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MAIN EXAMINATION

JANUARY – APRIL 2022

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

REGULAR PROGRAMME

CHEM 307: APPLIED ORGANIC CHEMISTRY I

Date: APRIL 2022	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any TWO Questions	

Q1.

a. Explain the meaning of radical polymerization. **[2 marks]**

b. Write a three steps mechanism involved in polymerization of ethene in the presence of hydrogen peroxide as the radical initiator. **[8 marks]**

c. Outline the three common methods used in the termination step in radical polymerization. **[6 marks]**

d. Polystyrene is a polymer material used for insulation in house construction. Complete the reaction scheme below by showing the product formed on reaction of three molecules of styrene. **[4 marks]**

e. Define the following terms: **[4 marks]**

i. Monomers

ii. Polymers

iii. Homopolymers

iv. Copolymers

f. Condensation polymerization gives low molecular weight polymers in comparison to that obtained from chain growth polymerization. Explain **[4 marks]**

g. State four properties to consider when determining the type of polymer to use in electrical insulation of electrical cables. **[2marks]**

Q2.

a. Explain what you understand by 'tacticity of polymers' **[2 marks]**

b. Using a reasonable mechanism, show the steps involved in the polymerization of propylene upon heating at 400 ^{o}C. **[6 marks]**

c. Using a section of polypropylene structure, explain the three types of tacticity in polymers

[6 marks]

d. Describe briefly any three polymer post-processing methods **[6 marks]**

Q3.

a. Explain the difference between cationic chain-growth polymerization and anionic chain growth polymerization. **[4 marks]**

b. Using a reasonable mechanism and a catalyst of your choice, show the three important steps in cationic polymerization of 2-methylpropene. **[12 marks]**

c. Branching in polymerization plays a major role in controlling some of the physical properties of polymers such as density of the polymer (high-density polyethylene or low-density polyethylene). Illustrate with the help of a mechanism how branching occurs in the polymerization of ethene. **[4 marks]**

Q4.

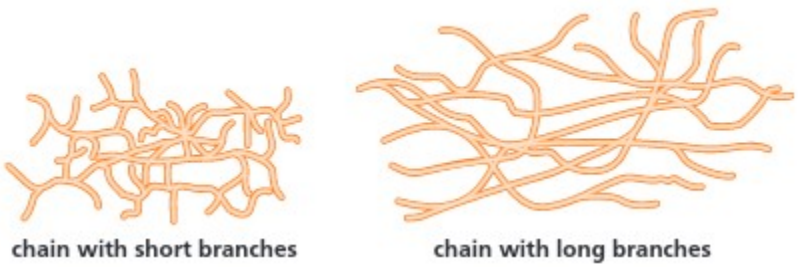
a. Explain what you understand by ring-opening polymerization **[2 marks]**

b. Branch polymerization determines a number of properties, such as density, in various polymers.

i. Explain why branched polymers have low density compared to linear polymers

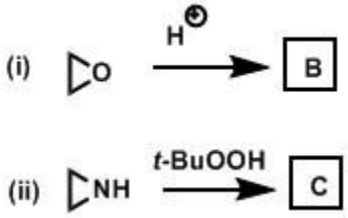
[2 marks]

ii. The figure below shows two different chain lengths of branched polymers.



Account for the different chain lengths in branched polymers. Mechanism required. **[6 marks]**

c. Using a reasonable reaction mechanism, provide the products from the monomers **[6 marks]**



d. Explain the following terminologies as used in polymer chemistry **[4 marks]**

i. Polydispersity index

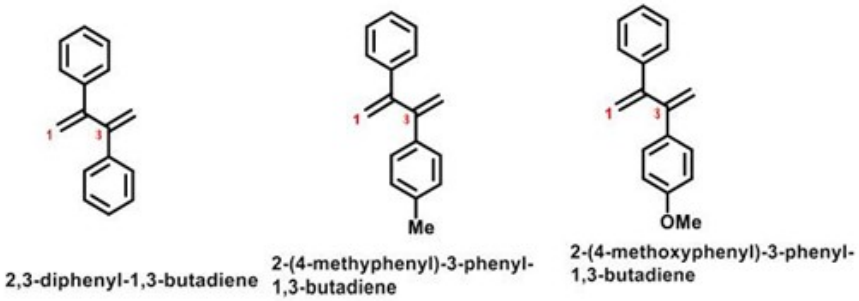
ii. Molecular weight average

iii. Glass

iv. Glass transition temperature

Q5.

2,3-Diphenyl-1,3-butadiene and derivatives below are monomers used in the synthesis of poly(-2,3-diphenyl-1,3-butadiene) derivatives.



2,3-diphenyl-1,3-butadiene | 2-(4-methyphenyl)-3-phenyl-1,3-butadiene | 2-(4-methoxyphenyl)-3-phenyl-1,3-butadiene

i. Draw a representative polymer framework illustrating the *cis*- and *trans*-1,3- poly(- 2,3-diphenyl-1,3-butadiene) and for the other two monomers provided above. **[12 marks]**

ii. Ziegler catalyst requires Natta co-catalyst for its desirable catalytic activity. Suggest a reason for this requirement using a reasonable reaction mechanism. **[8 marks]**

END