Technical University of Mombasa

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY

BTAC 11M / BTAC 12M EVE

ACH 4313: SURFACE & COLLOID CHEMISTRY

SEMESTER EXAMINATION

DECEMBER 2013 SERIES 2 HOURS

Instructions to candidates:

This paper consist of FIVE questions
Answer question ONE (compulsory) and any other TWO questions

QUESTION ONE

(a) (i) Differentiate between "physical adsorption" and "chemisorption". **(2 marks)**

(ii) Explain the difference in the volumes of chlorine and oxygen physically adsorbed by 1gm of charcoal at 25˚C and 1 atm pressure, given in the following table.

Gas	Volume adsorbed (cm^3)
Cl_2	238
O_2	8.5

(4 marks)

b) The Gibbs adsorption equation for a dilute solution is expressed as:

$$S = -\frac{C}{RT}.\frac{d\delta}{dc}.$$

(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, $-d\delta/dc$, is 165 erg. cm^{-2} $mol^{-1}L$.

Determine the amount of phenol adsorbed at the surface of the solution in moles/cm^2.

[$R = 8.314 \times 10^7$ ergs.deg^{-1} $mole^{-1}$] **(4 marks)**

c) (i) Explain the difference between a " true solution" and a " colloidal dispersion". **(2 marks)**

(ii) Briefly describe the operation of the following methods for the purification of colloidal dispersions,

I. Electrodialysis **(3 marks)**
II. Ultrafiltration **(3 marks)**

d) Explain how a negatively charged silver iodide soli is formed **(4 marks)**

e) (i) State the TWO types of emulsions **(1 mark)**

(ii) Describe a simple method which can be used to distinguish the TWO types of emulsions **(3 marks)**

QUESTION TWO

a) (i) State the basic principle of a chromatographic analysis. **(1 mark)**

(ii) Briefly explain how a chromatographic separation of a mixture of compounds in solution can be accomplished. **(5marks)**

b) (i) Define the term "monomolecular" film **(1 mark)**

(ii) Explain the formation of a monolayer of a long-chain fatty acid sample on the surface of water, using a sketch for demonstration. **(5 marks)**

(iii) A film containing 5.14×10^{-5}g of hexadecyl alcohol spread on water was compressed into a monomolecular layer accupying on area of 15.0 x 17.9cm. Calculate the cross-sectional area of one molecule.

{Avogadro constant (N_A) = 6.02×10^{23}} **(8 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)**

(iii) Explain the meaning and cause of the term "salting out" as applied to lyophilic sols **(3 marks)**

(iv) Briefly explain how the effect in (iii) above can be solved. **(3 marks)**

b) (i) Define the term " peptization". **(1 mark)**

(ii) Briefly explain how water peptizes a starch (hydrophilic) sol. **(3 marks)**

c) Explain why most solutes are generally more easily adsorbed from aqueous than from ethanolic solution. **(4 marks)**

QUESTION FOUR

a) The adsorption of carbon monoxide on mica at 90˚ K gave the following results

Pressure, mmHg	105	453	545	791	1059
Volume adsorbed (cm^3)	1300	1630	1680	1780	1830

Show that the data fit the Langmuir adsorption isotherm. $\left[pV^{-1} = (k_1)^{-1} + k_2(k_1)^{-1}.p\right]$ **(9 marks)**

b) (i) Explain the difference between" intrinsic" and "extrinsic" colloids, giving ONE example of each type. **(3 marks)**

(ii) Explain the basic principle of the " condensation methods" for the preparation of colloidal dispersions. **(2 marks)**

c) Using a sketch, explain the formation of micelles by detergent solutions. **(6 marks)**

QUESTION FIVE

a) Define the following terms:

(i) Colligative property **(1 mark)**
(ii) Monodisperse sol **(1 mark)**
(iii) Polydisperse sol **(1 mark)**
(iv) Number average molecular mass $\left(\overline{Mn}\right)$ **(1 mark)**

b) Explain the following:-

(i) In the osmatic pressure method for macromolecular mass determination, the data are normally extrapolated to infinite dilution. **(3 marks)**
(ii) The molecular mass determined by the osmatic pressure method is often referred to as the " Number average molecular mass". **(2 marks)**

c) The osmotic pressures of a sample of polyisobutylene in cyclohexane at 25˚C at several concentrations are as follows:

c, $g.mL^{-1}$	0.020	0.015	0.010	0.0075	0.005	0.0025
Π, bar	0.0118	0.0067	0.003	0.00175	0.00091	0.00035

Determine the number average molecular mass of the sample.

{ R= 0.08314L. bar.$K^{-1}mol^{-1}$; $\lim_{c \to O}\left(\frac{\pi}{c}\right)=\frac{RT}{M}$ **(11 marks)**