

2915/202

**INDUSTRIAL CHEMISTRY I AND  
INSTRUMENTAL METHODS OF  
ANALYSIS I**

**Oct./Nov. 2019**

**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;*

*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 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.**

## SECTION A (40 marks)

Answer **ALL** the questions in this section.

1. Define the following terms as used in statistical analysis of experimental data:
  - (a) mean; (1 mark)
  - (b) mode; (1 mark)
  - (c) median; (1 mark)
  - (d) range. (1 mark)
2. (a) State **two** monochromation methods used in flame photometry. (2 marks)  
(b) Describe how each of the stated monochromation methods functions. (2 marks)
3. With the aid of a sketch graph, explain how  $\lambda_{\max}$  for  $\text{SO}_4^{2-}$  ions can be determined in a UV-visible spectroscopy using a single AR salt. (4 marks)
4. Convert the following percent transmittance values into absorbance:
  - (a) 80% (2 marks)
  - (b) 0% (2 marks)
5. The following masses in mg of AR  $\text{KMnO}_4$  were obtained in an experiment to calibrate a colorimeter.  
  
50.1, 49.80, 51.10, 50.50, 51.20.  
  
Calculate the standard deviation for the measurements. (4 marks)
6. Sketch a triple effect forward feed evaporator arrangement. (4 marks)
7. Explain why mercury compounds are prohibited in cosmetic products. (4 marks)
8. (a) Write the structural formulae for the following detergents:
  - (i) sodium alkylbenzene sulfonate; (1 mark)
  - (ii) glycerol. (1 mark)(b) State any **two** disadvantages of detergents. (2 marks)

wood  
fibre

9. An evaporator concentrates a 10% solution to 50% . Determine the amount of vapour produced per hour if the feed is 10 kg/s. (4 marks)

10. Given the following information:

Normality of HCl = 0.2 N

Volume of HCl used in the test = 10 ml

Volume of HCl used in the blank = 18 ml

Weight of sample = 100 g

Calculate the saponification value of the sample. (4 marks)

### SECTION B (60 marks)

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

11. (a) At the 95% confidence limit, determine the confidence interval for the amount of aspirin in a single analgesic tablet drawn from a population where

$$\mu = 250 \text{ mg and } \sigma^2 = 250 \text{ mg} \quad (6 \text{ marks})$$

(b) A manufacturer's process for analysing aspirin tablets yielded the following results after ten tablets were randomly selected.

254, 249, 252, 249, 249, 250, 247, 251, 252 and 253.

Calculate the standard error in the measurements. (14 marks)

12. (a) (i) Draw a labelled block diagram of a double beam UV-visible spectrophotometer. (7 marks)

(ii) Explain the advantages of the instrument drawn in a (i) above. (4 marks)

(b) Outline a procedure that can be used to analyse a binary mixture by UV-visible spectrophotometry. (9 marks)

13. (a) Differentiate between constant rate filtration and constant pressure filtration. (4 marks)

(b) With the aid of a diagram, describe the operation of a continuous rotary vacuum filter. (16 marks)

14. A plant is to distill 10 000 kg/h of methanol-water mixture. The mixture contains 75% w/w methanol and 25% w/w water. The overhead product is to contain 99.5% w/w methanol and the bottom product 1% methanol. The feed is brought at boiling point of the mixture and the reflux ratio is 2.35.

- (a) Calculate the moles of overhead product and bottom product per hour. (8 marks)
- (b) Determine the number of ideal plates using McCabe-Thiele method. The equilibrium data is given in Table I.

Table I

$x$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
$y$	0.417	0.579	0.669	0.729	0.780	0.825	0.871	0.915	0.959	1

$$y_n = \frac{R}{1+R} x_{n+1} + \frac{x_D}{1+R}$$

(12 marks)

15. (a) Table II shows data obtained after carrying out a moisture determination experiment of a lignocellulose material.

Table II

Weight of sample plus dish before drying	= 4.42 g
Weight of sample plus dish after drying	= 4.23 g
Weight of empty dish	= 3.5 g

Calculate the percentage moisture in the sample:

- (i) on wet basis; (4  $\frac{1}{2}$  marks)
- (ii) on dry basis. (3  $\frac{1}{2}$  marks)
- (b) Table III shows data that was obtained after determination of ash content of a certain cellulosic material in triplicate sample.

Table III

	Sample 1	Sample 2	Sample 3
Weight of crucible with dry residue (g)	340	343	344
Weight of crucible with ash (g)	334	336	335

If the weight of the crucible is 330 g, determine:

- (i) the average weight of the residue; (3 marks)
- (ii) the percentage ash content of the sample. (3 marks)
- (iii) the average ash content. (3 marks)
- (c) State any **three** forms of cellulose. (3 marks)



Values of t for the 95% Confidence Interval	
Degrees of Freedom	t
1	12.71
2	4.30
3	3.18
4	2.78
5	2.57
6	2.45
7	2.36
8	2.31
9	2.26
10	2.23
12	2.18
14	2.14
16	2.12
18	2.10
20	2.09
30	2.04
50	2.01
$\infty$	1.96

Confidence Intervals for Normal Distribution Curves Between the Limits $\mu \pm z\sigma$	
z	Confidence Interval (%)
0.50	38.30
1.00	68.26
1.50	86.64
1.96	95.00
2.00	95.44
2.50	98.76
3.00	99.73
3.50	99.95

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