UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2012/2013

January 2013

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

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains SEVEN printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi TUJUH muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. TWO questions from PART A and FIVE questions from PART B.
[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan dari BAHAGIAN A dan LIMA soalan dari BAHAGIAN B.]

Instruction: Answer FIVE questions. Answer **ALL** questions from PART A and **THREE** questions from PART B. 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 dan **TIGA** soalan dari BAHAGIAN B. 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.]

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PART A / *BAHAGIAN A*

1. [a] Write and explain the following free radical polymerization mechanism 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) Permulaan dengan benzoil peroksida.

(ii) Perambatan.

(iii) Penamatan secara penggabungan.

(60 marks/*markah*)

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

Bandingkan perbezaan antara pempolimeran rantai dan pempolimeran langkah.

(40 marks/*markah*)

2. [a] What is hydrogen bonding?

Apakah yang dimaksudkan dengan ikatan hidrogen?

(30 marks/*markah*)

[b] Explain the difference between ionic bond and covalent bond.

Jelaskan perbezaan antara ikatan ionik dan ikatan kovalen.

(20 marks/*markah*)

[c] Draw Lewis formulas of the following molecules or ions, showing all electron pairs.

(i) PH_3.

(ii) AlH_4^-.

(iii) $COCl_2$ (all atoms are bonded to carbon).

(iv) $HCON_3$ (hydrogen is bonded to oxygen).

(v) NO_2^- (order of atoms is ONO).

Lukiskan formula Lewis bagi molekul-molekul atau ion-ion yang berikut, tunjukkan semua pasangan elektron.

(i) PH_3.

(ii) AlH_4^-.

(iii) $COCl_2$ *(semua atom terikat pada karbon).*

(iv) $HCON_3$ *(hidrogen terikat pada oksigen).*

(v) NO_2^- *(susunan atom terdiri ONO).*

(50 marks/*markah*)

PART B / *BAHAGIAN B*

3. [a] Discuss the ring opening polymerization.

Bincangkan pempolimeran pembukaan-gelang.

(50 marks/*markah*)

[b] Discuss the synthesis of the following polymer:

(i) Melamine-formaldehyde.

(ii) Novolacs.

Bincangkan sintesis bagi polimer seperti berikut:

(i) Melamina-formaldehid.

(ii) Novolak.

(50 marks/*markah*)

4. [a] Draw the functional group and write the general formula for each organic compounds as given below:

(i) Haloalkane.

(ii) Ether.

(iii) Ketone.

(iv) Amide.

(v) Aldehyde.

Lukiskan kumpulan berfungsi dan tulis formula am bagi setiap unsur seperti yang tertera di bawah:

(i) Haloalkana.

(ii) Eter.

(iii) Keton.

(iv) Amida.

(v) Aldehid.

(30 marks/*markah*)

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[b] Discuss on how 'London forces' affected the boiling point of substances based on relative polarizability of electrons and relative surface area of the molecules involved.

Bincangkan bagaimana 'London forces' mempengaruhi takat didih bagi sesuatu unsur berdasarkan polariti relatif bagi elektron dan luas permukaaan relatif bagi molekul-molekul yang terlibat.

(40 marks/*markah*)

[c] Describe the exception of Octet Rule. Give **TWO (2)** examples.

*Jelaskan berkenaan Pengecualian Peraturan Oktet. Berikan **DUA (2)** contoh.*

(30 marks/*markah*)

5. [a] Write and explain the following cationic polymerization mechanism of isobutylene:

(i) Initiation by $AlCl_3$ and CH_3Cl.

(ii) Propagation.

(iii) Termination by uni-molecular rearrangement.

Tuliskan dan jelaskan mekanisme pempolimeran kationik bagi isobutilena seperti berikut:

(i) Permulaan dengan $AlCl_3$ dan CH_3Cl.

(ii) Perambatan.

(iii) Penamatan dengan penyusunan semula uni-molekul.

(60 marks/*markah*)

[b] State the differences between free radical polymerization and ionic polymerization.

Nyatakan perbezaan di antara pempolimeran radikal bebas dan pempolimeran ionik.

(40 marks/*markah*)

6. [a] Describe how Fourier Transform Infra-Red (FTIR) spectroscopy can be used to identify a polymer chemical structure.

Jelaskan bagaimana spektroskopi Infra-Merah Jelmaan Fourier boleh digunakan untuk mengenali struktur kimia polimer.

(30 marks/*markah*)

[b] In Fourier Transform Infra-Red (FTIR), what is meant by 'infra-red active'. Give two (2) examples to illustrate your answer.

Dalam spektroskopi Infra-Merah Jelmaan Fourier, apakah yang dimaksudkan dengan "aktif infra-merah". Berikan dua (2) contoh bagi menggambarkan jawapan anda.

(30 marks/*markah*)

[c] Which one of the following compounds is most consistent with the infra-red spectrum given in Figure 1? Explain your reasoning.

Berdasarkan unsur-unsur berikut, yang mana satukah paling konsisten dengan spektrum infra-merah yang diberikan dalam Rajah 1? Jelaskan jawapan anda.

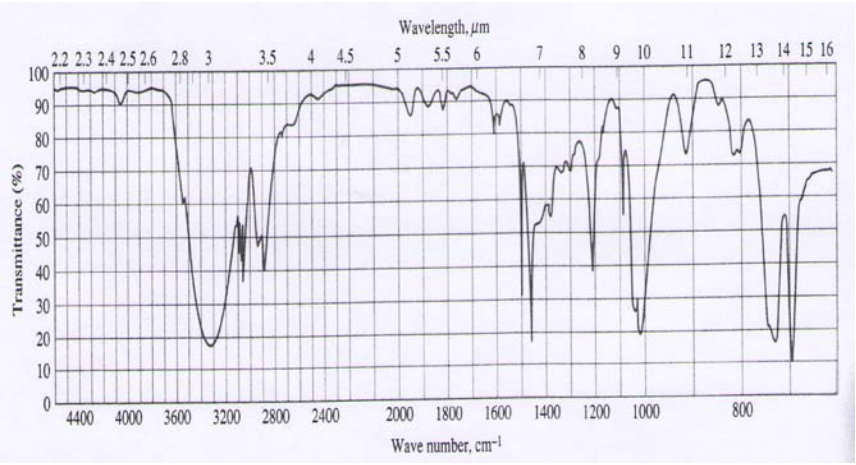

Figure 1: Infra-red spectrum / *Rajah 1: Spektrum infra-merah*

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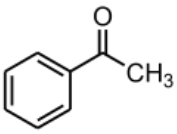
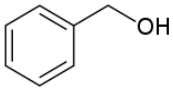


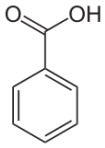
Acetophenone

Asetophenon



Benzyl Alcohol

Benzil Alkohol



Benzoic Acid

Benzoik Asid

(40 marks/*markah*)

7. [a] Discuss the living polymerization.

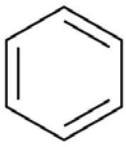
Bincangkan pempolimeran hidup.

(50 marks/*markah*)

[b] Cyclohexene is non-aromatic but benzene is an aromatic structure as shown in Figure 2. Discuss their differences in terms of stability, conformation and reactivity.

Sikloheksena bersifat tak-aromatik manakala benzena bersifat aromatik seperti ditunjukkan dalam Rajah 2. Bincangkan perbezaan antara keduanya berdasarkan kestabilan, konformasi dan reaktiviti.

Cyclohexene / *Sikloheksena*



Benzene / *Benzena*

Figure 2 / *Rajah 2*

(50 marks/*markah*)

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