

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1**SOALAN 1**

- CLO 1 (a) A polymer is a large molecule made up of repeating sub-units called monomers. Define the polymerization process.
Polimer ialah molekul besar yang terdiri daripada subunit berulang yang dipanggil monomer. Definisikan proses pempolimeran.
[2 marks]
[2 markah]
- (b) Thermoplastics are a polymer that can be melted and reshaped multiple times without significant chemical degradation.
Termoplastik adalah sejenis polimer yang boleh dicairkan dan dibentuk semula beberapa kali tanpa mengalami degradasi kimia yang ketara.
- CLO 1 i. Polyvinyl chloride (PVC) is a synthetic thermoplastic polymer made from vinyl chloride monomers. Explain **TWO (2)** effects of the chlorine atom on the PVC properties
*Polivinil klorida (PVC) ialah polimer termoplastik sintetik yang diperbuat daripada monomer vinil klorida. Terangkan **DUA (2)** kesan atom klorin terhadap sifat PVC.*
[2 marks]
[2 markah]

CLO 1

- ii. Figure 1b(ii) shows any molecular weights more than 10,000; the materials are considered as polyethylene (PE) polymer. Based on the figure, interpret the relationship between molecular weight, crystallinity and density.

Rajah 1b(ii) menunjukkan mana-mana berat molekul melebihi 10,000, bahan tersebut dianggap sebagai polimer polietilena (PE). Berdasarkan rajah tersebut, tafsirkan hubungan antara berat molekul, kehabluran dan ketumpatan.

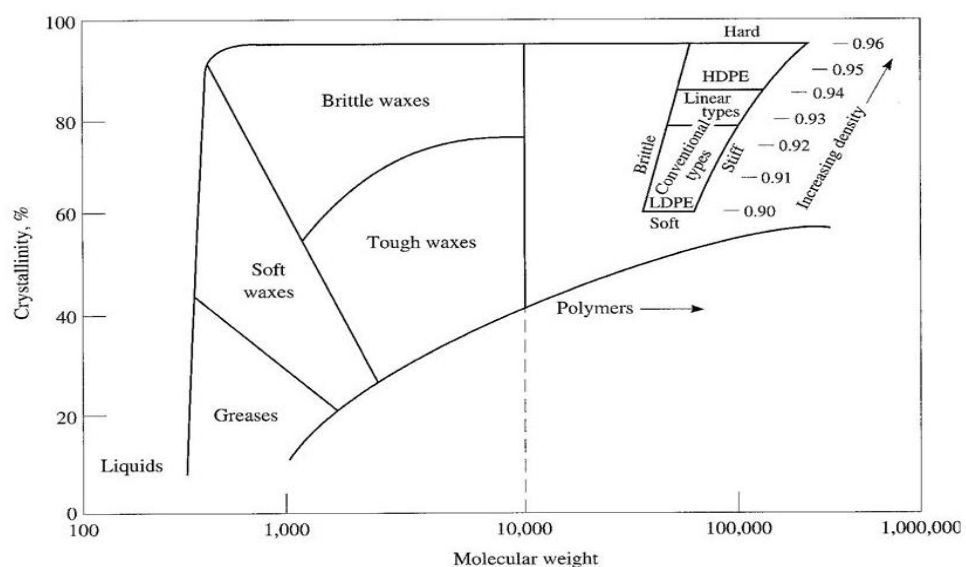


Figure 1b(ii): Relationship graph between molecular weight, crystallinity and density of PE-like materials.

Rajah 1b(ii): Graf hubungan antara berat molekul, kehabluran dan ketumpatan bahan seperti PE.

[3 marks]

[3 markah]

- (c) ABS is a common thermoplastic polymer made up of three distinct monomers: acrylonitrile (C_3H_3N), butadiene (C_4H_6), and styrene (C_8H_8). ABS is a popular material for 3D printing due to its ease of use and durability.

ABS ialah polimer termoplastik yang terdiri daripada tiga monomer berbeza: akrilonitril (C_3H_3N), butadiene (C_4H_6), dan stirena (C_8H_8). ABS ialah bahan popular digunakan dalam percetakan 3D kerana kemudahan penggunaan dan ketahanannya.

CLO 2

- i. Figure 1c(i) shows the molecular weight data for polybutadiene during the production process of ABS plastic. Calculate the degree of polymerization of this polymer.

Rajah 1c(i) menunjukkan data berat molekul untuk polibutadiene semasa proses penghasilan plastik ABS. Kira tahap pempolimeran polimer ini.

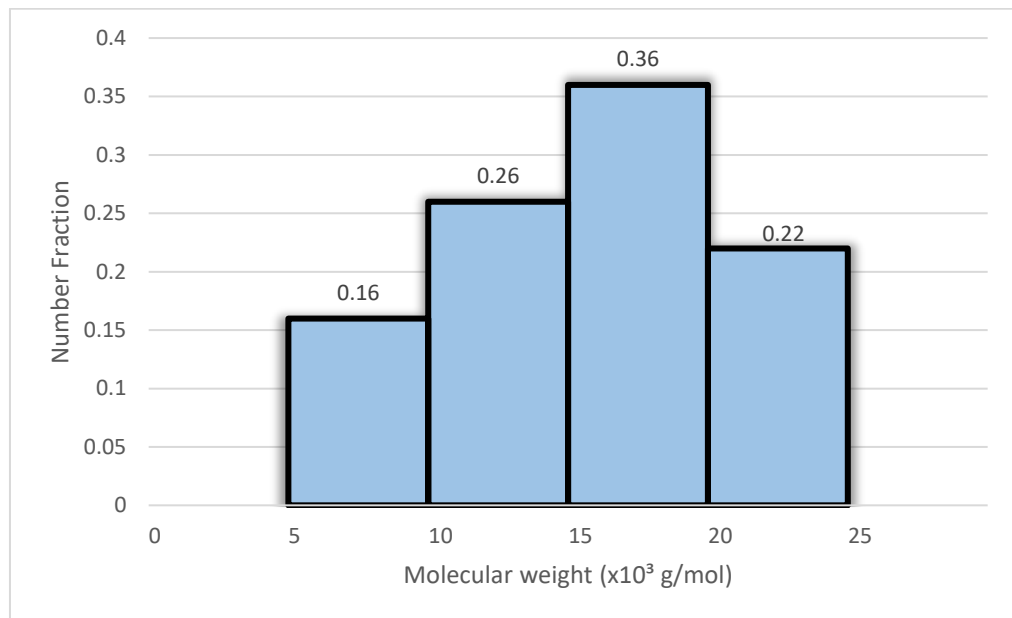


Figure 1c(i): Molecular Weight Data / *Rajah 1c(i): Data Berat Molekul*

[8 marks]

[8 markah]

CLO 2

- ii. In order to produce ABS plastic, the following polymer 24 wt% polyacrylonitrile, 40 wt% polybutadiene, and 36 wt% polystyrene, must be mixed accordingly. Calculate the mole fraction of each component in this material.

Untuk menghasilkan plastik ABS, polimer-polimer iaitu 24 wt% polyacrylonitrile, 40 wt% polybutadiene, dan 36 wt% polystyrene, perlu dicampur dengan sewajarnya. Kira pecahan mol setiap komponen polimer dalam bahan ini.

[10 marks]

[10 markah]

QUESTION 2

SOALAN 2

CLO 1

- (a) Polyamides or nylon are made through the polymerization of monomers containing amide (-CONH-) groups. State **TWO (2)** main routes to synthesized polyamide.

*Poliamida atau nilon dibuat melalui pempolimeran monomer yang mengandungi kumpulan amida (-CONH-). Nyatakan **DUA (2)** langkah sintesis poliamida.*

[2 marks]

[2 markah]

- (b) Engineering thermoplastics such as polyester and polyoxymethylene (POM) are a group of high-performance polymers that are designed to meet various engineering applications' requirements.

Termoplastik kejuruteraan seperti polyester dan polioksimetilena ialah sekumpulan polimer berprestasi tinggi yang direka untuk memenuhi keperluan pelbagai aplikasi kejuruteraan.

CLO 1

- i. The differences between PBT and PET are best understood by examining the chemical structure of the repeating unit that makes up the polymer chains. Compare **THREE (3)** differences between PBT and PET in their properties

*Perbezaan antara PBT dan PET dapat difahami dengan memeriksa struktur kimia unit berulang yang membentuk rantai polimer. Bandingkan **TIGA (3)** perbezaan antara PBT dan PET melalui sifatnya.*

[3 marks]

[3 markah]

CLO 1

- ii. The main problem of POM-based implants was the degradation of POM during melt processing. Write a suitable process to prevent degradation from occurring on POM.

Masalah utama implan berasaskan POM ialah kemerosotan POM semasa pemprosesan cair. Tulis proses yang sesuai untuk mengatasi degradasi daripada berlaku pada POM.

[8 marks]

[8 markah]

CLO1

- (c) Crosslinking reactions bind the polymer molecules in a three-dimensional network and the reaction are irreversible.

Tindak balas silang mengikat molekul polimer bersama, dalam rangkaian tiga dimensi dan tindak balas ini tidak boleh diterbalikkan.

- i. Figure 2c(i) shows the crosslinking reaction of polymer. Elaborate **TWO (2)** possible conditions for crosslinking process to happen.

*Rajah 2c(i) menunjukkan tindak balas silang polimer. Huraikan **DUA (2)** keadaan yang mungkin untuk proses pertautan silang berlaku.*

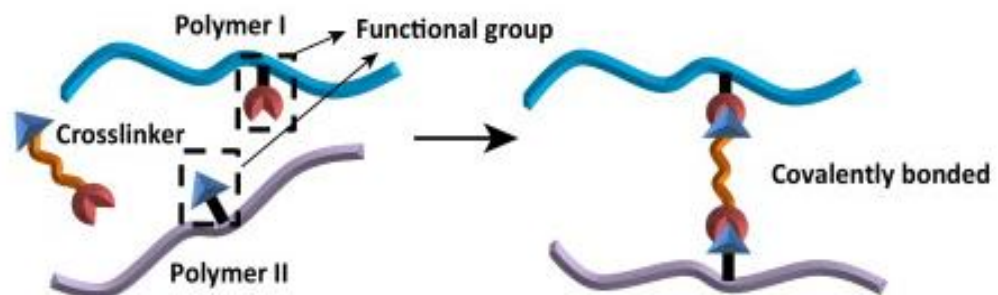


Figure 2c(i): Crosslinking reaction of polymer.

Rajah 2c(i): Tindak balas silang polimer.

[4 marks]

[4 markah]

CLO1

- ii. Phenolic resins are mainly produced thermoset by the condensation polymerization reaction of phenol and formaldehyde with water as a by-product. Draw the synthesis process of phenolic completely with the name and structure of reactant and product of the reaction.

Resin fenolik adalah termoset yang paling banyak dihasilkan melalui tindak balas pempolimeran pemeluwapan fenol dan formaldehid dengan air sebagai hasil sampingan. Lukiskan proses sintesis fenolik dengan lengkap bersama dengan nama dan struktur kimia bahan dan produk tindakbalas.

[8 marks]

[8 markah]

QUESTION 3

SOALAN 3

CLO 1

- (a) Injection moulding is a widely used manufacturing process for producing plastic parts and products. List **TWO (2)** materials that can be used with injection moulding machines.

*Pengacuan suntikan ialah proses pembuatan yang digunakan secara meluas untuk menghasilkan bahagian dan produk plastik. Senaraikan **DUA (2)** bahan yang boleh digunakan dengan mesin acuan suntikan.*

[2 marks]

[2 markah]

- (b) Injection moulding melts plastic material and injects it into a mould to create a specific shape once it cools and solidifies.

Pengacuan suntikan mencairkan bahan plastik dan menyuntiknya ke dalam acuan untuk mencipta bentuk tertentu setelah ia sejuk dan pejal.

CLO 1

- i. Elaborate the function of the component of injection moulding machine as shown in Figure 3b(i).

Huraikan fungsi komponen mesin pengacuan suntikan yang ditunjukkan dalam Rajah 3b(i).

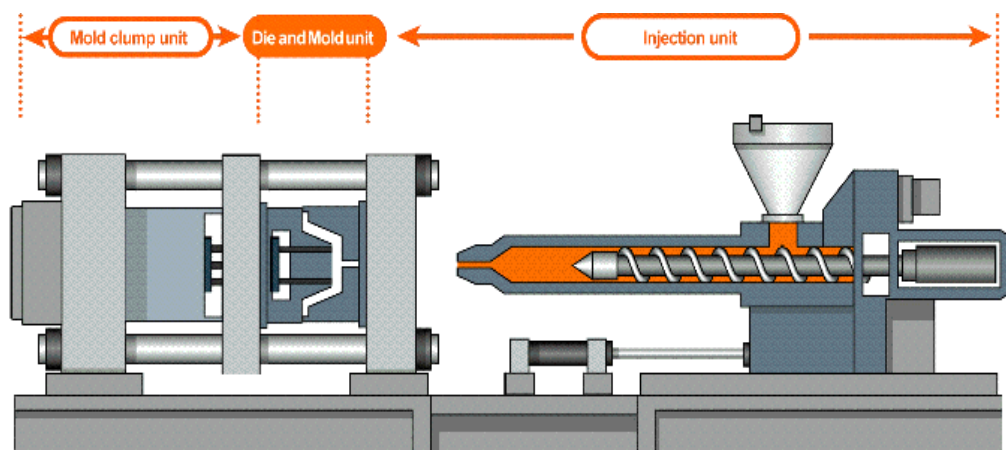


Figure 3b(i): Injection moulding machine

Rajah 3b(ii): Mesin pengacuan suntikan

[3 marks]

[3 markah]

CLO 1

- ii. Figure 3b(ii) shows the defect detected on the final product from the injection moulding process. Examine the defect, **THREE (3)** respective causes and troubleshooting of the problem.

*Rajah 3b(ii) menunjukkan kecacatan yang dikesan pada produk akhir daripada proses pengacuan suntikan. Periksa kecacatan, **TIGA (3)** punca dan penyelesaian masalah bersesuaian bagi kecacatan tersebut.*

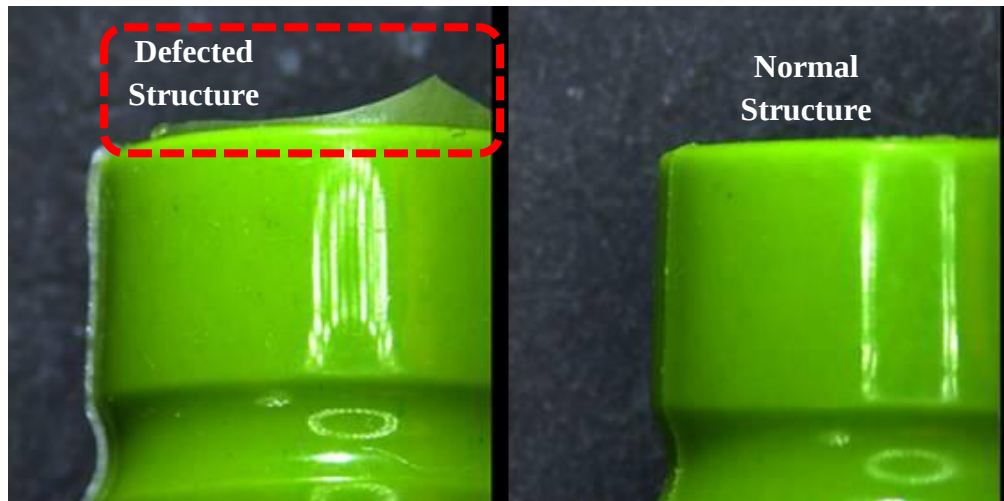


Figure 3b(ii): View of the defect structure

Rajah 3b(ii): Pandangan kecacatan strukturan

[8 marks]

[8 markah]

- (c) Blow moulding is a manufacturing process to create hollow plastic parts and containers, such as bottles and containers.

Pengacuan tamparan adalah proses pembuatan yang digunakan untuk membuat bahagian dan bekas plastik berongga, seperti botol dan bekas.

CLO 1

- i. Interpret **TWO (2)** advantages and disadvantages of the blow moulding process.

*Tafsirkan **DUA (2)** kebaikan dan keburukan proses pengacuan tiupan.*

[4 marks]

[4 markah]

CLO 1

- ii. Injection blow moulding combines elements of both injection moulding and blow moulding. Write the operating mechanism of the injection blow moulding process based on Figure 3c(ii).

Pengacuan pukulan suntikan menggabungkan unsur pengacuan suntikan dan pengacuan pukulan. Tulis mekanisme pengendalian proses pengacuan pukulan suntikan berdasarkan Rajah 3c(ii).

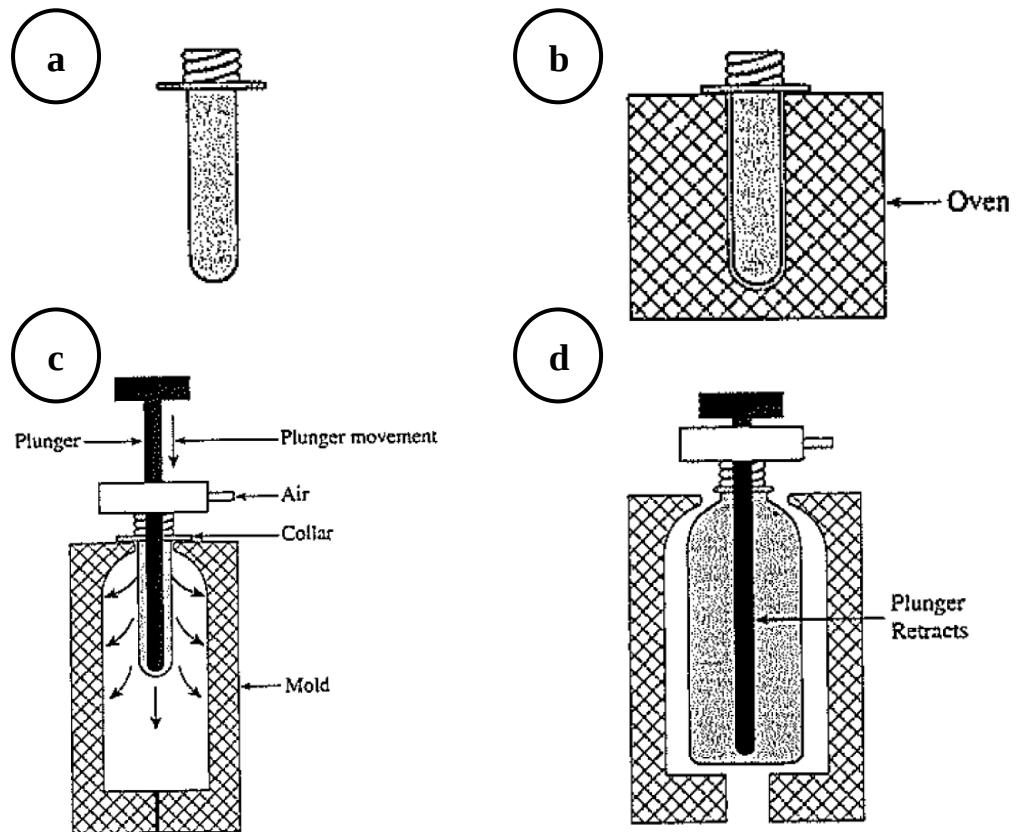


Figure 3c(ii): Injection blow moulding process operating mechanism

Rajah 3c(ii): Mekanisme pengendalian proses pengacuan tamparan suntikan

[8 marks]

[8 markah]

QUESTION 4

SOALAN 4

- CLO 1 (a) A compression moulding machine is used to shape and cure the material of thermosetting plastics under heat and pressure to produce parts. State **TWO (2)** closure types of compression moulding available in the industry.
*Mesin pengacuan mampatan digunakan untuk membentuk dan membentuk bahan plastik termoset di bawah haba dan tekanan menghasilkan bahagian. Nyatakan **DUA (2)** jenis penutupan acuan mampatan yang terdapat dalam industri.*
[2 marks]
[2 markah]
- b) Plunger transfer moulding and pot transfer moulding are two variations of the transfer molding process that are often used for creating parts that have intricate shapes, require tight tolerances and demand specific material properties.
Pengacuan pemindahan pelocok dan pengacuan pemindahan periuk adalah dua variasi proses pengacuan pemindahan yang sering digunakan untuk mencipta bahagian yang mempunyai bentuk yang rumit, memerlukan toleransi yang ketat dan menuntut sifat bahan tertentu.
- CLO 1 i. Explain **THREE (3)** process characteristics of the pot transfer moulding.
*Terangkan **TIGA (3)** ciri proses pengacuan pindah pasu.*
[3 marks]
[3 markah]
- CLO 1 ii. Draw the operating mechanism flow of the plunger transfer moulding process with complete labelling.
Lukiskan aliran mekanisme pengendalian proses pengacuan pemindahan pelocok dengan label yang lengkap.
[8 marks]
[8 markah]

CLO1

- c) You are working as an Assistant Engineer at a company that involves production by using a thermoforming machine. In this manufacturing process, a plastic sheet is heated resulting in a various highly usable product.

Anda bekerja sebagai Pembantu Jurutera di syarikat pengeluaran dengan menggunakan mesin thermoforming, proses pembuatan di mana kepingan plastik dipanaskan untuk menghasilkan pelbagai jenis produk bermutu.

- i. The three general methods of thermoforming process are known as vacuum forming, pressure forming and mechanical forming. Explain the vacuum forming and pressure forming.

Thermoforming boleh dibahagikan kepada tiga kaedah umum yang dikenali sebagai pembentukan vakum, pembentukan tekanan dan pembentukan mekanikal. Terangkan pembentukan vakum dan pembentukan tekanan.

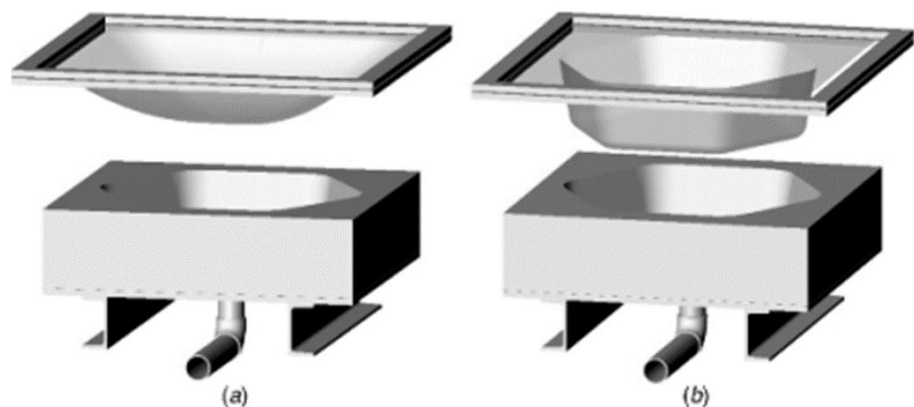
[4 marks]

[4 markah]

CLO1

- ii. To start up the thermoforming machine, as the Assistance Engineer, you need to write the operating flow of Thermoforming using Female Mould Techniques based on Figure 4c(ii).

Bagi memulakan mesin thermoforming, sebagai Penolong Jurutera anda perlu menulis aturan operasi untuk Thermoforming menggunakan Teknik 'Female Mould' berdasarkan Rajah 4c(ii).



[8 marks]

[8 markah]

SOALAN TAMAT