UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Kedua
Sidang Akademik 2005/2006

April/Mei 2006

EKC 107 – Proses Kimia Organik

Masa : 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi DUA BELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.

Arahan: Jawab **EMPAT** (4) soalan. Jawab mana-mana **DUA** (2) soalan dari Bahagian A. Jawab mana-mana **DUA** (2) soalan dari Bahagian B.

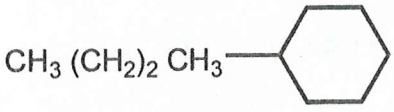
Pelajar boleh menjawab semua soalan dalam Bahasa Malaysia. Jika pelajar ingin menjawab dalam Bahasa Inggeris, pelajar hendaklah menjawab sekurang-kurangnya SATU soalan dalam Bahasa Malaysia.

...2/-

Bahagian A : Jawab mana-mana DUA soalan.
Section A : Answer any TWO questions.

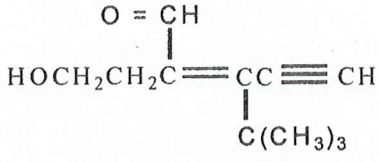
1. [a] Berikan nama IUPAC bagi sebatian-sebatian berikut:-

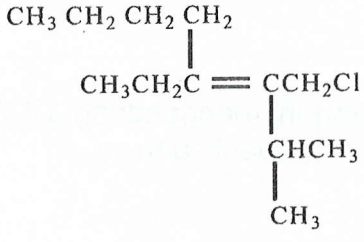
[i] 

[ii] 

[2 markah]

[b] Lukis dan labelkan isomer-isomer E dan Z untuk sebatian-sebatian berikut:-

[i] 

[ii] 

[2 markah]

[c] Tindakbalas pengklorinan fotokimia untuk 2,2,4–trimetilpentana menghasilkan empat isomer monoklorida.

[i] Tuliskan formula struktur untuk keempat-empat isomer tersebut. Namakan isomer-isomer itu.

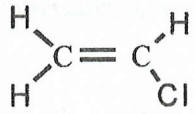
[4 markah]

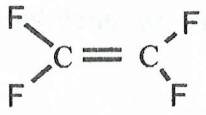
[ii] Kedua-dua klorida primer merupakan 65% daripada pecahan monoklorida. Kenalpastikan kedua-dua klorida primer tersebut. Dengan andaian yang kesemua hidrogen primer dalam 2,2,4–trimetilpentana mempunyai kereaktifan yang sama, anggarkan peratusan setiap klorida primer yang terdapat di dalam campuran produk di atas.

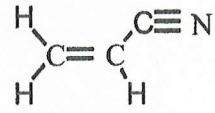
[4 markah]

...3/-

[d] Struktur bagi tiga monomer diberikan di bawah. Dalam setiap kes, tunjukkan struktur polimer yang akan dihasilkan daripada pempolimeran ke atas monomer.

[i] 
Vinilklorida

[ii] 
Tetrafloroetilena

[iii] 
Akrilonitril

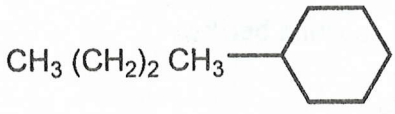
[3 markah]

[e] Terangkan bagaimana polietilena yang berketumpatan rendah dan tinggi dihasilkan. Beri komen terhadap sifat-sifat serta kegunaannya.

[10 markah]

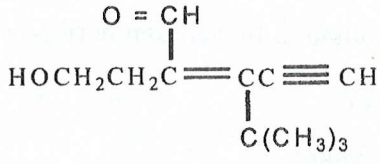
1. *[a]* *Give IUPAC names for the following compounds.*

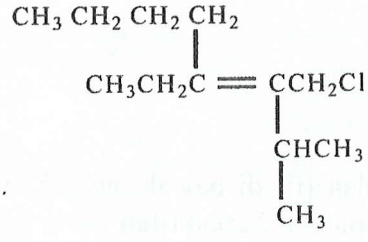
[i] 

[ii] 

[2 marks]

[b] *Draw and label the E and Z isomers for each of the following compounds:-*

[i] 

[ii] 

[2 marks]

[c] *Photochemical chlorination of 2,2,4–trimethylpentane gives four isomeric monochlorides.*

[i] *Write structural formula for these four isomers. Name them.*

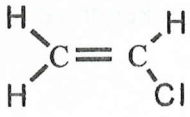
[4 marks]

...4/-

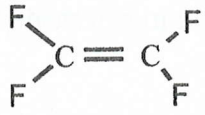
[ii] The two primary chlorides make up 65% of the monochloride fraction. Identify the two primary chlorides. Assuming that all the primary hydrogens in 2,2,4–trimethylpentane are equally reactive, estimate the percentage of each of the two primary chlorides in the product mixture.

[4 marks]

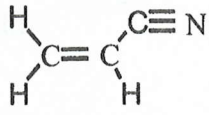
[d] The structures of three monomers are shown below. In each case, show the structure of the polymer that would result from polymerization of the monomer.

[i] 

Vinylchloride

[ii] 

Tetrafluoroethylene

[iii] 

Acrylonitrile

[3 marks]

[e] Describe how low density and high density polyethylene are made. Comment on their properties and use.

[10 marks]

2. [a] Lukiskan struktur untuk setiap sebatian berikut:

[i] 3,3–dimetilsiklopentena

[ii] 6–bromo–2, 3–dimetil–2–heksena

[2 markah]

[b] Berikan definisi untuk setiap sebutan di bawah dan berikan satu contoh

[i] penambahan Markornikov

[ii] penambahan anti-Markornikov

[iii] hidroborasi

[iv] penambahan elektrofilik.

[8 markah]

[c] Untuk kedua-dua bahagian [i] dan [ii] di bawah, andaikan semua kumpulan metilena di dalam alkana mempunyai kereaktifan yang sama sebagai tapak untuk pembrominan radikal bebas.

[i] Pembrominan ke atas heptana menghasilkan campuran monobromida yang mengandungi 15% 1-bromoheptana

(a) Apakah monobromida lain yang terhasil semasa tindakbalas ini?

[3 markah]

...5/-

(b) Anggarkan peratusan bagi setiap isomer tambahan tersebut.

[3 markah]

[ii] Pengklorinan dodekana menghasilkan pecahan monoklorida yang mengandungi 19% 2-klorododekana. Anggarkan peratusan 1-klorododekana yang hadir dalam pecahan tersebut.

[3 markah]

[d] Seorang pelajar Ijazah Tinggi yang tidak berpengalaman hendak menghasilkan 3,3–dimetil–2–butanol. Dia mencampurkan 3,3–dimetil–1–butana dengan asid cair. Pelajar ini mendapati satu campuran yang terhasil adalah sebatian-sebatian 2,3–dimetil–2–butanol dan 2,3–dimetil–2–butana. Dengan menggunakan mekanisma yang terperinci, tunjukkan kenapa produk-produk ini terbentuk dan bukannya alkohol seperti yang dikehendaki.

[6 markah]

2. *[a] Draw the structure for each of the following compounds:*

[i] 3,3–dimethylcyclopentene

[ii] 6–bromo–2, 3–dimethyl–2–hexene

[2 marks]

[b] Define each term and give an example

[i] Markovnikov addition

[ii] anti-Markovnikov addition

[iii] hydroboration

[iv] electrophilic addition.

[8 marks]

[c] For both part [i] and [ii] below, assume that all the methylene group in the alkane are equally reactive as sites of free-radical bromination.

[i] The bromination of heptane gave a mixture of monobromides containing 15% 1-bromoheptane

(a) What are the other monobromides formed during the reaction?

[3 marks]

(b) Estimate the percentage of each of these additional isomers in the monobromide fraction.

[3 marks]

...6/-

[ii] The chlorination of dodecane gave a monochloride fraction containing 19% 2-chlorododecane. Estimate the percentage of 1-chlorododecane present in that fraction.

[3 marks]

[d] An inexperienced graduate student wanted to make 3,3–dimethyl–2–butanol. He treated 3,3–dimethyl–1–butane with dilute acid and recovered a mixture of 2,3–dimethyl–2–butanol and 2,3–dimethyl–2–butane. Using a detailed mechanism, show why these products are formed rather than the desired alcohol.

[6 marks]

3. [a] Ramalkan produk-produk utama daripada tindakbalas berikut:-

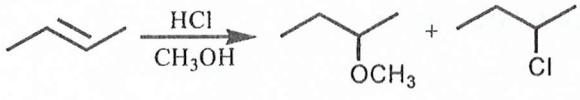
[i] 2 - metilpropena + HBr + $CH_3-\overset{\overset{O}{\|}}{C}-O-O-\overset{\overset{O}{\|}}{C}-CH_3 \longrightarrow ?$

[ii] 1 – metilsikloheksena + HBr + $CH_3\,CH_2 - O - O - CH_2\,CH_3$. ⟶ ?

[4 markah]

[b] Cadangkan mekanisma-mekanisma yang sepadan untuk tindakbalas-tindakbalas berikut.

[i] 

[ii] 

[iii] 

[9 markah]

[c] Terangkan secara ringkas, 5 ciri proses kimia yang boleh menaikkan kos modal.

[6 markah]

...7/-

[d] Dalam tindakbalas peretakan bermangkin C_{16} H_{34}, sebatian-sebatian berikut terhasil. Cadangkan mekanisma-mekanisma untuk pembentukan sebatian-sebatian ini:-

[i] $CH_2 = CH\ CH_2\ CH_3$

[ii] $CH_3\ CH_2\ \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}\ H\ CH_3$

[6 markah]

3. *[a] Predict the major products of the following reactions.*

[i] 2 - methylpropene + HBr + $CH_3-\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}-O-O-\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}-CH_3$ ⟶ ?

[ii] *1 – methylcyclohexene + HBr + $CH_3\ CH_2 - O - O - CH_2\ CH_3$.* ⟶ ?

[4 marks]

[b] Propose mechanisms consistent with the following reactions.

[i]

[ii]

[iii]

[9 marks]

[c] Briefly explain the five features of chemical processes which tend to increase capital cost.

[6 marks]

[d] In the catalytic cracking reaction of C_{16} H_{34}, the following compounds were generated. Propose mechanisms for the formation of these compounds:-

[i] $CH_2 = CH\ CH_2\ CH_3$

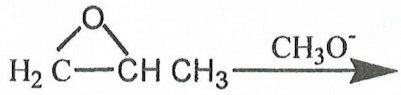
[ii] $CH_3\ CH_2\ \underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}\ H\ CH_3$

[6 marks]

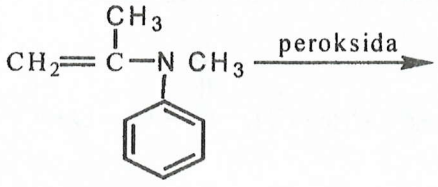
...8/-

Bahagian B : Jawab mana-mana DUA soalan.
Section B : Answer any TWO questions.

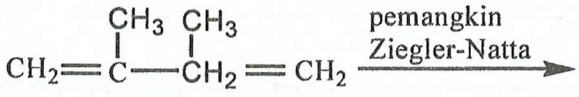
4. [a] Lukiskan segmen pendek polimer yang terhasil daripada sebatian-sebatian di bawah dalam keadaan tindakbalas berikut:

[i] 

[2 markah]

[ii] 

[2 markah]

[iii] 

[2 markah]

[b] Senaraikan kumpulan-kumpulan monomer berikut di dalam tertib keupayaan menurun bagi menjalani proses pempolimeran kation.

[i] $CH_2 = CH\,CH_3$ $CH_2 = CHOCCH_3$ $CH_2 = CHCOCH_3$

[3 markah]

[ii] 

[3 markah]

[c] Bila lapisan kulit pokok getah ditoreh, cecair putih melekit (susu getah) akan keluar. Ia adalah polimer yang mengandungi banyak unit isoprena.

[i] Lukiskan segmen pendek bagi getah asli.

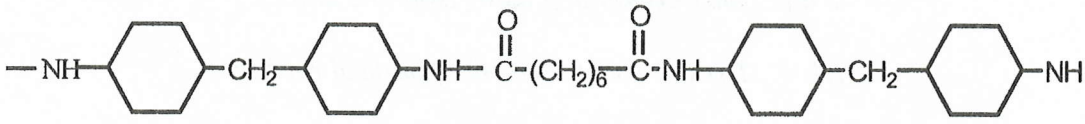
[4 markah]

[ii] Kenapa getah adalah bahan kalis air?

[3 markah]

...9/-

[d] Quiana adalah fabrik tiruan yang rasanya seperti sutera.



[i] Apakah monomer yang digunakan untuk mensintesis Quiana?

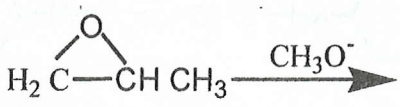
[4 markah]

[ii] Adakah Quiana itu sejenis nilon atau poliester? Berikan sebab bagi jawapan anda.

[2 markah]

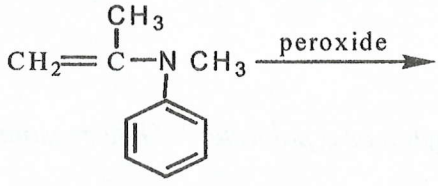
4. [a] *Draw a short segment of the polymers obtained from the following compounds under the given reaction conditions:*

[i]



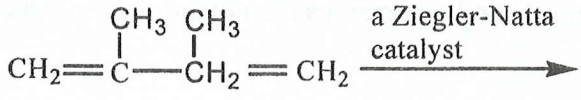
[2 marks]

[ii]



[2 marks]

[iii]



[2 marks]

[b] List the following groups of monomers in order of decreasing ability to undergo cationic polymerization.

[i] $CH_2 = CH\,CH_3$ $CH_2 = CHOCCH_3$ $CH_2 = CHCOCH_3$

[3 marks]

[ii]

[3 marks]

...10/-

[c] When a bark of a rubber tree is cut, a sticky white liquid (latex) comes out. It is a polymer containing many isoprene units.

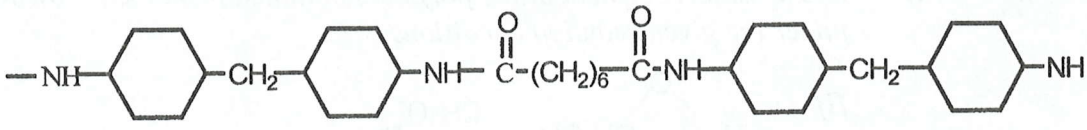
[i] Draw a short segment of natural rubber.

[4 marks]

[ii] Why rubber is a waterproof material?

[3 marks]

[d] Quiana is a synthetic fabric that feels very much like silk.



[i] What monomers are used to synthesize Quiana?

[4 marks]

[ii] Is Quiana a nylon or a polyester? Give reasons for your answer.

[2 marks]

5. [a] [i] Tunjukkan bagaimana sabun mandi boleh disediakan daripada minyak.

[10 markah]

[ii] Tuliskan struktur bagi sebatian-sebatian tersebut dan namakan proses yang terlibat.

[2 markah]

[b] Tuliskan mekanisma lengkap untuk asilasi Friedel-Crafts bagi bromobenzena dengan asetil klorida menggunakan aluminium klorida sebagai mangkin. Tunjukkan semua langkah dan kesemua bentuk resonan untuk mana-mana perantara yang terlibat bagi laluan ke produk utama yang dijangkakan.

[9 markah]

[c] Apakah itu pembina detergen? Kelaskan kumpulan utama pembina-pembina inorganik?

[4 markah]

...11/-

5. *[a] [i] Show how a bath soap can be prepared from oil.*

[10 marks]

[ii] Write a structure of the compounds and name the process involved.

[2 marks]

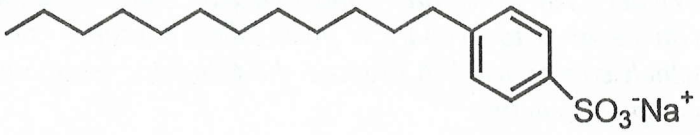
[b] Write a complete mechanism for the Friedel-Crafts acylation of bromobenzene with acetyl chloride using aluminum chloride as a catalyst. Show all steps and all resonance forms for any intermediates involved for the pathway to the expected major product.

[9 marks]

[c] What are detergent builders? Classify the major groups of inorganic builders?

[4 marks]

6. [a] Detergen sintetik seperti sebatian yang dilukiskan di bawah digunakan untuk mencuci pakaian.



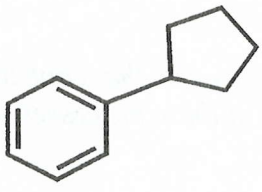
[i] Bagaimanakah untuk mensintesis detergen ini?

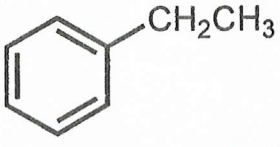
[ii] Terangkan bagaimana detergen ini membersihkan pakaian.

[6 markah]

[b] Akilasi Friedel-Crafts dan asilasi Friedel-Crafts diikuti dengan penurunan boleh diguna untuk menyediakan alkil benzena. Berikan bahan permulaan yang mana digunakan untuk menyediakan sebatian berikut, dan tuliskan tindakbalas lengkap.

[i] 

[ii] 

[iii] 

[9 markah]

...12/-

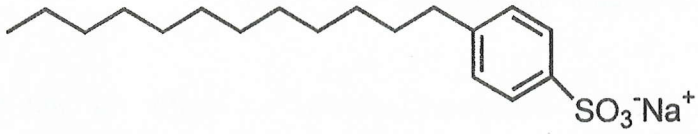
[c] Apakah itu benzena? Apakah proses-proses yang menyumbang secara setara kepada penghasilan benzena secara industri? Terangkan satu daripada proses-proses tersebut secara ringkas?

[5 markah]

[d] Apakah itu petrokimia? Senaraikan beberapa petrokimia komersial utama dan terbitannya?

[5 markah]

6. *[a] The synthetic detergent like the compound drawn below used to clean clothes.*



[i] How to synthesize this detergent?

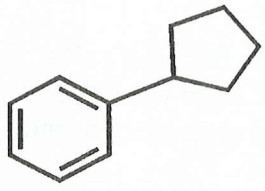
[ii] Explain how this detergent cleans away dirt.

[6 marks]

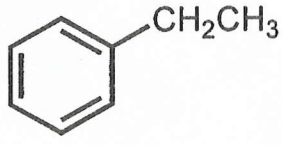
[b] Friedel-Crafts alkylation and Friedel-Crafts acylation followed by reduction can be used to prepare a given alkyl benzene. Give the starting material which can be used to prepare the following compounds, and write down the complete reaction.

[i]

[ii]



[iii]



[9 marks]

[c] What is benzene? What are the processes that contribute equally to industrial benzene production? Explain one of these processes in a brief?

[5 marks]

[d] What is petrochemical? List some of the major commercial petrochemicals and their derivatives?

[5 marks]

- ooo O ooo -