

**DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2022/2023 SESSION**

COURSE TITLE: POLYMER CHEMISTRY

COURSE CODE: CHM 315

CREDIT UNITS: 3

TIME ALLOWED: 2 HOURS 30 MINUTES

INSTRUCTION: ANSWER FOUR THREE QUESTIONS

Q1 (a). Define the following terms:

- (i) Polymer (ii) Copolymer (iii) Degree of Polymerization (iv) Oligomer
(v) Rheology (vi) Polymer morphology **(6 marks)**

(b) In a tabular form, write the structural formula of the monomer and repeating units of the following polymers (i) polystyrene (ii) poly vinyl acetate (iii) polyvinyl chloride (iv) poly methyl metaacrylate **(4 marks)**

(c) Using structures only, illustrate the following types of polymers

- (i) homopolymer (ii) Random copolymer (iii) Block copolymer (iv) Graft copolymer
(v) Alternate copolymer **(5 marks)**

Q2.(a). Define the following terms (i) Number average molecular weight (ii) Weight average molecular weight (iii) viscosity average molecular weight (iv) thermoplastics and thermosetting **(4 marks)**

(b) A sample of polystyrene is composed of a series of fractions of different sized molecules:

Fraction	Weight fraction	Molecular weight
A	0.10	12000
B	0.19	21000
C	0.24	35000
D	0.18	49000
E	0.11	73000
F	0.08	102000
G	0.06	122000
H	0.04	146000

Calculate (i) number average molecular weight (ii) weight average molecular weight
(iii) Polydispersity index **(6 marks)**

(c) In a tabular form, highlight any five differences between flexible and rigid plastics
(5 marks)

Q3.(a) Describe the working principle of Gel Permeation Chromatography. **(5 marks)**

(b) 0.1 g sample of polystyrene was dissolved in 100 cm³ of butanone at 2.5% in an Ubbelohde capillary viscometer, if the flow times for pure butanone was 220 sec and that of 0.1% polystyrene was 280 second. Determine the viscosity average molecular weight of the solution. [Given the value of k and a to be 3.9×10^{-3} and 0.581 respectively] **(7 marks)**

(c). Briefly discuss the limitations of Membrane Osmometry **(3 marks)**

Q4. (a) A 21.3 g sample of poly (hexamethylenediamide) was found to contain 2.5×10^{-3} mol of carboxyl groups by both titration with base and acid. From the data, the polymer was found to have a number average molecular weight of 8520.

(i) Describe experimentally how to obtain the correct value of M_n .

(ii) Highlight any four limitations of this technique

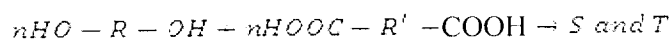
(iii) List any three factors complicating this analysis **(10 marks)**

(b). In a tabular form, enumerate any four differences between industrial and suspension polymerization **(2 marks)**

(c). List any three factors governing the mechanical properties of a polymer **(3 marks)**

Q5. (a). Briefly explain the textural behaviour of polymer in (i) dilute solution (ii) molten state **(4 marks)**

(b) Consider the reaction below



(i) Identify the products S and T

(ii) Suggest the class name of the polymer formed

(iii) what type of polymerization is applicable here?

(iv) propose a suitable mechanism for the formation of S and T **(6 marks)**

(c). Briefly discuss any two of the following models

(i) Folded Chain Lamellar (ii) Extended chain crystals (iii) Fringed micelle

(5 marks)