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# UNIVERSITI SAINS MALAYSIA

First Semester Examination  
2014/2015 Academic Session

December 2014 / January 2015

## EBP 200/3 – Polymeric Materials [Bahan Polimer]

Duration : 3 hours  
[Masa : 3 jam]

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Please ensure that this examination paper contains EIGHT printed pages before you begin the examination.

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

This paper consists of SEVEN questions. ONE question in PART A, THREE questions in PART B and THREE questions in PART C.

*[Kertas soalan ini mengandungi TUJUH soalan. SATU soalan di BAHAGIAN A, TIGA soalan di BAHAGIAN B dan TIGA soalan di BAHAGIAN C.]*

**Instruction:** Answer FIVE questions. Answer ALL questions from PART A, TWO questions from PART B and TWO questions from PART C. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.

**[Arahan:** Jawab LIMA soalan. Jawab SEMUA soalan dari BAHAGIAN A, DUA soalan dari BAHAGIAN B dan DUA 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.]*

**PART A / BAHAGIAN A**

1. [a] Explain the following observations:
- (i) Polyvinyl chloride (PVC) requires incorporation of thermal stabilizers and antioxidants but not flame retardants.
  - (ii) Ultra high molecular weight polyethylene (UHMWPE) cannot be processed via conventional processing routes such as injection moulding but normally processed by compression moulding or ram extrusion.

*Terangkan pemerhatian berikut:*

- (i) *Polivinil klorida (PVC) memerlukan penambahan penstabil haba dan antioksidan tetapi tidak memerlukan perencat api.*
- (ii) *Polietilena Berberat Molekul Ultra Tinggi (UHMWPE) tidak boleh diproses menggunakan pemprosesan konvensional seperti acuan suntikan tetapi biasanya diproses menggunakan pengacuan mampatan atau pengekstrudan ram.*

(50 marks/markah)

- [b] Make comparisons of thermoplastic and thermosetting polymers on the basis of
- (i) Possible molecular structure arrangement upon drawing.
  - (ii) Mechanical characteristics upon chosen application.

*Buat perbandingan polimer termoplastik dan termoset berasaskan*

- (i) *Susunan struktur molekul yang mungkin apabila dikenakan terikan.*
- (ii) *Ciri-ciri mekanikal terhadap aplikasi yang dipilih.*

(50 marks/markah)

**PART B / BAHAGIAN B**

2. [a] Vulcanization is one of the important processes in producing natural rubber product.
- (i) With the help of a suitable diagram, explain what is vulcanization process and how does vulcanization change the properties of natural rubber?
  - (ii) What are the differences between an elastomer and a thermoset?

*Pemvulkanan adalah salah satu proses penting dalam menghasilkan produk getah asli.*

- (i) *Dengan bantuan gambarajah yang sesuai, terangkan apakah proses pemvulkanan dan bagaimana pemvulkanan menukar sifat getah asli?*
- (ii) *Apakah perbezaan-perbezaan antara elastomer dan termoset?*

(60 marks/markah)

- [b] There are a number of ways in which polymeric materials may degrade over a period of time. Explain polymer degradation below;
- (i) Photo degradation
  - (ii) Oxidative degradation

*Terdapat pelbagai cara bagaimana bahan polimer boleh terdegradasi dalam jangkamasa tertentu. Jelaskan degradasi polimer di bawah;*

- (i) *Degradasi foto*
- (ii) *Degradasi oksidatif*

(40 marks/markah)

3. [a] Briefly explain the mechanical failures for polymeric materials below and explain how these failures can be described as brittle, ductile or crazing deformation.
- (i) Creep rupture
  - (ii) Impact failure

*Terangkan secara ringkas kegagalan mekanikal untuk bahan polimer di bawah dan terangkan bagaimana kegagalan ini boleh digambarkan sebagai ubah bentuk rapuh, mulur atau keretakan halus.*

- (i) Pecah krip*
- (ii) Kegagalan hentaman*

(40 marks/markah)

- [b] The front and rear bumper beams on a car was made from polypropylene/fiberglass composite. Based on the information given, estimates the longitudinal modulus and transverse modulus these beams assuming a fiberglass (E-glass) composition of 40 wt % (weight percent).

Given:

Modulus of PP = 1380 MPa

Modulus of fiberglass = 72.4 GPa

Density of fiberglass = 2.55 g/cm<sup>3</sup>

Density of PP = 0.905 g/cm<sup>3</sup>

*Rasuk penampian depan dan belakang pada sebuah kereta diperbuat daripada komposit polipropilena/gentian kaca. Berdasarkan maklumat yang diberikan, anggarkan modulus membujur dan modulus melintang rasuk ini dengan mengandaikan gentian kaca (E-kaca) berkomposisi 40 wt% (peratus berat).*

(60 marks/markah)

