
UNIVERSITI SAINS MALAYSIA

First Semester Examination
2009/2010 Academic Session

November 2009

EKC 107 – Organic Chemistry
[Kimia Organik]

Duration : 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of ELEVEN pages of printed material before you begin the examination.

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

Instructions: Answer **FOUR** (4) questions. Section A is **COMPULSORY**. Answer any **TWO** (2) questions from Section B. All questions carry the same marks.

Arahan: Jawab **EMPAT** (4) soalan. Bahagian A **WAJIB** dijawab. Bahagian B pilih **DUA** (2) soalan sahaja. Semua soalan membawa jumlah markah yang sama.]

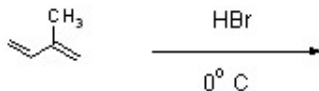
In the event of any discrepancies, the English version shall be used.

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

Section A : Answer ALL questions.

Bahagian A : Jawab SEMUA soalan.

1. [a] [i] Predict the major product of the following reaction.
Ramalkan produk utama bagi tindakbalas berikut.



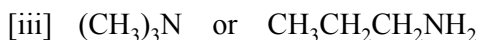
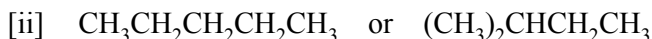
- [ii] HBr can be added to an alkene in the presence of peroxides (ROOR).
What function does the peroxide serve in this reaction?

*HBr boleh ditambah ke alkena dengan kehadiran peroksida (ROOR).
Apakah fungsi peroksida di dalam tindakbalas ini?*

[4 marks/markah]

- [b] Which of the following molecules has the higher boiling point? Briefly explain your choice.

*Molekul berikut yang manakah mempunyai takat didih yang tinggi.
Terangkan pilihan anda dengan jelas.*



[6 marks/markah]

- [c] Would you expect sodium chloride (NaCl) to be highly soluble in the organic solvent hexane ($\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$)? Briefly explain your answer.

Adakah anda jangka yang natrium klorida (NaCl) itu adalah terlalu larut di dalam pelarut organik heksana? Terangkan jawapan anda dengan jelas.

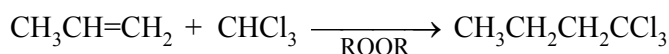
[3 marks/markah]

- [d] Explain the two (2) methods of how carbonium ions are generated?
Terangkan kedua-dua (2) kaedah bagaimana ion karbonium dihasilkan?

[6 marks/markah]

- [e] The following reaction is known to proceed by a free radical chain mechanism. Suggest a reasonable, step-by-step mechanism for this reaction.

Diketahui bahawa tindakbalas berikut boleh berlaku melalui mekanisma rantai radikal yang bebas. Cadangkan mekanisma langkah demi langkah yang sesuai bagi tindakbalas ini.

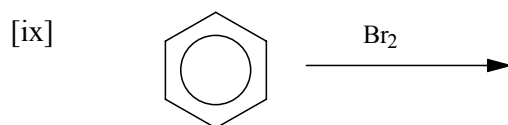
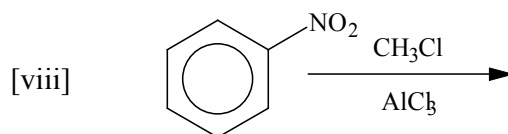
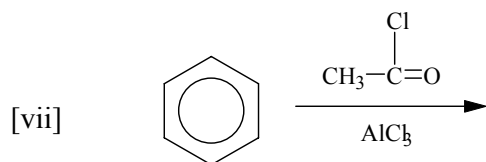
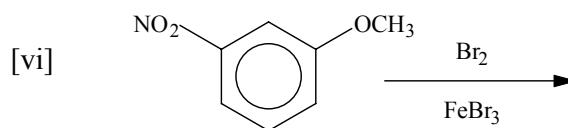
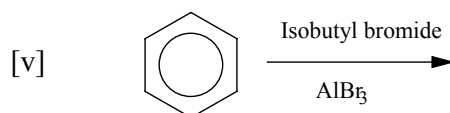
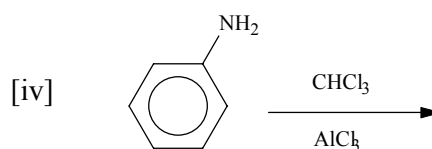
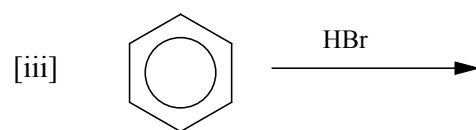
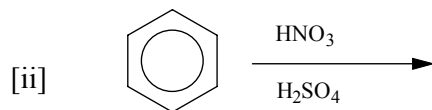
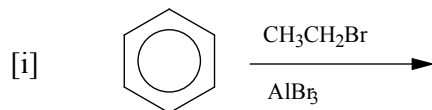


[6 marks/markah]

2. [a] Fill in the blank.
Isikan tempat kosong.
- [i] In order for a compound to be aromatic it must satisfy certain rules. The compound or ion must be _____ and planar, have all atoms in the ring with _____ hybridization, and have _____ electrons in _____ orbitals.
Bagi menjadikan sesuatu sebatian itu sebagai aromatik, ianya mesti memenuhi peraturan tertentu. Sebatian atau ion mestilah _____ dan satah, mempunyai semua atom dalam gelung dengan penghibridan _____, dan mempunyai _____ elektron dalam _____ orbital.
- [ii] Another name for 1,3 dibromobenzene is _____.
Nama lain bagi 1, 3 dibromobenzena adalah _____.
- [iii] Benzene is more stable than compounds having 6 membered ring and three double bonds. This is because benzene has _____.
Benzena adalah lebih stabil daripada sebatian yang mempunyai 6 gelung anggota dan tiga ikatan kembar. Ini kerana benzena mempunyai _____.
- [iv] Benzene ring deactivators have something in common. They all have _____.
Penyahgiat gelung benzena mempunyai suatu persamaan. Semuanya mempunyai _____.
- [v] Name two ring substituents that will prevent the ring from reacting in a Freidel-Craft reaction _____ and _____.
Namakan dua bahan ganti gelung yang akan menghalang gelung tersebut daripada bertindakbalas Freidel-Craft _____ dan _____.
- [vi] 4-methylbenzoic acid would tend to add a third group at carbon number _____.
Asid 4-metilbenzoik cenderung untuk menambah kumpulan ketiga pada karbon yang bernombor _____.
- [5 marks/markah]*

[b] Draw structural formulas for the products if a reaction occurs. If no reaction occurs write N.R.

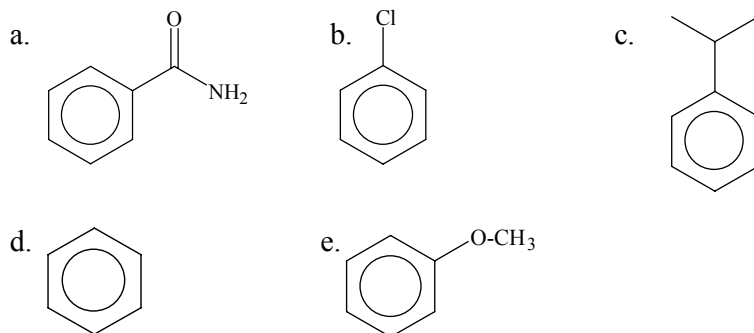
Lukiskan formula struktur bagi hasil berikut sekiranya tindakbalas berlaku. Sekiranya tiada tindakbalas berlaku, tuliskan N.R.



[9 marks/markah]
...5/-

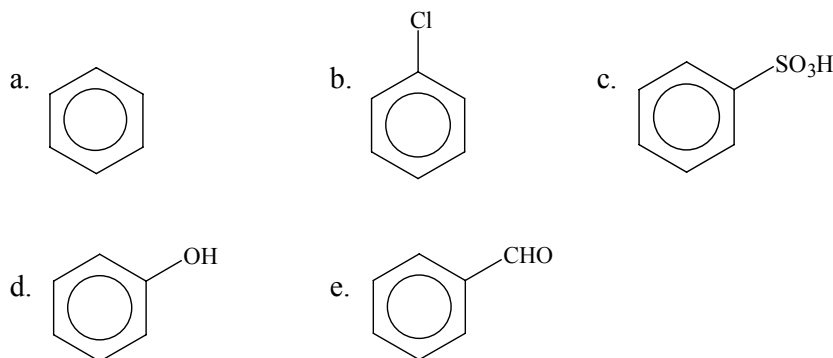
- [c] [i] Which of these compounds give the most meta product when treated with Br_2 / Fe ?

Di antara sebatian berikut, yang manakah memberikan hasil meta yang paling banyak apabila ditindakbalas dengan Br_2 / Fe ?



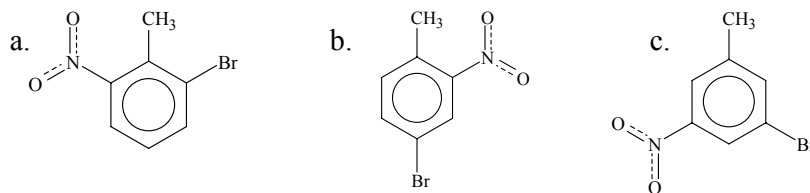
- [ii] Which compounds undergo electrophilic substitution on the ring most rapidly?

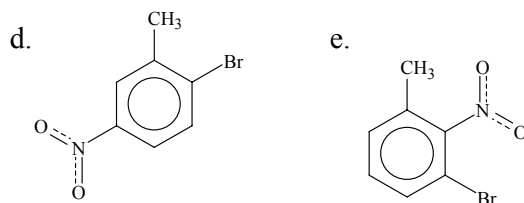
Sebatian manakah yang mengalami penggantian elektrofilik pada gelung dengan paling pantas?



- [iii] In the reaction of 2-nitrotoluene with bromine in the presence of iron, which of the products shown below is the most abundant in the mixture?

Dalam tindakbalas 2-nitrotoluena dengan bromin dengan kehadiran besi, hasil manakah yang berikut merupakan paling banyak dalam campuran?





- [iv] Which of the following compounds would be the most likely to undergo a nucleophilic aromatic substitution with hydroxide ion in normal conditions?

Manakah antara sebatian berikut yang paling cenderung untuk mengalami penggantian aromatik neuklofilik dengan ion hidroksida dalam keadaan biasa?

- Benzene
Benzena
- Chlorobenzene
Klorobenzena
- Benzoic acid
Asid Benzoik
- p-chlorotoluene
p-klorotoluena
- 2,4,6-trinitro-1-chlorobenzene
2,4,6-trinitro-1-klorobenzena

[6 marks/markah]

- [d] Step growth and chain growth are the two common methods of polymerization. Explain each method and give an example in each one.

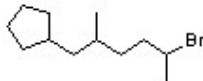
Pertumbuhan langkah dan pertumbuhan rantai merupakan dua kaedah biasa bagi pempolimeran. Terangkan setiap kaedah dan berikan contoh bagi setiap satunya.

[5 marks/markah]

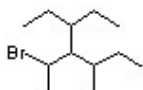
Section B : Answer any TWO questions.

Bahagian B : Jawab mana-mana DUA soalan.

3. [a] Identify the correct IUPAC name for the following structure:
Kenal pastikan nama IUPAC yang betul bagi struktur berikut:



[i]



[ii]

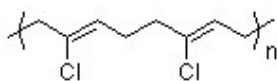
[iii] $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{C}(\text{CH}_3)_3$

[5 marks/markah]

- [b] A polymer is a large molecule composed of many smaller repeating units (the monomers) bonded together.

Polimer adalah molekul yang besar mengandungi unit-unit kecil yang berulang-ulang (monomer) berikatan bersama-sama.

- [i] State the respective best initiator available for a free-radical, cationic or anionic polymerization.
Jelaskan pemula terbaik bagi pempolimeran radikal bebas kation dan beranion.
- [ii] When ethylene is polymerized by free-radical initiation, what type of polyethylene is formed?
Bila etilena dipempolimerankan oleh pemula radikal bebas, apakah jenis polietilena yang terbentuk?
- [iii] Super glues are typically composed of what polymer?
Polimer apakah yang terdapat di dalam gam super?
- [iv] Provide the structure of the monomer from which polystyrene is formed.
Berikan struktur monomer yang membentuk polisterina?
- [v] Neoprene is a flexible, chemically resistant polymer used in shoe soles, hoses and wetsuits. Based on the polymer structure of neoprene provided below give a structure for the monomer of neoprene.
Neoprena adalah anjal, polimer tahan-kimia yang digunakan untuk tapak kasut, ladam dan baju hujan. Berdasarkan struktur polimer neoprena yang diberikan dibawah, berikan struktur monomer bagi neoprena.



1 unit neoprene

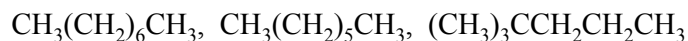
...8/-

- [vi] Provide a mechanism to show how $\text{H}_2\text{C}=\text{CHCO}_2\text{CH}_3$ is polymerized using butyllithium as the initiator.

Berikan mekanisma untuk menunjukkan bagaimana $\text{H}_2\text{C}=\text{CHCO}_2\text{CH}_3$ dipolimerkan dengan menggunakan butyllithium sebagai pemula.

[12 marks/markah]

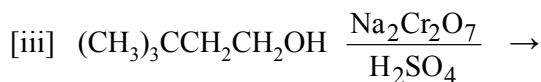
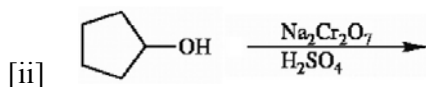
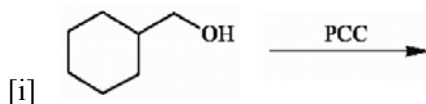
- [c] [i] Place the following alkanes in order of increasing boiling point:
Aturkan alkana berikut dalam urutan takat didih yang meningkat.



- [ii] Why are alkanes described as hydrophobic?
Mengapakah alkana dijelaskan sebagai hidrofobik?
- [iii] Which intermolecular force is primarily responsible for the interactions among alkane molecules?
Daya antara molekul manakah yang bertanggungjawab bagi interaksi di antara molekul-molekul alkana?

[8 marks/markah]

4. [a] Provide the structure of the major organic product in the reaction below:
Berikan struktur bagi produk organik yang utama bagi tindakbalas berikut:



[3 marks/markah]

- [b] [i] Describe how soaps function as cleaning agents.
Jelaskan bagaimana sabun berfungsi sebagai agen pembersihan.
- [ii] Provide the structure of soap. Label the hydrophilic and hydrophobic regions of the molecule you have drawn.
Berikan struktur sabun. Labelkan bahagian hidrofobik dan hidrofilik bagi molekul yang anda lakarkan.

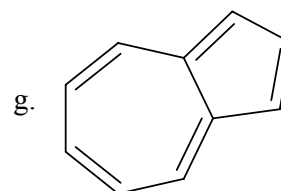
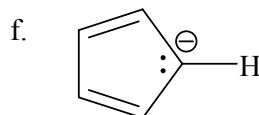
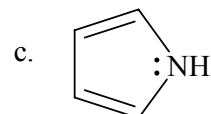
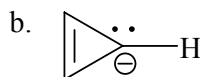
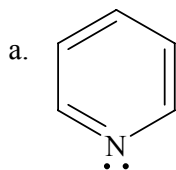
[4 marks/markah]

- [c] [i] State Markovnikov's rule, and show one example.
Jelaskan hukum Markovnikov dan berikan satu contoh.
- [ii] Based on the relative stabilities of the intermediates involved, explain the basis for Markovnikov's rule in the addition of hydrogen halides to alkenes.
Berdasarkan kestabilan relatif bagi perantara-perantara yang terlibat, terangkan asas hukum Markovnikov di dalam penambahan hidrogen halida ke alkena.

[5 marks/markah]

- [d] Which of the following compounds are aromatic based on Hückel's rule and assume the compounds are planar?

Di antara berikut, sebatian manakah yang dikategorikan sebagai aromatik berdasarkan hukum Hückel dan anggapkan sebatian tersebut adalah satah?



[6 marks/markah]

- [e] [i] Explain the synthesis of Aspirin.
Terangkan sintesis bagi Aspirin.
- [ii] Explain the function of each molecule in the Aspirin compound.
Terangkan fungsi bagi setiap molekul dalam sebatian Aspirin.

[7 marks/markah]

5. [a] Draw structures of the following compounds:
Lukiskan struktur bagi sebatian berikut:

[i] TNT
TNT

[ii] PVC
PVC

[iii] bibenzyl
bibenzil

[iv] 4-bromobenzenesulfonic acid
asid 4-bromobenzenasulfurik

[v] aspirin
aspirin

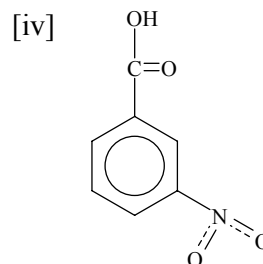
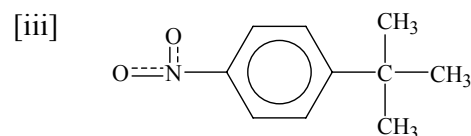
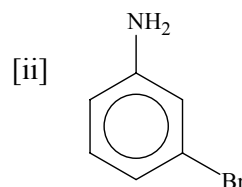
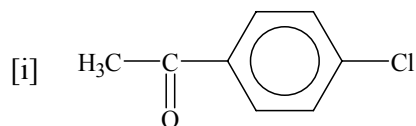
[vi] naphthalene
naftalena

[vii] poly(methylstyrene)
Poli(metilstirena)

[7 marks/markah]

- [b] Show the steps you would use to synthesize the compounds below using any or more of the following: toluene, benzene, any straight chain carboxylic acid, and alkyl halide with 4 or fewer carbons, and any common reagents you might need.

Tunjukkan langkah yang digunakan untuk mensintesisakan sebatian berikut menggunakan mana-mana atau lebih yang berikut: toluena, benzena, mana-mana asid karboksilik berantai lurus, dan halida alkil dengan 4 atau kurang karbon, dan mana-mana reagen biasa yang mungkin diperlukan.



[8 marks/markah]

- [c] Consider the reaction of anisole (methoxybenzene) with SO_3 in the presence of H_2SO_4 .

Pertimbangkan tindakbalas anisol (metoksibenzena) dengan SO_3 dalam kehadiran H_2SO_4 .

- [i] Write the formula for the major product(s) of this reaction.

Tuliskan formula bagi dua hasil utama tindakbalas ini.

- [ii] What is the electrophile in this reaction?

Apakah elektrofil dalam tindakbalas ini?

[3 marks/markah]

- [d] Based on the physical behavior of polymers, list down the major categories of polymers.

Berdasarkan kelakuan fizikal polimer, senaraikan kategori utama bagi polimer.

[4 marks/markah]

- [e] What is the difference between isotactic and atactic polymers?

Apakah perbezaan antara polimer isotaktik dan ataktik.

[3 marks/markah]