



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

END OF SEMESTER 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 “physical (van der Waals’) adsorption” and “chemisorption”. (2 marks)
- (ii) Explain the difference in the volumes in the physical adsorption of the following gases by 1 gram of charcoal at 25°C and 1 atm. pressure.

Gas	Volume adsorbed (cm ³)
Carbon dioxide	50
Sulphur dioxide	400

(7 marks)

- (b) (i) Explain the difference between a “true solution” and a “colloidal dispersion”. (2 marks)

- (ii) Briefly describe the operation of electro dialysis method for the purification of colloidal dispersions. (3 marks)
- (c) (i) Explain the meaning of the term “salting out” as applied to lyophilic sols. (3 marks)
- (ii) Briefly explain how the effect in (iii) above can be solved. (3 marks)
- (d) The Gibb’s equation for adsorption from solution is expressed as:

$$S = - \frac{c}{RT} \cdot \frac{d\gamma}{dc} \text{ for a dilute solution.}$$

- (i) Explain the meaning of the terms in the expression. (4 marks)
- (ii) For a 0.05M solution of phenol in water at 20°C, the rate at which the surface tension varies with concentration, $-d\gamma/dc$, is 165 erg.cm².mol⁻¹L. Determine the amount of phenol adsorbed at the surface of the solution in moles/cm².
{R = 8.314 x 10⁷ ergs.deg⁻¹mole⁻¹} (4 marks)
- (iii) Briefly explain the effect of phenol on the interfacial tension between the two liquids in view of the result in (ii) above. (2 marks)

Question TWO

- (a) (i) Define the terms “tyndal effect” and “tyndal beam”. (2 marks)
- (ii) Draw a schematic diagram of an ultramicroscope and briefly explain how it works. (7 marks)
- (iii) Give TWO applications of the tyndal beam. (2 marks)
- (b) (i) Define the term “unimolecular film”. (1 mark)
- (ii) A film containing 6.25 x 10⁻⁵ gram of octadecanoic acid (C₁₇H₃₅COOH) spread on water was compressed into a unimolecular film occupying an area of 16 x 18 cm. Calculate the cross-sectional area of one molecule.
{Avogadro’s constant, N_A = 6.023 x 10²³} (8 marks)

Question THREE

- (a) (i) Define the term “coagulation”. (1 mark)
- (ii) State the TWO factors that influence the coagulation of lyophobic sols by electrolytes. (2 marks)

- (iii) Differentiate between “electrical double layer” and “electrokinetic potential”.
(2 marks)
- (iv) Explain how the electrical charge on colloidal particles contributes to the stability of lyophobic sols.
(3 marks)
- (b) (i) Define the term “adsorption isotherm”.
(1 mark)
- (ii) Sketch a general adsorption isotherm of a gas by a solid at two different temperatures and explain the salient features of the plot.
(7 marks)
- (c) (i) Define the term “demulsification”.
(1 mark)
- (ii) Briefly describe ONE chemical and TWO physical methods of demulsification.
(3 marks)

Question FOUR

- (a) (i) Define the term “lyotropic series”.
(1 mark)
- (ii) Explain the trend in the following part of the lyotropic series: $\text{Li}^+ > \text{Na}^+ > \text{K}^+$.
(5 marks)
- (b) Explain the formation of a negatively charged silver iodide sol.
(4 marks)
- (c) (i) Define the term “amphiphile”.
(1 mark)
- (ii) Using a sketch, explain the formation of “micelles” by detergent solutions.
(6 marks)
- (d) Explain the difference between “intrinsic” and “extrinsic” colloids, giving ONE example of each type.
(3 marks)

Question FIVE

- (a) (i) Define the term “colligative property”.
(1 mark)
- (ii) Explain why the molecular mass determined by the osmotic pressure method is often referred to as the “**number average molecular mass**”,
(2 marks)
- (iii) Explain why in the osmotic pressure method for macromolecular mass determination, the data are normally extrapolated to infinite dilution.
(3 marks)
- (b) (i) Define the term “electrophoretic mobility”.
(1 mark)
- (ii) Calculate the velocity of a protein molecule of radius 2.0 nm and average charge of +5 in the direction of an applied potential gradient of 100 Vcm^{-1} .

$$\{\text{Mobility } u = \frac{eZ(Vm-1)}{6\pi r\eta}; \quad e = 1.602 \times 10^{-19} \text{ C};$$

viscosity of water @ 20°C = $1.005 \times 10^{-3} \text{ Kg m}^{-2} \text{ s}^{-1}$ } (6 marks)

- (c) (i) Define the term “aerosol”.. (1 mark)
- (ii) Give two types of aerosol, briefly explaining their phase constitution. (2 marks)
- (d) (i) State the TWO types of emulsion. (1 mark)
- (ii) Describe a simple method which can be used to distinguish the TWO types of emulsion in (i) above. (3 marks)