

2915/306
ANALYTICAL CHEMISTRY III
PRACTICE
Oct./Nov. 2021
Time: 4 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL
DIPLOMA IN ANALYTICAL CHEMISTRY
MODULE III

ANALYTICAL CHEMISTRY III PRACTICE

4 hours

INSTRUCTIONS TO CANDIDATES

*You should have answer booklet for this examination.
This paper consists of **THREE** questions.
Answer **ALL** the questions in this paper.
Candidates should answer the questions in English.*

This paper consists of 6 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

Question 1 (45 marks)

PART I

You are provided with the following:

- 70 cm³ of solution A *extremely acid*
- 70 cm³ of solution B *to do*
- 70 cm³ of solution C *to do*
- 70 cm³ of 5% NaOH
- 70 cm³ 5% NaHCO₃
- 70 cm³ of 5% KCl
- 4 pairs of litmus paper (Red and Blue)
- Source of heat
- Distilled water

You are required to deduce the functional group in solution A solution B and solution C respectively based on their solubilities and pH.

Table I

Part	Test	Solution	Observation	Inference
(a)	Draw 10 cm ³ each of solution A, B and C respectively into three different test tubes. Using litmus paper, test for the pH of each solution	A	(1 mark)	(1 mark)
		B	(1 mark)	(1 mark)
		C	(1 mark)	(1 mark)
(b)	Draw 10 cm ³ each of solution A, B and C into three different test tubes. To each, add 10 cm ³ of 5% NaOH solution. Gently shake and observe	A	(1 mark)	(1 mark)
		B	(1 mark)	(1 mark)
		C	(1 mark)	(1 mark)
(c)	Draw 10 cm ³ of solution A, B and C into three different test tubes. Add 10 ml of 5% NaHCO ₃ solution. Gently shake and observe.	A	(1 mark)	(1 mark)
		B	(1 mark)	(1 mark)
		C	(1 mark)	(1 mark)
(d)	Draw 10 cm ³ of solution A, B and C into three different test tubes. Add 10 ml of 5% HCl solution. Gently shake and observe.	A	(1 mark)	(1 mark)
		B	(1 mark)	(1 mark)
		C	(1 mark)	(1 mark)
(e)	Draw 10 cm ³ of solution A, B and C into three different test tubes. Add 10 cm ³ of distilled water. Gently shake and observe.	A	(1 mark)	(1 mark)
		B	(1 mark)	(1 mark)
		C	(1 mark)	(1 mark)

PART II

PART II

You are provided with the following solutions:

10 ml of 0.002 M KMnO_4

15 ml of 4M H_2SO_4

20g KOH pellets

20mls of H_2O_2 solution

10mls of Conc. HCl

You are required to observe the colour changes and write the oxidation state of manganese in the reactions.

	Test	Observation	Inference
i.	Take 10 cm^3 each of 0.002 M KMnO_4 solution into a test tube. record the colour and state the oxidation state.	(1 mark)	(1 mark)
ii.	To same test tube in (i), acidify it with three drops of 4M H_2SO_4 acid and add KOH pellets and shake until a colour change is observed.	(1 mark)	(1 mark)
iii.	To same test tube in (ii), add drops of H_2O_2 and shake until a colour change is observed.	(1 mark)	(1 mark)
iv	To the same test tube in (iii), add conc HCl dropwise until the next colour change is observed.	(1 mark)	(1 mark)

(v) Write balanced equations for the experiments in step ii, iii and iv. (6 marks)

(vi) State the most stable oxidation state of manganese in the reactions above. (Mn=25).

(1 mark)

Question 2 (35 marks)

PART I

You are provided with the following:

- 100 cm³ of 2.0 M HCl
- 100 cm³ of 2.0 M KOH
- 250 cm³ of plastic beaker
- 250 cm³ of Borosilicate glass beaker
- Thermometer
- Measuring cylinder

You are required to calculate the molar enthalpy of neutralization for HCl using KOH solution.

(a) Procedure

- (i) Measure exactly 60 cm³ of 2.0 M HCl and transfer it into a beaker. Note the temperature.
- (ii) Measure exactly 60 cm³ of 2.0 M KOH and transfer it into a beaker. Note the temperature.
- (iii) Gently add KOH into the solution and note the highest temperature.

Observations

Temperature of the acid 1 ½ mark
Temperature of the base 1 ½ mark
Highest temperature of mixture 2 marks

- (b) Using the data above, calculate the molar heat of neutralization of HCl with KOH. (C=4200J/kg/k) and density is 1g/cm³ (5 marks)
- (c) Write the chemical equation for the neutralization process above. (2 marks)
- (d) State with reasons, whether the process is exothermic or endothermic. (3 marks)

Question 3 (Case study) 20 marks)

You are a quality safety offices working for the National Bureau of Standards. It has been reported that residents of Salama estate are showing sings of diarrhea and excessive vomiting. Preliminary investigations suggest the food poisoning is due to a know hotel X which uses stolen transformer oil which is a polychlorinated biphenyls (PCB) too cook their food.

- (a) Suggest an appropriate method of sampling the food. (2 marks)
- (b) On reaching the lab, the sample were extracted and standard addition method of analysis, used to quantify them. The obtained results are tabulated below.

Amount of PCB added to sample in ppm	0	3	5	7	9	11
Instrumental response	18	24	30	34	36	37

- (i) Using the table above, calculate the concentration of polychlorinated biphenyls (PCB) in the food samples. (12 marks)
- (ii) State the recommendation you would give to he state given that the highest permissible limit of PCB is 10 ppm (3 marks)
- (iii) State two analytical instruments you can use to measre the concentration of PCB. (2 marks)
- (iv) Give **two** reasons why you would use standard addition method over other forms of calibration. (2 marks)

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