INDEX NO:- ----------

UNIVERSITI SAINS MALAYSIA

First Semester Examination
2009/2010 Academic Session

November 2009

KOT 121 – Organic Chemistry I
[Kimia Organik I]

Duration: 3 hours
[Masa : 3 jam]

Please check that this examination paper consists of FORTY ONE pages of printed materials before you begin the examination.

Instructions:

PART A (40 marks), comprising 40 multiple-choice questions (MCQ), **has to be answered within the first hour of the examination on the OMR forms provided. The completed OMR forms will be collected one hour after the commencement of the examination.**

PART B (60 marks) consists of essay-type questions. Answer any **THREE (3)** questions.

Answer each question on a new page.

You may answer either in Bahasa Malaysia or in English.

Ensure that your OMR form is complete [with your index number, course code, answers to the questions]. Use only a 2B pencil on your OMR form.

Submit the answer scripts and question paper to the Invigilator before you leave the Examination Hall at the end of the examination.

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

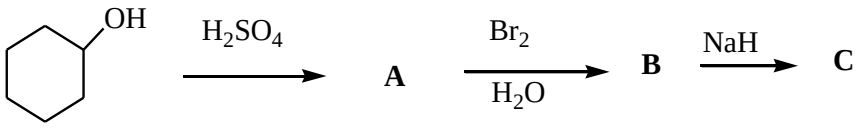
SECTION B (60 MARKS)

Answer THREE questions.
Only the first THREE questions answered in the answer book will be marked.
You must start each question on a new page.

This section contains FOUR questions.

1. (a) Determine the products **(A)** to **(D)** in the following reactions.

(i)



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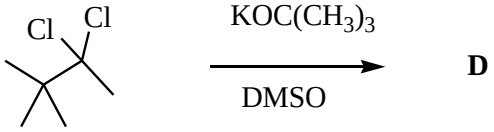
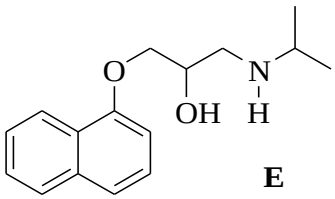


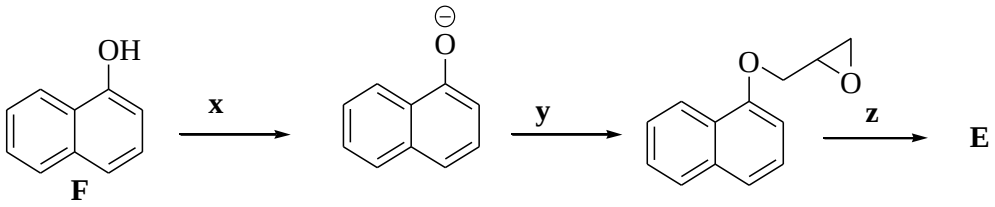
(6 marks)

(b) An antihypertensive agent, **E** can be prepared from naphthol, **F** by two nucleophilic substitution reactions.



E

(i) Give the reagents **x, y,** and **z** in these reactions



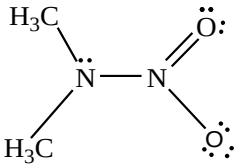
(ii) Give a mechanism for the steps **x** and **y.**

(8 marks)

(c) 3-Methyl-2-butanol and 2-methyl-1-propanol are converted to their corresponding bromides when heated with hydrogen bromide. Write a suitable mechanism for each reaction, and state whether the reaction is S_N1 or S_N2.

(6 marks)

2. (a) Nitroamines are common functional groups found in energetic materials, such as cyclotrimethylenetrinitramine (RDX). For the structure shown below:

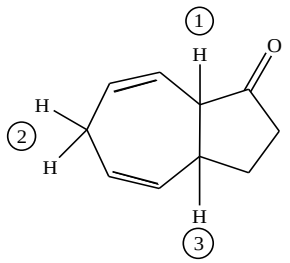


(i) Draw TWO other significant resonance structures, including the formal charges

(ii) Indicate the hybridization on EACH nitrogen and oxygen atoms

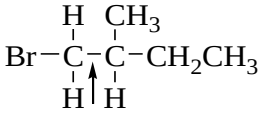
(8 marks)

(b) Rank the indicated protons in the following compound in order of increasing acidity. Explain your answer.



(4 marks)

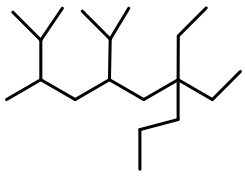
(c) Consider rotation about the indicated bond in the molecule below. Draw the most stable conformer using Newman Projection of the molecule during rotation about the indicated bond.



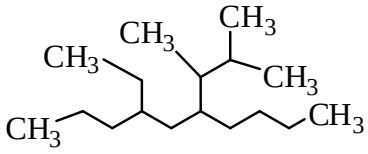
(2 marks)

(d) Provide IUPAC names for the following structures:

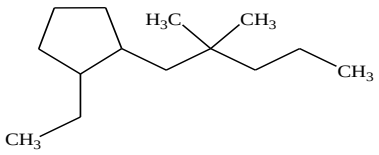
(i)



(ii)

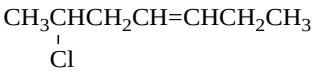


(iii)



(6 marks)

3. (a) The following compound contains only one chiral centre. Explain why it has four stereoisomers.



(6 marks)

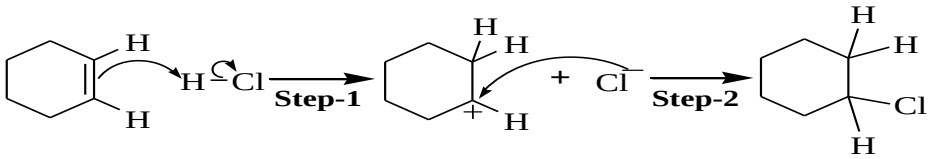
(b) Can one predict whether a compound with a single chiral centre is dextrorotatory or levorotatory based on the *R*/*S* assignment at this chiral centre? Explain briefly.

(4 marks)

(c) A solution prepared by mixing 10 mL of a 0.10 M solution of the *R* enantiomer and 30 mL of a 0.10 M solution of the *S* enantiomer was found to have an observed specific rotation of +4.8°. What is the specific rotation of each of the enantiomers?

(4 marks)

(d) Consider the following two-step reaction:



(i) How many bonds are broken and formed in Step-1?
(ii) Would you predict the $\Delta H°$ of Step-1 to be positive or negative?
(iii) How many bonds are broken and formed in Step-2?
(iv) Would you predict the $\Delta H°$ of Step-2 to be positive or negative?
(v) Which is the rate-determining step?
(vi) Draw the structures for the transition states in both steps of the mechanism.

(6 marks)

4. (a) Propose a mechanism for the acid-catalysed hydration of 3-methyl-1-butene to give 2-methyl-2-butanol.

(6 marks)

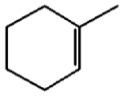
(b) Treating 1,3-butadiene with one mole of HBr gives a mixture of two products. Propose a mechanism for the formation of these two products.

CH_2=CH-CH=CH_2 + HBr ⟶ CH_2=CH-CH(Br)-CH_3 + CH_3-CH=CH-CH_2-Br

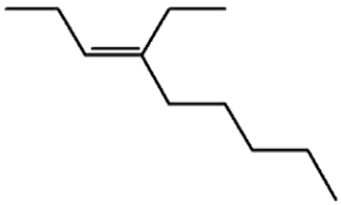
(4 marks)

(c) Draw structural formulas for the products of ozonolysis of the following alkenes:

(i)



(ii)



(4 marks)

d) Hydroboration-oxidation of 2-pentyne gives a mixture of two ketones, each with the molecular formula $C_5H_{10}O$. Propose structural formulas for these two ketones. Explain your proposal.

(6 marks)

TERJEMAHAN

Arahan:

BAHAGIAN A (40 markah, mengandungi 40 soalan objektif (MCQ), **perlu dijawab dalam masa 1 jam pertama di dalam borang jawapan OMR yang disediakan. Borang OMR akan dikutip 1 jam selepas peperiksaan bermula.**

BAHAGIAN B (60 markah), mengandungi soalan bertulis. Jawab **TIGA** (3) soalan sahaja. Jawab setiap soalan di muka surat yang baru.

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

Pastikan borang OMR diisi dengan lengkap [nombor angka giliran, kod kursus, jawapan]. Gunakan hanya pensil 2B bagi borang OMR.

Sila serahkan buku jawapan dan kertas soalan ini kepada pengawas sebelum anda keluar dari dewan peperiksaan.

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

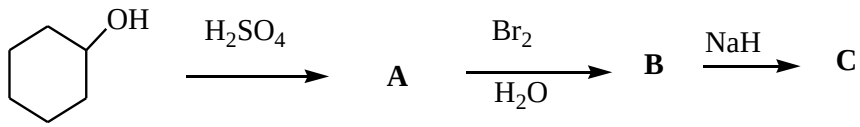
BAHAGIAN B (60 MARKAH)

Jawab sebarang TIGA soalan.
Hanya TIGA jawapan yang pertama akan diperiksa.
Jawab tiap-tiap soalan pada muka surat yang baru.

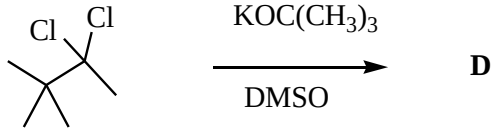
Bahagian ini mengandungi EMPAT soalan.

1. (a) Tentukan hasil **(A)** sehingga **(D)** dalam tindakbalas berikut.

(i)

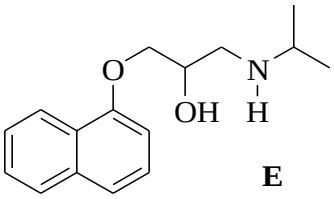


(ii)



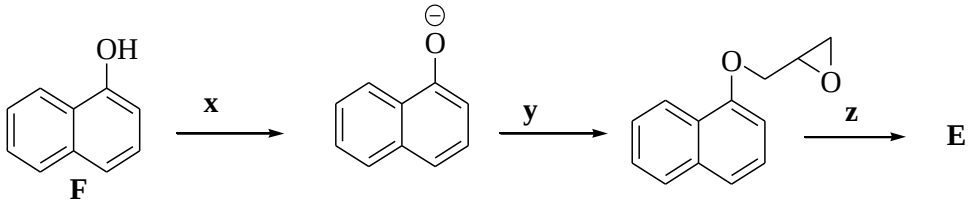
(6 markah)

(b) Agen anti hipertensif, **E** boleh disediakan daripada naftol, **F** melalui dua tindak balas penukargantian nukleofilik.



E

(i) Berikan reagen **x, y** dan **z** dalam tindak balas ini.



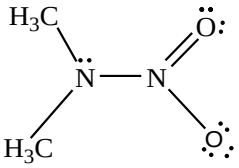
(ii) Berikan mekanisme bagi langkah **x** dan **y.**

(8 markah)

(c) 3-Metil-2-butanol and 2-metil-1-propanol ditukarkan kepada bromida yang berkaitan apabila dipanaskan dengan hidrogen bromida. Tuliskan mekanisme yang sesuai bagi setiap tindak balas dan nyatakan sama ada tindak balas tersebut adalah S_N1 atau S_N2?

(6 markah)

2. (a) Nitroamina merupakan kumpulan berfungsi yang terdapat dalam bahan bertenaga misalnya, siklotrimetilenatrinitramina (RDX). Bagi struktur berikut:

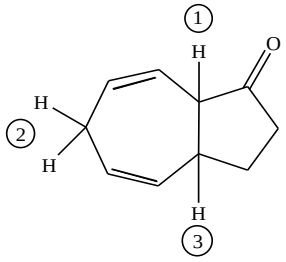


(i) Lukiskan DUA struktur resonans yang utama termasuk cas formal.

(ii) Tunjukkan penghibridan bagi setiap atom nitrogen dan oksigen.

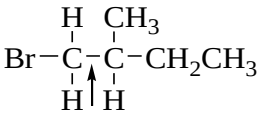
(8 markah)

(b) Susunkan proton yang ditunjukkan dalam sebatian berikut mengikut kekuatan asid dalam tertib menaik. Jelaskan jawapan anda.



(4 markah)

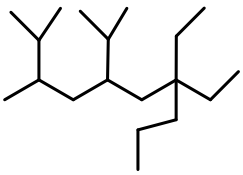
(c) Pertimbangkan putaran ikatan yang ditunjukkan dalam molekul berikut. Lukiskan konformer yang paling stabil menggunakan unjuran Newman.



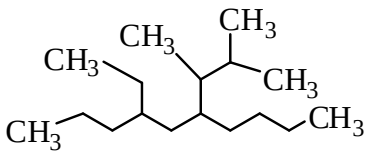
(2 markah)

(e) Berikan nama IUPAC bagi setiap sebatian berikut:

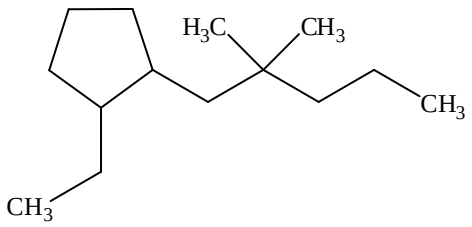
(i)



(ii)



(iii)



(6 markah)

3. (a) Sebatian berikut mempunyai satu pusat kiral. Terangkan kenapa ia mempunyai empat stereoisomer.

$$CH_3\underset{\underset{Cl}{|}}{C}HCH_2CH{=}CHCH_2CH_3$$

(6 markah)

(b) Bolehkah diramalkan sama ada sebatian yang mempunyai satu pusat kiral adalah pemutaran dekstro atau pemutaran levo berpandukan konfigurasi *R/S* pada pusat kiral? Terangkan.

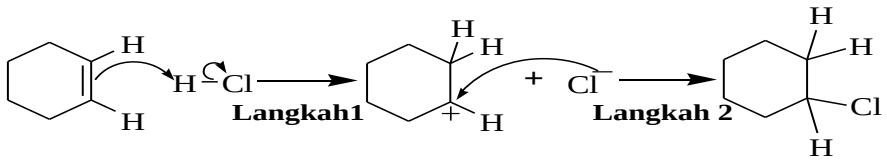
(4 markah)

(c) Larutan yang disediakan dengan mencampurkan 10 mL (0.10 M) larutan enantiomer *R* dan 30 mL (0.10 M) larutan enantiomer *S* didapati mempunyai putaran spesifik +4.8°. Apakah putaran spesifik bagi setiap enantiomer?

(4 markah)

…40/-

d) Berpandukan dua langkah tindak balas berikut:



(i) Berapakah bilangan ikatan yang terputus dan terbentuk dalam Langkah 1?

(ii) Ramalkan sama ada $\Delta H°$ dalam Langkah 1 adalah positif atau negatif.

(iii) Berapakah bilangan ikatan yang terputus dan terbentuk dalam Langkah 2?

(iv) Ramalkan sama ada $\Delta H°$ dalam Langkah 2 adalah positif atau negatif.

(v) Yang manakah langkah penentuan kadar?

(vi) Lukiskan struktur untuk keadaan peralihan dalam kedua-dua langkah mekanisme.

(6 markah)

4. (a) Cadangkan suatu mekanisme penghidratan bermangkinkan asid bagi 3-metil-1-butena untuk menghasilkan 2-metil-2-butanol.

(6 markah)

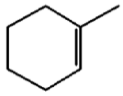
(b) Pengolahan 1,3-butadiena dengan satu mol HBr menghasilkan suatu campuran yang mengandungi dua hasil. Cadangkan suatu mekanisme bagi pembentukan dua hasil tersebut.

CH_2=CH-CH=CH_2 + HBr ⟶ CH_2=CH-CH(Br)-CH_3 + CH_3-CH=CH-CH_2-Br

(4 markah)

(c) Lukiskan formula struktur bagi hasil ozonolisis alkena yang berikut:

(i)



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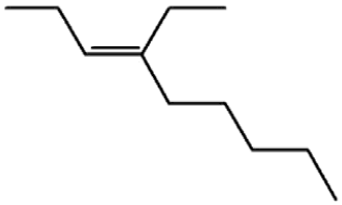

(4 markah)

(d) Penghidroboranan-pengoksidaan 2-pentuna menghasilkan suatu campuran yang mengandungi dua keton dengan formula molekul $C_5H_{10}O$. Cadangkan formula struktur bagi kedua-dua keton tersebut. Jelaskan.

(6 markah)

-oooOooo-