DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
FIRST SEMESTER EXAMINATION 2021/2022 SESSION
COURSE CODE: CHM 315

UNITS: 3
COURSE TITLE: INTRODUCTION TO POLYMER CHEMISTRY
TIME ALLOWED: 2 HOURS 30 MINUTES
INSTRUCTIONS: ANSWER FOUR QUESTIONS

[H=1, O=16, N=14, C=12]

Q1. (a) Give four characteristics each of step and chain growth polymerization **(4 marks)**

(b).The classification of polymers as either addition or condensation is considered ambiguous. Explain **(6 marks)**

(c). Consider the following polymerization reaction;

$nH_2N(CH_2)_6NH_2 + nHOOC\text{-}(CH_2)_4COOH \longrightarrow -[HN(CH_2)_6\ NH-CO-(CH_2)_4-CO]n + nH_2O$

(i) Identify the polymer formed. **(2 marks)**

(ii) Calculate the average molecular mass of the polymer.at 99% completion (**3 marks)**

Q2. (a) Using structures **only**, explain the following types of polymers:

i. Homopolymer
ii. Random copolymer
iii. Block copolymer
iv. Graft copolymer
v. Alternate copolymer **(5 marks)**

(b (i) Highlight any four limitations of end-group analysis? **(2 marks)**

(ii) List any three factors complicating end-group analysis. **(3 marks)**

(c) A 0.5 g sample of unsaturated polyester was reacted with an excess of acetic anhydride. The acid (-COOH) liberated was titrated with 8.17 cm^3 of 1.02 x 10^{-2} $moldm^{-3}$ potassium hydroxide solution for complete neutralization. Calculate the molecular mass of the polyester? **(5 marks)**

Q3.(a).(i) With the aid of an appropriate diagram, describe concisely the working principle of Gel Permeable Chromatography (GPC) **(5 marks)**

(ii) Justify the choice of a cross linked polystyrene as a column material in GPC **(3 marks)**

(b) Highlight any four drawbacks of GPC. **(2 marks)**

(c) A hypothetical polymer sample consists of the following fractional distribution.

Weight fraction, *wi*,	0.04	0.23	0.31	0.25	0.13	0.04
Mean Mol Wt, *Mi* x 10^3	7	11	16	23	31	39

Calculate the weight average molecular weight, $\overline{M_w}$. **(5 marks)**

Q4. (a). Concisely explain the following:

(i) Folded chain lamellar model (ii) Extended chain crystals model

(ii) Morphological states of polymer molecules **(6 marks)**

(b) Mention four ways by which polymer crystallinity can be induced **(4 marks)**

(c) Explain the textural behaviour of polymers in (i) dilute solution (ii) molten state

(5 marks)

Q5. (a). Define the following terms:

i. Configuration ii. Conformation iii. Tacticity **(3 marks)**

(b). Differentiate between the following pair of terms:

i. Thermoplastics and thermosets.

ii. Stress and strain

iii. Isotactic and syndiotactic **(3 marks)**

(c) (i) What is the molecular weight of a polyester sample if 12 cm^{-3} of 0.01$moldm^{-3}$ of KOH were required to neutralize 0.25 g of the polymer sample having a –COOH end group? **(5 marks)**

(ii). At a concentration of 0.0020 g/cm^3, a polymer exhibited an osmotic pressure height of 0.30 cm in a solvent of 1.0 gcm^{-3} density at 30°C. Given that the second viral coefficient is zero, calculate the number average molecular mass. [Hint: R = 8.314 x 10^7ergs mol^{-1} K^{-1}, g = 9.8 m^{-2}] **(4 marks)**