



# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

## UNIVERSITY EXAMINATION FOR:

THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

(ANALYTICAL AND INDUSTRIAL OPTIONS)

ACH 4313 : SURFACE AND COLLOID CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

**SERIES:** APRIL 2016

**TIME:** 2 HOURS

**DATE:** Pick Date Select Month Pick Year

### Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

### Question ONE

- (a) (i) Differentiate between “adsorption” and “absorption”. (2 marks)
- (ii) Briefly explain how variations in temperature and pressure influence the adsorption of a gas on a solid. (2 marks)
- (iii) The Freundlich adsorption isotherm is represented by the empirical equation  $a = kp^n$ . Explain the meaning of the terms in the equation. (2 marks)
- (b) (i) State the major characteristic of a colloidal state. (1 marks)
- (ii) Define the terms “disperse phase” and “dispersion medium” as applied to colloidal systems. (2 marks)
- (iii) Explain the basic principles of the “condensation” and “dispersion” methods for the preparation of colloidal dispersions. (4 marks)
- (c) (i) Define the terms “surface tension” and “interfacial tension”. (2 marks)

- (ii) Explain how the interfacial tension between the emulsifier and water or oil influences the stability of oil/water emulsions. (6 marks)
- (d) (i) Define the term “sol”. (1 mark)
- (ii) Explain the basic principle of the ultracentrifuge method for macromolecular weight determination. (1 mark)
- (iii) Explain why the macromolecular weights determined by the ultracentrifuge method are referred to as “**weight average molecular weight**” ( $M_w$ ). (2 marks)
- (iv) The rotor speed in an equilibrium ultracentrifuge study of a protein sol was found to be  $1.65 \times 10^4$  rotations.min<sup>-1</sup>. Calculate the angular velocity of the sol in rad.sec<sup>-1</sup>. (5 marks)

### Question TWO

- (a) (i) State the basic principle of a chromatographic analysis. (1 mark)
- (ii) Briefly explain how a separation of a mixture of compounds in solution can be accomplished by column chromatography. (5 marks)
- (b) (i) Define the term “monomolecular film”. (1 mark)
- (ii) Using a sketch explain how a monolayer of a long-chain fatty acid sample is formed on the surface of water. (5 marks)
- (c) Explain the difference between the following pairs of terms:
  - (i) ”Electroosmosis” and “streaming potential”. (2 marks)
  - (ii) ”Ampholytes” and “zwitterions”. (2 marks)
  - (iii) ”Monodisperse” and “polydisperse” sols. (2 marks)
  - (iv) ”Adsorbent” and “adsorbate”. (2 marks)

### Question THREE

- (a) (i) Explain the difference between “lyophilic” and “lyophobic” sols, giving TWO examples of each type. (4 marks)
- (ii) State TWO factors which determine the stability of lyophilic sols. (2 marks)
- (b) Explain why most solutes are generally more easily adsorbed from aqueous than from ethanolic solution. (4 marks)
- (c) (i) Define the terms “foam” and “anti-foaming agent”. (2 marks)
- (ii) State TWO factors that influence liquid foam stability. (2 marks)

- (iii) Briefly explain the conditions which necessitate the use of anti-foaming agents. (1 mark)
- (iv) Explain the difference between “open-cell” and “closed-cell” solid foams. (2 marks)
- (v) Give ONE application of liquid and TWO applications of solid foams. (3 marks)

#### Question FOUR

- (a) (i) Define the term “amphiphile”. (1 mark)
- (ii) Briefly explain how an emulsifier enhances the stabilization of an oil-in-water emulsion. (3 marks)
- (iii) Briefly discuss the stabilization of emulsions by solid emulsifiers. (4 marks)
- (b) Explain the formation of a positively charged silver iodide sol. (4 marks)
- (c) (i) Define the term “peptization”. (1 mark)
- (ii) Briefly explain how water peptizes a gelatin (lyophilic) sol. (3 marks)
- (d) The interfacial tension between toluene and water at 25°C is 44.09 dynes.cm<sup>-1</sup>, while the surface tension of water, at the same temperature, is 71.82 dynes.cm<sup>-1</sup>. Determine the surface tension of toluene at 25°C. (4 marks)

#### Question FIVE

- (a) Briefly describe the operation of the following methods for preparation of colloidal dispersions.
  - (i) Colloid mill. (3 marks)
  - (ii) Electrical disintegration. (3 marks)
- (b) (i) State the TWO methods which can be used for the purification of colloidal dispersions, and explain the basic principle on which EACH operates. (3 marks)
- (ii) Briefly describe the operation of ultrafiltration method for the purification of colloidal dispersions. (3 marks)
- (c) A monomolecular film containing  $5.19 \times 10^{-5}$  gram of hexadecanoic acid (C<sub>15</sub>H<sub>31</sub>COOH) spread on water occupied an area of 265 cm<sup>2</sup>. Calculate the area occupied by one molecule.
 

{Avogadro’s constant,  $N_A = 6.023 \times 10^{23}$  mole<sup>-1</sup>} (8 marks)