BINDURA UNIVERSITY OF SCIENCE EDUCATION
CHEMISTRY DEPARTMENT

COURSE: CH104 ANALYTICAL CHEMISTRY I

BSc CHEMISTRY EDUCATION (HONS): PART I
Bsc CHEMICAL TECHNOLOGY(HONS):PART 1 AUG 2024

2 HOURS

ANSWER QUESTIONS ONE AND FOUR OTHERS. EACH QUESTION CARRIES 20 MARKS

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1. a) Describe the procedure for an indirect iodometric titration. [3 marks]

   b) Give two reasons why a titration is conducted. [2 marks]

   c) List four methods of checking the accuracy of an analytical method. [4 marks]

   d) State the methods that can be employed to minimize impurities during precipitation. [3 marks]

   e) Write short notes to explain the following terms:
      i) Ionic strength
      ii) Common ion effect
      iii) Co-precipitation
      iv) Masking agent [4× 2 marks]

SECTION A: ANSWER ANY TWO QUESTIONS

2. (a) (i) Define pH [1 mark]

   (ii) Find the pH and fraction of dissociation (α) of a 0.100 M solution of the weak acid HA with Ka = 1.0×10^{-5}. [6 marks]

   (b) (i) Define a buffer solution. [2 marks]

   (ii) Write the Henderson – Hasselbalch equation for a solution of formic acid, HCO_2H. [2 marks]

(iii) Calculate the quotient $[HCO_2^-] / [HCO_2H]$ at pH = 3 using the expression in (ii) above. Ka = 1.80×10^{-4}. [5 marks]

(c) Find the pH of 0.050 M NaCN. [4 marks]

3. a) How many significant figures are there in the following numbers?

(i) 0. 047

(ii) 8.300

iii) 180 [3 marks]

(b) Write each answer with the correct number of significant figures.

i) 1.342X 5.5 = 7.381

ii) 23.445 + 7.83 = 31.275 [1×2 marks]

c) i) Describe internal standards as a calibration method in quantitative chemical analysis. [5 marks]

ii) Explain when it is useful to use internal standards. [3 marks]

d) i) What is meant by standard addition? [2 marks]

ii) When is it appropriate to use a standard addition method? [3 marks]

e) Distinguish between random errors and systematic errors. [2 marks]

4. a) i) For the numbers 116.0, 97.9, 114.2, 106.8, and 108.3, find the mean, standard deviation, range, and 90% confidence interval for the mean. [14 marks]

(ii) Using the Q-test, decide whether 97.9 in (i) should be discarded. [5 marks]

b) What is the use of a student t -test? [1 mark]

SECTION B: ANSWER <u>ANY TWO</u> QUESTIONS FROM THIS SECTION.

5. a) Write the mass balance for a solution prepared by dissolving 0.025 M of H_3PO_4 in 1.00 L [5 marks]

b) If a solution contains the following ionic species H^+, OH^-, K^+, $H_2PO_4^-$, HPO_4^{2-} and PO_4^{3-} . Write the charge balance. [6 marks]

c) Using urea as an example explain what is homogeneous precipitation. [4 marks]

d) A 10.00 mL solution containing Cl^- was treated with excess $AgNO_3$ to precipitate 0.4368 g of AgCl. What was the molarity of Cl^- in the unknown. [5 marks]

6. a) Describe the following EDTA titration techniques:

i) Direct titration [3 marks]

ii) Displacement titration [4 marks]

iii) Back titration [4 marks]

b) Explain the advantages and disadvantages of potassium dichromate as an oxidizing agent. [4 marks]

c) What is the concentration of Hg_2^{2+} containing a solution of NaCl 0.03 M saturated with $Hg_2Cl_{2(s)}$? Given that Ksp for Hg_2Cl_2 is 1.2×10^{-18} [5 marks]

7. a) State the properties of an ideal product of precipitation. [4 marks]

b) Distinguish between nucleation and particle growth. [2 marks]

c) Discuss the techniques that might be employed to promote particle growth during precipitation. [6 marks]

d) Distinguish between:

i) Inclusion and occlusion

ii) Absorption and adsorption. [2×3 marks]

e) Give the formula for relative supersaturation. [2 marks]

END OF PAPER