# TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTH SCIENCES

DEPARTMENT OF PURE & APPLIED SCIENCES

## UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN APPLIED CHEMISTRY:

BTAC 2014/S-FT AND BTAC 2015/S-PT

ACH 4313: SURFACE AND COLLOIDS CHEMISTRY

SPECIAL/SUPPLEMENTARY EXAMINATION

### SERIES: SEPT. 2017

### 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. Answer question ONE (Compulsory) and any other TWO questions.
**Do not write on the question paper.**

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**Question ONE**

**(a) i**. Define the following terms as used in surface and colloid chemistry.
    I. Surfactants     (**2** marks)
    II. Contact angle     (**2** marks)
    III. Surface free energy     (**2** marks)
    IV. Adsorption     (**2** marks)

  **ii.** Distinguish between lyophilic sols and lyophobic sols.     (**4** marks)

**(b) i.** Write down a mathematical expression described by B.E.T adsorption isotherm and define all variables.     (**4** marks)

  **ii.** Differentiate between emulsions and foams.     (**4** marks)

**iii.** Give any TWO general rules that have been developed to explain the biodegradation of most surfactant types. (**2** marks)

**(c) i.** 2 g of nitrogen is adsorbed on 1.5 g of metal powder at 300 K and 0.7 atm. Express the mass, number of moles and volume of nitrogen at 300K and 0.7 atm and S.T.P respectively, adsorbed per gram of the adsorbent. (**4** marks)

**ii.** In a coagulation experiment, 5 ml of $As_2S_3$ sol is mixed with distilled water and 0.1 M solution of NaCl so that the total volume is 10 ml. it has been observed that all tubes containing more than 4.7 ml of sodium chloride coagulate within 5 minutes. Determine the flocculation value of NaCl for $As_2S_3$ sol. (**3** marks)

**iii.** State TWO general types of emulsions. (**2** marks)

## Question TWO

**(a) i.** Define the term *electro-osmotic flow [EOF]* and write down a mathematical expression used to determine EOF. (**6** marks)

**ii.** Outline the FOUR general groups of surfactants giving ONE example in each case. (**6** marks)

**(b) i.** A gold sol contains 0.193 g of gold per $dm^{-3}$. The particles are spherical in shape with radius of 120 nm. If the density of gold is 19.3 g $cm^{-3}$. Determine:
  I. The number of particles present in $10^{-14}$ of the sol. (**3** marks)
  II. The interfacial area of the gold particle in 1 $m^3$ of the sol. (**3** marks)

**ii.** State any THREE applications of each of the following:
  **I.** Surfactants in *Industry* (**3** marks)
  **II.** Surfactants in *Consumer* products (**3** marks)

## Question THREE

**(a) i.** Define the term *coagulation*. (**2** marks)

**ii.** Discuss briefly any TWO applications of colloids under the following classes.

  **I.** Natural applications (**6** marks)
  **II.** Technical applications (**6** marks)

**(b) i.** The osmotic pressure of nitrocellulose has been measured at various concentrations, at $27^0$ C and the graph drawn between $\pi/c$ and $c$ gives a straight line that has an intercept at c = 0 and is equal to 0.355 torr/$g^{-1}$. Determine molecular weight of the nitrocellulose samples. [R = 0.082 L atm $K^{-1}mol^{-1}$] (**2** marks)

**ii.** State any FOUR characteristics of chemisorption. (**4** marks)


**Question FOUR**

**(a) i.** Describe briefly purification of colloidal sols by *Ultrafiltration* method. (**4** marks)

   **ii.** Explain briefly the *Adsorption theory* of catalysis and what is meant by the term
    *shape selective catalysis.* (**5** marks)

**(b) i.** 1 g of water of a water-insoluble substance of density 0.8 g cm$^{-3}$ is dispersed in 2 liters of
   water, leading to the formation of a colloidal sol containing $10^{13}$ particles of spherical
   shape per mm$^3$. Determine the radius of the particle. (**6** marks)

   **ii.** Draw a chemical structure illustrating cross-section of soap micelle in water. (**5** marks)


**Question FIVE**

**(a) i.** State THREE methods used to stabilize foams. (**3** marks)

   **ii.** Electrophoresis has been applied to a variety of analytical separation problems. List
   FIVE such separation areas. (**5** marks)

**(b) i.** State any FOUR factors affecting adsorption of gases on solids. (**4** marks)

   **ii.** Draw sketch curves represented by each of the following adsorption isotherms.
    **I.** BET isotherm
    **II.** Langmuir isotherm (**6** marks)

   **ii.** State any TWO applications of adsorption. (**2** marks)