RAJARATA UNIVERSITY OF SRI LANKA

FACULTY OF APPLIED SCIENCES

B.Sc (General) Degree in Applied Sciences

B.Sc. Second year Semester II Examination February / March 2019

CHE 2103 – ANALYTICAL CHEMISTRY

Answer both questions. Time: One hour

The use of a non-programmable calculator is permitted.

---

1). (a) Express the results of the following calculations using significant figures:

(i) $\log (4.82 \times 10^4)$

(ii) $\dfrac{0.005681 \times 2.463}{22.30 \times 0.304}$

(b) Find the uncertainties of the result of the following calculation:

$$\frac{(39.84 \pm 0.04)(0.0994 \pm 0.0001)(224.3 \pm 0.2)}{(426.4 \pm 0.3)}$$

(c) The concentration of a solution is determined by four separate titrations, the results being 0.2041, 0.2049, 0.2039 and 0.2043. Calculate the standard deviation and the coefficient of variation of these results.

(d) Describe three types of systematic errors that might occur while weighing a solid on an analytical balance.

(e) A chemist analyzes an iron ore for FeO and obtained a value of 12.35%, with a standard deviation of 0.08. Calculate the 95% confidence interval of the mean based on four determinations. The values of t for ν (degrees of freedom) are given below:

ν	90%	95%
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776

(f) Briefly define by giving an example of common ion effect. What is the pH of a solution that is 0.400 M in formic acid and 1.00 M in sodium formate? Check the validity of any assumptions you have made in this calculations.

(g) Phosphate in a 0.2711 g sample was precipitated giving 1.1682 g of $(NH_4)_2PO_4.12$ MoO_3 (f.wt = 1876.5 g / mol). Find percentage P (f.wt = 30.97 g / mol) in the sample.

(h) A 0.3745 g sample containing sodium bicarbonate (f.wt = 84 g / mol) was titrated with standard solution of hydrochloric acid, requiring 40.72 mL, The hydrochloric acid was standardized by titrating 0.1876 g sodium carbonate (f.wt = 106 g / mol) , which required 37.86 mL acid. Calculate the percentage of sodium bicarbonate in the sample.

(8 ×15 = 120 marks)

Q2). Answer either Part A or Part B

Part A

(a) An analyst obtained the following results for the concentration in mg/mL of cholesterol in a blood sample: 240, 265, 230, and 244. Can any result be rejected by the Q test at the 95 % confidence level? Critical values for the Rejection Quotient, Q is given in the table below:

Number of observation	90 %	95 %
3	0.941	0.970
4	0.765	0.829
5	0.642	0.710

(20 marks)

(b) A calibration curve for the colorimetric determination of phosphorous in urine is prepared by reacting standard solutions of phosphate with molybdenum (VI) and reducing the phosphomolybdic acid complex to produce the characteristic blue colour. The measured absorbance A is plotted against the concentration of phosphorous. From the following data, determine the linear least squares line and calculate the phosphorous concentration in the urine sample.

P /ppm	A
0.005	0.132
0.010	0.290
0.020	0.498
0.030	0.642
0.040	0.750
Urine sample	0.422

(Hint: - the slope m of the line, $m = \dfrac{\sum x_i y_i - \left[\left(\sum x_i \sum y_i\right)/n\right]}{\sum x_i^2 - \left[\left(\sum x_i\right)^2/n\right]}$

(35 marks)

(c) Write down Henderson-Hasselbalch equation. $NH_4Cl(s)$ is added to the 2.00 M $NH_3(aq)$ with negligible volume change until the pH of the solution reaches 9.00. Calculate the final concentration of $NH_4^+(aq)$ in the buffer solution.

(25 marks)

Part B

(a) Calculate the pH at 0.0, 10.0, 25.0, 50.0 and 60.0 mL titrant in the reaction in the titration of 50.0 mL of 0.100 M CH_3COOH with 0.100 M NaOH. Sketch the titration curve and state a suitable indicator for this titration. (Ka of $CH_3COOH = 1.75 \times 10^{-5}$, $Kw = 1.00 \times 10^{-14}$).

(40 marks)

(b) Define the following terms:

(i) Gravimetric factor.

(ii) Nucleation.

(iii) Coprecipitation.

(15 marks)

(c) A mixture containing only $FeCl_3$ (f.wt = 162.2 g / mol) and $AlCl_3$ (f.wt = 133.34 g / mol) weighs 6.95 g. The chlorides are converted to hydroxides and ignited to Fe_2O_3 (f.wt = 159.7 g / mol) and Al_2O_3 (f.wt = 101.96 g / mol). The oxide mixture weighs 3.36 g. Calculate the percentage Fe (at wt = 55.85) and Al (at wt = 26.98) in the sample.

(25 marks)

-END-