Name: _____

# Chemistry 150                                        **Exam 1**

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 = $6.022 \times 10^{23}$ $^{units}/_{mol}$
$32.00^{o}F = 0.000^{o}C = 273.15K$
1 foot = 12 inches
1 inch = 2.54cm (exactly)
1 pound = 453.6 g = 16 ounces
1 amu = $1.6605 \times 10^{-24}$ g
Masses of subatomic particles:
  Proton    1.00728amu =  $1.6726 \times 10^{-24}$ g
  Neutron  1.00866amu =  $1.6749 \times 10^{-24}$ g
  Electron  0.000549amu = $9.1094 \times 10^{-28}$ g

| 1 H 1.0079 | | | | | | | | | | | | | | | | | 2 He 4.0026 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 Li 6.941 | 4 Be 9.0122 | | | | | | | | | | | 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 22.990 | 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 44.956 | 22 Ti 47.88 | 23 V 50.942 | 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 72.61 | 33 As 74.922 | 34 Se 78.96 | 35 Br 79.904 | 36 Kr 83.80 |
| 37 Rb 85.468 | 38 Sr 87.62 | 39 Y 88.906 | 40 Zr 91.224 | 41 Nb 92.906 | 42 Mo 95.94 | 43 Tc (98) | 44 Ru 101.07 | 45 Rh 102.91 | 46 Pd 106.42 | 47 Ag 107.87 | 48 Cd 112.41 | 49 In 114.82 | 50 Sn 118.71 | 51 Sb 121.76 | 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 183.84 | 75 Re 186.21 | 76 Os 190.23 | 77 Ir 192.22 | 78 Pt 195.08 | 79 Au 196.97 | 80 Hg 200.59 | 81 Tl 204.38 | 82 Pb 207.2 | 83 Bi 208.98 | 84 Po (209) | 85 At (210) | 86 Rn (222) |
| 87 Fr (223) | 88 Ra 226.03 | 89 Ac 227.03 | 104 Rf (261) | 105 Db (262) | 106 Sg (263) | 107 Bh (262) | 108 Hs (265) | 109 Mt (266) | 110 (269) | 111 (272) | 112 (277) | | 114 | | 116 | | |

| 58 Ce 140.12 | 59 Pr 140.91 | 60 Nd 144.24 | 61 Pm (145) | 62 Sm 150.36 | 63 Eu 151.97 | 64 Gd 157.25 | 65 Tb 158.93 | 66 Dy 162.50 | 67 Ho 164.93 | 68 Er 167.26 | 69 Tm 168.94 | 70 Yb 173.04 | 71 Lu 174.97 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90 Th 232.04 | 91 Pa 231.04 | 92 U 238.03 | 93 Np 237.05 | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (251) | 99 Es (252) | 100 Fm (258) | 101 Md (258) | 102 No (259) | 103 Lr (260) |

*Score*

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

1. Which of the following sets of elements contains a metal, a metalloid and a nonmetal?
   a. Rb, Nb, Pb
   b. C, P, I
   c. **Mn, F, Si**
   d. F, Ar, Ti
   e. Cu, Ag, Au

2. Which of the following organic molecules has the *fewest carbon atoms*?
   a. **Methanol**
   b. Pentyne
   c. Butane
   d. Ethyl amine
   e. Propene

3. Which of the following formulas is *least ionic*?
   a. PbO
   b. RbBr
   c. $Fe_2S_3$
   d. **$SF_6$**
   e. ZnSe

4. Different isotopes of an element:
   a. **Have the same number of protons**
   b. Have the same charge
   c. Have the same number of electrons
   d. Have the same mass number
   e. Have the same number of neutrons

5. Which of the following represents the *largest volume*?
   a. 785 L
   b. **$3.6x10^8$ mL**
   c. 29.2 kL
   d. $8.82x10^{-8}$ mL
   e. $1.4x10^{-3}$ kL

6. Which of the following polyatomic ions has the *most oxygen atoms*?
   a. sulfite
   b. hypochlorite
   c. cyanide
   d. **phosphate**
   e. nitrite

Score

7. Complete each row of the following table (3pts per box):

| Symbol | Number of Protons | Number of Neutrons | Number of Electrons | Atomic Number | Mass Number | Charge |
|--------|-------------------|--------------------|--------------------|---------------|-------------|--------|
| V | 23 | 25 | 19 | 23 | 48 | +4 |
| Ge | 32 | 39 | 34 | 32 | 71 | -2 |
| S | 16 | 18 | 16 | 16 | 34 | 0 |
| Na | 11 | 14 | 11 | 11 | 25 | 0 |

**Multiple Choice Calculations** (9pts each):

8. What is the formula weight of nickel(II) nitrate? (Atomic # of nickel = 28)
   a. 120.69 $^g/_{mol}$
   b. 131.39 $^g/_{mol}$
   c. 179.38 $^g/_{mol}$
   d. **182.70 $^g/_{mol}$**
   e. 204.08 $^g/_{mol}$

9. How many selenium atoms are present in a 8.313g sample of selenium (Atomic # = 34)?
   a. 0.1053 atoms
   b. 0.2445 atoms
   c. **$6.340 \times 10^{22}$ atoms**
   d. $1.472 \times 10^{23}$ atoms
   e. $5.719 \times 10^{24}$ atoms

10. 4.842mols of lithium (Atomic # = 3) has a mass of how many grams?
    a. 0.6976 g
    b. 1.614 g
    c. 14.53 g
    d. **33.61 g**
    e. $2.916 \times 10^{24}$ g

11. What is the mass of a sample of aluminum (Atomic # = 13) that contains $1.31 \times 10^{24}$ Al atoms?
    a. 2.18 g
    b. 5.98 g
    c. 12.4 g
    d. 28.3 g
    e. **58.7 g**

Score

12. The elevation of Moorhead is approximately 892 feet above sea level.  What is this in meters?
    a.   42.1 m
    b.   227 m
    c.   **272 m**
    d.   297 m
    e.   $2.72 \times 10^6$ m

**Problems:**

13. The newly discovered element Obscurium (Ob) has two stable isotopes.  $^{284}$Ob has a mass of 285.883amu and $^{287}$Ob has a mass of 288.909amu.  If the average atomic mass of Ob is 286.968amu, what is the percent abundance of the lighter isotope?    (13pts)

> (fraction $^{284}$Ob)(mass $^{284}$Ob) + (fraction $^{287}$Ob)(mass $^{287}$Ob) = average atomic mass of Ob
> Let's call the fraction of $^{284}$Ob "x".  Since there are only 2 isotopes, the fraction of $^{287}$Ob must be "1-x"
> (x)(285.883amu) + (1-x)(288.909amu)  =  286.968amu
> x  =  0.6414
> The lighter isotope is 64.14% abundant

14. A number of biologically important structures and processes rely on the formation of disulfide bonds.  You have isolated a natural product that has a disulfide bond and has been analyzed to have the following composition:  %C = 40.88, %H = 6.86, %N = 15.89, %S = 36.38.  What is the *empirical* formula of this substance?  Further study reveals that this substance contains 2 disulfide bonds, with each disulfide bond containing 2 sulfur atoms.  What is the molecular formula and molecular weight of this substance? (14pts)

> Assume 100g of sample, convert to moles, divide to get mole ratio of the empirical formula, use the info in the problem to determine the multiplier for the molecular formula.
>
> C:   40.88g / 12.011$^g$/$_{mol}$  =  3.40mols C          3.40mols C / 1.13mols N  =  3 $^C$/$_N$
> H:   6.86g / 1.0079$^g$/$_{mol}$  =  6.81mols H          6.81mols H / 1.13mols N  =  6 $^H$/$_N$
> N:   15.89g / 14.007$^g$/$_{mol}$  =  1.13mols N          1.13mols N / 1.13mols N  =  1 $^N$/$_N$
> S:   36.38g / 32.066$^g$/$_{mol}$  =  1.13mols S          1.13mols S / 1.13mols N  =  1 $^S$/$_N$
>
> So the empirical formula is:  $C_3H_6NS$
> From the problem, there are 2 disulfide bonds and each disulfide bond contains 2 sulfur atoms, so there must be a total of 4 sulfurs in this natural product.  The empirical formula has only 1 sulfur, so the empirical formula must be multiplied by 4 to get the correct number of sulfurs.
> Molecular Formula  =  4($C_3H_6NS$)  =  $C_{12}H_{24}N_4S_4$
> The molecular weight of the substance is:
> 12(12.011$^g$/$_{mol}$)  +  24(1.0079$^g$/$_{mol}$)  +  4(14.007$^g$/$_{mol}$)  +  4(32.066$^g$/$_{mol}$)  =  352.614$^g$/$_{mol}$

Score