CHEM 212 Name:_____
Exam 1

1. If the grade cutoff at Pogo gold mine is 0.15± 0.02 oz Au/ ton ore, what is that concentration in ppb and weight percent?

1 oz = 28.349 grams; 1 ton= 907,184.74g

2. You have a sample of about 0.1 ppb gold that you must accurately quantify.

Table 1. Comparison of effective range of analytical methods for Au and comparison of multi-element capabilities, turnaround and cost

Au ppb									Multi-element	Possible* Turnaround Days	Cost US$ (30 g sample)
0.01	0.1	1	10	100	1000	10 000	100 000	1 000 000			
				FA-GRAVIMETRIC					no	1-3	9-12
			FA-AA, DCP, ICP						yes (Au, Pd+Pt)	1-3	8-10 (Pt, Pd + $5)
			FA-INAA						no	2-4	10-11
			INAA						yes "Au+34"	8	10-15 (multi incl.)
		BLEG-GFAA							no	2-4	14-40 (1 kg sample)
	BLEG-ICP/MS								yes "Au+50"	2-4	35 (multi incl.) (1 kg sample)
				CYANIDATION-AA					no	2-4	6-8
			AQUA REGIA-AA						yes "Au+30"	1-3	5-7 (multi + $5)
		AQUA REGIA-GFAA							yes "Au + 30"	1-3	7-10 (multi + $5)

* Assumes no other samples in the lab.

Given the information in Table 1, which method would you select and why?

3. This quantification method must be calibrated using aqueous standards. In order to generate your calibration curve, you need to complete the following dilutions from a 213 ppm Au stock solution. You have an automatic pipette and 50 ml volumetric flasks available for the task. Fill in this table to help you make the dilutions in the lab.

Au concentration (ppm)	Aliquot of Au stock (mL)	Volume diluent (mL)	Total volume (mL)
100			50
75			50
50			50
30			50
15			50
7			50

4. After achieving erratic results using a calibration curve, you decide to use a standard addition to reanalyze several samples.

a. What advantage does the standard addition method have over a calibration curve?

b. You prepared and ran solutions, and graphed your data. Determine the concentration of Au in your unknown solution.

A=286 [Au] +0.245

6. Determine if each of the situations described below describes random or systematic error.

Write an S (systematic) or R (random) next to each.

Different mass measurements measured on the same balance with the same object.

Consistently high concentration measurements of unknowns resulting from high blank measurements.

What type of error is likely causing the effects seen in Figure 1?

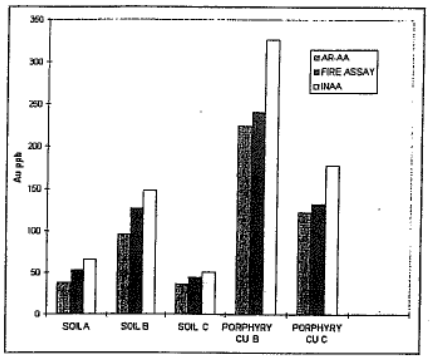

Fig. 1. Comparison of analytical techniques for gold (from Hall et al., 1989).

7. Which type of error is always present and can be estimated, but not corrected?

9. Table 2 from the Fire Assay paper shows results from several replicate measurements of a reference material performed by different techniques. Use the INAA data below to determine if this data set is statistically different from the certified value of this standard (48 $\pm$ 2 ppb). Be sure to show your work.

Table 2. Fire assay results from two Fire Assay-AA runs of the CANMET UMT-1 versus INAA gold values. Example of improper fluxing not in homogeneity of sample.

First Run Fire Assay-AA 30 g Aliquot		Second Run Fire Assay-AA 30 g Aliquot		INAA 30 g Aliquot	
14	9	38	40	49	
11	13	26	39	49	
4	10	37	42	48	
10	11	39	34	51	
16	6	40	42	49	
21	11	45	40	47	
13	25	30	41	55	
11	19	23	43	53	
12	21	35	36	53	
8	22	41	37	54	
12	15		43	48	
16	25				53
12	18				61
11	14				57
15	12				48
14	24				53
Average = 14 +/– 5		Average = 38 +/– 6		Average = 52 +/–4	

Average fire assay 14 ppb (32 aliquots) range: 4 to 25
Average fire assay 38 ppb (21 aliquots) range: 26 to 45
Average INAA 52 ppb (16 aliquots) range: 48 to 61