
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2010/2011

November 2010

EBP 103/3 - Polymer Organic Chemistry *[Kimia Organik Polimer]*

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains EIGHT printed pages before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi LAPAN muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. TWO questions in PART A, THREE questions in PART B and TWO questions in PART C.

[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A, TIGA soalan di BAHAGIAN B dan DUA soalan di BAHAGIAN C.]

Instruction: Answer FIVE questions. Answer ALL questions from PART A, ONE question from PART B, PART C and ONE question from any sections. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

[Arahan: Jawab LIMA soalan. Jawab SEMUA soalan dari BAHAGIAN A, SATU soalan dari BAHAGIAN B, BAHAGIAN C dan SATU soalan dari mana-mana bahagian. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]

The answers to all questions must start on a new page.

[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

PART A**BAHAGIAN A**

1. [a] Write the chemical reaction for the synthesis of the following polymers:
- (i) polycarbonate
 - (ii) poly(ethylene terephthalate)
 - (iii) epoxy prepolymer
 - (iv) polyurethane
 - (v) polyurea
 - (vi) polyamide 6

Tuliskan tindakbalas kimia untuk sintesis bagi polimer seperti berikut:

- (i) *polikarbonat*
- (ii) *poli(etilena tereftalat)*
- (iii) *prapolimer epoksi*
- (iv) *poliuretana*
- (v) *poliurea*
- (vi) *poliamida 6*

(60 marks/markah)

- [b] Write the following reactions:
- (i) photolysis decomposition of 2,2'-azobisisobutyronitrile
 - (iii) disproportionation of styrene macro-radicals

Tuliskan tindakbalas berikut:

- (i) *penguraian fotolisis bagi 2,2'-azobisisobutironitril*
- (ii) *disproporsionasi bagi radikal makro stirena*

(40 marks/markah)

2. [a] Based on molecular orbital theory, explain why the bond length of ethyne is shorter than ethene?

Berdasarkan teori orbital molekul, terangkan kenapa ikatan etunaa lebih pendek berbanding ikatan etena.

(20 marks/markah)

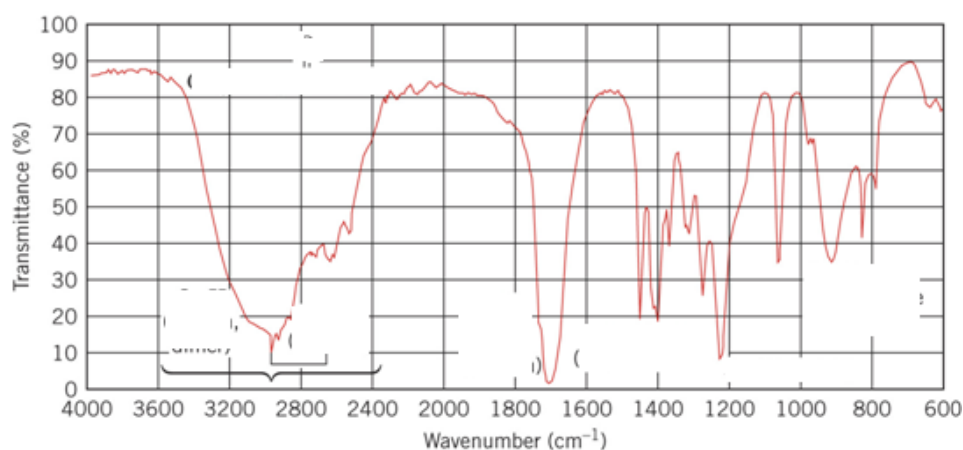
- [b] What is a functional group of organic molecules. Describe a method commonly used to determine the functional groups present in a compound.

Apakah yang dimaksudkan kumpulan berfungsi bagi molekul organik? Jelaskan satu kaedah lazim yang digunakan bagi penentuan kumpulan berfungsi bagi suatu sebatian.

(30 marks/markah)

- [c] A figure given below represent the IR spectrum of a carboxylic acid. Could you identify the functional groups which are present in this acid.

Di bawah diberi satu spektrum IR bagi sejenis asid karboksilik. Bolehkah anda tentukan kumpulan berfungsi bagi asid tersebut.



(50 marks/markah)

PART B**BAHAGIAN B**

3. [a] Write and explain the following cationic polymerization mechanism of isobutylene.
- (i) Initiation by $\text{AlCl}_3/\text{H}_2\text{O}$
 - (ii) Propagation
 - (iv) Termination by uni-molecular rearrangement

Tuliskan dan jelaskan mekanisme pemolimeran kationik bagi isobutilena seperti berikut:

- (i) *permulaan dengan $\text{AlCl}_3/\text{H}_2\text{O}$*
- (ii) *perambatan*
- (iii) *penamatan dengan penyusunan semula uni-molekul*

(60 marks/markah)

- [b] Compare the difference between chain-growth polymerization and step-growth polymerization.

Bandingkan perbezaan antara pemolimeran rantai dan pemolimeran langkah.

(40 marks/markah)

4. [a] Discuss on living polymer. Discussion should be supported by chemical reaction.

Bincangkan polimer hidup. Perbincangan perlu disokong dengan tindakbalas kimia.

(60 marks/markah)

- [b] Write and explain the chemical reaction for the synthesis of phenol-formaldehyde resins.

Tuliskan dan jelaskan tindakbalas kimia untuk sintesis bagi resin fenol-formaldehid.

(40 marks/markah)

5. [a] Discuss on ring opening polymerization. Answer must be supported by TWO examples.

Bincangkan pempolimeran pembukaan-gelang. Jawapan mesti disokong dengan DUA contoh.

(40 marks/markah)

- [b] Write and explain the following free radical polymerization mechanisms of styrene:

- (i) initiation by benzoyl peroxide
- (ii) propagation
- (iii) termination by combination

Tuliskan dan jelaskan mekanisme pempolimeran radikal bebas bagi stirena seperti berikut:

- (i) *pemulaan dengan benzoil peroksida*
- (ii) *perambatan*
- (iii) *penamatan secara penggabungan*

(60 marks/markah)

PART C**BAHAGIAN C**

6. [a] What is the difference between carbocation(carbonium) and carbanion in term of Lewis acids and bases. Give your answer based on heterolysis of covalent bond.

Dengan berpandukan kepada asid dan bes Lewis, apakah perbezaan antara karbokation (Karbonium) dengan karbanion. Berikan jawapan anda berdasarkan penguraian heterolisis ikatan kovalen.

(20 marks/markah)

- [b] Alkene generally react by ionic mechanisms involving nucleophiles and electrophiles. Give definition for each of these terms.

Secara umum alkena bertindakbalas secara mekanisme ionik yang melibatkan elektrophil dan nukleofil. Berikan takrifan elektrophil dan nukleofil tersebut.

(20 marks/markah)

- [c] What will be the predominant product when HBr is added to $C_6H_5CH=CHCH_3$. Write a complete reaction to support your answer.

Apabila HBr ditambah kepada $C_6H_5CH=CHCH_3$, apakah hasil utama yang akan diperolehi? Tuliskan persamaan tindakbalas lengkap bagi menyokong jawapan anda.

(60 marks/markah)

7. [a] What is the difference between conformation isomer and stereoisomer? How to distinguish between anti, gauche and eclipsed conformations of 1,2-dichloroethane?

Apakah perbezaan antara stereoisomer dengan isomer konformasi? Bagaimana membezakan antara konformasi isomer anti, gauci dan gerhana bagi molekul 1,2-dikloroetana?

(30 marks/markah)

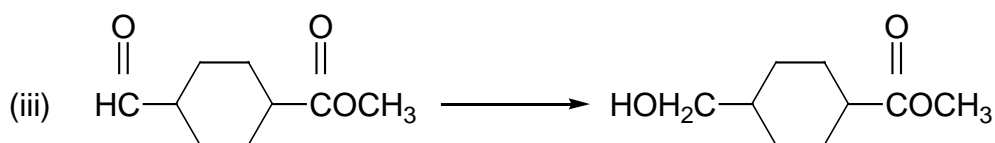
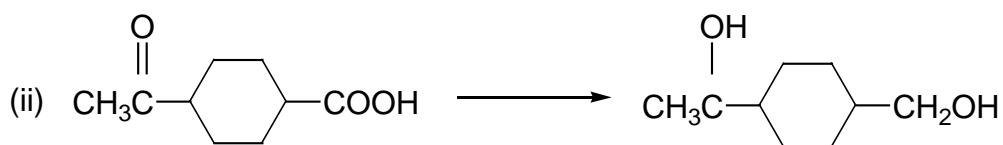
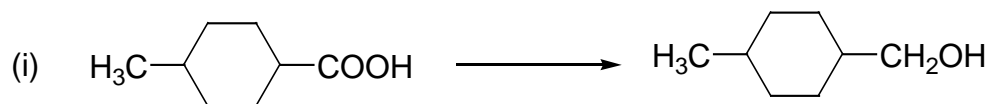
- [b] Using Newman projection formula, draw a potential energy diagram for energy changes that arise from rotation about C2-C3 bond of butane. From the diagram, name which conformations are stereoisomers conformation. What makes eclipsed conformation has the greatest energy of all conformations?

Dengan menggunakan formula projeksi Newman, lakar gambarajah tenaga keupayaan bagi perubahan tenaga akibat daripada pemutaran ikatan antara C2-C3 bagi molekul butana. Berpadukan gambarajah, namakan konformasi apa yang boleh dianggap contoh kepada konformasi stereoisomer. Apa alasan anda? Apakah yang menyebabkan konformasi gerhana mempunyai tenaga keupayaan yang tertinggi?

(40 marks/markah)

- [c] Which reducing reagent, LiAlH_4 or NaBH_4 would you use to carry out the following transformations?

Reagen penurunan yang mana, LiAlH_4 atau NaBH_4 , boleh anda gunakan dalam tindakbalas berikut:



(30 marks/markah)