
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2008/2009

April/Mei 2009

EBS 242/3 - Petrography & Ore Microscopy **[Petrografi & Mikroskopi Bijih]**

Duration : 3 hours
[Masa : 3 jam]

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

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

This paper contains SEVEN questions. TWO questions in PART A and FIVE questions in PART B.

[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A dan LIMA soalan di BAHAGIAN B.]

Instructions: Answer **FIVE** questions. Answer **ALL** questions from PART A and **THREE** questions from PART B. If a candidate answers more than five questions only the first five questions in the answer sheet will be graded.

[Arahan: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A dan **TIGA** soalan dari BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima 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.]

PART A**BAHAGIAN A**

Answer all the following questions.

Jawab semua soalan berikut.

1. Please define or describe the following:
 - (a) Phaneritic and Porphyritic (igneous rock)
 - (b) Erosion and Lithification (sedimentary rock)
 - (c) Metamorphic facies (metamorphic rock)
 - (d) Bireflectance and Pleochroism (ore microscopy)
 - (e) Relief and Becke Lines (optical mineralogy)

Takrif atau terangkan mengenai perkara-perkara berikut

- (a) *fanerit dan porfiritik (Batuan igneous)*
- (b) *hakisan dan pematuan (batuan sedimen)*
- (c) *Metamorf fasis (Batuan metamorf)*
- (d) *Dwibalikan dan Pleokroisma (Mikroskopi bijih)*
- (e) *Jasad timbul dan garis Becke (Mikroskopi bijih)*

(20 marks/markah)

2. Given Figure 1(a) and (b) shows the classification charts or diagrams of the two common rock classes or categories (Rock A and Rock B) in the earth crust. Discuss and elaborate about their classification schemes.

Carta atau gambarajah 1(a) dan (b) yang diberikan menunjukkan skema pengelasan dua kategori utama Batuan pembentukan kerak bumi (Batuan A dan Batuan B). Bincang dan perjelaskan skema-skema pengelasan ini.

(a) Rock A

Batuan A

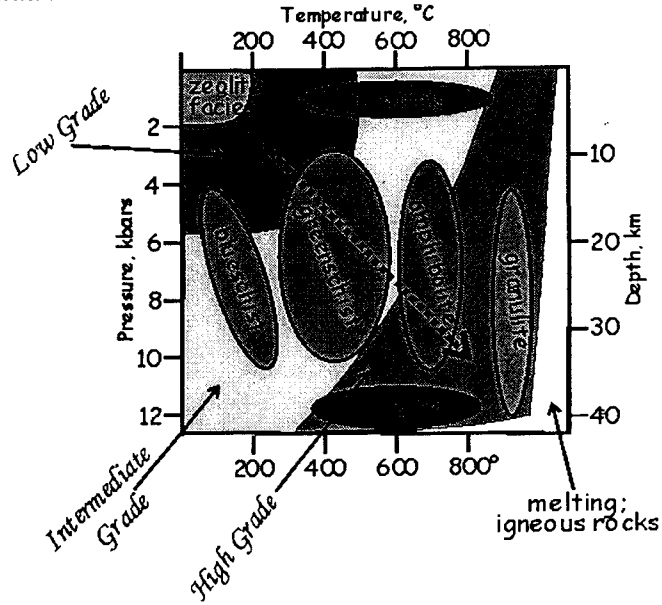


Figure 1(a)
Rajah 1(a)

(b) Rock B

Batuan B

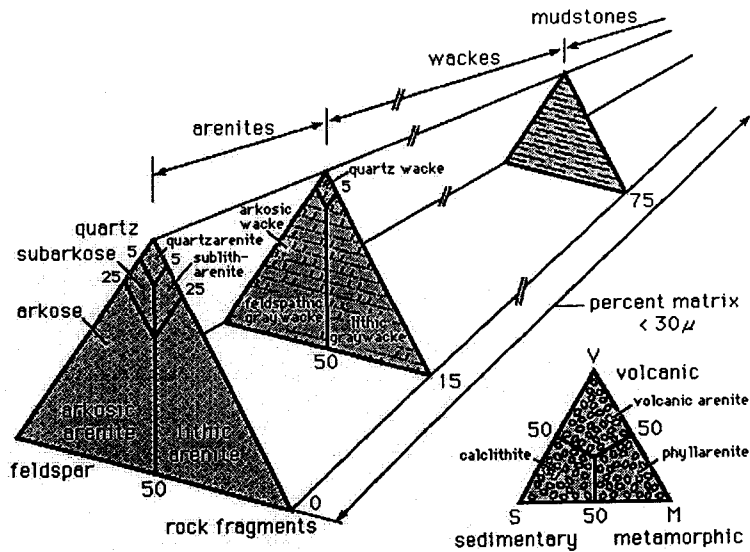


Figure 1(b)

Rajah 1(b)

(20 marks/markah)

...4/-

PART B**BAHAGIAN B**

Please answer any three (3) of the following questions in this section.

Sila jawab mana-mana tiga (3) soalan berikut.

3. Answer the following question:

- (a) Based on the QAPF classification system, determine the class/type and the name of these igneous rocks according to their respective composition and textures as given in the following Table A.

Table A

Features	Igneous A	Igneous B	Igneous C
Composition	Q: > 23% AP: < 9% Plg: > 66% Acc: Muscovite (< 2%)	Q: 45% AP: 40% Plg: 10% Acc: Biotite	Q: 6% AP: < 24% Plg: > 65% Acc: Olivine (> 5%)
Texture	Medium to coarse grained	Coarse grained	Aphanetic
Distinguished features	Granular	Euhedral, pink feldspar phenocryst, Porphyritic	Lava flow Mafic Plagioclase lath

Notes: Q: Quartz; AP: Alkali feldspar; Plg: Plagioclase and Acc: Accessory mineral.

- (b) State and describe the optical properties between the following minerals:
- (i) Quartz and biotite (transparent minerals)
 - (ii) Covellite and pyrite (opaque minerals)
 - (iii) Calcite and gold

Jawab soalan-soalan berikut:

- (a) Berdasarkan kepada sistem pengelasan QAPF, tentukan kelas/jenis serta nama batuan-batuan igneus yang mempunyai tekstur dan komposisi seperti berikut sebagaimana diberikan dalam Jadual A.

JADUAL A

<i>Fetor</i>	<i>Igneus A</i>	<i>Igneus B</i>	<i>Igneus C</i>
Komposisi	Q: > 23% AP: < 9% Plg: > 66% Acc: Muscovit (< 2%)	Q: 45% AP: 40% Plg: 10% Acc: Biotit	Q: 6% AP: < 24% Plg: > 65% Acc: Olivin (> 5%)
Tekstur	Berbutir sederhana hingga kasar	Berbutir kasar	Afanetik
Fetor-fetor unggul	Berbutir	Fenokris Feldspar berwarna merah jambu Porfiritik	Aliran lava Mafik Bilah-bilah plagioklas

Nota: Q: Kuarza; AP: Alkali felspar; Plg: Plagioklas and Acc: Mineral aksesori

- (b) Nyata dan terangkan mengenai sifat-sifat optik di antara kedua pasangan-pasangan mineral berikut:

- (i) Kuarza dan biotit (mineral lutsinar)
- (ii) Kovelit dan pirit (mineral legap)
- (iii) Kalsit dan emas

(20 marks/markah)

4. Please answer any two (2) of the following questions:

- (a) Genetically, sedimentary rocks are classified into a few main classes or categories. Please state and describe these classes with appropriate (rock types) examples.
- (b) Write down the recommended procedures for the preparation of "polished section" samples for ore microscopy analyses.
- (c) The anisotropy shown by non-cubic crystals in their physical properties can also be shown by their absorption – this phenomenon is called pleochroism and is a useful distinguishing property. Define and how such property is determined under polarizing microscope?

Sila jawab mana-mana dua (2) soalan berikut:

- (a) *Secara genetik, batuan sedimen telah dikelaskan kepada beberapa kategori utama. Sila nyatakan dan terangkan kelas-kelas ini beserta dengan contoh-contoh bersesuaian.*
- (b) *Tuliskan tatacara yang lazim disyorkan dalam penyediaan spesimen "keratan bergilap" untuk analisis mikroskopi bijih.*
- (c) *Ketakisotropian yang ditunjukkan oleh hablur-hablur mineral bukan kubus dalam sifat fiziknya juga boleh ditunjukkan oleh keboleherapannya – fenomena ini dipanggil "pleokroisma" dan merupakan sifat pengecaman penting. Takrifkan dan bagaimana sifat ini ditentukan di bawah mikroskop pengutub?*

(20 marks/markah)

5. Please answer any two (2) of the following questions:
- (a) Please state and describe types of metamorphisms. What kind of process is responsible during those metamorphism processes with appropriate (rock types) examples.
 - (b) What determines the retardation of mineral crystal and its governing factors? Please determine the birefringence of mineral augite with R.I. values for $n_s = 1.724$ and $n_f = 1.700$ respectively for standard thin section.
 - (c) Briefly define or describe the following:
 - (i) Porphyritic and Aphanitic textures (igneous rock)
 - (ii) Metasomatism and neomineralization

Sila jawab mana-mana dua (2) soalan berikut:

- (a) *Sila nyatakan dan terangkan jenis-jenis metamorf. Apakah proses yang terlibat semasa metamorf tersebut, beserta dengan contoh-contoh batuan yang bersesuaian.*
- (b) *Apakah yang menentukan nilai pembantutan hablur mineral dan faktor kebergantungannya? Sila tentukan nilai dwibalikan mineral augit yang mempunyai I.B. masing-masing $n_s = 1.724$ dan $n_f = 1.700$ untuk keratan nipis piawai.*
- (c) *Secara ringkas berikan tarifan atau keterangan mengenai perkara berikut:*
 - (i) *Tekstur porforitik dan Aphanitik*
 - (ii) *Metasomatisma dan neo permineralan*

(20 marks/markah)

6. Please answer any two (2) of the following questions:
- (a) Briefly define or describe the following:
 - (i) Anisotropy and Polarization colour (ore microscopy)
 - (ii) Isotropic and anisotropic minerals (mineralogy optic)
 - (iii) Privilege direction and how to determine this (mineralogy optic)
 - (b) Relief (in optical mineralogy)
 - (c) Briefly discuss the differences between the properties of the following rocks (composition, texture and other distinguished features).
 - (i) Marble and limestone
 - (ii) Rhyolite and granite
 - (iii) Shale and sandstone
 - (iv) Basalt and syanite

Sila jawab mana-mana dua (2) soalan berikut:

- (a) *Secara ringkas, takrif dan terangkan perkara-perkara berikut:*
 - (i) *Anisotropi dan warna pengutuban (mikroskopi bijih)*
 - (ii) *Mineral-mineral isotrop dan tak isotrop (mineralogi optik)*
 - (iii) *Arah istimewa pengutub dan cara penentuan (mineralogi optik)*
- (b) *Jasad timbul (dalam mineralogi optik)*
- (c) *Secara ringkas, bincangkan sifat-sifat perbezaan-persamaan utama di antara pasangan batuan berikut (komposisi, tekstur dan fetur-fetur unggul lain)*
 - (i) *Marbel dan batu kapur*
 - (ii) *Riolit dan granit*
 - (iii) *Syal dan batu pasir*
 - (iv) *Basalt dan syanit*

(20 marks/markah)

7. Please answer any two (2) of the following questions:

- (a) "Texture" which describes about the fabric and grain size nature of igneous rocks is an important criterion in naming these rocks. Please define or briefly describe the following "textures" that typify igneous rocks.
- (i) Holocrystalline and hypocrytalline
 - (ii) Phenocrystalline and aphanitic
 - (iii) Crystal shapes
- (b) What "unpolarized" and "polarized" lights area mean?
- (c) Briefly, define the term "clastic" and "non-clastic" in sedimentary rocks and what is (in general) the origin of the quartz that is so abundant in common sand deposits.

Sila jawab mana-mana dua (2) soalan berikut:

- (a) "Tekstur" yang menjelaskan mengenai tabii fabrik dan saiz butiran yang terdapat pada batuan igneous adalah kriteria penting dalam penamaan batuan ini. Takrifkan atau secara ringkas terangkan pengertian "tekstur" yang mencirikan batuan igneous.
- (i) Holokristalin dan hipokristalin
 - (ii) Fenokristalin dan aphanitik
 - (iii) Bentuk-bentuk hablur
- (b) Apakah itu cahaya "tak terkutub" dan "terkutub"?
- (c) Secara ringkas, takrifkan istilah "klas" dan "tak klas" di dalam batuan sedimen dan mengapakah secara rawaknya, terdapat banyak kehadiran kuarza di dalam mendapan pasir?

(20 marks/markah)