KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE

COURSE CODE: SCH 326

COURSE TITLE: SOFT MATTER CHEMISTRY

DURATION: 2 HOURS

DATE: 5/10/2021 **TIME: 2:00-4:00PM**

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **4** printed pages. Please Turn Over

Question 1

a) What is meant by the following terms; [4mks]

i. Soft matter

ii. Adsorption.

iii. Unit Cell

iv. Wetting.

b) State three Characteristics of Soft matter systems. [3mks]

c) Given r = radius of atom and a = edge length of a unit cell, calculate Packing fraction of Face centred cubic unit cell. [3mks]

d) By use of diagrams, describe contact angle in relation to hydrophilic and hydrophobic solid surfaces. [4mks]

e) State three differences between physical and chemical adsorption [3mks]

f) Explain three factors affecting adsorption. [3mks]

g) Explain what is observed when electric current is passed through a colloidal sol. [2mks]

h) Describe the structure of a Surfactant. [2mks]

i) A polymer sample has four different kinds of molar masses as 1.5×10^5, 2.0×10^5, 3.5×10^5, 5×10^5 present in the ratio 1:3:4:2. Calculate

I. Number average molecular weight. [2mks]

II. Weight average molecular weight. [2mks]

j) State two factors affecting glass transition temperature (Tg). [2mks]

Question 2

a) Explain two factors affecting surface tension [4mks]

b) State three applications of surface tension. [3mks]

c) Explain two types of wetting of solid surfaces. [4mks]

d) Given the following data on interfacial tensions (mN/m)

Interface	air/hexane	air/Hg	Hg/Hexane	Hg/water	Hexane/water
$\gamma/(mNm^{-1})$	18	485	378	415	50

Calculate and the spreading coefficient and comment on your answers when;

i. hexane is in contact with the Hg/water interface [3mks]

ii. hexane is in contact with air/Hg surface. [3 marks]

e) Explain three applications of adsorption. [3mks]

Question 3

a) Derive Langmuir adsorption isotherm equation, given the gas pressure at equilibrium is P and the equilibrium fraction of the surface covered by adsorbate is θ, [6mks]

b) State four limitations of Langmuir Adsorption Equation. [4mks]

c) Describe Freundlich adsorption isotherm [8mks]

d) Calculate the amount of adsorption using Freundlich isotherm of the solute on activated charcoal in which the Slope value n = 0.2 and the distribution coefficient is k = 0.19. The equilibrium concentration of the adsorptive is 0.12. [2mks]

Question 4

a) State four differences between thermoplastic and thermosetting polymers. [4mks]

b) Below, molecular weight data for a polypropylene material are tabulated.

Molecular Weight range (g/mol)	x_i	w_i
8000 – 16000	0.05	0.02
16000-24000	0.16	0.10
24000-32000	0.24	0.20
32000-40000	0.28	0.30
40000- 48000	0.20	0.27
48000- 56000	0.07	0.11

Compute

i. the number average molecular weight. [5mks]

ii. the weight-average molecular weight. [5mks]

iii. the degree of polymerization [2mks]

c) The intrinsic viscosity [η] of a polymer solution is 3.6×10^{-1} dlg^{-1} at 298 K. The constants K and α in Mark-Hauwink equation are 3.6×10^{-4} and 0.64 respectively. Calculate the molecular weight of the polymer. [4mks]

Question 5

a) Explain the use of the following methods;

i. ultracentrifuging [2mks]

ii. ultra filtration [2mks]

b) Distinguish between hydrophilic sols and hydrophobic sols [4mks]

c) Give a brief explanation of the following concepts in colloid science. [2 Marks]

i. double layer

ii. zeta potential

d) State four Assumptions of DLVO theory [4mks]

e) Calculate the Debye lengths in 10 mol/m^3 aqueous solutions of NaCl and $AlCl_3$ at 298K. (given, $\frac{N_A e^2}{\varepsilon\varepsilon_0 KT} = 5.404 \times 10^{15}$m) [6marks]