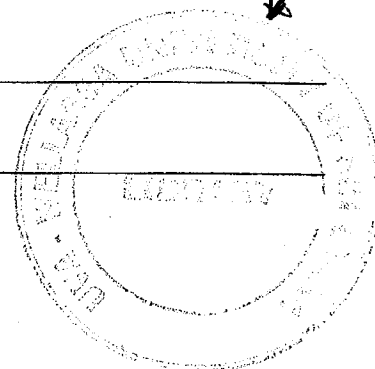


Uva Wellassa University, Sri Lanka
End Semester Examination – December 2009
CHE 451-2 Polymer Technology



Time: Two (02) hours

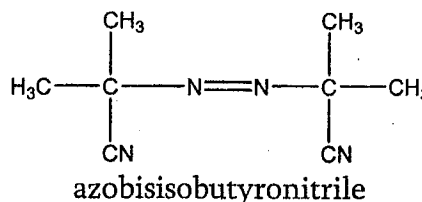
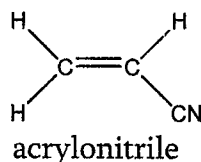
Total five (05) questions
Answer four (04) questions only



1. a. Explain the followings: Use illustrations where necessary
- I. Homopolymer
 - II. Dimer polymer
 - III. Supramolecular network polymer

(15 marks)

- b. Write down the reaction scheme for the polymerization of acrylonitrile using azobisisobutyronitrile as the initiator, assuming, termination takes place by combination.



(20 marks)

- c. I. Explain the emulsion polymerization process, discussing the advantages and disadvantages of the process over the other polymerization processes.

(20 marks)

- d. I. Explain the difference of the molecular arrangement of amorphous state and the crystalline state.

(15 marks)

- II. Compare and contrast the glassy state and rubbery state of amorphous polymer.

(20 marks)

- III. What is meant by glass transition temperature of an amorphous polymer?

(10 marks)

2. a. A polymer solution contains 200 molecules of molar mass $75,000 \text{ g mol}^{-1}$, 500 molecules of molar mass $100,000 \text{ g mol}^{-1}$ and 200 molecules of molar mass $125,000 \text{ g mol}^{-1}$. Calculate:

- I. Number average degree of polymerization
- II. Weight average degree of polymerization
- III. Heterogeneity index

(30 marks)

- b. In a free radical addition polymerization reaction what would be the effect of
- Increasing $[M]_0$ four times at constant $[I]_0$
 - Increasing $[I]_0$ four times at constant $[M]_0$

on the followings:

- The total radical concentration at steady state
- The rate of polymerization
- The number average degree of polymerization

(45 marks)

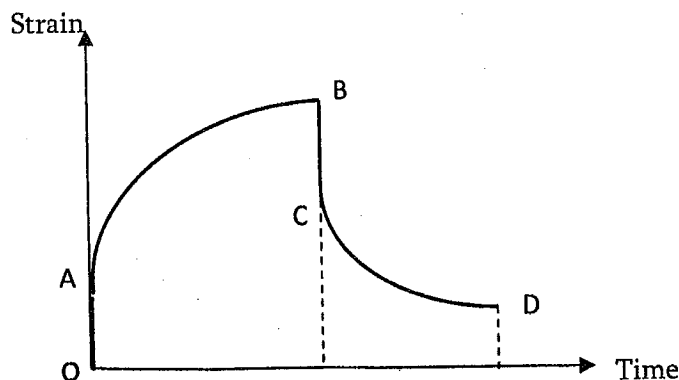
- c. 12-hydroxystearic acid in the molten state at 433.5 K was polymerized by condensation. COOH concentration values obtained by sampling the reaction mixture at various times are given bellow.

Time /hours	0	0.5	1.0	1.5	2.0	2.5	3.0
[COOH] /mol dm ⁻³	3.10	1.30	0.83	0.61	0.48	0.40	0.34

Explain how would you determine whether a catalyst was employed for the reaction or not using the above data. (Determination is not required)

(25 marks)

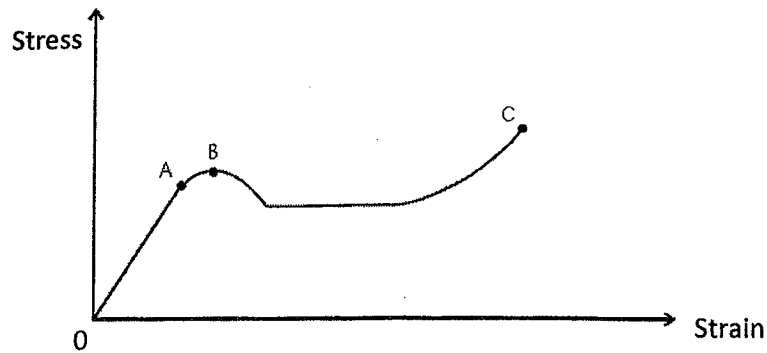
3. a. Explain the visco-elastic nature of polymer? (15 marks)
- b. Mechanical models are often used to describe the visco-elastic nature of polymer. The Maxwell's model and Voigt's model, each consists of a spring and a dashpot. Describe the visco-elastic nature of polymer using above two models. (30 marks)
- c. Suggest a mechanical model to explain the creep nature of a polymeric material. (15 marks)
- d. The following graph shows the mechanical response of a visco-elastic polymeric material subjected to a constant load for a finite time interval.



Use the model you suggested in part c to describe each state of the graph.

(40 marks)

4. Typical stress – strain curve of a polymeric material is given below.



a. Explain the behavior of above polymeric material.

(15 marks)

b. Draw stress – strain curves of the followings on the same graph.

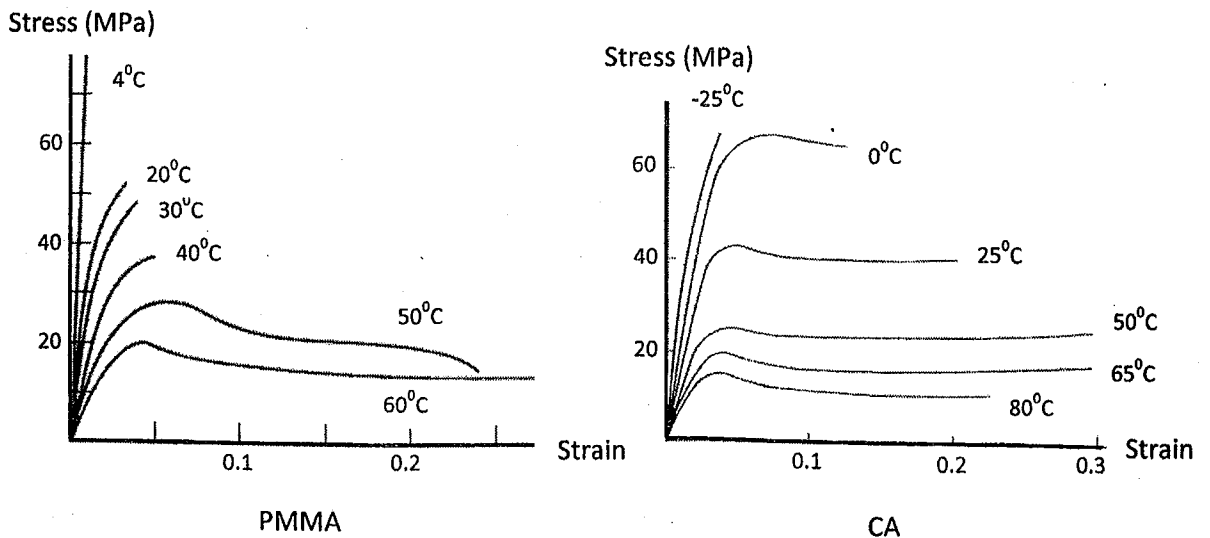
- I. Brittle material
- II. Plastic material

(20 marks)

c. Vulcanized rubber, bakelite are thermosets, while polystyrene (PS), poly(methyl methacrylate) (PMMA), cellulose acetate (CA) are thermoplastics. List five properties of thermoplastics and five properties of thermosets.

(20 marks)

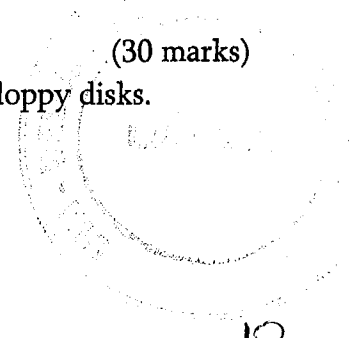
d. Typical stress – strain curves with temperature variance for PMMA and CA are given below.



Which one of the above two materials is most suitable to produce floppy disks for Sri Lanka. Justify your answer.

(30 marks)

e. Briefly describe the processing method that you use to produce floppy disks.



5. a. What is the monomer of natural rubber? Draw the structure. (15 marks)
- b. Explain the purpose of adding ammonia to field latex. (10 marks)
- c. I. What is the purpose of adding compounding ingredients to the polymer material? (15 marks)
- II. List five types of compounding ingredients and briefly describe the effect of those ingredients on polymer material. (10 marks)
- d. Briefly describe the solid tyre manufacturing process. (25 marks)
- (40 marks)