PERIODIC TABLE OF THE ELEMENTS

1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 ------	9 VIIB	10 ------	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIII A
1 **H** 1.008																	2 **He** 4.003
3 **Li** 6.941	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** 47.88	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	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** (98)	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 **Rf** (261)	105 **Ha** (262)	106 **Sg** (263)	107 **Ns** (262)	108 **Hs** (265)	109 **Mt** (266)	110 (269)	111 (272)	112						

58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
90 **Th** 232.0	91 **Pa** 231.0	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

CHEM 141 Exam 1 Fall 2012
DO NOT START UNTIL INSTRUCTED.

Before you begin the exam, fill in your name, ID number and section and sign the honor pledge.

Name _____ Section _____
Class ID Numb _____

Rule of Academic Responsibility (From the *Carolina Community*.)

"**It is the responsibility of every student at the University of South Carolina at Columbia to adhere steadfastly to truthfulness and to avoid dishonesty, fraud, or deceit of any type in connection with any academic program.**"

I have fulfilled the Rule of Academic Responsibility.

_____ _____
Signature Date

Do Not Write Here	
1 (10)	
2 (7)	
3 (10)	
4 (20)	
5 (20)	
6 (15)	
7 (8)	
8 (10)	
9 (15)	
Total 100 (115)	

Instructions: there are 9 questions on 9 pages.

Most computations have a box for you to write (neatly) the final answer.
Show all work on this exam.

You have 50 minutes to complete the exam.

(10) 1. **Definitions**. Circle T if everything is true. Circle F is anything is false. I will grade your ten best answers so don't leave any blank.

Sample: The moon rises in the east because the rotation of the moon on its axis (length of lunar day) is equal to the length of time needed for the moon to orbit around the earth.

Answer: **False**. Although every statement is true, the reason the moon rises in the east is because the earth rotates on its axis and has nothing to do with lunar days and lunar months.

T F A. All experiments lead to the conclusion that energy is neither gained nor lost in a chemical reaction, but none of our current theories is able to explain this observation.

T F B. The Qualitative Analysis scheme relies on selective precipitation to separate groups of ions.

T F C. An anion consists of one or more atoms with an overall positive charge

T F D. The molecular formula of a hydrocarbon can be determined by combustion analysis in concert with mass spectrometry of the sample.

T F E. The theoretical yield is the ratio of the amount of product isolated to the maximum amount that can be formed. The theoretical yield can exceed 100% on occasion.

T F F. A weak acid, like HI, does not ionize completely in solution.

T F G. An acid is a proton donor and this definition holds even in water.

T F H. When metallic iron reacts with oxygen to form rust, the iron changes from Fe^{2+} to Fe^{3+} thus, the iron is oxidized.

T F I. A titration involves a chemical reaction and a way to determine when the reaction is over.

T F J. The Milliken oil drop experiment measures the charge on an electron.

T F K. Among patients with heart disease, heavy, even obese, patients have significantly lower survival rates than to normal or light patients.

T F L. If you study for an exam in two or more places you are more likely to score higher on the test.

(7) 2. **Atomic structure**. Fill in the all blanks

Symbol	$^{18}O^{2-}$	
Number of protons		57
Number of neutrons		82
Number of electrons		54
Charge		
Mass number		
Atomic number		
Group (1-18) number from Periodic Table		
Period (from Periodic Table)		

(10) 3. **Nomenclature and solubility**. Fill in the blanks. In the "Solubility" column write Y or N. I will grade your best 10 so answer them all.

Name	Formula	Solubility
Aluminum hydroxide		
	Cr_2O_3	
Silver sulfate		
	$Cu_3(PO_4)_2$	
Ammonium carbonate		
	N_2O_4	

(20) 4. **Molecular Formula**.

(12) A. 19.81-mg sample containing only carbon, hydrogen, and oxygen burns in excess O_2 to produce 41.98 mg of CO_2 and 6.45 mg of H_2O. Determine the empirical formula of the compound.

1
H
1.0

6
C
12.0

8
O
16.0

(8) B. This compound is a diprotic acid (has two acidic protons that can be titrated, like H_2SO_4). In a titration experiment, 1.000 g of the acid requires 24.1 mL of 0.50 M NaOH to neutralize. Use this information to determine the molar mass of the acid.

(20) 5. **Stoichiometry**.

(15) A. Calculate the mass of silver produced if 3.22 g of zinc metal and 4.35 g of silver nitrate react according to the following equation:

$$Zn(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Zn(NO_3)_2(aq)$$

Species	Atomic weight
Ag	107.9
$AgNO_3$	169.9
Zn	65.4

(5) B. Write the net ionic equation for this reaction.

(15) 6. **Solution stoichiometry**. Junior Chemist has a summer job interning in his father's chemistry factory. He feels highly qualified, having passed Chem 111 and Chem 112 (although it took him two tries to pass the latter) but his father is not so confident in his son's abilities. So he starts him off with a simple lab question.

(3) A. Calculate the mass of sodium hydroxide (NaOH) needed to make 250 mL of 0.200 M solution.

(3) B. Junior tried to weigh the mass of NaOH he calculated in the last part, but he found that it absorbs water and carbon dioxide from the air and cannot be weighed easily. But he can buy a premade 1.00 M solution of NaOH and he knows that he can make the desired solution by dilution. He asks you for some help. Calculate the volume of the 1.00 M solution needed to make 250 mL of 0.200 M NaOH solution.

(3) C. He uses the 0.200 M NaOH to characterize an acid that was made by his sister in the pharmaceutical division. Junior receives a white tablet, of mass 1.00 g, that is identified as acetylsalicylic acid, $C_9H_8O_4$, molecular weight 180.2. What volume of 0.200 *M* NaOH will be needed to exactly neutralize the acetylsalicylic acid? The **balanced** chemical equation is:

$$C_9H_8O_4 + NaOH \rightarrow C_9H_7O_4Na + H_2O$$

(6) D. When Junior did the experiment it took less base to neutralize the acid than expected. You make him repeat it, and his results are reproducible. Junior is quaking at the idea of telling his father that the aspirin product is defective and that a 1.00-g tablet contains only 0.650 g of aspirin. He offers to let you drive his vintage 1964-1/2 Mustang for a week if you can provide a logical hypothesis that he can communicate to his father that doesn't involve a mistake in the analysis. Provide a logical explanation that might account for this fact?

(8) 7. **Assign oxidation numbers.**

$LiAlH_4$ $KAl(SO_4)_2$

(10) 8. **Balance redox equation**. Balance one of the two equations.

$CN^- + MnO_4^- \rightarrow MnO_2 + CNO^-$ basic

$Cr_2O_7^{2-} + Cl^- \rightarrow Cr^{3+} + Cl_2$ acidic