1. **(12 points)** Explain the difference between:
   (a) Zeeman and Smith-Hieftje background correction.
   (b) Doppler and pressure broadening.
   (c) Continuous variation and mole ratio method for complex-ion studies.
   (d) Fluorescence excitation spectrum and fluorescence emission spectrum

2. **(10 points)** The percentage of an additive in a gasoline was measured 7 times with the following results: 0.13, 0.12, 0.16, 0.17, 0.20, 0.11%. Find the (a) average, (b) standard deviation, (c) relative standard deviation, (d) 90% and 95% confidence interval for the percentage of the additive.

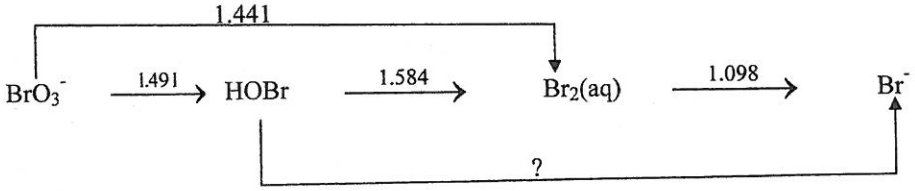
3. **(10 points)** A standard Reference Material is certified to contain 94.6 ppm of an organic contaminant in soil. Your analysis gives value of 98.6, 98.4, 97.2, 94.6, and 96.2 ppm. Do your results different from the expected results at the 95% confidence level?

4. **(10 points)** Chloroform is an internal standard in the determination of DDT in a polarographic analysis in which each compound is reduced at the electrode surface. A mixture containing 0.500mM chloroform and 0.800 mM DDT gave signals of 15.3 μA for chloroform and 10.1 μA for DDT. An unknown solution (10.0mL) containing DDT was placed in a 100-mL volumetric flask and 10.2 μL chloroform (FM 119.39, density = 1.484 g/mL). After dilution to the mark, polarographic signals of 29.4 and 8.7 μA were observed for the chloroform and DDT, respectively. Find the concentration of DDT in unknown solution.

5. **(10 points)** The pH of 0.100 M ethylamine is 11.8. (a) Find the K_a for ethylamine. (b) Calculate the pH of 0.100 M ethylamine chloride.

6. **(13 points)** The base B has pK_b =5.00. (a) What is the pK_a for acid BH^+? (b) At what pH is $[BH^+] = [B]$? (c) Which is the principal species at pH 7.00: B or BH^+? (d) What is the quotient $[B]/[BH^+]$ at pH 10.0?

7. **(10 points)** Based on the Latimer diagram displayed blow, write a balanced chemical equation (in acid solution) for the reaction : $HOBr \rightarrow Br^-$. (a) Calculate the E^o for this reaction. (b) Will this reaction occur spontaneously?



8. **(10 points)** In a normal-phase column, a solute was found to have retention times of 29.0 min, and an unretained sample had a retention time of 1.05 min with mobile phase of 50% (by volume) CH_2Cl_2 and 50% n-hexane.
   (a) Calculate the solvent composition that would bring retention factor of the solute down to 10.
   (b) Estimate the composition of $CHCl_3$/ n-hexane should be when CH_2Cl_2 is replaced with $CHCl_3$ and keep the retention factor of the solute at 10.
   (Use P' value of n-hexane: 0.1; CH_2Cl_2:3.2; $CHCl_3$:4.1)

9. **(15 points)** The following data were obtained by gas-liquid chromatography on a 40-cm packed column:

	t_R, min	W_b, min
Air	1.9	---
Methylcyclohexane	10.0	0.76
Methylcyclohexene	10.9	0.86
Toluene	13.4	1.06
n-hexanol	14.6	1.12

(a) Calculate the plate height of the column.
(b) Calculate the resolution for species methylcyclohexane and methylcyclohexene.
(c) How many plates are required if a resolution of 1.5 is desired in separating methylcyclohexane and methylcyclohexene if other parameters are fixed.

Table 1 Values of Student's t for Various Levels of Probability

Degrees of Freedom	Confidence Level (%)				
	80	90	95	99	99.9
1	3.08	6.31	12.7	63.7	637
2	1.89	2.92	4.30	9.92	31.6
3	1.64	2.35	3.18	5.84	12.9
4	1.53	2.13	2.78	4.60	8.60
5	1.48	2.02	2.57	4.03	6.86
6	1.44	1.94	2.45	3.71	5.96
7	1.42	1.90	2.36	3.50	5.40
8	1.40	1.86	2.31	3.36	5.04
9	1.38	1.83	2.26	3.25	4.78
10	1.37	1.81	2.23	3.17	4.59
∞	1.29	1.64	1.96	2.58	3.29

Table 2 Critical values for F at 5% level

Degrees of Freedom (Numerator)

(Denominator)	2	3	4	5	6	12	∞
2	19.00	19.16	19.25	19.30	19.33	19.41	19.50
3	9.55	9.28	9.12	9.01	8.94	8.74	8.53
4	6.94	6.59	6.39	6.26	6.16	5.91	5.60
5	5.79	5.41	5.19	5.05	4.95	4.68	4.36
6	5.14	4.76	4.53	4.39	4.28	4.00	3.67
12	3.89	3.49	3.26	3.11	3.00	2.69	2.30
∞	3.00	2.60	2.37	2.21	2.10	1.75	1.00

TABLE 4–1 Ordinate and area for the normal (Gaussian) error curve, $y = \frac{1}{\sqrt{2\pi}} e^{-z^2/2}$

$\lvert z\rvert^a$	y	Area^b	$\lvert z\rvert$	y	Area	$\lvert z\rvert$	y	Area
0.0	0.398 9	0.000 0	1.4	0.149 7	0.419 2	2.8	0.007 9	0.497 4
0.1	0.397 0	0.039 8	1.5	0.129 5	0.433 2	2.9	0.006 0	0.498 1
0.2	0.391 0	0.079 3	1.6	0.110 9	0.445 2	3.0	0.004 4	0.498 650
0.3	0.381 4	0.117 9	1.7	0.094 1	0.455 4	3.1	0.003 3	0.499 032
0.4	0.368 3	0.155 4	1.8	0.079 0	0.464 1	3.2	0.002 4	0.499 313
0.5	0.352 1	0.191 5	1.9	0.065 6	0.471 3	3.3	0.001 7	0.499 517
0.6	0.333 2	0.225 8	2.0	0.054 0	0.477 3	3.4	0.001 2	0.499 663
0.7	0.312 3	0.258 0	2.1	0.044 0	0.482 1	3.5	0.000 9	0.499 767
0.8	0.289 7	0.288 1	2.2	0.035 5	0.486 1	3.6	0.000 6	0.499 841
0.9	0.266 1	0.315 9	2.3	0.028 3	0.489 3	3.7	0.000 4	0.499 904
1.0	0.242 0	0.341 3	2.4	0.022 4	0.491 8	3.8	0.000 3	0.499 928
1.1	0.217 9	0.364 3	2.5	0.017 5	0.493 8	3.9	0.000 2	0.499 952
1.2	0.194 2	0.384 9	2.6	0.013 6	0.495 3	4.0	0.000 1	0.499 968
1.3	0.171 4	0.403 2	2.7	0.010 4	0.496 5	∞	0	0.5

a. $z = (x - \mu)/\sigma$.

b. The area refers to the area between $z = 0$ and $z =$ the value in the table. Thus the area from $z = 0$ to $z = 1.4$ is 0.419 2. The area from $z = -0.7$ to $z = 0$ is the same as from $z = 0$ to $z = 0.7$. The area from $z = -0.5$ to $z = +0.3$ is (0.191 5 + 0.117 9) = 0.309 4. The total area between $z = -\infty$ and $z = +\infty$ is unity.