

# Chemistry 150

# Exam 4

Be sure to put your name on each page. This page can be removed from your exam so that you will have a Periodic Table handy throughout the exam, it does not need to be turned in. Show all your work for non-multiple choice problems which require any sort of calculation, no credit will be given for answers without work shown. If you have shown a significant amount of work or multiple drawings for a problem, draw a box around what you consider your final answer.

Avogadro's Number =  $6.022 \times 10^{23}$  units/mol

$h = 6.626 \times 10^{-34}$  Jsec

$32.00^\circ\text{F} = 0.000^\circ\text{C} = 273.15\text{K}$

$\lambda = h/mv$

1 foot = 12 inches

1 J = 1 kg (m/sec)<sup>2</sup>

1 inch = 2.54cm (exactly)

$c = \lambda\nu = 3.00 \times 10^8$  m/sec

1 pound = 453.6 g = 16 ounces

$E_{\text{photon}} = h\nu$

1 amu =  $1.6605 \times 10^{-24}$  g

Masses of subatomic particles:

Proton  $1.00728\text{amu} = 1.6726 \times 10^{-24}$  g

Neutron  $1.00866\text{amu} = 1.6749 \times 10^{-24}$  g

Electron  $0.000549\text{amu} = 9.1094 \times 10^{-28}$  g

Density of Water =  $1.000^{\text{g}}/\text{mL}$

$R = 0.08206$  L $\cdot$ atm/mol $\cdot$ K

$PV = nRT$

1 calorie = 4.184 J = 0.001 Calorie

1 <b>H</b> 1.0079																	2 <b>He</b> 4.0026
3 <b>Li</b> 6.941	4 <b>Be</b> 9.0122											5 <b>B</b> 10.811	6 <b>C</b> 12.011	7 <b>N</b> 14.007	8 <b>O</b> 15.999	9 <b>F</b> 18.998	10 <b>Ne</b> 20.180
11 <b>Na</b> 22.990	12 <b>Mg</b> 24.305											13 <b>Al</b> 26.982	14 <b>Si</b> 28.086	15 <b>P</b> 30.974	16 <b>S</b> 32.066	17 <b>Cl</b> 35.453	18 <b>Ar</b> 39.948
19 <b>K</b> 39.098	20 <b>Ca</b> 40.078	21 <b>Sc</b> 44.956	22 <b>Ti</b> 47.88	23 <b>V</b> 50.942	24 <b>Cr</b> 51.996	25 <b>Mn</b> 54.938	26 <b>Fe</b> 55.847	27 <b>Co</b> 58.933	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.546	30 <b>Zn</b> 65.39	31 <b>Ga</b> 69.723	32 <b>Ge</b> 72.61	33 <b>As</b> 74.922	34 <b>Se</b> 78.96	35 <b>Br</b> 79.904	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.468	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.906	40 <b>Zr</b> 91.224	41 <b>Nb</b> 92.906	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.07	45 <b>Rh</b> 102.91	46 <b>Pd</b> 106.42	47 <b>Ag</b> 107.87	48 <b>Cd</b> 112.41	49 <b>In</b> 114.82	50 <b>Sn</b> 118.71	51 <b>Sb</b> 121.76	52 <b>Te</b> 127.60	53 <b>I</b> 126.90	54 <b>Xe</b> 131.29
55 <b>Cs</b> 132.91	56 <b>Ba</b> 137.33	71 <b>Lu</b> 174.97	72 <b>Hf</b> 178.49	73 <b>Ta</b> 180.95	74 <b>W</b> 183.84	75 <b>Re</b> 186.21	76 <b>Os</b> 190.23	77 <b>Ir</b> 192.22	78 <b>Pt</b> 195.08	79 <b>Au</b> 196.97	80 <b>Hg</b> 200.59	81 <b>Tl</b> 204.38	82 <b>Pb</b> 207.2	83 <b>Bi</b> 208.98	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> 226.03	103 <b>Lr</b> (260)	104 <b>Rf</b> (261)	105 <b>Db</b> (262)	106 <b>Sg</b> (263)	107 <b>Bh</b> (262)	108 <b>Hs</b> (265)	109 <b>Mt</b> (266)	110 <b>Ds</b> (269)	111 <b>Rg</b> (272)	112 <b>Cn</b> (277)	113	114	115	116	117	118

57 <b>La</b> 138.91	58 <b>Ce</b> 140.12	59 <b>Pr</b> 140.91	60 <b>Nd</b> 144.24	61 <b>Pm</b> (145)	62 <b>Sm</b> 150.36	63 <b>Eu</b> 151.97	64 <b>Gd</b> 157.25	65 <b>Tb</b> 158.93	66 <b>Dy</b> 162.50	67 <b>Ho</b> 164.93	68 <b>Er</b> 167.26	69 <b>Tm</b> 168.94	70 <b>Yb</b> 173.04
89 <b>Ac</b> 227.03	90 <b>Th</b> 232.04	91 <b>Pa</b> 231.04	92 <b>U</b> 238.03	93 <b>Np</b> 237.05	94 <b>Pu</b> (244)	95 <b>Am</b> (243)	96 <b>Cm</b> (247)	97 <b>Bk</b> (247)	98 <b>Cf</b> (251)	99 <b>Es</b> (252)	100 <b>Fm</b> (258)	101 <b>Md</b> (258)	102 <b>No</b> (259)

Fall 2011

**Multiple Choice:** Circle the letter of the most correct response. (5pts. per question)

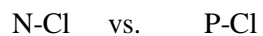
- Which of the following is **not** a possible set of quantum numbers for an electron?
  - $n = 1, \ell = 2, m_\ell = +1, m_s = +1/2$
  - $n = 2, \ell = 0, m_\ell = 0, m_s = +1/2$
  - $n = 3, \ell = 1, m_\ell = -1, m_s = -1/2$
  - $n = 3, \ell = 2, m_\ell = +2, m_s = -1/2$
  - $n = 4, \ell = 3, m_\ell = -2, m_s = +1/2$
- Electronegativity
  - Is the negative charge of an ion
  - Is a measure of how strongly an atom attracts electrons in a covalent bond
  - Is determined by assigning one electron to each atom of a bond
  - Is the energy required to remove an electron from an atom in the gas phase
  - Is the energy required to remove a *pair* of electrons from an atom
- A covalent bond:
  - Is always polar
  - Forms ions in solution
  - Always contains a metal
  - Involves sharing electrons
  - Always has high bond energy
- Electronegativity **decreases**:
  - As the quantum number “n” decreases
  - As atoms get smaller
  - Top to bottom on the Periodic Table
  - Left to right across the Periodic Table
  - In the center of the Periodic Table
- What orbital hybridization gives a **square pyramid molecular shape**?
  - sp
  - sp<sup>2</sup>
  - sp<sup>3</sup>
  - sp<sup>3</sup>d
  - sp<sup>3</sup>d<sup>2</sup>

**Trends:** For each of the following, circle the correct response (1pts) and give a *brief* explanation of your choice (6pts).

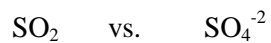
6. Which atom is larger? Explain:  
Ni (Z=28) vs. Ru (Z=44)

7. Which ion is larger? Explain:  
Ti<sup>4+</sup> vs. Ti<sup>2+</sup> (Z=22)

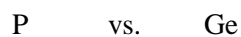
8. Which bond is shorter? Explain:



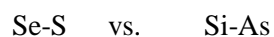
9. Which SO bond is shorter? Explain:



10. Which element is more electronegative? Explain:



11. Which bond is less polar? Explain:



For each of the following, write out a correct electron configuration. You may use noble gas shorthand notation for species below the 2<sup>nd</sup> row of the Periodic Table. (6pts each)

12. Germanium (At.# = 32)

13. Cesium (At.# = 55)

14. Phosphide ion (At.# = 15)

15. Iron(III) ion (At.# = 26)

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16. What are the 3 most likely charges (+ or -) of a tellurium ion (At.# = 52)? Explain your answers. (15pts)

For each of the following, draw a correct Lewis Structure, determine the formal charge on each atom, name the electronic geometry, draw an appropriate VSEPR structure, name the molecular shape, and show the dipole moment of any polar molecules/ions. (15pts each)

17.  $\text{RnF}_4$

18.  $\text{PO}_3^{-3}$

19.  $\text{SbOBr}_3$