
UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2012/2013 Academic Session

June 2013

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

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains TEN printed pages and THREE pages APPENDIX before you begin the examination.

[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEPULUH muka surat beserta TIGA muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of 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.]

Instruction: 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 answered in the answer script would be examined.

[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.]

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.]

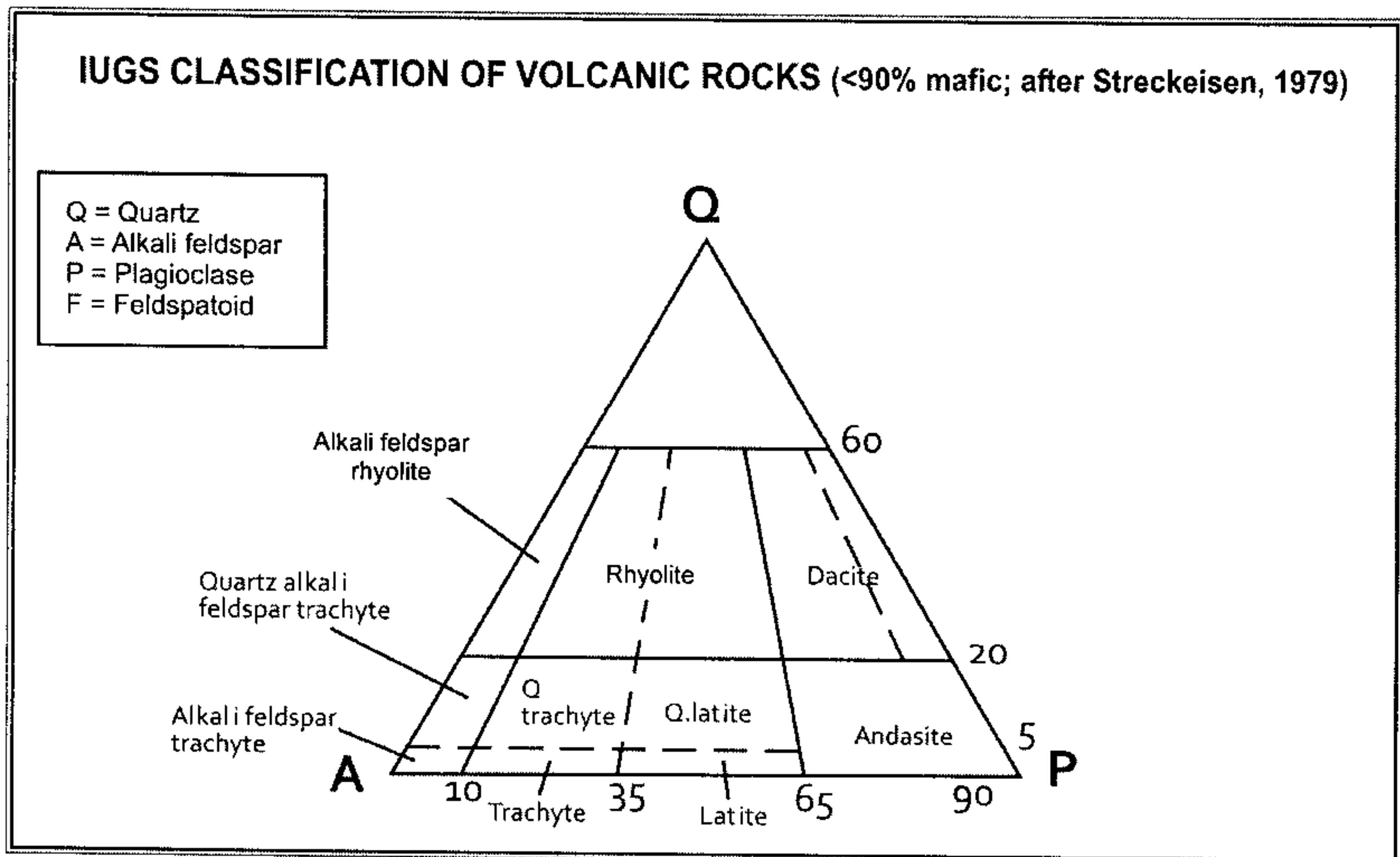
In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

PART A / BAHAGIAN A

1. [a] Figure 1 shows the classification charts or diagrams of the common rock classes or categories (Rock A) in the earth's crust. Discuss and elaborate about the classification scheme.

Rajah 1 yang diberikan menunjukkan skema pengelasan atau kategori bagi batuan pembentukan kerak bumi (Batuan A). Bincang dan perelaskan skema pengelasan ini.

Rock A / Batuan A**Figure 1****Rajah 1**

(50 marks/markah)

- [b] Figure 2 shows the Bowen's Reaction Series to describe how magma changes its chemical composition as it cools. Discuss and elaborate the usage of the series in the formation of sedimentary rock.

Rajah 2 menunjukkan Siri Tindakbalas Bowen digunakan untuk menggambarkan bagaimana magma menukar komposisi kimia kerana ia menyejuk. Bincang dan huraikan penggunaan siri dalam pembentukan batu enapan.

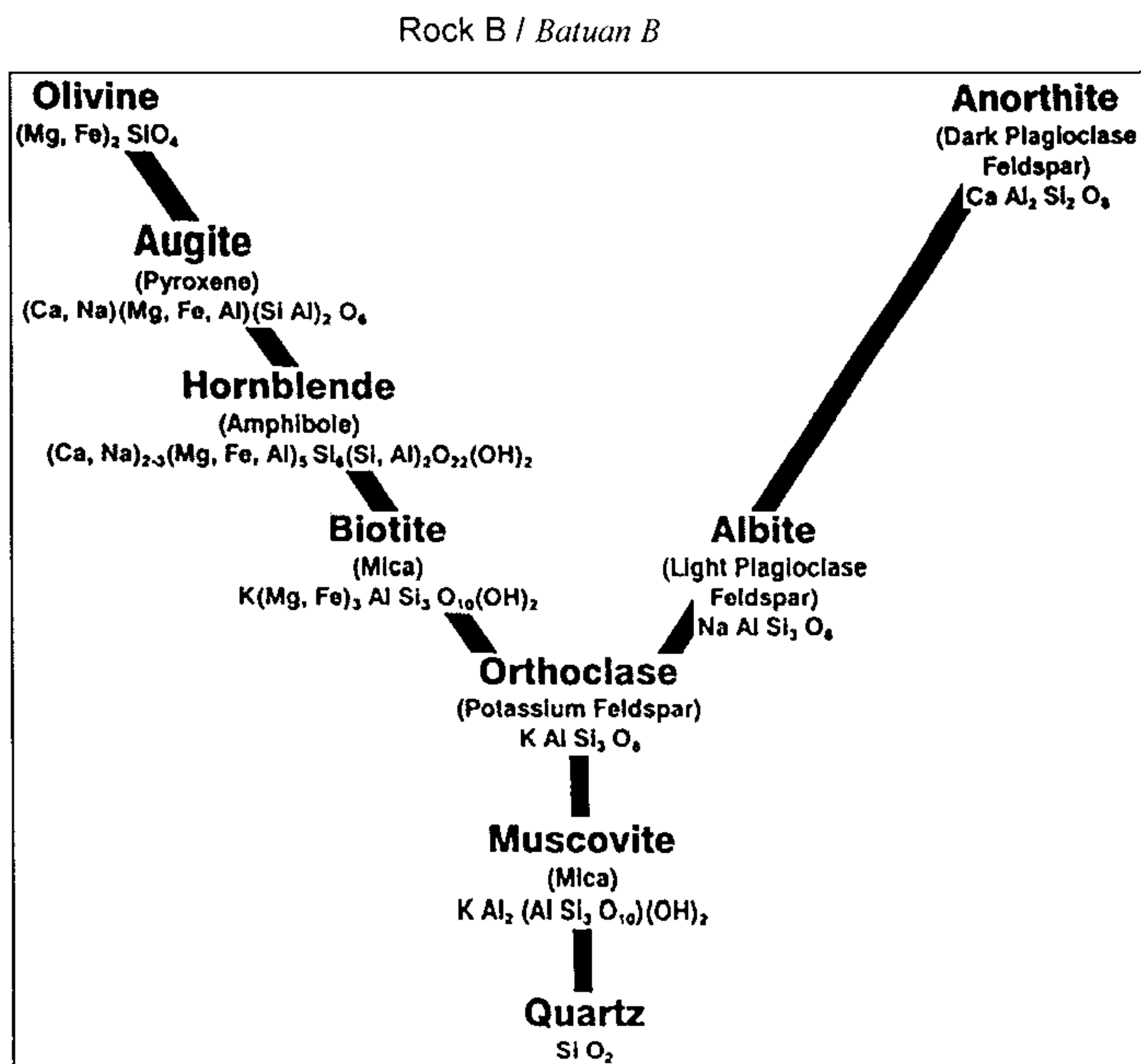


Figure 2

Rajah 2

(50 marks/markah)

2. Answer the following questions.

Jawab soalan-soalan berikut.

- (a) Ore microscopy study is a technique that can provide valuable information that will help mineral processing engineer in mineral extraction process design. Discuss such valuable information and its consequence.

Kajian mikroskopi bijih adalah satu teknik yang boleh memberikan maklumat yang berharga yang boleh membantu jurutera pemprosesan mineral dalam mineral reka bentuk proses pengekstrakan. Bincangkan apa-apa maklumat yang berharga dan akibatnya.

(50 marks/markah)

- (b) State some of the metallic minerals (mineral assemblage) optical properties that differentiate:
- (i) Pyrite, bornite, chalcopyrite and covellite (in porphyry copper)
 - (ii) Gold, pyrite, galena and quartz (in gold-bearing quartz vein)
 - (iii) Magnetite, hematite and quartz (Iron ore)

Nyatakan beberapa mineral logam (himpunan mineral) sifat optik yang membezakan:

- (i) *Pirit, bornite, kalkopirit dan kovelit (tembaga porfiri)*
- (ii) *Emas, pirit, galena dan kuarza (dalam urat-emas kuarza)*
- (iii) *Magnetit, bijih besi dan kuarza (bijih besi)*

(50 marks/markah)

PART B / BAHAGIAN B

3. Answer the following question.

Jawab soalan-soalan berikut.

- (a) Based on the QAPF classification system (Appendix 1 and 2), determine the composition, texture and any distinguishing features of the following igneous rocks as given in Table A.

Berdasarkan sistem pengelasan QAPF (Lampiran 1 dan 2), menentukan komposisi, tekstur dan mana-mana ciri-ciri dibezakan igneus batuan berikut seperti yang diberikan dalam Jadual A.

Table A / Jadual A

Features / Fetur	Granite / Granit	Diorite / Diorit	Rhyolite / Riolite
Composition <i>Komposisi</i>	Q / K: AP / AF: Plg / Plg: Acc / Acc:	Q / K: AP / AF: Plg / Plg: Acc / Acc:	Q / K: AP / AF: Plg / Plg: Acc / Acc:
Texture <i>Tekstur</i>			
Distinguished features <i>Fetur-fetur khas</i>			

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

Nota: K: Kuarza; AF: Alkali felspar; Plg: Plagioklas dan Acc: Mineral aksesori

(50 marks/markah)

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- (b) Briefly discuss the differences between the properties of the following rocks (composition, texture, grain size and other distinguishing features).
- (i) Limestone and tuff
 - (ii) Arkose and sandstone
 - (iii) Breccia and conglomerate

Secara ringkas, bincangkan sifat-sifat perbezaan-persamaan utama di antara pasangan batuan berikut (komposisi, tekstur, saiz butiran dan fetur-fetur unggul lain).

- (i) *Batu kapur dan tuf*
- (ii) *Arkos dan batu pasir*
- (iii) *Breksia dan konglomerat*

(50 marks/markah)

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

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

- (a) Minerals are grouped into three different optical classes depending on the crystal system to which they belong. Please state the classes and briefly describe how to distinguish the minerals under the polarised microscope with appropriate examples for each crystal class.

Mineral dikelaskan kepada tiga kelas optikal berdasarkan sistem kristal. Sila nyatakan sistem kelas tersebut dan takrifkan secara umum bagaimana sifat ini boleh ditentukan di bawah mikroskop pengutub beserta contoh.

(50 marks/markah)

- (b) How are metamorphic rocks formed? Illustrate the mineralogical and textural changes that occurs when shale is subjected to low, medium and high grade metamorphism.

Bagaimana batuan metamorf terbentuk? Menggambarkan perubahan mineralogi dan tekstur yang berlaku apabila syal tertakluk kepada metamorphism gred rendah, sederhana dan tinggi.

(50 marks/markah)

- (c) What rocks are formed when the following are subjected to higher grades of metamorphism?
- (i) Limestone
 - (ii) Peat
 - (iii) Sandstone
 - (iv) Shale

Batu apa yang terbentuk apabila berikut tertakluk kepada gred yang lebih tinggi daripada metamorphism?

- (i) *Limestone*
- (ii) *Gambut*
- (iii) *Sandstone*
- (iv) *Syal*

(50 marks/markah)

5. For each of the rock type listed below, please state the key minerals that are present and discuss the principle or significant optical properties in identifying those rocks (Appendix 1, 2 and 3).

Bagi setiap batuan yang disenaraikan di bawah, sila nyatakan mineral utama yang hadir dan membincangkan dan bincangkan ciri-ciri mineralogi yang utama dan penting di dalam mengenal pasti mineral tersebut (Lampiran 1, 2 dan 3).

Rock <i>Batuan</i>	Minerals <i>Mineral</i>	Grain size <i>Saiz butiran</i>	Key texture <i>Tesktur utama</i>	Type of rock <i>Jenis batuan</i>
Andesite <i>Andesit</i>				
Basalt <i>Basalt</i>				
Gabbro <i>Gabro</i>				
Sandstone <i>Batu pasir</i>				
Schist <i>Syis</i>				

(100 marks/markah)

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6. Answer the following.

Jawab yang berikut.

(a) Explain the following:

- (i) What is the difference between **uniaxial** and **biaxial mineral**.
- (ii) The relationship of double refraction, velocities and refractive indices when a narrow beam of light entering an isotropic crystal.

Berikan keterangan mengenai perkara berikut:

- (i) *Apakah perbezaan di antara mineral ekapaksi dan dwipaksi.*
- (ii) *Perhubungan di antara bias duaan, kelajuan dan indeks biasan apabila cahaya menembusi mineral bersifat ekapaksi.*

(50 marks/markah)

(b) Please describe or explain the following:

- (i) Extinction angle properties of a mineral grain.
- (ii) The method used to study the extinction angle of a mineral under the polarised microscope with appropriate example of minerals.

Sila beri keterangan atau penjelasan mengenai perkara berikut:

- (i) *Ciri-ciri sudut padaman bagi satu mineral.*
- (ii) *Kaedah yang digunakan bagi mengetahui sudut padaman bagi satu mineral di bawah mikroskop terkutub beserta contoh mineral yang sesuai.*

(50 marks/markah)

7. Answer the following.

Jawab yang berikut.

(a) Explain the following

- (i) Karb hardness and how it is conducted.
- (ii) Bireflectance and pleochroism.
- (iii) Internal reflection.

Terangkan yang berikut:

- (i) *Karb kekerasan dan bagaimana ia adalah kelakuan.*
- (ii) *Dwibalikan dan pleokroisme.*
- (iii) *Pantulan dalaman*

(50 marks/markah)

(b) (i) Discuss the stages in ore mineral section preparation process.

Bincangkan peringkat yang terlibat di dalam proses penyediaan mineral bijih.

(ii) Please define or describe the following:

- (a) Relief and Becke Lines (optical mineralogy).
- (b) Anisotropy and Polarization colour (igneous petrography).

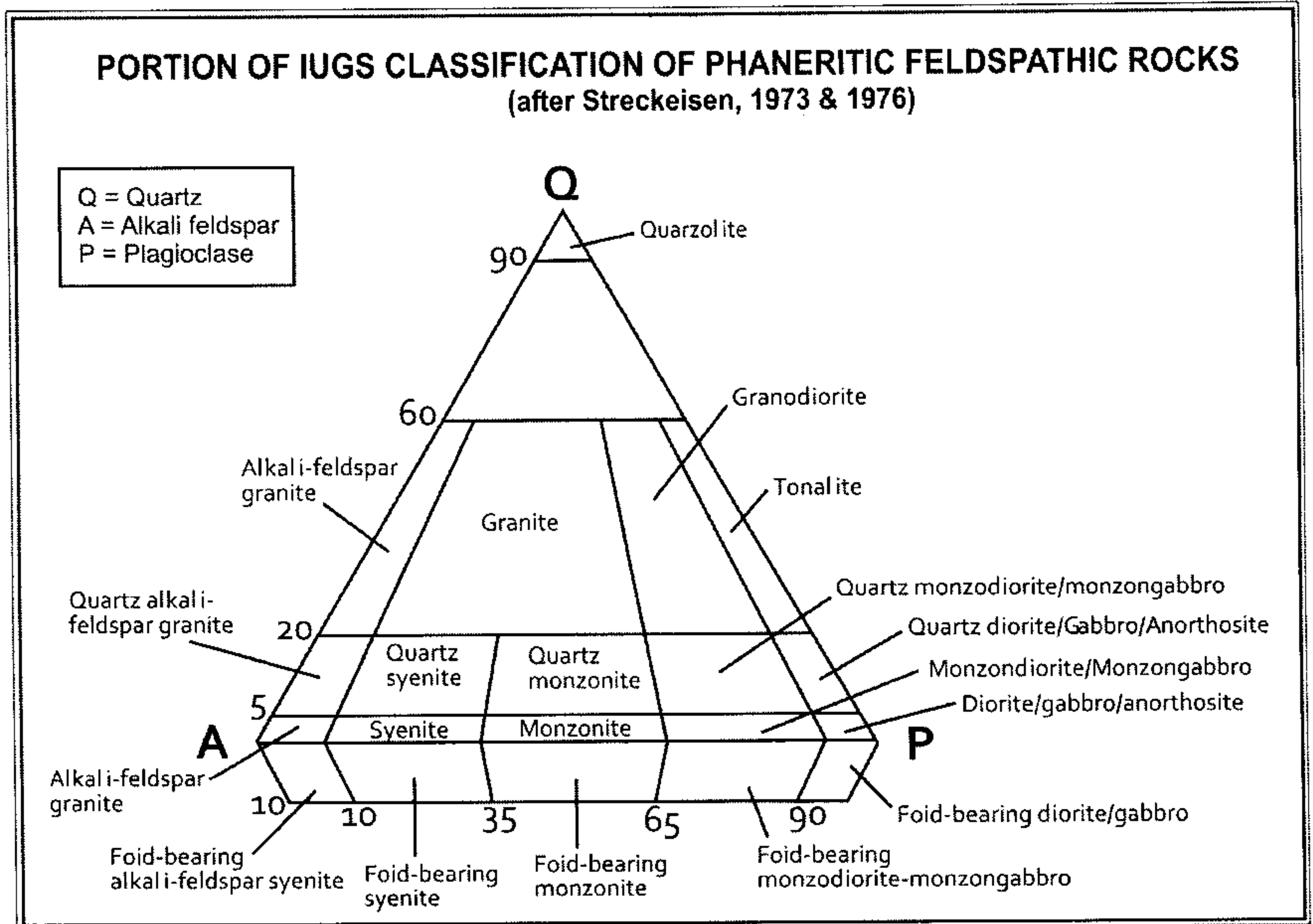
Takrif atau terangkan mengenai perkara-perkara berikut:

- (a) *Jasad timbul dan garis Becke (Mineralogi optik).*
- (b) *Anisotropi dan warna pengutuban (petrografi igneus).*

(50 marks/markah)

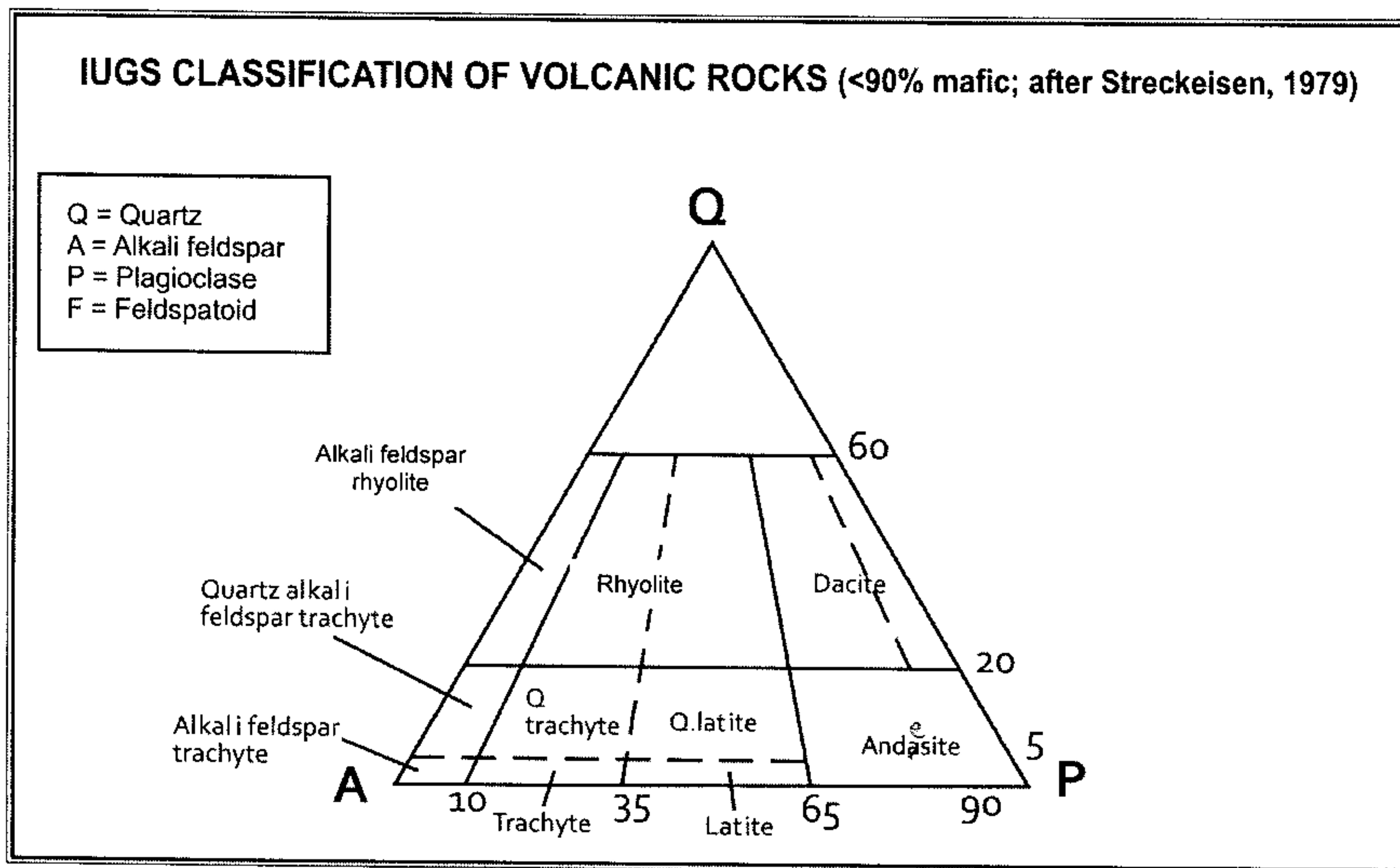
APPENDIX 1

LAMPIRAN 1



APPENDIX 2

LAMPIRAN 2



APPENDIX 3

LAMPIRAN 3

