



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. Second year Semester II Examination – November / December 2016
CHE 2103 –Analytical Chemistry I

Answer both questions.

Time: 1 hour

The use of non-programmable calculator is permitted.

- 1). (a) Carry out the following operations and express each answer with the correct number of significant figures:

(i) $2.64 \times 10^3 + 3.27 \times 10^2$

(ii)
$$\frac{0.0382 \times 3.65 \times 10^3 \times 2.304}{8.64 \times 10^4}$$

- (b) Calculate the mean and relative average deviation in ppt, for the following set of data: 0.0512, 0.0520, 0.0516, and 0.0506.
- (c) What is meant by the term determinate error and briefly explain the different types of determinate errors and give one reason to occur in each type of determinate error.
- (d) Use the Q test to determine if the 3.483 value can be dropped from the following data set at 90 % confidence level.

3.274, 3.258, 3.265, 3.258, 3.350, 3.483

Hint: - Values of Q at 90% confidence:

Q	0.94	0.74	0.64	0.56	0.51	0.47	0.44	0.41
N	3	4	5	6	7	8	9	10

- (e) Based on the data given (d) above, calculate the 95% confidence interval and report the statistically probable mean value at 95% confidence.

Hint:- Values of Student's t at 95% confidence

t	12.71	4.303	3.182	2.776	2.571	2.447	2.365	2.306	2.262	2.228
Degrees of freedom.	1	2	3	4	5	6	7	8	9	10

- (f) Write both a charge balance and a mass balance equation for a 0.1M H_2SO_4 . Assume the H_2SO_4 ionizes to both HSO_4^- and SO_4^{2-} .
- (g) A 3.2306 g iron ore sample is dissolved in acid. The iron is reduced to Fe^{2+} and the solution is diluted to 250 cm^3 in a volumetric flask. 50 cm^3 aliquots are titrated with 0.01753 mol dm^{-3} standard solution of $\text{K}_2\text{Cr}_2\text{O}_7$. The average titrant volume was 36.30 cm^3 to reach the equivalence point.
- (i) Write down the redox reaction for the titration.
- (ii) Calculate the weight percent of iron (55.847) in the ore sample.
- (h) Express the weight percent in terms of Fe_2O_3 (FW 159.69) for the data given in part (f) above.
- (i) Lanthanum iodate, $\text{La}(\text{IO}_3)_3$, (F.W. 663.62) has $K_{sp}=1.0 \times 10^{-11}$. How many grams lanthanum iodate will dissolve in 1.00 L pure water?
- (j) Estimate the amount (in gram) of lanthanum iodate will dissolve in 1.00 L of a 0.050 mol dm^{-3} solution of soluble LiIO_3 ? State any assumption made in this calculations.

(10 x 12 marks = 120 marks)

- 2). Answer either part (A) or part (B)

Part (A)

Answer all parts.

- (a) Gravimetric analysis of nickel by precipitation with dimethylglyoxime gave the linear ($y = mx + b$) calibration. Regression values for the slope and intercept, with their standard deviations are 0.297 ± 0.020 , 0.20 ± 0.035 respectively. Calculate the weight percentage of nickel, and estimate the error using propagation formulas, for a sample with precipitate weight 5.120 ± 0.001 g.

(25 marks)

- (b) Calculate the variances of the data 3.274, 3.258, 3.265, 3.258, 3.350, 3.483 with and without the 3.483 value. Apply the F-test to determine if there is a significant difference in the two variances at 90% confidence. Does your F- test result agree with the Q test result?

Hint:- Values of F at 90% confidence

Degrees of freedom s_2	Degrees of freedom s_1				
	2	3	4	5	6
2	9.00	9.16	9.24	9.29	9.33
3	5.46	5.39	5.34	5.31	5.28
4	4.32	4.19	4.11	4.05	4.01
5	3.78	3.62	3.52	3.45	3.90
6	3.46	3.29	3.18	3.11	3.05

(30 marks)

- (c) A 2.00 g sample of limestone was dissolved in hydrochloric acid and all the calcium present in the sample was converted to $\text{Ca}^{2+}_{(\text{aq})}$. Excess ammonium oxalate solution, $(\text{NH}_4)_2\text{C}_2\text{O}_{4(\text{aq})}$, was added to the solution to precipitate the calcium ions as calcium oxalate, $\text{CaC}_2\text{O}_{4(\text{s})}$. The precipitate was filtered, dried and weighed to a constant mass of 2.43 g. Determine the percentage by mass of calcium in the limestone sample. (The relative atomic weight of C, O and Ca are 12.01, 16.00 and 40.08 respectively).

(25 marks)

Part (B)

Answer all parts.

- (a) Draw the titration curve for 50 cm^3 of $0.1 \text{ mol dm}^{-3} \text{ Na}_2\text{CO}_3$ versus $0.1 \text{ mol dm}^{-3} \text{ HCl}$. Explain why boiling the solution near the end point in this titration increases the sharpness of the end point.

(20 marks)

- (b) Calculate the solubility of CaCO_3 solution using a systematic approach to chemical equilibrium. You may assume a closed system (no CO_2 (g) in atmosphere). (K_{a1} , K_{a2} , K_w are 4.3×10^{-7} , 4.8×10^{-11} and 1.0×10^{-14} respectively).

(40 marks)

- (c) A student weighed out 2.950 g of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$ and dissolved in 50 cm^3 of sulphuric acid and poured into a 250 cm^3 volumetric flask which was made up to the mark with distilled water. 25.0 cm^3 of this solution was titrated and required 21.20 cm^3 of $0.0100 \text{ mol dm}^{-3} \text{ KMnO}_4$ solution to reach the end point. Estimate the x . (relative atomic weights of H, O, S and Fe are 1.08, 16.00, 32.07 and 55.85 respectively).

(20 marks)