UNIVERSITY OF ESWATINI

MAIN EXAMINATION 2019/2020

TITLE OF PAPER:	**APPLIED POLYMER CHEMISTRY**
COURSE NUMBER:	**CHE618**
TIME ALLOWED:	**THREE (3) HOURS**
INSTRUCTIONS:	**THERE ARE <u>FOUR (4)</u> QUESTIONS IN THIS PAPER. ANSWER <u>QUESTION ONE</u> (TOTAL 40 MARKS) AND <u>ANY TWO OTHER QUESTIONS</u> (EACH QUESTION IS 30 MARKS)**

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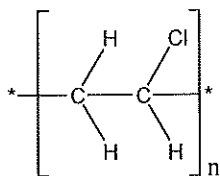
Question 1

(a) Define the following terms;
   (i) Homopolymer
   (ii) Statistical polymers
   (iii)Block copolymer
   (iv)Crystallization temperature
   (v) Hooke's Law   [10]

(b) Draw the chemical structure of a typical repeat unit of the following 4 classes of polymers;
   (i) A polyether
   (ii) A polyurea
   (iii)A polyamide
   (iv)A polycarbonate   [12]

(c) Differentiate between the structures of nylon 6, 6 and nylon-6, 10. In each case, draw the structures of the repeat unit.   [8]

(d) What do you mean by copolymer? Give two examples.   [4]
(e) How are polymers classified on the basis of their structure? Give one example of each.   [6]
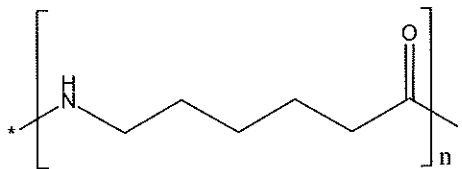
Question 2

(a) GPC is a common technique to determine the molecular weight of a polymer.
   (i) What does GPC stand for? Give two other names for this instrument and explain what each of these names has to do with the functioning of this instrument.   [7]

(b) By clearly stating all your assumptions, show that the steady state rate of polymerization (R_p) is given by;   [8]

$$R_p = k_p \left(\frac{R_i}{2k_t} \right)^{1/2} [M]$$

(c) (i) Draw the structure of the monomer of each of the following polymers;
(ii) Name at least two applications of each polymer. [8]

polyvinyl chloride   nylon-6

(d) Define T_m and T_g and indicate how they are affected by chemical structure [7]

Question 3

(a) By Clearly stating any facts and assumptions, show that the number average degree of polymerization (X_n) is given by; [5]

$$\overline{X}_n = \frac{1}{1-p}$$

(b) What is the extent of the reaction (p), for good fibers of nylon 6-6 with, Mn =10,000 g/mol, and X_n = 110. Give your answer in percentages, up to 2 decimal places. [3]

(c) What is vulcanization? How it is done? [4]

(d) Write down five (5) characteristic properties of a good plasticizer. [5]

(e) Sketch the;
   (i) ^{1}H NMR spectrum,
   (ii) ^{1}H-decoupled ^{13}C NMR spectrum and
   (i) DEPT135 ^{13}C NMR spectrum you would expect to observe for the following polymer. [9]
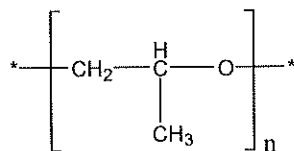
Isotactic poly(propylene oxide)

(f) Differentiate between addition and condensation polymerization. [4]

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Question 4

(a) Give a scheme for the formation of polycaprolactone from the monomer **A**, including any catalyst, intermediates and byproducts, and giving the structure of the final product. **[15]**
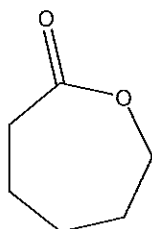
A

(b) Polycaprolactone has similar materials properties to polyethene: by comparing the molecular structures of the polymers, suggest an explanation for this. **[10]**

(c) Why might the use of polycaprolactone be favoured over polyethene? **[5]**

---The End---