UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

EBB 113/3 – Engineering Materials
[Bahan Kejuruteraan]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains THIRTY SEVEN printed pages and ONE page of OBJECTIVE ANSWER PAPER before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi TIGA PULUH TUJUH muka surat yang bercetak dan SATU muka surat KERTAS JAWAPAN OBJEKTIF sebelum anda memulakan peperiksaan ini.]

This paper contains FOURTY objectives questions in PART A, TWO subjective questions in PART B and TWO subjective questions in PART C.
[Kertas soalan ini mengandungi EMPAT PULUH soalan objektif pada BAHAGIAN A, DUA soalan subjektif pada BAHAGIAN B dan DUA soalan subjektif pada BAHAGIAN C.]

Instruction: Answer **ALL** questions in **PART A**, **ONE** question from **PART B** and **ONE** question from **PART C**. For PART B and C, if a candidate answers more than one question (for each part) only the first answer will be examined and awarded marks.
*[**Arahan**: Jawab **SEMUA** soalan pada **BAHAGIAN A**, **SATU** soalan daripada **BAHAGIAN B** dan **SATU** soalan daripada **BAHAGIAN C**. Bagi soalan di BAHAGIAN B dan C, jika calon menjawab lebih daripada satu soalan (bagi setiap bahagian) hanya soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

Answer to any question must start on a new page.
[Mulakan jawapan anda untuk setiap 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.]

...2/-

PART A / BAHAGIAN A

1. Calculate the linear atomic density in the [100] direction in the copper crystal lattice in atoms per millimeter. Copper has an FCC structure with a lattice constant of 0.361 nm.

Kirakan ketumpatan linear atom sepanjang arah [100] di dalam hablur kekisi kuprum per milimeter. Kuprum mempunyai struktur FCC dan pemalar kekisi 0.361 nm

a) 7.84×10^6 atoms/mm
b) 3.92×10^6 atoms/mm
c) 1.96×10^6 atoms/mm
d) 2.94×10^6 atoms/mm

2. The electron configuration of Manganese is _____.

Konfigurasi elektron bagi Manganese ialah _____.

a) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7$
b) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$
c) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^1$
d) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2 4p^1$

3. What is the notation for vector direction in the cubic crystal structure in Figure 1?

Apakah penandaan untuk arah vektor yang ditunjukkan dalam struktur hablur kubik di dalam Rajah 1?

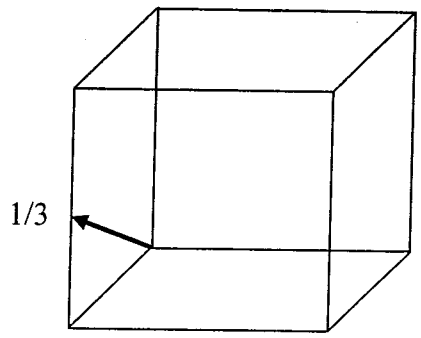


Figure 1 / *Rajah 1*

a) [301]

b) $[0\bar{3}1]$

c) $[\bar{2}0\bar{1}]$

d) $[\bar{3}1\bar{1}]$

4. What is the relationship between lattice constant, a, and atomic radius, R, of a face centered cubic (FCC) cell?

Apakah perhubungan antara pemalar kekisi, a, dan jejari atom, R, bagi satu sel permukaan berpusat jasab (FCC)?

a) $a = 2R\sqrt{2}$

b) $a = 4R\sqrt{3}$

c) $a = 3R\sqrt{2}$

d) $a = 3R\sqrt{3}$

5. Figure 2 below shows the first five peaks of the x-ray diffraction pattern for tungsten, which has a BCC crystal structure; monochromatic x-radiation having a wavelength of 0.1542 nm was used.

Rajah 2 menunjukkan spektrum pembelauan sinar-x bagi tungsten yang mempunyai struktur BCC; sinar-x monokromatik yang mempunyai panjang gelombang 0.1542 nm telah digunakan.

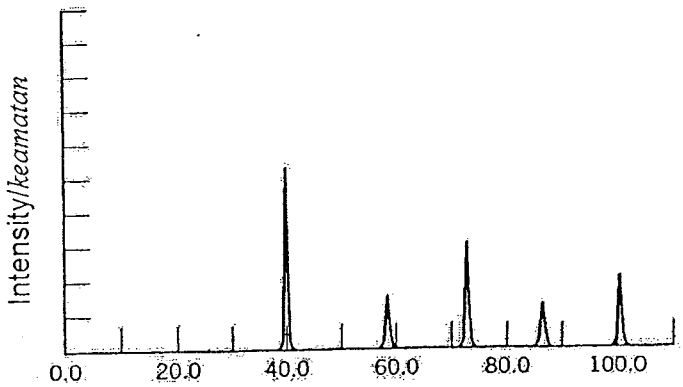


Figure 2/*Rajah 2*

a) (001)

b) (110)

c) (213)

d) (100)

6. Determine the Miller index for the plane shown in Figure 3:

Tentukan indeks Miller bagi satah yang ditunjukkan di dalam Rajah 3:

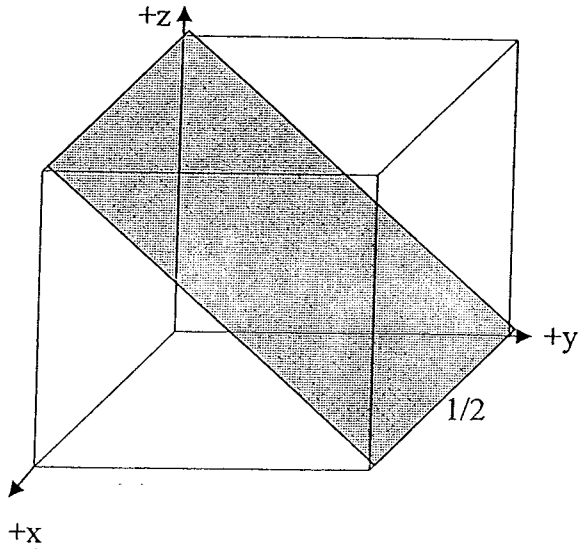


Figure 3/*Rajah 3*

a) $(0\,\bar{1}\,2)$

b) $(1\,\bar{1}\,\bar{1})$

c) $(0\,\bar{1}\,\bar{1})$

d) $(00\,\bar{1})$

7. What are the factors that affect diffusion

i. Pressure

ii. Temperature

iii. Time

iv. Size of diffusing species

Apakah faktor yang mempengaruhi resapan?

i. Tekanan

ii. Suhu

iii. Masa

iv. Saiz spesis yang meresap

a) i & ii

b) ii & iii

c) i, iii & iv

d) ii, iii & iv

8. Calculate the diffusion coefficient of a 5 mm thick iron plate at 700°C if the diffusion flux and the concentration gradient of carbon are given as 2.4×10^{-9} kg/m^2-s and 0.4 kg/m^3 respectively. Assuming a steady state is achieved.

Kirakan pemalar resapan pada 700°C bagi plat besi berketebalan 5mm jika flux resapan dan perbezaan kepekatan karbon masing-masing diberikan sebagai 2.4×10^{-9} kg/m^2-s *dan 0.4* kg/m^3. *Andaikan keadaan mantap dicapai.*

a) -3×10^{-11} m^2/s

b) 4×10^{-11} m^2/s

c) -4×10^{-11} m^2/s

d) 3×10^{-13} m^2/s

...7/-

9. Low density in grain boundaries causes

   i. high mobility

   ii. high diffusivity

   iii. high chemical reactivity

Sempadan butiran yang berketumpatan rendah akan menyebabkan

   i. pergerakan yang tinggi

   ii. resapan yang tinggi

   iii. Tindakbalas kimia yang tinggi

a) i & ii

b) ii & iii

c) i & iii

d) i, ii & iii

10. Among the following, which is not a point defect?

a) Vacancy defect

b) Interstitial defect

c) Dislocation defect

d) Substitutional defect

Antara di bawah, yang mana bukan kecacatan titik?

a) Kecacatan kekosongan

b) Kecacatan celahan

c) Kecacatan dislokasi

d) Kecacatan penggantian

11. Determine the composition, in atom percent, of an alloy that consists of 97 wt% aluminum and 3 wt% copper

Hitungkan komposisi, dalam peratus atom, bagi sesuatu aloi yang mengandungi 97 wt% aluminum dan 3 wt% kuprum

a) C'_{Al} = 97 at%, C'_{Cu} = 3 at%

b) C'_{Al} = 98.7 at%, C'_{Cu} = 1.30 at%

c) C'_{Al} = 3 at%, C'_{Cu} = 97 at%

d) C'_{Al} = 1.3 at%, C'_{Cu} = 98.7 at%

12. What is the definition of solid solution?

a) The formation of nuclei during the solidification of a solution

b) Impurity atoms fill-up the free volume

c) Impurity atoms substitute the host atoms

d) A homogeneous crystalline phase that contains two or more species

Apakah definisi larutan pepejal?

a) Pembentukan nukleus semasa pembekuan larutan

b) Atom asing yang mengisi ruang kosong

c) Atom asing yang menggantikan atom perumah

d) Sesuatu fasa hablur homogen yang mengandungi dua atau lebih spesis

13. Name two atomic **mechanisms** of diffusion

a) Vacancy diffusion and interstitial diffusion
b) Steady state and non-steady state diffusion
c) Primary and secondary diffusion
d) Self-diffusion and interdiffusion

Namakan dua mekanisme resapan atom

a) Resapan kekosongan dan resapan celahan
b) Resapan keadaan mantap dan tidak mantap
c) Resapan utama dan sekunder
d) Resapan sendirian dan resapan sesama

14. From the tensile test, all data below can be obtained, **except**:

a) Tensile strength
b) Ductility
c) Hardness
d) Reduction in area

Berpandukan ujian tegangan, semua data berikut boleh diperolehi, ***kecuali****:*

a) Kekuatan tegangan
b) Kemuluran
c) Kekerasan
d) Pengurangan luas permukaan

15. The cross section area of specimen, *A* will increase in ....., due to the load that squeezes the ends of a specimen between two platens.

a) Tensile Test
b) Compression Test
c) Bending Test
d) Hardness Test

Luas keratan rentas spesimen, A akan bertambah dalam ....., disebabkan oleh beban kenaan yang akan menekan hujung spesimen di antara dua plat.

a) Ujian Tegangan
b) Ujian Mampatan
c) Ujian Lentur
d) Ujian Kekerasan

16. The hardness of the materials can be measured by these methods, **except**:

a) Rockwell
b) Charpy
c) Brinell
d) Vickers

Kekerasan bahan boleh diuji dengan kaedah berikut, ***kecuali****:*

a) Rockwell
b) Charpy
c) Brinell
d) Vickers

17. A 2.60 mm diameter rod is subjected to a load of 450 kg. Calculate the engineering stress.

Sebatang rod yang mempunyai diameter 2.60 mm dikenakan beban sebanyak 450 kg. Kirakan tegasan kejuruteraan.

a) 84.75 MPa
b) 831 MPa
c) 604 MPa
d) 207 MPa

Question 18 and 19 are based on Figure 4
Soalan 18 dan 19 adalah berpandukan Rajah 4

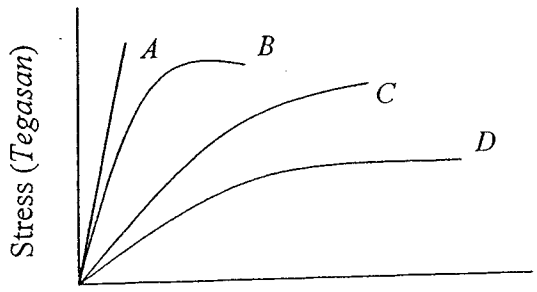


Figure 4 / *Rajah 4*

18. In Figure 4, which material shows the highest ductility amongst the four materials?

Antara bahan-bahan yang ditunjukkan dalam Rajah 4, bahan yang manakah menunjukkan kemuluran yang paling tinggi?

a) A
b) B
c) C
d) D

19. Which material is the most brittle?

Bahan yang manakah yang paling rapuh?

a) A
b) B
c) C
d) D

20. From the interpretation of a phase diagrams, all the information below can be obtained, **except**:

a) Type of phase that are present
b) The composition of these phases
c) The duration for phases changes
d) The percentage or weight fractions of the phases

Tafsiran data daripada gambarajah fasa akan memberi semua maklumat berikut, ***kecuali****:*

a) Jenis fasa yang hadir
b) Komposisi fasa
c) Tempoh perubahan fasa
d) Peratusan atau pecahan berat bagi setiap fasa

21. If you were to design an artificial hip joint what material would you choose?

a) Al-alloy coated with Silica
b) High carbon steel
c) Titanium alloy
d) Polyethylene

Jika anda ingin merekabentuk bahagian pinggul buatan, apakah bahan yang anda pilih?

a) Aluminium yang disalut silika
b) Keluli karbon tinggi
c) Aloi titanium
d) Polietilin

22. What is the process as shown in Figure 5 below?

a) Forging
b) Rolling
c) Drawing
d) Extrusion

Apakah proses yang ditunjukkan di dalam Rajah 5 di bawah?

a) *Penempaan*
b) *Penggulingan*
c) *Penarikan*
d) *Penerobosan*

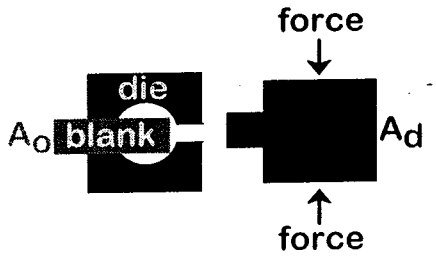


Figure 5 / *Rajah 5*

23. Normalisation is used to

a) Refine steel grains
b) Produce austenitic steel
c) Temper martensitic steel
d) Perform precipitation hardening

Penormalan digunakan untuk

a) Mengecilkan butiran keluli
b) Menghasilkan keluli austenitik
c) Membaja keluli martensitik
d) Melakukan pengerasan mendakan

24. What is the parameter used to describe the extent of electrons scattering in a semiconductor?

a) Velocity
b) Conductivity
c) Doping
d) Mobility

Apakah parameter yang digunakan untuk menerangkan berkenaan dengan kadar serakan elektron di dalam semikonduktor?

a) Kelajuan
b) Kekonduksian
c) Pendopan
d) Kelincahan

25. If a material has a strong covalent interatomic bonding then the material can be thought to have

a) Very high electrical conductivity
b) Very low electrical conductivity
c) Free electrons
d) Energy gap <1eV

Jika satu bahan mempunyai ikatan kovalen yang kuat, maka bahan itu akan mempunyai

a) Kekonduksian elektrik yang sangat tinggi
b) Kekonduksian elektrik yang sangat rendah
c) Elektron bebas
d) Jurang tenaga < 1eV

26. What are the imperfections shown in Figure 6?

Apakah kecacatan yang ditunjukkan di dalam Rajah 6

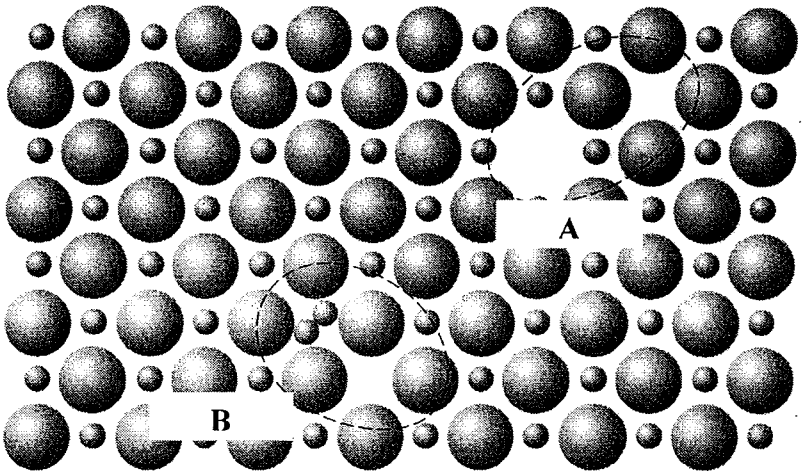


Figure 6 / *Rajah 6*

a) A-Schottky defect, B-Frenkel defect

b) A-Frenkel defect, B-Schottky defect

c) A-interstitial defect, B-Frenkel defect

d) A-substitutional defect, B-Schottky defect

a) A-kecacatan Schottky, B-kecacatan Frenkel

b) A- kecacatan Frenkel, B-kecacatan Schottky

c) A-kecacatan celahan, B-kecacatan Frenkel

d) A-kecacatan gantian, B-kecacatan Schottky

27. Various type of silicate structure can be formed by the sharing of oxygen and and silicon ions. Which type of silicate structure has a repeating unit as shown in Figure 7?

Pelbagai jenis struktur silikat boleh terbentuk dengan perkongsian antara ion oksigen dan silikon. Jenis struktur silikat yang manakah yang mempunyai unit berulang seperti yang ditunjukkan dalam Rajah 7?

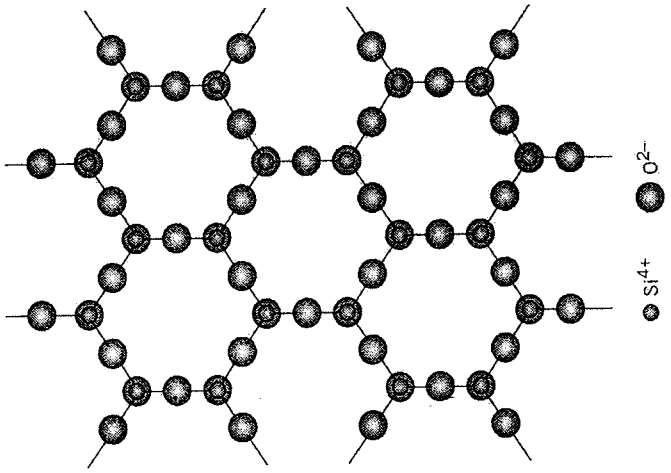


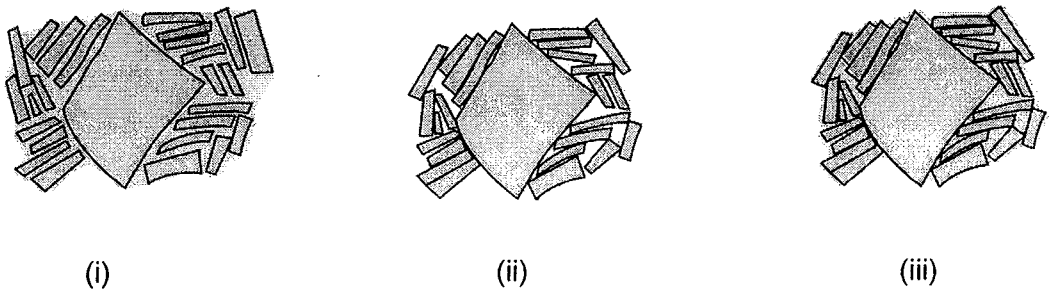
Figure 7 / *Rajah 7*

a) Simple silicate
b) Layered silicate
c) Amorphous silicate
d) Vitreous silicate

a) Silikat tunggal
b) Silikat berlapis
c) Silikat amorfus
d) Silikat berkaca

28. There are several stages in the removal of water from clay particles during the drying process. Arrange the sequence of Figure 8 in right order for drying process of clay particles.

Terdapat beberapa peringkat penyingkiran air daripada partikel tanah liat semasa proses pengeringan. Susunkan turutan dalam Rajah 8 dengan betul bagi proses pengeringan partikel tanah liat tersebut.



(i) (ii) (iii)

Figure 8 / *Rajah 8*

a) (i)→(ii) →(iii)

b) (ii)→(iii) →(i)

c) (iii)→(ii) →(i)

d) (i)→(iii) →(ii)

29. Which is the following is not a common ceramic processing technique

a) Hydroplastic forming
b) Tape casting
c) Forging
d) Powder pressing

Yang manakah antara berikut bukan teknik umum bagi pemprosesan seramik

a) Pembentukan hidro-plastik
b) Penuangan pita
c) Tempaan
d) Penekanan serbuk

30. Which of the following is not glass forming process

a) Pressing
b) Hydroplastic forming
c) Blowing
d) Drawing

Yang manakah antara berikut bukan proses pembentukan

a) Penękanan
b) Pembentukan hidroplastik
c) Peniupan
d) Penarikan

31. Following are phenomena observed during sintering except for

a) Particle bonding
b) Pore addition
c) Neck formation and growth
d) Grain boundary formation

Berikut adalah fenomena yang diperhatikan semasa pensinteran kecuali

a) Pengikatan partikel
b) Peningkatan liang
c) Pembentukan dan pertumbuhan leher
d) Pembentukan sempadan butir

32. Which of the following materials have perovskite crystal structure

Yang manakah di antara bahan berikut mempunyai struktur hablur perovskite

a) CsCl
b) Al_2O_3
c) FeO
d) $BaTiO_3$

33. Which of the following is (are) composite(s)?

a) Concrete
b) Wood
c) Bone
d) All of the above

Manakah di antara berikut adalah komposit?

a) Konkrit
b) Kayu
c) Tulang
d) Semua di atas

34. As particle content is increased, how does the strength of a particle-reinforced composite change?

a) Strength increases
b) Strength decreases
c) Strength unaffected
d) Strength, decreases and then increases

Apabila kandungan partikel bertambah, bagaimana kekuatan komposit diperkuat partikel berubah?

a) Kekuatan bertambah
b) Kekuatan berkurang
c) Kekuatan tidak berubah
d) Kekuatan berkurang dan kemudian bertambah

35. How are *continuous* fibers typically oriented in fibrous composites?

a) Aligned
b) Partially oriented
c) Randomly oriented
d) All of the above

Secara tipikal, bagaimana corak gentian selanjar tersusun di dalam komposit gentian?

a) Selari
b) Separa selari
c) Rawak
d) Semua di atas

36. Carbon fiber-reinforced composites have which of the following properties

a) Relatively high strengths
b) Relatively high stiffnesses
c) High service temperatures (> 200°C)
d) All of the above

Komposit diperkuat gentian karbon mempunyai sifat-sifat berikut

a) Kekuatan tinggi
b) Kekakuan tinggi
c) Suhu gunapakai tinggi (> 200°C)
d) Semua di atas

Questions 37-38 are based on the following information:

Soalan 37-38 adalah berdasarkan kepada maklumat-maklumat berikut:

The mechanical properties of a metal may be improved by incorporating fine particles of its oxide. Given that the moduli of elasticity of the metal and oxide are, respectively, 60 GPa and 380 GPa. Calculate:

Sifat mekanikal logam boleh ditingkatkan dengan penambahan partikel oksida logam. Diberi nilai-nilai modulus terikan untuk logam dan oksida adalah 60GPa dan 380 GPa. Kirakan:

37. What is the upper-bound modulus of elasticity value (in GPa) for a composite that has a composition of 33 vol% of oxide particles.

Berapakah nilai modulus terikan (sempadan atas) untuk komposit yang mengandungi 33% isipadu partikel oksida.

a) 166 GPa
b) 83.1 GPa
c) 200 GPa
d) 102.5 GPa

38. What is the lower-bound modulus of elasticity value (in GPa) for a composite that has a composition of 33 vol% of oxide particles.

Berapakah nilai modulus terikan (sempadan bawah) untuk komposit yang mengandungi 33% isipadu partikel oksida.

a) 166 GPa
b) 83.1 GPa
c) 200 GPa
d) 102.5 GPa

...25/-

39. Glass transition temperature (T_g) depends on the following factors EXCEPT:

a) Bulky side group
b) Polar group
c) Double bond and aromatic group
d) Single bond and aliphatic group

Suhu peralihan kaca (T_g) bergantung kepada faktor-faktor berikut KECUALI:

a) Kumpulan sisi yang besar
b) Kumpulan terkutub
c) Dwi-ikatan dan kumpulan aromatik
d) Ikatan tunggal dan kumpulan alifatik

40. What is the by product of condensation polymerization

a) Acid
b) Water
c) Carbon dioxide
d) Hydrogen

Apakah bahan sampingan daripada pempolimeran kondensasi

a) Asid
b) Air
c) Karbon dioksida
d) Hidrogen

(40 marks/*markah*)

PART B / *BAHAGIAN B*

1. [a] (i) Briefly cite the main differences among ionic, covalent, and metallic bonding.

Senaraikan secara ringkas perbezaan antara perikatan ionik, kovalen, dan logam.

(6 marks/*markah*)

(ii) State the Pauli exclusion principle.

Nyatakan prinsip "Pauli exclusion".

(4 marks/*markah*)

[b] (i) Compute the number of kilograms of hydrogen per hour that passes through a 6-mm-thick sheet of palladium having an area of 0.25 m^2 at 600 °C. Assume a diffusion coefficient of 1.7 x 10^{-8} m^2/s, the concentration at the high-low-pressure sides of the plate are 2.0 and 0.4 kg of hydrogen per cubic meter of palladium and a **steady-state** condition have been attained.

Hitungkan pada suhu 600°C, berapa kilogram (dalam masa sejam) hidrogen yang melalui plat palladium berketebalan 6 mm yang mempunyai keluasan 0.25 m^2. Andaikan pemalar resapan adalah 1.7 x 10^{-8} m^2/s, kepekatan hidrogen adalah 2.0 dan 0.4 kg/m^3, dan syarat steady-state dipenuhi.

(6 marks/*markah*)

...27/-

(ii) Cites 2 reasons why interstitial diffusion is normally more rapid than vacancy diffusion.

Nyatakan 2 sebab mengapa resapan celahan lebih pantas daripada resapan kekosongan.

(4 marks/*markah*)

[c] The following engineering stress-strain data were obtained for alloy of 0.2% C plain-carbon steel.

(i) Plot the engineering stress-strain curve

(ii) Calculate the modulus of elasticity

(iii) Determine the yield strength at a strain offset of 0.002

(iv) Determine the tensile strength of this alloy

(v) Determine the approximate ductility, in percent elongation?

Data tegasan-terikan kejuruteraan berikut diperolehi bagi keluli plain-karbon 0.2% C.

(i) Lakarkan kurva tegasan-terikan kejuruteraan bagi data-data ini

(ii) Kirakan modulus keelastikan bagi keluli ini

(iii) Tentukan tegasan alah menggunakan 0.002 ofset bagi keluli ini

(iv) Tentukan kekuatan tegangan keluli ini

(v) *Tentukan kemuluran paling hampir, dalam peratus pemanjangan?*

Figure 9: Data stress/strain curve engineering for plain carbon steelof 0.2% C
Jadual 9: Data tegasan-terikan kejuruteraan bagi keluli plain-karbon 0.2% C

Stress/*Tegasan Kejuruteraan* (Mpa)	Strain/*Terikan Kejuruteraan* (mm/mm)
0	0
135	0.001
245	0.002
267	0.005
303	0.01
320	0.02
329	0.04
334	0.06
338	0.08
334	0.1
325	0.12
307	0.14
290	0.16
250	0.18
228	0.19 (Fracture/*patah*)

(10 marks/*markah*)

2. [a] Density of potassium, which has BCC structure and one atom per lattice point, is 0.855 g/cm^3. The atomic weight of potassium is 39.09 g/mol. Calculate:

Ketumpatan potassium, yang mempunyai struktur BCC dan satu atom per titik kekisi, ialah 0.855 g/cm^3. Berat atomik potassium ialah 39.09 g/mol. Kirakan:

(i) the lattice parameter and
pemalar kekisi dan

(5 marks/*markah*)

(ii) the atomic radius of potassium.
jejari atomik potassium

(5 marks/*markah*)

[b] (i) Calculate the number of vacancies per cubic meter in gold at 900°C. The energy for vacancy formation is 0.98 eV/atom. The density and atomic weight for Au are 18.63 g/cm^3 (at 900 °C) and 196.9 g/mol, respectively. (Boltzman constant = 8.62 × 10^{-5} eV/atom−K).

Kirakan bilangan kekosongan per kubik meter dalam emas at 900 °C. Tenaga untuk pembentukan kekosongan adalah 0.98 eV/atom. Ketumpatan dan berat atom bagi Au adalah 18.63 g/cm^3 (pada 900 °C) dan 196.9 g/mol masing-masing. (Pemalar Boltzman = 8.62 x 10^{-5} eV/atom-K).

(6 marks/*markah*)

(ii) Describe both vacancy and self-interstitial crystalline defects.
Huraikan kecacatan hablur kekosongan dan celahan-sendirian

(4 marks/*markah*)

...30/-

[c]

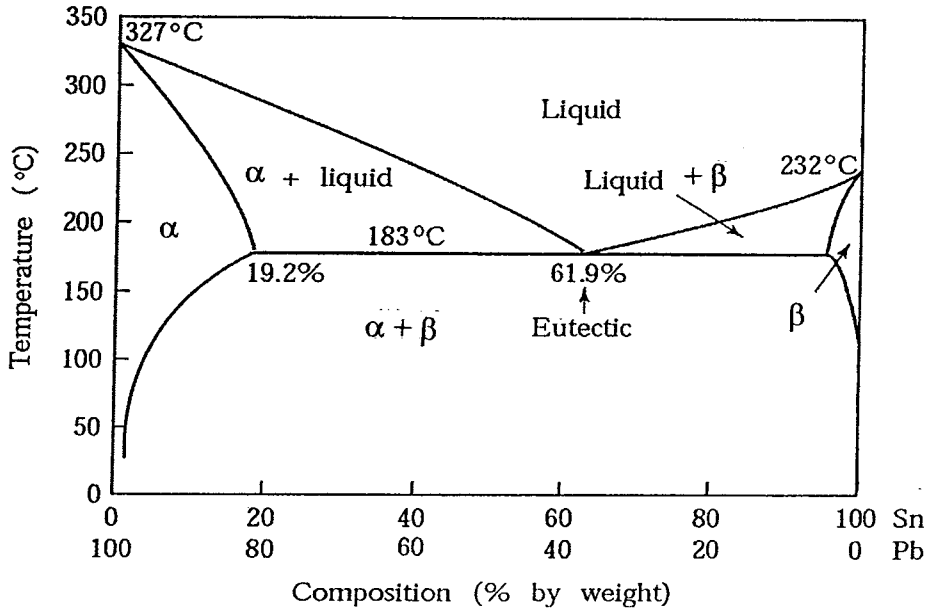


Figure 10: Pb - Sn phase diagram
Rajah 10: Gambarajah fasa Pb - Sn

Consider the binary eutectic copper silver phase diagram in Figure 2. Analyse the phases of the 30 wt % Sn – 70 wt % Pb alloy at:

(i) 300 °C

(ii) 230 °C

(iii) 183 °C + ΔT

(iv) 183 °C - ΔT

In the phase analysis, include:

(i) The phases present

(ii) The chemical compositions of the phases

(iii) The amount of each phases

(iv) Sketch the microstructure

Pertimbangkan gambarajah fasa sistem binari eutektik Pb – Sn dalam Rajah 2 berikut Lakukan analisis fasa pada aloi berkomposisi 30 wt % Sn – 70 wt % Pb pada:

(i) $300\,^{o}C$

(ii) $230\,^{o}C$

(iii) $183\,^{o}C + \Delta T$

(iv) $183\,^{o}C - \Delta T$

Dalam analisis tersebut, kenalpasti parameter-parameter berikut:

(i) *Fasa-fasa yang hadir*

(ii) *Komposisi kimia fasa-fasa tersebut*

(iii) *Jumlah setiap fasa*

(iv) *Lakarkan mikrostruktur fasa-fasa tersebut*

(10 marks/*markah*)

PART C / *BAHAGIAN C*

3. [a] (i) If you were to design an engine block for automotive industry what material would you choose? Describe a fabrication method to produce the engine block.

Jika anda ingin merekabentuk blok enjin untuk industri automotif, apakah bahan yang anda akan pilih? Terangkan satu kaedah fabrikasi untuk pengeluaran blok enjin tersebut.

(4 marks/*markah*)

(ii) In designing a pipe to carry effluent, what general factors should you consider to minimize chances of corrosion?

Di dalam merekabentuk paip untuk membawa bahan kumbahan, apakah faktor-faktor umum yang perlu anda perhatikan untuk meminimakan kakisan?

(3 marks/*markah*)

(iii) Comment on the conductivity of silicon at 700K. What would happen to the conductivity if silicon is doped with antimony?

Berikan komen berkenaan dengan kekonduksian silikon pada suhu 700K. Apakah akan berlaku kepada kekonduksian silikon jika didop dengan antimoni?

(3 marks/*markah*)

[b] (i) Explain briefly why the tendency of a polymer to crystallise decreases with increasing molecular weight.

Terangkan secara ringkas kenapa keupayaan polimer untuk menghablur berkurang dengan pertambahan berat molekul.

(5 marks/*markah*)

(ii) The density of totally crystalline nylon 6,6 at room temperature is 1.213 g/cm^3. At room temperature the unit cell for this material is triclinic with lattice parameters:

a = 0.497 nm α = 48.4°

b = 0.547 nm β = 76.6°

c = 1.729 nm γ = 62.5°

Ketumpatan nilon 6,6 pada suhu bilik ialah 1.213 g/cm^3. Pada suhu bilik, sel unit bagi bahan ini adalah triklinik dengan parameter kekisi:

a = 0.497 nm α = 48.4°

b = 0.547 nm β = 76.6°

c = 1.729 nm γ = 62.5°

If the volume of a triclinic unit cell, V_{tri}, is a function of these lattice parameters as:

$$V_{tri} = abc\sqrt{1-\cos^2\alpha-\cos^2\chi-\cos^2\gamma+2\cos\alpha\cos\beta\cos\gamma}$$

Sekiranya isipadu bagi unit sel triklinik, V_{tri}, berkadar dengan parameter-parameter "kekisi" seperti:

$$V_{tri} = abc\sqrt{1-\cos^2\alpha-\cos^2\chi-\cos^2\gamma+2\cos\alpha\cos\beta\cos\gamma}$$

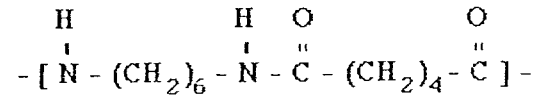
...34/-

Determine the number of repeat units per unit cell

Kirakan jumlah unit ulang bagi setiap sel

(Repeat unit for nylon 6,6)

(*Unit ulang bagi nilon 6,6)*



C=12, H=1, N=14, O=16

(5 marks/*markah*)

[c] (i) Show the minimum cation to anion radius ratio for a coordination number of 6 is 0.414.

Tunjukkan bahawa nisbah jejari minimum kation kepada anion untuk nombor koordinasi 6 ialah 0.414.

(5 marks/*markah*)

(ii) Draw a flow chart to illustrate the float glass forming process.

Lukiskan carta alir untuk menunjukkan proses pembuatan kaca terapung.

(5 marks/*markah*)

4. [a] (i) Define cast iron. State the best casting technique to produce garden furniture made from cast iron, explain your answer.

Takrifkan besi tuang. Nyatakan kaedah tuangan terbaik untuk menghasilkan perabot taman yang dibuat dari besi tuang, terangkan jawapan anda.

(3 marks/*markah*)

(ii) Explain how erosion corrosion occurs in a pipe carrying corrosive gas. State two ways in preventing this corrosion from happening.

Terangkan bagaimana kakisan berlaku di dalam paip yang membawa gas menghakis. Nyatakan dua kaedah untuk menghalang kakisan ini daripada berlaku.

(3 marks/*markah*)

(iii) What is the origin of conductivity of p-type semiconductor? Sketch an energy band diagram to support your answer.

Apakah asalan kekonduksian semikonduktor jenis-p? Lakarkan gambarajah jalur tenaga untuk membantu jawapan anda.

(4 marks/*markah*)

[b] (i) For a polymer matrix fibre reinforced composites:

- List three functions of the matrix phase.
- Compare the desired mechanical characteristics of matrix and fibre phases.
- Cite two reasons why there must be a strong bond between fibre and matrix at their interface.

Bagi polimer matriks komposit terkuat gentian:

- *Senaraikan tiga fungsi fasa matrik.*
- *Bandingkan keperluan mekanikal bagi fasa matrik dan gentian.*
- *Nyatakan dua alasan kenapa ikatan bagi gentian dan matrik perlu kuat.*

(6 marks/*markah*)

(ii) The tensile strength and number-average molecular weight for two polyethylene materials are as follows:

Kekuatan tensil dan berat molekul bagi dua polietilena adalah seperti berikut:

Tensile strength / *Kekuatan tensil* (MPa)	Number-average molecular weight *Berat molekul purata-nombor* (g/mol)
90	20,000
180	40,000

Estimate the number-average that is required to give a tensile strength of 140 MPa.

Anggarkan berat molekul purata berat yang diperlukan untuk menghasilkan 140 MPa kekuatan tensil.

(4 marks/*markah*)

[c] (i) From a molecular prespective, briefly explain the mechanism by which clay minerals become hydroplastic when water is added.

Dari sudut molekul, terangkan secara ringkas mekanisma di mana mineral tanah liat mempunyai sifat hidroplastik apabila ditambah air.

(5 marks/*markah*)

(ii) Cite three properties of diamond and their application.

Berikan tiga sifat-sifat intan dan penggunaannya.

(5 marks/*markah*)

UNIVERSITI SAINS MALAYSIA
PEPERIKSAAN SEMESTER I, SIDANG AKADEMIK 2008/2009

EBB 113/3 – Bahan Kejuruteraan

Angka Giliran : _____

Angka Giliran Dalam Perkataan : _____

KERTAS JAWAPAN BAHAGIAN A
Kepilkan Kertas Jawapan ini bersama skrip jawapan anda.

1.	=A=	=B=	=C=	=D=		21.	=A=	=B=	=C=	=D=
2.	=A=	=B=	=C=	=D=		22.	=A=	=B=	=C=	=D=
3.	=A=	=B=	=C=	=D=		23.	=A=	=B=	=C=	=D=
4.	=A=	=B=	=C=	=D=		24.	=A=	=B=	=C=	=D=
5.	=A=	=B=	=C=	=D=		25.	=A=	=B=	=C=	=D=
6.	=A=	=B=	=C=	=D=		26.	=A=	=B=	=C=	=D=
7.	=A=	=B=	=C=	=D=		27.	=A=	=B=	=C=	=D=
8.	=A=	=B=	=C=	=D=		28.	=A=	=B=	=C=	=D=
9.	=A=	=B=	=C=	=D=		29.	=A=	=B=	=C=	=D=
10.	=A=	=B=	=C=	=D=		30.	=A=	=B=	=C=	=D=
11.	=A=	=B=	=C=	=D=		31.	=A=	=B=	=C=	=D=
12.	=A=	=B=	=C=	=D=		32.	=A=	=B=	=C=	=D=
13.	=A=	=B=	=C=	=D=		33.	=A=	=B=	=C=	=D=
14.	=A=	=B=	=C=	=D=		34.	=A=	=B=	=C=	=D=
15.	=A=	=B=	=C=	=D=		35.	=A=	=B=	=C=	=D=
16.	=A=	=B=	=C=	=D=		36.	=A=	=B=	=C=	=D=
17.	=A=	=B=	=C=	=D=		37.	=A=	=B=	=C=	=D=
18.	=A=	=B=	=C=	=D=		38.	=A=	=B=	=C=	=D=
19.	=A=	=B=	=C=	=D=		39.	=A=	=B=	=C=	=D=
20.	=A=	=B=	=C=	=D=		40.	=A=	=B=	=C=	=D=