



# THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A constituent of JKUAT)

Faculty of Applied and Health Sciences

DEPARTMENT OF PURE AND APPLIED SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF  
TECHNOLOGY IN APPLIED CHEMISTRY

## ACH 4404: POLYMER TECHNOLOGY

SPECIAL/SUPPLEMENTARY EXAMINATION

FEBRUARY 2013 SERIES

2 HOURS

Instructions to candidates:

This paper consist of **FIVE** questions

Answer question **ONE** (compulsory) and any other **TWO** questions

### Question ONE

a) Explain the following terms as used in polymer chemistry

- (i) Oligomer
- (ii) Bulk polymerization
- (iii) Conversion factor
- (iv) Sundiofacticity
- (v) Monodispesity

**(10marks)**

b) Use compound I below

- (i) Identify the repeat unit in polymeric compound 1 above and draw the monomer.

**(2marks)**

- (ii) Work out the degree of polymerization given that the molecular mass of compound 1 is 620,000. (C =12, O = 16 and H=1) **(3marks)**

- c) (i) Describe the end group analysis in determination of average values of polymer molecular weights and molecular weight distribution. **(5marks)**
- (ii) Calculate the number average molecular weight  $M_n$  bar for a polymer containing 9 moles of MW 40,000. **(2marks)**
- d) Explain microscopic techniques used to analyse polymer fibres. **(3marks)**
- e) Give THREE applications of polyester fibres **(3marks)**
- f) Differentiate between chain and step growth polymerization. **(2marks)**

### Question TWO

- a) Explain the importance of the degree of crystallinity with respect to the properties of polymers. **(2marks)**
- b) Using an oil seal formation state any five compounding materials with suitable examples added to rubber and explain their function. **(10marks)**
- c) Explain the factors that affect glass transition temperature of polymers. **(8marks)**

### Question THREE

- a) Derive the kinetic rate expression for step growth polymerization reaction.



Assuming stoichiometric ratio A: B 1:1 **(6marks)**

- b) The benzoyl peroxide initiation of styrene at 60°C follows a simple kinetic expression  $R_i = 2fk_d[I]_0$ . For a solution of 0.01M peroxide and 1.0M styrene in benzene, the initial rates of initiation and polymerization are  $R_i = 5.7 \times 10^{-11}$  M/s and  $R_p = 2.3 \times 10^{-7}$  M/s respectively. Assume termination by coupling of radicals.
- (i) Write down the initiation step
- (ii) Work out the ratio of the two rates  $R_i$  and  $R_p$  and explain the value.
- (iii) Draw the structure of polystyrene **(6marks)**
- c) Describe osmometry as a characterization technique in determination of average values of polymer molecular weights **(5marks)**
- d) State any THREE processing techniques used in plastic processing. **(3marks)**

### Question FOUR

- a) (i) Explain the term thermoforming **(2marks)**

- (ii) State the sequence of operations in thermoforming. **(5marks)**
- b) Explain the importance of dies in profile extrusion. **(3marks)**
- c) State the functionality of the monomers adipic acid, ethyleneglycol and glycerol.

**(3marks)**

- d) Describe the various stages involved in melt spinning process by which polymer fibres are obtained. **(7marks)**

### **Question FIVE**

- a) Classify polymers based on their thermal characteristics giving an example in each case.

**(3marks)**

- b) Draw the structure of monomer(s) and repeating units for the following

(i) Polyisobutylene

(ii) Nylon – 6

**(4marks)**

- c) Using a schematic diagram explain injection moulding. **(5marks)**

- d) Explain the characteristics of the following additives in polymer compounding.

(i) Release agents

(ii) Anti-ozonants

(iii) Extenders

(iv) Pigments

**(8marks)**