2915/202
INDUSTRIAL CHEMISTRY I AND INSTRUMENTAL METHODS OF ANALYSIS I
Oct./Nov. 2021
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE II

INDUSTRIAL CHEMISTRY I AND INSTRUMENTAL METHODS OF ANALYSIS I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Non-programmable scientific calculator.
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **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 question paper consists of 4 printed pages.

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

Turn over

SECTION A (40 marks)

Answer ALL the questions in this section.

1. List **four** classes of cosmetics. (4 marks)

2. State **four** uses of cosmetics. (4 marks)

3. Differentiate between unit *operation* and unit *process*. (4 marks)

4. (a) State **four** purposes of testing melting point of lipsticks. (1 mark)

   (b) Describe the melting point test of lipsticks. (3 marks)

5. (a) Define the term evaporation. (1 mark)

   (b) Explain **three** factors that determine the rate of evaporation. (3 marks)

6. State **four** factors that influence the intensity of emitted radiations in atomic emission spectroscopy (AES). (4 marks)

7. A photometer with linear response to radiation gave a reading of 685 mV with a blank in the path of radiation and 179 mV when the blank was replaced by a absorbing sample of 200 ppm of $K_2Cr_2O_7$. Given that K = 39, Cr = 52, O = 16, calculate the absorbance of the sample. (4 marks)

8. Explain the following terms as used in UV-visible spectroscopy.

   (a) chromophore;

   (b) bathochromic shift.

   (4 marks)

9. Define the following terms as used in instrumental methods of analysis:

   (a) instrumental methods of analysis; (2 marks)

   (b) instrumental calibration. (2 marks)

10. Describe the preparation of 200 cm^3 of a solution of calcium carbonate of concentration 200 ppm with respect to calcium. (4 marks)

SECTION B (60 marks)

*Answer any **THREE** questions from this section.*

11. (a) (i) Explain two conditions required for analysis of a sample by flame emission spectroscopy (FES). (4 marks)

(ii) Describe the basic operating principles of flame emission spectroscopy (FES). (8 marks)

(b) Describe how standard addition method is used for the calibration of flame emission spectroscopy (FES). (8 marks)

12. (a) (i) List **three** common interferences in UV-visible spectrophotometry. (3 marks)

(ii) State **three** advantages of UV-visible spectrophotometry as a method of analysis. (3 marks)

(b) (i) Define the phrase '*instrumental sensitivity*'. (1 mark)

(ii) Determine the instrumental sensitivity of $KMnO_4$, whose absorbance is 0.65 in a 200 ppm solution. (*f.wt* $KMnO_4 = 158$). (4 marks)

(c) Draw a labelled schematic diagram of a double beam UV-visible spectrophotometer. (9 marks)

13. (a) (i) A metal ore is suspected to contain magnesium as magnesium carbonate. Describe how the ore can be digested into an aqueous solution. (4 marks)

(ii) Describe how the amount of magnesium in the ore can be quantified by flame photometry. (6 marks)

(b) The data in table I are results that were obtained in a calibration experiment for the quantitative estimation of magnesium in a mineral ore by flame photometry.

Table I

Concentration of standards in ppm	0.00	5.00	10.00	15.00	20.00
Relative detector response	25.0	35.0	54.8	69.0	82.10

(i) Calcullate the corrected relative detector response.

(ii) Plot the calibration curve and use it determine the concentration of magnessium in a sample whose corrected detector response was 24.00 .

14. (a) Explain the following terms as used in water quality analysis:

(i) alkalinity;
(ii) total dissolved solids;
(iii) biological oxygen demand.
(iv) total hardness.

(4 marks)

(b) Describe the process of extraction of cellulose materials. (8 marks)

(c) Describe **four** characteristics of a good lipstick. (8 marks)

15. (a) (i) Define the term distillation. (2 marks)
(ii) State the following types of distillation as applied in unit operation processes:

I. steam distillation; (2 marks)

II. fractional distillation; (2 marks)

III. vacuum distillation. (2 marks)

(b) Explain the meaning of the following types of surfactants as used in the manufacture of detergents:

(i) anionic surfactants;
(ii) cationic surfactants;
(iii) non-ionic surfactants;
(iv) amphoteric surfactants.

(8 marks)

(c) Give **two** applications for each of the following unit operations techniques.

(i) centrifugation;
(ii) crystallization.

(4 marks)

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