1. (10%) Five aliquots of a water sample were analyzed for cadmium (Cd) and the following concentration (in $\mu g\ L^{-1}$) determined: 3.8, 3.6, 4.1, 4.0, and 3.9.
   (a) Calculate the mean, standard deviation, and the 95% confidence interval.
   (b) Determine whether the 3.6 value in the first data set is an outlier for that set at the 95% confidence level
   (c) Analysis of an additional aliquot from the same sample yielded a concentration of 3.2 ppb. Should this result be accepted or rejected?

2. (10%) Iron standards were made-up and their absorbances were measured. The following results were obtained

Concn. (ppm)	Abs.	stdev	Number of replicates
0	0.015	0.006	10
5	0.228	0.008	6
10	0.455	0.011	6
20	0.912	0.013	6

   (a) What is the detection limit for iron?
   (b) What is the calibration sensitivity?
   (c) What is the analytical sensitivity at the 5 ppm level?
   (d) What is the limit of quantitation, LOD?

3. The following volumes of a solution containing 1.51 ppm Zn^{+2} were pipetted into separatory funnels, each containing 5.00 mL of an known; i.e., 0.00, 5.00, 10.00, and 15.00 mL of 1.51 ppm Zn was added to different 5 mL portions of the same solution. Each was extracted with three 5-mL aliquots of CCl_4 containing an excess of 8-hydroxyquinone. The extracts were then diluted to 25.00 mL and their fluorescence measured. The results were:

Vol Std Zn^{+2}, mL	Fluorometer reading
0.00	6.08
5.00	11.24
10.00	15.47
15.00	20.84

Calculate the concentration of Zn in the unknown. (10%)

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4. (10%) Use the following to calculate the K_{sp} for AgI.
   $Ag^+ + e^- \text{----> } Ag$ $\quad E^o = 0.799$ V
   $AgI + e^- \text{---> } Ag + I^-$ $\quad E^o = -0.151$ V

5. (10%) Calculate the IR absorption frequency expected for the O-H bond (force constant (k)=500 N/m, c=3×10^8 m/s)

6. (10%) Name 4 processes that complete with fluorescence to deactivate an excited molecule

7. (10%) Calculate the total carbonates (total inorganic carbon) when 380 ppmv carbon dioxide gas is in equilibrium with water at pH =6 and 8, respectively. Use the following equations and the equilibrium constants:
   a) $CO_2\,(g) \text{---> } CO_2\,(aq)$ $\quad K_H = 0.034$
   b) $CO_2\,(aq) + H_2O \text{---> } H^+ + HCO_3^-$ $\quad K_a = 4.2 \times 10^{-7}$
   c) $HCO_3^- \text{---> } H^+ + CO_3^{-2}$ $\quad K_a' = 4.8 \times 10^{-11}$

8. (10%) The vapor pressure of mercury at 298 K is 0.00184 torr (mmHg). How many grams of mercury would it take to fully saturate the room which is approximately 20 x 30 x 8 m (Mole weight of Hg: 200.5);

9. (20%) The following data were obtained by GC for a separation on a 40 cm column where Vs/Vm was 0.422

Compound	t_R (retention time, min)	W_{base} (peak width at base, min)	Relative peak area	Relative detector response
Air	0.5	----	----	----
Solute A	10.0	0.77	33.11	0.66
Solute B	11.39	1.08	41.44	0.80
Solute C	17.5	1.16	35.8	0.95

   Calculate:
   a) The average number of plates of this column
   b) The resolutions between A and B, and between B and C
   c) The capacity factor for each solute
   d) The distribution constant for each solute
   e) The average plate height for the column
   f) The percentage of each solute in the sample