USM/PTJNC/BPA-PEP/PK01/L03

LAMPIRAN D3

Untuk kegunaan pejabat Seksyen Peperiksaan & Pengijazahan	
Nombor Sampul	
Tarikh Peperiksaan	
Sesi Peperiksaan	PAGI / PETANG

PENYEMAKAN KERTAS SOALAN PEPERIKSAAN

(Proof-reading of Examination Question Paper)

Gunakan satu proforma untuk satu kertas soalan peperiksaan.
(Use separate form for each question paper)

Kepada : Timbalan Pendaftar
Seksyen Peperiksaan dan Pengijazahan, BPA, Jabatan Pendaftar

SAYA/KAMI TELAH MENYEMAK SALINAN-SALINAN KERTAS SOALAN PEPERIKSAAN BERTAIP YANG DISEBUTKAN DI BAWAH INI :

[I/We have checked the typed copies of the Examination Paper stated below :

Kod Kursus : EBP 103/3 *(Course Code)* **Tajuk Kursus :** POLYMER ORGANIC CHEMISTRY *(Course Title)*

Jangka Masa Peperiksaan : 3 Jam *(Duration of Examination / Hours)*

Bilangan Muka Surat Bertaip : 11 Muka Surat *(Number of Typed: Pages / Pages)*

Bilangan Soalan Yang Perlu Dijawab : 5 Soalan *(Number of questions required to be answered / Questions)*

Soalan-soalan dijawab atas : *(Questions to be answered in)* Sila (√) *[Please (√)]*	BUKU JAWAPAN *(Answer Book)*	OMR *(OMR Form)*	JAWAB DALAM KERTAS SOALAN *(Answer In Question Paper)*
	✓		

DENGAN INI DISAHKAN BAHAWA KERTAS SOALAN PEPERIKSAAN INI ADALAH TERATUR, BETUL DAN SEDIA UNTUK DICETAK.
(Certified that this question paper is in order, correct and ready for printing)

Nama Pemeriksa : *[Name of Examiner(s)]*
- Huruf Besar *(In Block Capitals)*

RAZAINA BT. MAT TAIB

Tandatangan : *(Signature)* **Tarikh :** *(Date)* 30/10/2017.

Tandatangan dan Cop Rasmi : DEKAN/PENGARAH
(Signature and Offical Stamp Dean/Director)

PROFESOR DR. RUHAILAWATI HUSSAIN
Dekan
P. Peng. Kej. Bahan & Sumber Mineral
Kampus Kejuruteraan
Universiti Sains Malaysia

Tarikh : 16.11.17 *(Date)*

NOTA : Pemeriksa-pemeriksa yang menyediakan kertas soalan peperiksaan adalah bertanggungjawab atas ketepatan isi kandungan kertas soalan peperiksaan berkenaan.

(NOTE : Accuracy of the contents of the question paper is the responsibility of the Examiner(s) who set the question paper)

First Semester Examination
2017/2018 Academic Session

January 2018

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

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains ELEVEN printed pages *and ONE pages APPENDIX before you begin the examination.*
[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS muka surat dan SATU muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper contains SEVEN questions. THREE questions from PART A, TWO questions from PART B and TWO questions from PART C.
[Kertas soalan ini mengandungi TUJUH soalan. TIGA soalan dari BAHAGIAN A, DUA soalan dari BAHAGIAN B dan DUA soalan dari BAHAGIAN C.]

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A, **ONE** question from PART B and **ONE** question from PART C.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A, **SATU** soalan dari BAHAGIAN B dan **SATU** soalan dari BAHAGIAN C. 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 in the examination questions, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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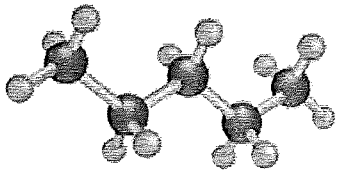
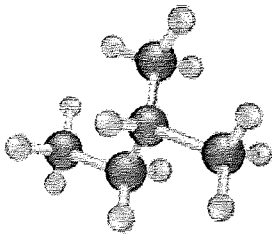
PART A/ *BAHAGIAN A*

1. (a). Give brief explanation for the following based on the intermolecular forces involved.
Berikan penjelasan ringkas untuk yang berikut dengan merujuk kepada daya antaramolekul yang terlibat.

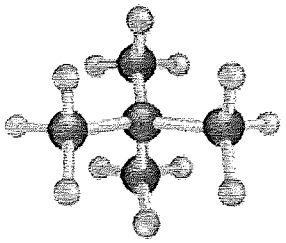
(i). The isomers of pentane (Fig. 1) have different boiling points.
Isomer bagi pentana (Rajah 1) mempunyai takat didih yang berbeza.



n-pentane
BP = 36.1°C



2-methylbutane
BP = 27.9°C



2,2-dimethylpropane
BP = 9.5°C

Fig. 1 Isomers of pentane
Rajah 1 Isomer bagi pentana

(ii). Polyvinyl chloride (PVC) is a harder plastic with a higher melting point than linear-density polyethylene (LDPE). Illustrate the interactions (if any) between the polymer chains. Fig. 2 shows repeating unit of PVC and polyethylene (PE).

Polivinil klorida (PVC) adalah plastik yang lebih keras dan mempamerkan takat lebur yang lebih tinggi daripada polietilena berketumpatan rendah (LDPE). Lakarkan interaksi (jika ada) di antara rantai polimer. Rajah 2 menunjukkan unit ulangan bagi PVC dan polietilena (PE).

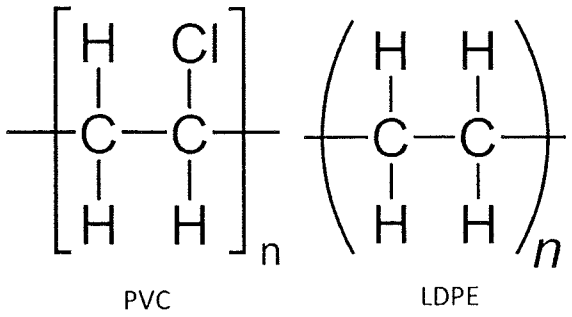


Fig. 2 Repeating unit of PVC and PE

Rajah 2 Unit ulangan bagi PVC dan PE

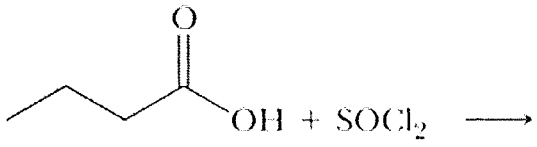
(50 marks/*markah*)

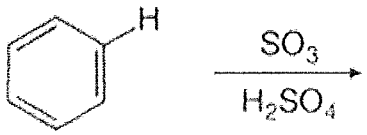
(b). Explain the expression "Like dissolves like". Why does methane dissolve readily in carbon tetrachloride and not in water?

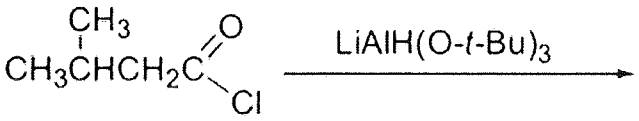
Terangkan ungkapan "Like dissolves like". Mengapakah metana sedia larut di dalam karbon tetraklorida dan tidak di dalam air?

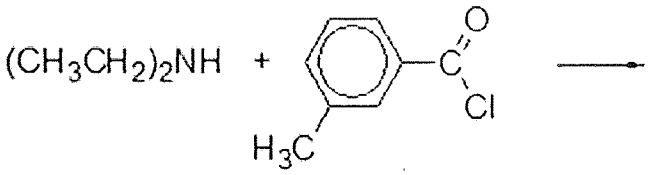
(50 marks/*markah)*

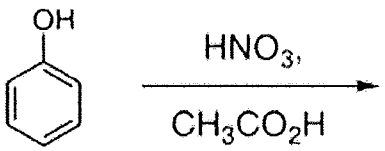
2. (a). Draw the products of the following chemical reactions.
Lukiskan produk bagi tindak-balas kimia di bawah.

i. 

ii. 

iii. 

iv. 

v. 

(50 marks/*markah*)

(b). Consider the free radical monochlorination of 2,2,5-trimethylhexane (Fig. 3). Draw all of the products and predict the percent composition of the products. The relative reactivity of hydrogen abstraction in a chlorination reaction: 1°: 2°: 3° = 1: 3.5: 5.

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

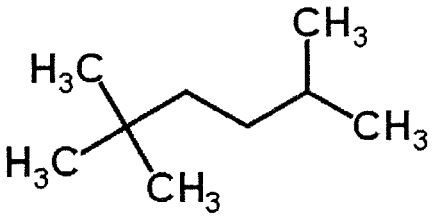


Fig. 3 : 2,2,5 – trimethylhexane

Rajah 3 : 2,2,5-trimetilheksana

(50 marks/*markah*)

3. (a). What is the difference between anionic and cationic polymerization? Explain your answer by giving an examples of initiator, monomer and mechanism used in both polymerization.

Apakah perbezaan di antara pempolimeran anionik dan kationik. Jelaskan jawapan anda dengan memberi contoh pemula, monomer dan mekanisma yang digunakan di dalam kedua-dua pempolimeran.

(60 marks/*markah*)

(b). Figure 4 shows the polymerization of lactic acid into polylactic acid. State the classification of the polymerization involve. Give 2 examples of other polymers that undergo the same polymerization process.

Gambarajah 4 menunjukkan pempolimeran asid laktik kepada polilaktik asid. Nyatakan jenis pempolimeran yang terlibat. Berikan 2 contoh polimer lain yang menjalani proses pempolimeran yang sama.

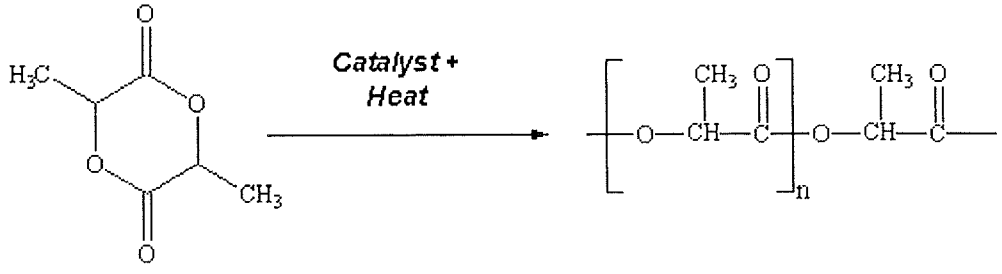


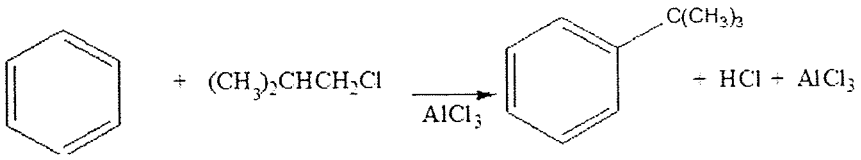
Fig. 4 : Polymerization of lactic into polylactic.

Rajah 4 : Pempolimeran laktik kepada polilaktid.

(40 marks/*markah*)

PART B/ *BAHAGIAN B*

4. (a). Draw and briefly describe the mechanism for the following reaction.
Lukis dan jelaskan secara ringkas mekanisma tindak-balas di bawah.



(50 *marks/markah*)

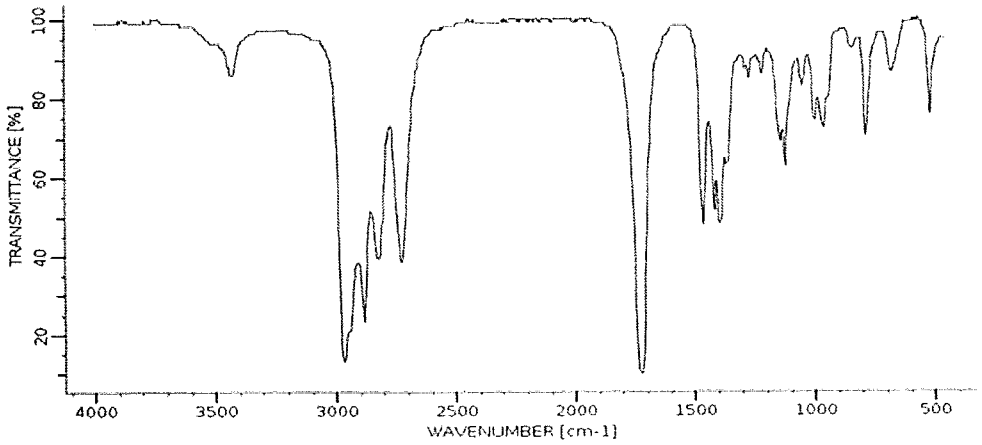
(b). The following IR spectra belong to a ketone, an aldehyde, an alchohol, an ester and a carboxylic acid. Identify the functional group(s) and match spectra A through E with these compounds. IR absorption table for some common covalent bonds is given in Appendix 1.

Spektra IR yang berikut adalah untuk keton, aldehid, alkohol, ester dan asid karboksilik. Tentukan kumpulan berfungsi dan padankan spektra A hingga E dengan sebatian-sebatian tesebut. Jadual penyerapan IR bagi sebahagian ikatan kovalen yang lazim diberikan di lampiran 1.

(50 marks/*markah*)

Appendix 1 : Spectrum A-E / Lampiran 1 : Spektrum A-E

Spectrum A



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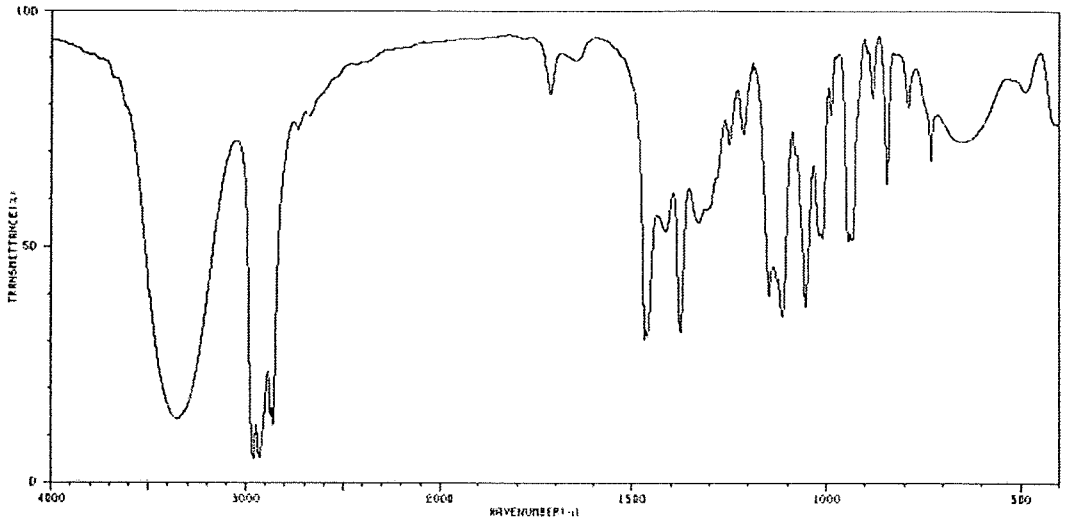
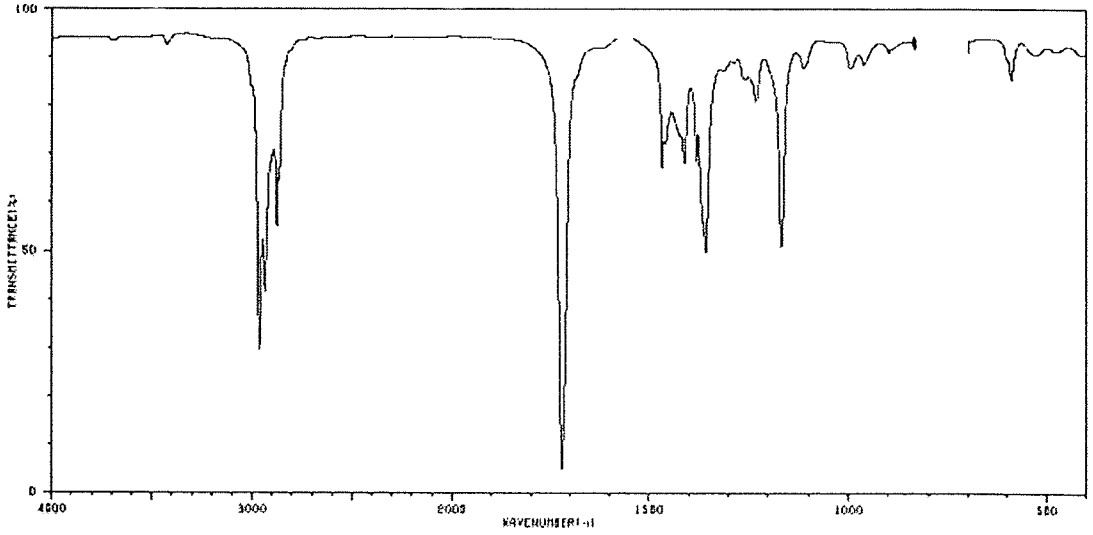
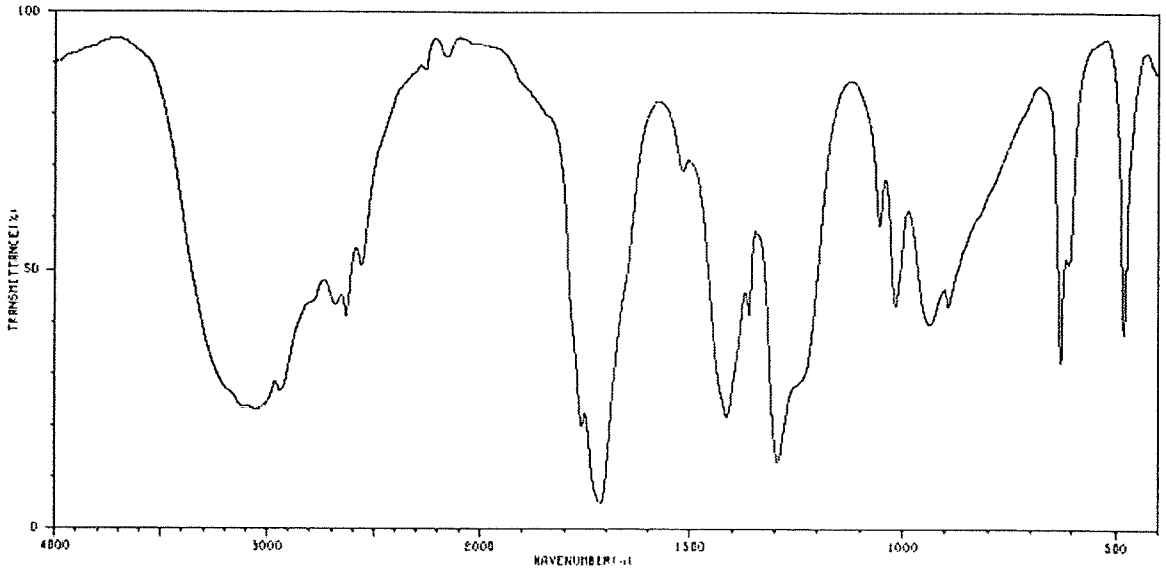
Spectrum B



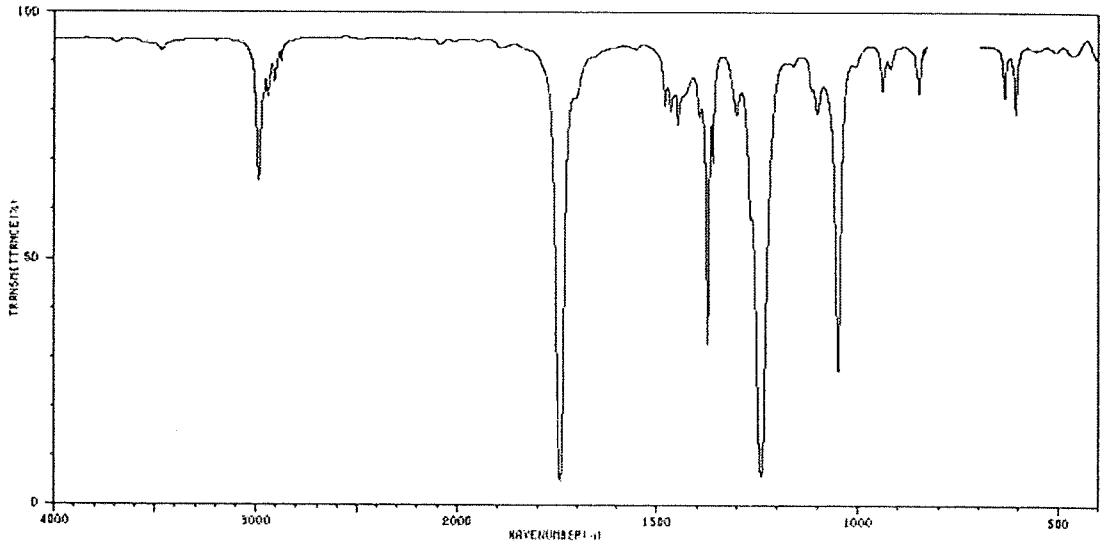
Spectrum C



Spectrum D



Spectrum E



5. (a). Explain (using representation of molecular orbitals) the structure and bonding found in ethane (C_2H_4), indicate clearly the structure of the molecule. The atomic number of C and H is 6 and 1, respectively.

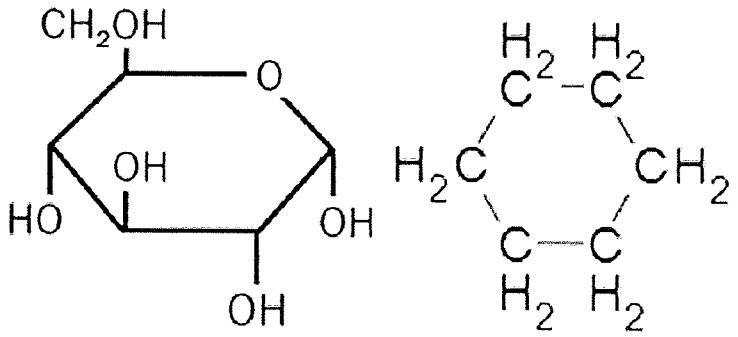
Terangkan (dengan gambaran orbital molekul) struktur and ikatan yang ada pada etena (C_2H_4), tentukan struktur molekul tersebut. Nombor atom bagi C and H masing-masing ialah 6 dan 1.

(50 marks/*markah*)

(b). The structures for glucose, $C_6H_{12}O_6$, and cyclohexane, C_6H_{14}, are shown below.

Struktur bagi glukosa $C_6H_{12}O_6$, dan sikloheksana C_6H_{14}, ditunjukkan di bawah.

Glucose **Cyclohexane**



Identify the type(s) of intermolecular attractive forces in glucose and cyclohexane. Glucose is soluble in water but cyclohexane is not soluble in water. Explain this observation.

Tentukan jenis-jenis daya tarikan antaramolekul yang wujud pada glukosa dan sikloheksana. Glukosa larut di dalam air tetapi sikloheksana tidak larut di dalam air. Terangkan pemerhatian ini.

(*50 marks/markah*)

PART C/ *BAHAGIAN C*

6. (a). Define the polymerization process described in Fig. 5(A) and (B)
Takrifkan pempolimeran yang digambarkan dalam Rajah 5(A) dan (B)
(20 marks/*markah*)

(b). Explain the mechanism involved in both polymerization process.
Jelaskan mekanisma yang terlibat dalam kedua-dua proses pempolimeran tersebut.
(50 marks/*markah*)

(c). What is the advantages of living polymerization? List three advantages.
Apakah kelebihan pempolimeran hidup? Nyatakan tiga kelebihan.
(30 marks/*markah*)

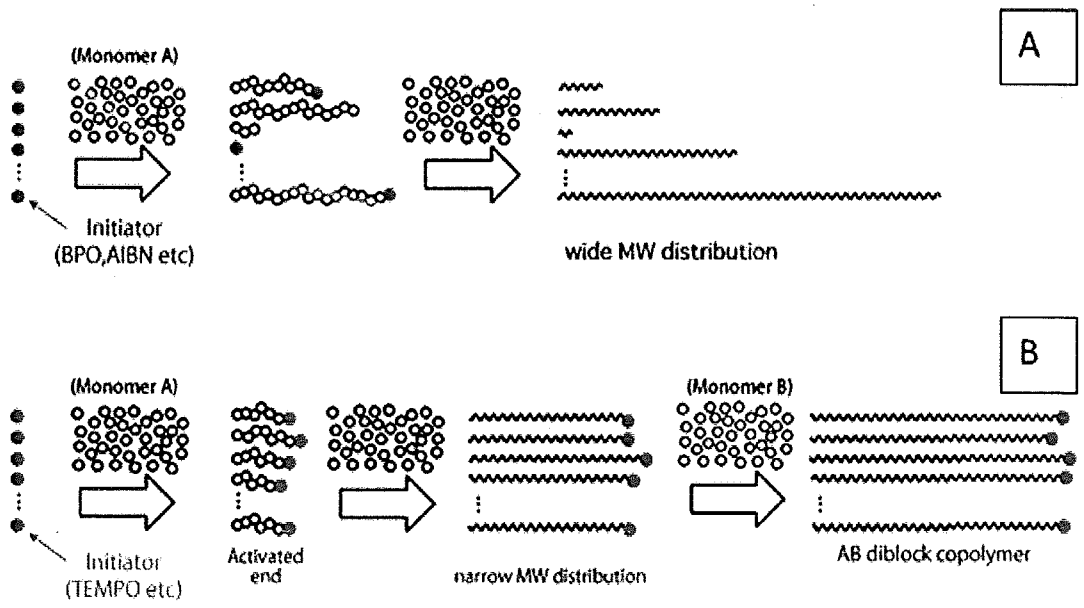


Fig. 5 : Polymerization process and the mechanism involved of (A) and (B).
Rajah 5 : Proses pempolimeran dan mekanisma terlibat bagi (A) dan (B).

7. (a). What is the differences between chain growth and step growth polymerization? Why the molecular weight step growth polymer builds up slowly compared with chain growth?

Apakah perbezaan di antara pempolimeran pertumbuhan rantai dan pempolimeran pertumbuhan langkah? Mengapa berat molekul rantai polimer pertumbuhan langkah lebih perlahan dibandingkan dengan pertumbuhan rantai?

(50 marks/*markah*)

(b). Reaction conditions of cationic reactions are easier than anionic reaction. Explain why.

Keadaan tindakbalas bagi tindakbalas kationik adalah lebih mudah berbanding tindakbalas anionik. Terangkan mengapa.

(20 marks/*markah*)

(c). Which of the following monomers cannot undergo chain growth polymerization? Explain why.

Yang mana antara monomer berikut tidak boleh melalui pempolimeran pertumbuhan rantai? Terangkan mengapa.

(i). $CH_2 = CHCOOR$

(ii). $COOH - CH_2 - COOH$

(30 marks/*markah*)

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APPENDIX / *LAMPIRAN*

CHARACTERISTIC INFRARED ABSORPTION BANDS OF FUNCTIONAL GROUPS

Class of Compounds	Absorption, cm^{-1}	Intensity	Assignment
Alkanes and Alkyls	2850-3000	s	C-H stretch
	1450-1470	s	C-H bend
	1370-1390	m	CH_3 C-H bend
	1365 + 1395 (two bands)	m	$-CH(CH_3)_2$ or $-(CH_3)_3$ bend
	715-725	w	$-(CH_2)_n$ bend
Alkenes	3020-3140	w-m	=C-H stretch
	1640-1670	vw-m	C=C stretch
$RCH=CH_2$	910 + 990 (two bands)	m + s	=C-H bend
$RR'C=CH_2$	885-895	s	=C-H bend
cis-RCH=CHR'	665-730	m-s, broad	=C-H bend
trans-RCH=CHR'	960-980	s	=C-H bend
RCH=CR'R''	790-840	s	=C-H bend
Alkynes			
R-C≡C-H	3265-3335	s, sharp	≡C-H stretch
	2100-2140	m	C≡C stretch
	610-700	s, broad	≡C-H bend
R-C≡C-R'	2190-2260	vw-w	C≡C stretch
Alkyl halides			
R-F	1000-1350	vs	C-F stretch
R-Cl	750-850	s	C-Cl stretch
R-Br	500-680	s	C-Br stretch
R-I	200-500	s	C-I stretch
Alcohols	3300-3400	s, broad	O-H stretch
$C=C-CH_2-OH$	1035-1050	m-s	C-O stretch
$R-CH_2-OH$ (1°) or C=C-CH(R)-OH	1050-1085	m-s	C-O stretch
RR'CH-OH (2°) or C=C-CRR'-OH	1085-1125	m-s	C-O stretch
RR'R''C-OH (3°)	1125-1205	m-s	C-O stretch
Ar-O-H	1180-1260	m-s	C-O stretch
Ethers			
R-O-R'	1085-1150	s	C-O-C stretch
Ar-O-R	1020-1075 and 1200-1275 (two band)	m-s	=C-O-C sym. & asym. stretch
Aldehydes	2700-2725	m	H-C=O stretch
R-CH=O	1720-1740	s	C=O stretch
C=C-CH=O or Ar-CH=O	1685-1710	s	C=O stretch
Ketones			
RR'C=O	1710-1720	s	C=O stretch
C=C-C(O)-R	1665-1685	s	C=O stretch
Ar-C(O)-R	1675-1695	s	C=O stretch
four member cyclic	1770-1780	s	C=O stretch
five member cyclic	1740-1755	s	C=O stretch
six member cyclic	1710-1720	s	C=O stretch

Class of Compounds	Absorption, cm^{-1}	Intensity	Assignment
Carboxylic Acids	2500-3500	s, broad	O-H stretch
R-C(O)-OH	1710-1715	s, broad	C=O stretch
C=C-C(O)-OH or Ar-C(O)-OH	1680-1710	s	C=O stretch
Esters	aliphatic 1160-1210 acetates ~1240 aromatic 1250-1310	s-vs	O=C-O-C stretch
R-C(O)-O-R	1735-1750	s	C=O stretch
C=C-C(O)-O-R or Ar-C(O)-O-R	1715-1730	s	C=O stretch
R-C(O)-O-Ar	1760-1790	s	C=O stretch
Acyl Chlorides			
R-C(O)-Cl	1785-1815	s	C=O stretch
Ar-C(O)-Cl	1770-1800	s	C=O stretch
Anhydrides			
R-C(O)-O-C(O)-R	~1750 + ~1815	s,s	C=O symmetric
Ar-C(O)-O-C(O)-Ar	~1720 + ~1775 (both two bands)	s,s	& asym. stretch
Nitriles			
R-C≡N	2240-2260	m-s	C≡N stretch
C=C-C≡N or Ar-C≡N	2220-2240	s	C≡N stretch
Amines			
$R-NH_2$	~3400 + ~3500 (two bands)	w	N-H symmetric & asym. stretch
	1580-1650	w-m	N-H bend
RR'N-H	3310-33350	w	N-H stretch
Amides			
$R-C(O)-NH_2$	3200-3400 and 3400-3500 (two bands)	w-m	N-H symmetric & asym. stretch
	1650-1690	s, broad	C=O stretch
	1590-1655	m-s	N-H bend
R-C(O)-NH-R	3400-3500	w-m	N-H stretch
	1640-1690	s, broad	C=O stretch
	1510-1560	m-s	N-H bend
R-C(O)-NR'R''	1630-1680	m-s	C=O stretch
Nitro Compounds			
$R-NO_2$	~1550 and ~1370	s s	N-O symmetric & asym. stretch
$C=C-NO_2$ or $Ar-NO_2$	~1525 and ~1335 (both two bands)	s s	N-O symmetric & asym. stretch
Aromatic Compounds	3010-3100	m	Ar C-H stretch
	1450-1600 (two to four bands)	m-s sharp	ring C=C stretch
monosubstituted	730-770 and 690-710 (two bands)	s s	C-H bend C-H bend
o-disubstituted	735-770	s	C-H bend
m-disubstituted	750-810 and 690-710	s s	C-H bend C-H bend
p-disubstituted	810-840	s	C-H bend

Intensity abbreviations: vw = very weak, w = weak, m = medium, s = strong, vs = very strong