



OBAFEMI AWOLOWO UNIVERSITY, ILE-IFE, NIGERIA
DEPARTMENT OF CHEMISTRY
B.Sc., Degree (Industrial Chemistry) Examination
Part II Rain Semester 2021/2022

ICH 204: Chemistry of Plastics and Elastomers

TIME ALLOWED: 2 hours
Instructions: Attempt ALL questions

DATE: June 2023
Provide graph sheets for the students

SECTION A

1. (a) In a second order catalyzed reaction, the following data were obtained during the condensation of 12-hydroxy steric acid at 433.5 K in the molten state by sampling the reaction mixture at various times. The concentration of RCOOH i.e. [-COOH] was determined for each sample by titrating with ethanolic sodium hydroxide and the data obtained are presented in the table below:

T (hr)	[-COOH] (mol dm ⁻³)
0	3.10
0.5	1.30
1.0	0.83
1.5	0.61
2.0	0.48
2.5	0.40
3.0	0.34

Use the data in the table above to answer the following questions:

- (i) Determine the rate constant for the reaction under these conditions.
(ii) What would be the extent of the reaction after 0.5 h and 2 h

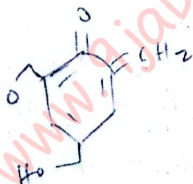
b. Unsaturated polyester resins, which are used as the matrix component of glass-fiber composites may be obtained by the copolymerization of maleic anhydride and diethylene glycol. The low-molecular-weight product obtained (prepolymer) is soluble in styrene. Describe, with the aid of equations, the possible structure of the prepolymer and that of the polymer resulting from benzoyl peroxide-initiated polymerization of a solution of the prepolymer in styrene.

c. Using phenol as a starting material, show by chemical reaction how Bakelite can be prepared. Why is Bakelite not used in forming molded object?

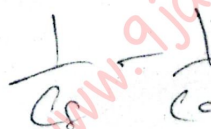
d. What is the role of benzoyl peroxide in addition polymerization of alkenes? Explain its mode of action with suitable example. **25 marks**

2. (a) Write the chemical structures of the following polymers:

- i. Poly (hexamethylene sebacamide),
ii. Poly (m-phenylene isophthalamide), and



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$$\frac{2.941}{0.34} - \frac{0.323}{0.10} = k$$

$$3 - 0 - 0 = k$$

iii. Poly (amic acid).

b. In a linear polymerization reaction between a diacid and diol, there is 5% more diacid molecule than diol.

(i) calculate the number average degree of polymerization (\bar{X}_n) for the reaction with an extent of reaction "P" of 0.999.

(ii) suppose equal number of functional group of the diacid and the diol molecules were used to obtain the polyester in 2b(i). What would be the value of (\bar{X}_n) for this case?

(iii) comment on the values of (\bar{X}_n) obtained in (2b i) and (2b ii) above.

10 marks

SECTION B

3a. You are a research team member and the laboratory head is interested in preparing a series of elastomers for public use. A member of your laboratory team suggested manipulation of Glass transition temperature (T_g) to maximise profit. To ensure profit is not prioritised over quality, what would be the content of your email to educate him based on the under listed reasons:

- The purpose for the determination of T_g (5 marks).
- The three importance of T_g that you know (6 marks).

b. You have just been appointed as a special adviser to the newly inaugurated president, and in your first meeting, another adviser on the environment advised the president against the production of polymers because they pollute the environment and are not important hence should be gotten rid of. Use your knowledge of the Chemistry of Plastics and Elastomers to explain to the president in not more than five sentences why polymers are so important, seen and felt everywhere? Make sure you include Mr. president as part of your example (5 marks).

4 a. (i) What is the major difference between block and graft copolymers, and what is the implication of this difference? (3 marks).

(ii) Which is the most widely used graft copolymer and how is it prepared? (3 marks).

(iii) How could you use graft copolymerisation techniques to reduce the water solubility of starch? (2 marks).

(iv) Give two common elastomers that are terpolymers (2 marks).

b (i) Neoprene, Nitrile, Natural (latex) rubber and Viton are commonly used as laboratory gloves; in writing, explain to a part 1 student why this is the case using typical uses and properties of each (4 marks).

(ii) What kind of specialty copolymer is Viton? (1 mark).

(iii) Prepare half a page document, including an equation, on Viton A for the student to use as a reference (5 marks).