

2915/306
ANALYTICAL CHEMISTRY III
PRACTICE
Oct/Nov. 2022
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 the following for this examination;

Answer booklet;

Scientific calculator.

This paper consists of TWO sections; A and B.

Answer ALL the questions in section A and THREE questions from section B.

Each question in section A carries 4 marks, while each question in section B carries 20 marks.

Maximum marks for each part of a question are indicated.

Candidates should answer the questions in English.

This paper consists of 5 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 (50 marks)**PART I**

You are provided with the following:

- 70 cm³ of solution Q
- 70 cm³ of solution R
- 70 cm³ of solution S
- 70 cm³ of 5% NaOH solution
- 70 cm³ of 5% NaHCO₃ solution
- 70 cm³ of 5% HCl acid
- Litmus paper
- Access to heat
- Distilled water

You are required to identify the functional-groups in solutions Q, R and S based on the pH, reactions and solubilities in different compounds.

Table 1

	Test	Solution	Observation	Inference
(a)	Draw 10 cm ³ each of Q, R, S into three different test tubes. Using litmus paper, test for whether the solution are acidic or basic	Q	(1 mark)	(2 marks)
		R	(1 mark)	(2 marks)
		S	(1 mark)	(2 marks)
(b)	Draw 10 cm ³ each of solution Q, R and S into three different test tubes. To each, add 10 cm ³ of 5% NaOH solution. Gently shake the mixture and observe	Q	(1 mark)	(2 marks)
		R	(1 mark)	(2 marks)
		S	(1 mark)	(2 marks)
(c)	Draw 10 cm ³ each of Q, R, S into three different test tubes and to each, add 10 cm ³ of NaHCO ₃ solution. Gently shake and observe	Q	(1 mark)	(1 mark)
		R	(1 mark)	(1 mark)
		S	(1 mark)	(1 mark)
(d)	Draw 10 cm ³ each of solutions Q, R and S into three different test tubes. Add 5% HCl acid, gently shake and observe	Q	(1 mark)	(1 mark)
		R	(1 mark)	(1 mark)
		S	(1 mark)	(1 mark)
(e)	Draw 10 cm ³ each of solution Q, R and S into three different test tubes. Add 10 cm ³ of distilled water. Gently shake and observe	Q	(1 mark)	(1 mark)
		R	(1 mark)	(1 mark)
		S	(1 mark)	(1 mark)

PART II

You are provided with the following:

Zinc powder
Droppers
Spatula
2.0 M NaOH
0.5 M Iron(III)Sulphate
1 test-tube and holder

You are required to carry out a redox reaction between zinc and iron(III) sulphate. Proceed as follows:

Procedure

1. Pour 10 ml of freshly prepared 0.5 M Iron(III)Sulphate into a clean test tube.
2. Add a spatula full of zinc powder into the test-tube, shake gently and observe.
3. Filter the mixture to obtain a filtrate.
4. Add drops of 2.0 M NaOH to the filtrate till in excess.
5. Fill your observations in Table II below.

Table II

TEST	OBSERVATION
Zinc powder	(2 marks)
NaOH	(2 marks)

- (a) Explain the purpose of the zinc powder. (3 marks)
- (b) Using the reactions in the above procedure, write the following equations:
- (i) oxidation equation; (1 mark)
 - (ii) reduction equation; (1 mark)
 - (iii) overall ionic equation; (2 marks)
 - (iv) general equation. (2 marks)

QUESTION 2 (30 marks)

PART I

You are provided with the following:

- (i) 3% H_2O_2
 - (ii) Boiled piece of Irish potato
 - (iii) Raw piece of Irish potato
 - (iv) Boiled piece of cow liver
 - (v) Raw piece of cow liver
- (a) Put a piece of each of the materials into a test-tube and add 3% H_2O_2 until submerged. Note the observations in table III below.

Table III

Material	Observation
(i) Raw Irish potato	(1.5 marks)
(ii) Boiled Irish potato	(1.5 marks)
(iii) Raw cow liver	(1.5 marks)
(iv) Boiled cow liver	(1.5 marks)

- (b) (i) Explain the difference in observation between the raw liver and cooked liver with 3% H_2O_2 . (4 marks)
- (ii) With the aid of an equation, write the equation for the reaction occurring in Question 2 Part I (a) above. (2 marks)
- (c) State how the rate of process above, can be increased. (3 marks)

PART II

You are provided with the following:

- Substance E
- Source of heat
- Dilute sulphuric acid
- NH_4OH
- Butanedione/ dimethylglyoxime
- Lime water
- Dilute NaOH

	Test	Observation	Inference
(a)	Pick a spatula, full of substance E. Heat until no further change occurs.	(2 marks)	(2 marks)
(b)	Pick another spatula full of substance E and add dilute sulphuric acid until no further change.	(2 marks)	(2 marks)
(c)	Divide the solution in part (b) above into three different portions: (i) To the first portion, add dilute NaOH until in excess. Gently heat this mixture (ii) To the second portion, add aqueous ammonia solution drop wise until in excess (iii) To the third portion, add butanedione	(2 marks) (1 mark) (1 mark)	(1 mark) (1 mark) (1 mark)

QUESTION 3 (20 marks)

A few years after the establishment of a small gold artisanal and small scale mining company, residents of Patapata village realized that residents had started becoming sick. Research by the Bureau of Standards showed a high level of mercury as a result of the industry. As an analytical chemist from the village, you have been contracted to investigate and justify the claims.

- State the meaning of heavy metals. (2 marks)
- State **three** reasons why mercury is considered poisonous. (3 marks)
- Design a method that can be used by an analytical chemist to validate or disapprove the levels of mercury in the environment. (10 marks)
- State any **two** instruments that can be used for analysis of mercury. (2 marks)
- As an expert, give an opinion on how the factory effluent can be controlled so as not to be poisonous. (3 marks)

THIS IS THE LAST PRINTED PAGE.