PART A / *BAHAGIAN A*

(1). (a) Consider CH_3NHCH_3 and perform the following:
Pertimbangkan CH_3NHCH_3 dan lakukan yang berikut:

(i). Draw the Lewis structure and fill in the number of lone pair/or double bonds.
Lukiskan struktur Lewis dan isikan bilangan 'lone pair'/atau ikatan berganda.

(ii). Determine the molecular shape around each central atom.
Tentukan bentuk molekul bagi setiap atom pusat.

(iii). Determine ideal bond angles and identify any distortion of the bond angles.
Tentukan sudut ikatan ideal dan kenal pasti sebarang herotan sudut ikatan.

(iv). Sketch the 3D structure of the molecule.
Lakarkan struktur 3D molekul tersebut.

Periodic table of elements and table of electronegativity of elements are given, respectively, in Appendix 1 and Appendix 2.
Jadual berkala unsur dan jadual keelektronegatifan unsur diberikan, masing-masing, dalam Lampiran 1 dan Lampiran 2.

(8 marks/*markah*)

(b). Arrange ethyl methyl ether ($CH_3OCH_2CH_3$), 2-methylpropane (isobutane, $(CH_3)_2CHCH_3$), and acetone (CH_3COCH_3) in order of increasing boiling points and explain why. These three compounds have essentially the same molar mass (58–60g/mol). Their molecular structures are given in Figure 1.

…3/-

Susun etil metil eter ($CH_3OCH_2CH_3$), 2-metilpropana (isobutana, $(CH_3)_2CHCH_3$), dan aseton (CH_3COCH_3) mengikut urutan peningkatan takat didih dan terangkan mengapa. Ketiga-tiga sebatian ini pada asasnya mempunyai jisim molar yang sama (58–60 g/mol). Struktur molekul mereka diberikan pada Rajah 1.

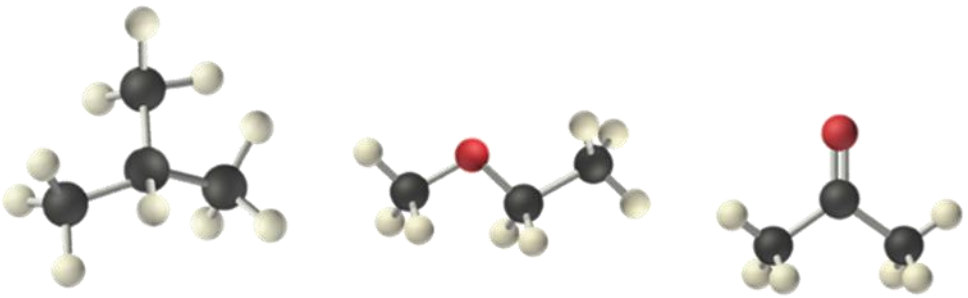


Figure 1 Molecular structures of 2-methylpropane, ethyl methyl ether and acetone.

Rajah 1 Struktur molekul 2-metilpropana, etil metil eter dan aseton.

(10 marks/*markah*)

(c). Bromine and iodine are both soluble in CCl_4, but bromine is much more soluble. Why?

Bromin dan iodin kedua-duanya larut dalam CCl_4, tetapi bromin lebih larut. Kenapa?

(2 marks/*markah*)

(2). (a). Consider the free radical monochlorination of 2,3-dimethylpentane (Figure 2). Show all the products and predict the percent composition of the products. The relative reactivity of H abstraction in a chlorination reaction: 1^o: 2^o: 3^o = 1: 3.5: 5.

Pertimbangkan monopengklorinan radikal bebas bagi 2,3-diimetilpentana (Rajah 2). Tunjukkan semua produk dan anggarkan peratusan komposisi bagi setiap produk. Secara relatif kereaktifan penyingkiran hidrogen bagi tindak-balas pengklorinan: 1^o: 2^o: 3^o = 1: 3.5: 5.

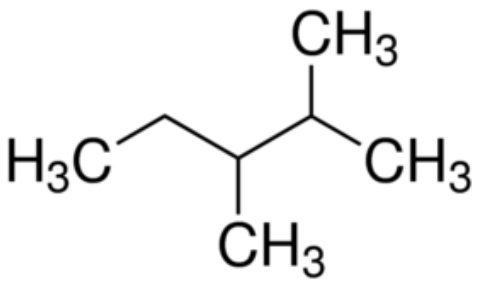


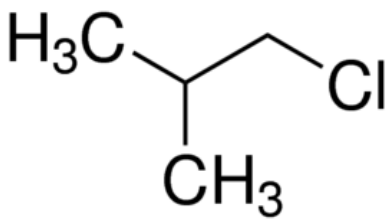
Figure 2: 2, 3-dimethylpentane

(Rajah 2: 2, 3-dimetilpentana

(10 marks/*markah*)

(b). Show the mechanism for the following alkyl halide reacts with benzene in the presence of $AlCl_3$.

Tunjukkan mekanisma bagi tindak-balas di antara alkil halida yang berikut dengan benzene dengan kehadiran $AlCl_3$.



(10 marks/*markah*)

(3). (a) Describe the differences between anionic and cationic polymerization. List example of initiator used in both polymerizations.

Jelaskan perbezaan di antara pempolimeran anionik dan kationik. Senaraikan contoh pemula yang digunakan di dalam kedua-dua pempolimeran.

(6 marks/*markah*)

(b) Explain why anionic polymerization is also considered as living polymerization

Jelaskan mengapa pempolimeran anionik juga diambilkira sebagai pempolimeran hidup

(4 marks/*markah*)

(c). Chain transfer reactions are usually categorized by the nature of the molecule that reacts with the growing chain. Describe chain transfer reaction in monomer, polymer, and solvent.

Tindakbalas pemindahan rantai kebiasaannya dikategorikan sebagai sifat molekul yang bertindakbalas dengan rantai yang semakin meningkat. Jelaskan tindakbalas pemindahan rantai dalam monomer, polimer dan pelarut.

(10 marks/*markah*)

PART B / *BAHAGIAN B*

(4). (a) The frequency of C=O stretching is higher than that of C=C stretching. The Intensity of C=O stretching is stronger than that of C=C stretching. Explain.

Kekerapan regangan C=O lebih tinggi daripada regangan C=C. Intensiti regangan C=O adalah lebih kuat daripada regangan C=C. Jelaskan.

(2 marks/*markah*)

(b) The FTIR spectrum shown in Figure 3 was obtained from an organic compound. The compound has a molecular formula $C_7H_6O_2$. Identify its functional groups and propose molecular structure for this compound. IR absorption table for some covalent bonds is given in Appendix 3.

Spektrum FTIR yang ditunjukkan dalam Rajah 3 diperolehi daripada satu sebatian organik. Sebatian ini mempunyai formula molekul $C_7H_6O_2$. Kenal pasti kumpulan berfungsinya dan cadangkan struktur molekul untuk sebatian ini. Jadual penyerapan IR untuk sebagian ikatan kovalen diberikan dalam Lampiran 3.

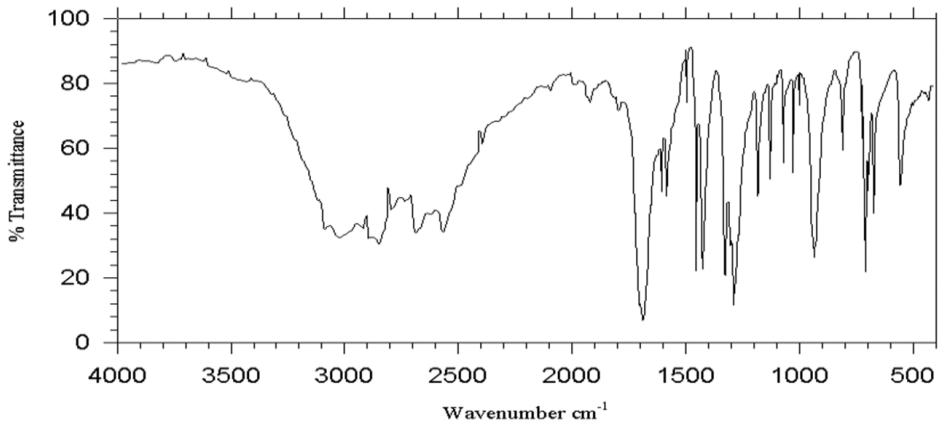


Figure 3 An FTIR spectrum an organic compound.

Rajah 3 Spektrum FTIR bagi satu sebatian organik.

(10 marks/*markah*)

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(c). How could IR spectrum be used to distinguish between the following pair of compounds?
Bagaimanakah spektrum IR boleh digunakan untuk membezakan antara pasangan sebatian berikut?

(i). Ketone vs. aldehyde
Keton lwn. aldehid

(ii). Alcohol vs. carboxylic acid
Alkohol lwn. Asid karbosilik

(iii). Secondary amine vs. secondary amide
Amina sekunder lwn. Amida sekunder

(iv). Ketone vs. ester
Keton lwn. Ester

(8 marks/*markah*)

(5). (a). Illustrate the Lewis structure for acetate ion (CH_3COO^-). What is the C-O bond order? Identify the most stable resonance structure if there is one. According to the VSEPR theory, what is the molecular structure of this ion? Illustrate the ion's 3D structure.

Lukiskan struktur Lewis bagi ion asetat (CH_3COO-). Apakah 'C-O bond order'? Tentukan struktur resonans yang paling stabil jika ada. Menurut teori VSEPR, apakah struktur molekul ion ini? Lukiskan struktur 3D ion.

(10 marks/*markah*)

(b) Identify the different types of intermolecular forces in nylon 6 and polycaprolactone. Rank them in the order of increasing intermolecular forces. Illustrate 2 polymer chains for each polymer

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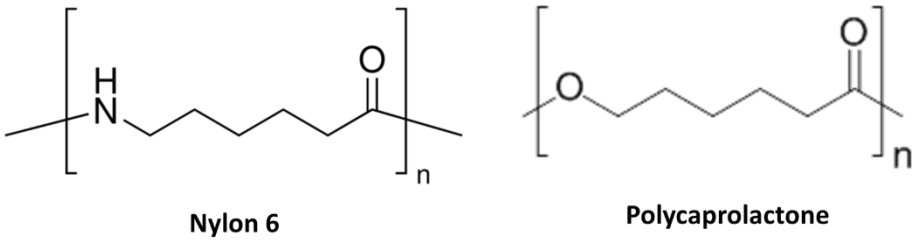
and show the intermolecular force (only the dominant) between the polymer chains. Which polymer would you anticipate exhibiting a higher melting point? The molecular structures of nylon 6 and polycaprolactone are given in Figure 4.

Tentukan pelbagai jenis daya antara molekul yang terdapat dalam nilon 6 dan polikaprolakton. Susunkan dalam susunan peningkatan daya antara molekul. Lakarkan 2 rantai polimer untuk setiap polimer dan tunjukkan daya antara molekul (hanya yang dominan) antara rantai polimer. Polimer manakah yang anda jangkakan menunjukkan takat lebur yang lebih tinggi? Struktur molekul nilon 6 dan polikaprolakton diberikan dalam Rajah 4.



Nylon 6 **Polycaprolactone**

Figure 4 Molecular structures of nylon 6 and polycaprolactone.

Rajah 4 Struktur molekul nilon 6 dan polykaprolakton.

(10 marks/*markah)*

PART C / *BAHAGIAN C*

(6). (a). Describe THREE (3) differences between chain growth and step growth polymerization. Why in a step-growth polymerization, the molecular weight of the polymer chain builds up slowly compared with chain growth polymerization?

Jelaskan TIGA (3) perbezaan di antara pempolimeran rantai dan pempolimeran langkah. Mengapa di dalam pempolimeran langkah, berat molekul rantai polimer dibina secara perlahan apabila dibandingkan dengan pempolimeran rantai?

(10 marks/*markah*)

(b). Figure 5 shows the polymerization of monomer X into polymer. Suggest and describe one technique to polymerize the polymer.

Rajah 5 menunjukkan pempolimeran monomer X kepada polimer. Cadangkan dan huraikan satu teknik pempolimeran polimer tersebut.

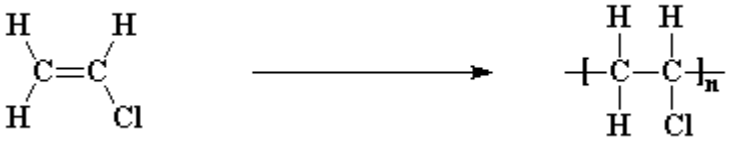


Figure 5: Polymerization of X

Rajah 5: Pempolimeran X

(10 marks/*markah*)

(7). (a). What are the differences between polyolefin, polyamide and polyesters? Give example of polyolefin, polyamide and polyesters.

Jelaskan perbezaan antara poliolefin, poliamida dan poliester. Berikan contoh bagi poliolefin, poliamida dan poliester.

(6 marks/*markah*)

(b). Table 1 listed the characteristic for Polymer A and Polymer B in term of its monomer used, types of polymerization and number of carbon atoms. Define Polymer A and Polymer B and its monomer name. Explain the mechanism to polymerize both polymers.

Jadual 1 menunjukkan senarai sifat-sifat bagi Polimer A dan Polimer B dari segi monomer yang digunakan, jenis pempolimeran dan juga jumlah nombor atoms. Takrifkan Polimer A dan Polimer B dan juga nama monomer. Jelaskan mekanisme pempolimeran bagi kedua-dua polimer tersebut.

(14 marks/*markah*)

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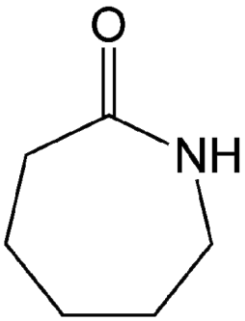
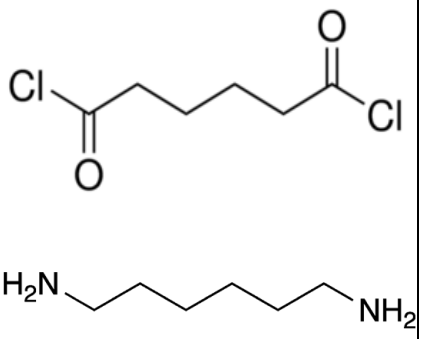
Table 1: Characteristic of Polymer A and Polymer B

	Polymer A / *Polimer A*	Polymer B / *Polimer B*
Momoner used / *Monomer yang digunakan*		
Types of Polymerization/*Jenis pempolimeran*	Ring opening polymerization / *Pempolimeran rantai terbuka*	?
Number of carbon atoms / *Nombor atom karbon*	?	12

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