Chemistry 222 **Name**_______________________________________
Fall 2010 **80 Points**
Exam 1: Chapters 1-4

Complete two (2) of problems 1-3 and four (4) of problems 4-8. CLEARLY mark the problem you do not want graded. You must show your work to receive credit for problems requiring math. Report your answers with the appropriate number of significant figures and with the appropriate units.

Do <u>two</u> of problems 1-3. Clearly mark the problem you do not want graded. (10 pts each)

1. Chose ONE of the following pairs of terms and briefly (but clearly) compare and contrast the two concepts.
   a. TC vs. TD
   b. Determinate Error vs. Indeterminate Error

2. We ignore the contribution of buoyancy in virtually all of the mass measurements we make in the laboratory. How can we get away with this? Identify one situation where we would be unable to ignore buoyancy-introduced error.

3. A statistical analysis is an essential component in the evaluation of experimental results. Early in our discussion of statistics, I mentioned that statistics only tell us about the precision of a measurement, not the accuracy. Why is this so? If this is true, how can we use the confidence interval to predict how close our results are to a “true” or accepted value?

Do <u>four</u> of problems 4-8. Clearly mark the problem you do not want graded. (15 pts each)

4. You need to prepare a 500.0 mL of solution that is 100.0 ppm magnesium. Clearly describe how you would prepare this solution starting from the points below.
   a. starting with solid magnesium chloride
   b. starting with a 0.100 M magnesium chloride solution

5. As a highly-paid TA for Quant. Lab, two students approach you with questions regarding the results for their KHP lab. A check of their calculations found no errors. Both students had the same unknown with a "true value" of 44.36% KHP. The expected relative standard deviation 0.15% RSD. Based on your understanding of the importance of both precision and accuracy and knowledge of uncertainties in experimental measurements, **select one student** and briefly describe possible causes for any undesirable characteristics of their results and suggest routes for improvement.

   Stewie Griffin: Average percent KHP: 44.3_2% KHP, absolute standard deviation 0.2% KHP
   Patrick Star: Average percent KHP: 44.66% KHP, absolute standard deviation 0.04% KHP

6. You have run a series of titrations to determine the unknown concentration of KHP in a solid sample. The results of six titrations indicate KHP concentrations of 46.14%, 45.69%, 40.15%, 45.55%, 46.07%, 45.98%. If the "true" value for KHP in this sample is 46.29%, do your results differ at the 95% confidence level?

7. Given your unnatural passion for solution preparation, you have been asked to instruct a class of green quant students on the proper use of a Class A volumetric pipet and volumetric flask for the preparation of a dilute solution from a more concentrated solution. Clearly outline the proper procedure for using this hardware to obtain high quality quantitative results. Include any pitfalls the students should avoid. It is likely that the terms TD and TC will appear in your discussion.

8. In an experiment, you use a solution of standardized sodium hydroxide ion to determine the concentration of a solution of hydrochloric acid. The data below was obtained for such a titration. Based on this information, calculate the concentration of HCl (with its associated absolute uncertainty) in the solution.

Concentration of NaOH standard	0.1117 ± 0.0005 M
Volume of NaOH solution used	20.00 ± 0.03 mL
Initial buret reading	1.46 ± 0.05 mL
Final buret reading	33.54 ± 0.05 mL

Blank Space if You Need Extra Room

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES
1 H 1.00797																1 H 1.00797	2 He 4.0026
3 Li 6.939	4 Be 9.0122											5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312											13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	*57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	‡89 Ac (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (262)	108 Hs (265)	109 Mt (266)	110 ? (271)	111 ? (272)	112 ? (277)						

Numbers in parenthesis are mass numbers of most stable or most common isotope.

Atomic weights corrected to conform to the 1963 values of the Commission on Atomic Weights.

The group designations used here are the former Chemical Abstract Service numbers.

* Lanthanide Series

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm (147)	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97

‡ Actinide Series

90 Th 232.038	91 Pa (231)	92 U 238.03	93 Np (237)	94 Pu (242)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (249)	99 Es (254)	100 Fm (253)	101 Md (256)	102 No (256)	103 Lr (257)

Possibly Useful Information

$m = \dfrac{m'\left(1 - \dfrac{d_a}{d_w}\right)}{\left(1 - \dfrac{d_a}{d}\right)}$	Density of air = 0.012 g/ml Density of balance weights = 8.0 g/ml
$\mu = \bar{x} \pm \dfrac{ts}{\sqrt{n}}$	$y = \dfrac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$
$t_{calculated} = \dfrac{\lvert \text{known value} - \bar{x} \rvert}{s}\sqrt{n}$	$s = \sqrt{\dfrac{\sum_i (x_i - \bar{x})^2}{n-1}}$
$t_{calculated} = \dfrac{\lvert \bar{x}_1 - \bar{x}_2 \rvert}{s_{pooled}}\sqrt{\dfrac{n_1 n_2}{n_1 + n_2}}$	$s_{pooled} = \sqrt{\dfrac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$
$t_{calculated} = \dfrac{\bar{d}}{s_d}\sqrt{n}$	$s_d = \sqrt{\dfrac{\sum_i (d_i - \bar{d})^2}{n-1}}$
$Q_{calculated} = \dfrac{\text{gap}}{\text{range}}$	$G_{calculated} = \dfrac{\lvert \text{suspect value} - \bar{x} \rvert}{s}$
$F_{calculated} = \dfrac{(s_1)^2}{(s_2)^2}$	Don't eat the yellow snow

Values of Student's t

Degrees of Freedom	Confidence Level (%) 90	95	99.5	99.9
1	6.314	12.706	127.32	636.619
2	2.920	4.303	14.089	31.598
3	2.353	3.182	7.453	12.924
4	2.132	2.776	5.598	8.610
5	2.015	2.571	4.773	6.869
6	1.943	2.447	4.317	5.959
7	1.895	2.365	4.029	5.408
8	1.860	2.306	3.832	5.041
9	1.833	2.262	3.690	4.781
10	1.812	2.228	3.581	4.587
20	1.752	2.086	3.153	3.850
30	1.697	2.042	3.030	3.646
40	1.684	2.021	2.971	3.551
60	1.671	2.000	2.915	3.460
120	1.658	1.980	2.860	3.373
∞	1.645	1.960	2.807	3.291

Values of *Q* for rejection of data

# of Observations	Q (90% Confidence)
4	0.76
5	0.64
6	0.56
7	0.51
8	0.47
9	0.44
10	0.41

Grubbs Test for Outliers

# of Observations	$G_{critical}$ At 95% confidence
4	1.463
5	1.672
6	1.822
7	1.938
8	2.032
9	2.110
10	2.176

Critical Values of F at the 95% Confidence Level

	Degrees of freedom for s_1								
Degrees of freedom for s_2	2	3	4	5	6	7	8	9	10
2	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4
3	9.55	9.28	9.12	9.01	8.94	8.89	8.84	8.81	8.79
4	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96
5	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74
6	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06
7	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64
8	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35
9	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14
10	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98