_\_\_ The photoelectric effect occurs when light strikes the surface of a metal and neutrons are ejected.

6. (24 pts) Fill in the following table

Compound	Lewis Structure	Name of Molecular Shape	Polar?
SF <sub>6</sub>			
SF <sub>4</sub>			
SF <sub>2</sub>			

7. (12 pts) The arsenate ion has the formula  $\text{AsO}_4^{3-}$ .
- Draw the best Lewis structure for arsenate, along with all equivalent resonance structures.
  - Indicate all non-zero formal charges.
  - What is the bond order of the As–O bond?
8. (10 pts) Two different Lewis structures can be written for the square planar molecule  $\text{PtCl}_2\text{Br}_2$ . (The platinum atom is central in each structure.)
- a) Draw each Lewis structure. (Assume Pt will have two lone pairs in each.)
- b) Are either of the compounds polar? Explain.

9. (10 pts) How many orbitals in an atom can have each of the following designations:

a) 5f

b) 2d

c)  $n = 2, m_\ell = 1$

d) 4p

e)  $n = 5$

10. (15 pts) Fill in each of the following blanks with either exothermic or endothermic. Be sure to indicate the phase (s,  $\ell$ , g) of each reactant and product when writing the subsequent balanced equations.

a) First ionization energies are always \_\_\_\_\_.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the first ionization energy for potassium:

b) Electron affinities are always \_\_\_\_\_.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the ion pair energy for bromine:

c) Ion pair energies are always \_\_\_\_\_.

Write the balanced reaction for which  $\Delta H$  (or  $\Delta E$ ) is the ion pair energy for KBr:

**Remember to consider the pledge!!**