
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 2006/2007
Peperiksaan Semester Kedua
Sidang Akademik 2006/2007

April 2007

EBS 232/3 - Optical Mineralogy *EBS 232/3 - Mineralogi Optik*

Time : 3 hours
Masa : 3 jam

Please ensure that this paper consists of ELEVEN printed pages before you proceed with the examination.

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

Answer any FIVE questions. Please answer ALL questions in PART A and any THREE questions in PART B. If a candidate answers more than five questions, only the first five answers will be examined and awarded marks.

Answer to any question must start on a new page.

All questions could be answered in Bahasa Malaysia or English.

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS muka surat yang bercetak sebelum anda memulakan peperiksaan.

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

Jawab LIMA soalan. Sila jawab SEMUA soalan di BAHAGIAN A dan mana-mana TIGA soalan di BAHAGIAN B. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Semua soalan boleh dijawab samada dalam Bahasa Malaysia atau Bahasa Inggeris.

PART A

BAHAGIAN A

1. Answer all the following questions.

[a] Briefly define or describe any **FIVE (5)** of the following optical properties related to the transparent minerals as observed under polarizing light (microscope).

- (i) Pleochroism
- (ii) Becke line and Refractive index (R.I)
- (iii) Double refraction
- (iv) Interference colour
- (v) Retardant and Birefringence

[b] Define or briefly describe the following terms usually related with igneous rocks texture and composition.

- (i) SIALIC and SIMATIC
- (ii) Aphanitic and Porphyritic
- (ii) Vesicular

(20 marks)

2. The following charts represent the classification schemes and principles of the two main categories of rocks of the earth-crust (**Chart A and Chart B**). Both charts illustrate the main features and principles that used for these rock classification schemes. Identify and discuss this principles and features as illustrated in the charts for both categories of rocks. Please define or describe the major terms and nomenclatures used in the charts.

(20 marks)

2. *Carta-carta berikut (Carta A dan Carta B) adalah mewakili skema dan prinsip pengelasan dua kategori utama batuan kerak bumi. Kedua-kedua carta tersebut memperlihatkan dan mengilustrasikan fitur-fitur dan prinsip yang digunakan dalam pengelasan kedua-dua batuan tersebut. Kenalpasti serta bincangkan kesemua prinsip dan fitur sebagaimana dipaparkan oleh carta-carta yang mewakili kedua-dua kategori batuan itu. Sila takrif atau jelaskan maksud terma-terma atau istilah utama yang terdapat dalam carta tersebut.*

(20 markah)

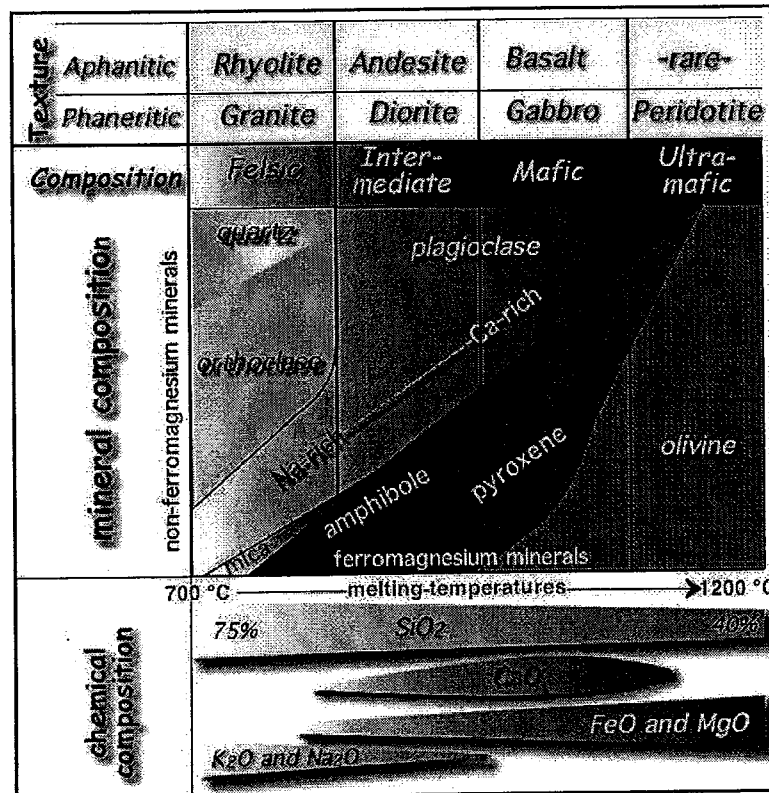


CHART A
CARTA A

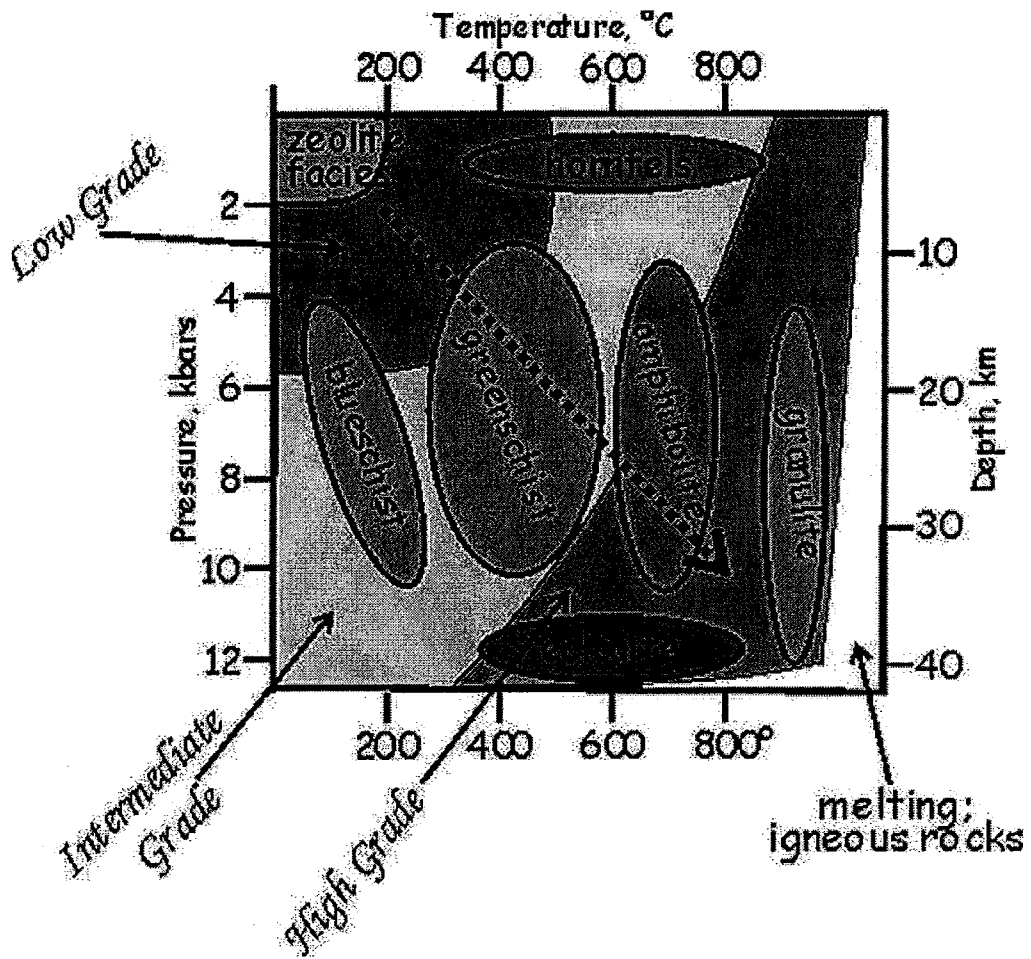


CHART B
CARTA B

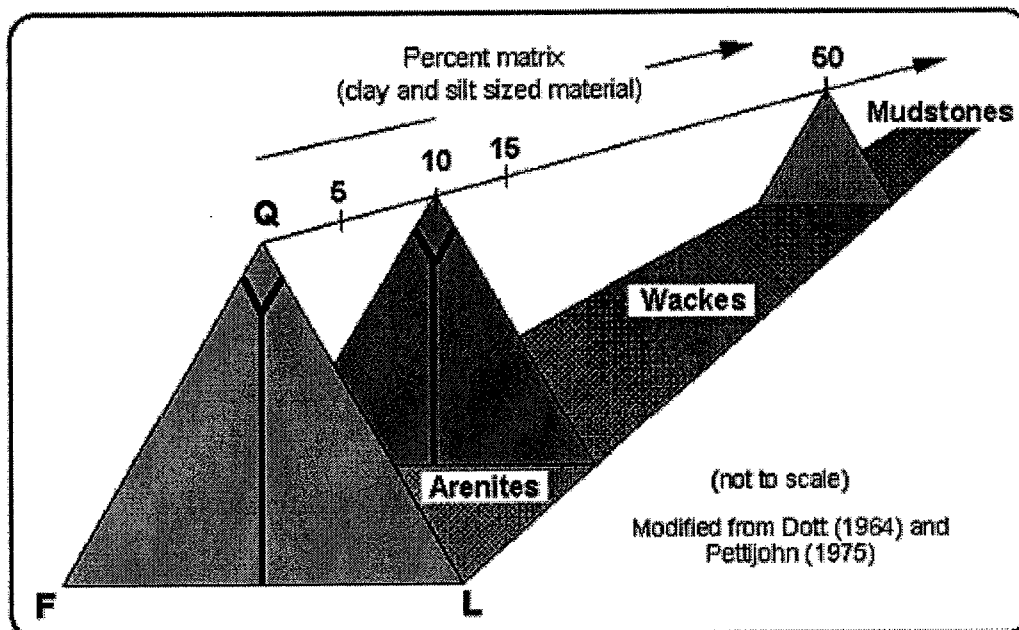
PART B**BAHAGIAN B**

3. Briefly discuss the scheme (principles and terms) used for this type of rock classification as represented and illustrated in **Chart C** as given by Pettijohn (1975).

(20 marks)

3. *Secara ringkas perihalkan skema (prinsip dan terma-terma) yang digunakan bagi pengelasan batuan daripada jenis ini yang diwakili dan diilustrasikan oleh Carta C sebagaimana disarankan oleh Pettijohn (1975).*

(20 markah)

**CHART C****CARTA C**

4. Briefly describe any **FIVE (5)** of the following terms and expressions used to describe the texture of metamorphic and sedimentary rocks.

- [a] Neomineralization and metasomatism (metamorphic)
- [b] Foliation and Massive (metamorphic)
- [c] Grain support and matrix support (sedimentary)
- [d] Granoblastics (metamorphic)
- [e] Granular texture (sedimentary)
- [f] Detrital and non-detrital texture (sedimentary)

(20 marks)

4. *Secara ringkas terangkan mana-mana LIMA (5) perkara-perkara berikut, iaitu mengenai terma-terma dan pernyataan yang digunapakai dalam memerihalkan tekstur batuan metamorf dan batuan sediment.*

- [a] *Neo-pemineralan dan metasomatisma (metamorf)*
- [b] *Foliasi dan masif (metamorf)*
- [c] *Sokongan butiran dan sokongan matrik (sedimen)*
- [d] *Granoblastik (metamorf)*
- [e] *Tekstur bergranul (sedimen)*
- [f] *Tekstur detrital dan bukan detrital (sedimen)*

(20 markah)

5. Briefly describe or discuss any **FIVE (5)** of the following concerning the optical properties of ore (opaque minerals) as observed under polarizing microscope.

- [a] Effect of impurities
- [b] Birefractance and Reflection pleochorism
- [c] Kalb hardness
- [d] Internal reflection
- [e] Color of relection
- [f] Anisotropy

(20 marks)

5. *Secara ringkas hurai atau bincangkan sebarang LIMA (5) perkara berikut yang bersangkutan dengan sifat-sifat optik mineral bijih (mineral legap) sebagaimana dicerap di bawah mikroskop pengutub.*

- [a] *Kesan bendasing*
- [b] *Dwibalikan dan Plekroisma balikan*
- [c] *Kekerasan Kalb*
- [d] *Balikan dalaman*
- [e] *Warna balikan*
- [f] *Anisotropi*

(20 markah)

6. 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

(20 marks)

6. 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

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

Nota : *Q* : Kuarza, *AP* : Alkali felspar, *Plg* : Plagioklas dan *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 markah)

7. Answer the following questions.

- [a] Briefly discuss the three (3) major categories of metamorphic rocks which are mainly classified based on their textural properties. However, the metamorphic rocks are also classified according to other three special criteria, please describe.
- [b] 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

(20 marks)

7. *Jawab semua soalan-soalan berikut.*

- [a] *Secara ringkas bincangkan tiga (3) ketogori utama batuan metamorf yang diklasifikasikan berasaskan kepada sifat-sifat teksturnya. Walaupun begitu, batuan metamorf juga dikelaskan berasaskan kepada tiga kriteria khusus lain, sila jelaskan.*
- [b] *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 markah)