

**SULIT**

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Second Semester Examination  
2023/2024 Academic Session

July/August 2024

**EBS242/3 – Petrography and Ore Microscopy  
(Petrografi dan Mikroskopi Bijih)**

Duration : 3 hours  
(Masa : 3 jam)

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Please check that this examination paper consists of SIXTEEN (16) pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi ENAM BELAS (16) muka surat yang bercetak sebelum anda memulakan peperiksaan ini].*

**Instructions** : Answer **FIVE (5)** questions. **Part A is COMPULSORY**. Answer **THREE (3)** questions from Part B. All questions carry the same marks.

**[Arahan** : Jawab **LIMA (5)** soalan. **Bahagian A WAJIB dijawab**. Jawab **TIGA (3)** soalan daripada Bahagian B. Semua soalan membawa jumlah markah yang sama.]

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

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

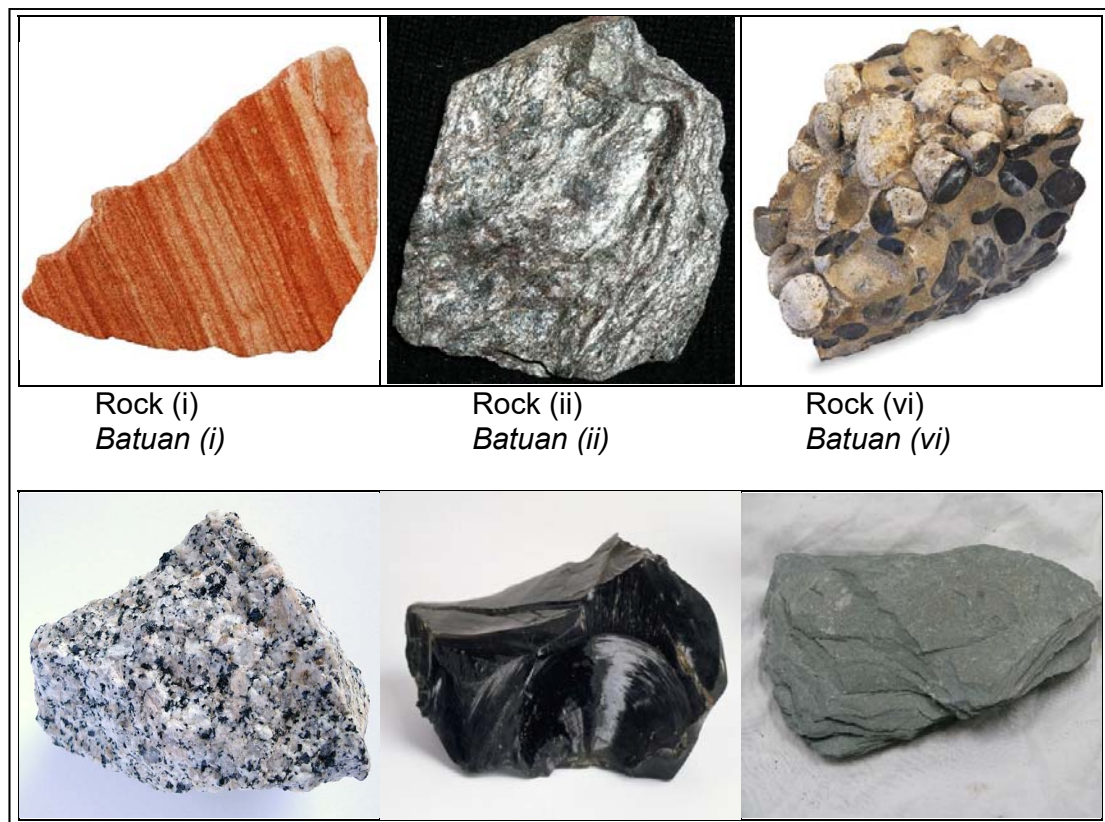
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**PART A / BAHAGIAN A**

- (1). (a). Figure 1 shows rock samples found in the earth crust. Discuss about the physical and chemical properties of the following rocks and subsequently determine the most possible types of the given specimens.

*Rajah 1 menunjukkan sampel batuan yang biasa dijumpai di kerak bumi. Bincang ciri-ciri fizikal dan kimia batuan yang disenarai dan seterusnya kenalpasti jenis bagi setiap contoh yang diberikan.*



Rock (i)  
Batuan (i)

Rock (ii)  
Batuan (ii)

Rock (vi)  
Batuan (vi)

Rock (iv)  
Batuan (iv)

Rock (v)  
Batuan (v)

Rock (vi)  
Batuan (vi)

**Figure 1: Rock samples**  
**Rajah 1: sampel batuan**

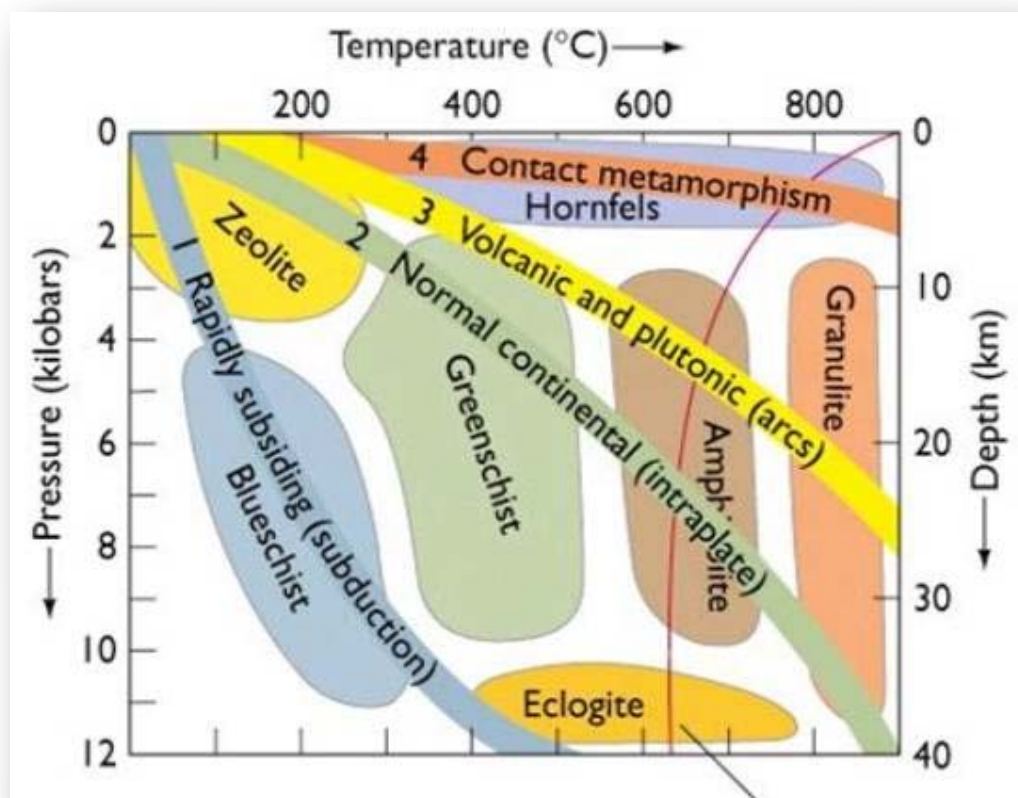
(12 marks/markah)

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- (b). Figure 2 shows the classification charts or diagrams of the common rock classes or categories (Rock B) in the earth crust. Discuss and elaborate about the classification scheme.

*Carta atau Rajah 2 yang diberikan menunjukkan skema pengelasan atau kategori bagi batuan pembentukan kerak bumi (Batuan B). Bincang dan perelaskan skema pengelasan ini.*



**Figure 2: Common rock classes**  
**Rajah 2: Kelas batuan umum**

(4 marks/markah)

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- (c). Genetically, sedimentary rocks are classified into a few main classes or categories. Please state and describe these classes with appropriate (rock types) examples.

*Secara genetic, batuan sedimen telah dikelaskan kepada beberapa kategori utama. Sila nyatakan dan terangkan kelas-kelas ini beserta dengan contoh-contoh bersesuaian.*

(4 marks/markah)

- (2). (a). In the realm of mineralogical analysis, ore microscopy predominantly targets opaque minerals. Elucidate the disparities between opaque and non-opaque minerals, furnishing exemplars to illustrate each category's distinctiveness.

*Dalam bidang analisis mineralogi, mikroskopi bijih kebanyakannya tertumpu kepada mineral-mineral legap. Terangkan perbezaan antara mineral legap dan tidak legap, dengan memberikan contoh bagi menggambarkan ciri-ciri unik dalam setiap kategori tersebut.*

(4 marks/markah)

- (b). Construct a comprehensive procedure for the preparation of thin sections from granitic rock samples to facilitate petrographic analysis. Include intricate steps involving cutting the sample into precise slices, affixing them onto glass substrates, and subsequent examination under a polarized microscope to ascertain mineral composition.

*Terangkan satu prosedur menyeluruh bagi penyediaan keratan nipis daripada sampel batuan granit bagi memudahkan analisis petrografi. Termasuk langkah-langkah rumit yang melibatkan pemotongan sampel kepada kepingan yang tepat, pemasangan pada substrat kaca, dan pemeriksaan lanjut di bawah mikroskop terpolarisasi untuk mengesahkan komposisi mineral.*

(5 marks/markah)

...5/-

- (c). Thin sections are viewed using a petrographic microscope under two different lighting conditions; plane polarized and crossed polarized light.

*Keratan nipis dilihat menggunakan mikroskop petrografi di bawah dua keadaan pencahayaan yang berbeza; cahaya satah-terkutub dan cahaya silang-terkutub.*

Discuss the following with examples.

*Bincangkan perkara berikut dengan contoh:*

- (i). Plane polarized light.

*Cahaya satah-terkutub.*

(3 marks/markah)

- (ii). Cross polarized light.

*Cahaya silang-terkutub.*

(3 marks/markah)

- (d). Metallic mineral is unique and need to be prepare in by polished section. This is due to the light from the microscope will be reflected on the surface of the polished mineral instead of passing through it. Design the procedure on polished section preparation of gold minerals.

*Mineral logam adalah unik dan perlu disediakan dengan keratan poles. Ini disebabkan cahaya daripada mikroskop akan dipantulkan pada permukaan mineral yang digilap dan bukannya melaluinya. Reka prosedur penyediaan keratan poles bagi mineral emas.*

(5 marks/markah)

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**PART B / BAHAGIAN B**

(3). (a). Define the following terms :

*Tentukan istilah berikut*

(i). Phase Retardation

*Fasa retardasi*

(ii). Refractive Index

*Indeks refraktif*

(iii). Dispersion

*Penyebaran*

(iv). Orthoscopic Light

*Cahaya Orthoscopic*

(v). Double Refraction

*Pembiasan berganda*

(vi). Pleochroisme

*Pleochroisme*

(6 marks/markah)

(b). Write an equation that relates wave frequency ( $f$ ), wavelength ( $\lambda$ ) and speed ( $v$ ).

*Tulis persamaan yang berkaitan frekuensi gelombang ( $f$ ), panjang gelombang ( $\lambda$ ) dan kelajuan ( $v$ ).*

(4 marks/markah)

...7/-

- (c). Name and describe two different methods for determining the refractive indices of minerals in oils. Describe the microscope setup and how each method works in some detail.

*Namakan dan terangkan dua kaedah yang berbeza untuk menentukan indeks biasan mineral dalam minyak. Terangkan persediaan mikroskop dan bagaimana setiap kaedah berfungsi dengan terperinci.*

(5 marks/markah)

- (d). Petrographic microscopes produce plane polarized light. What is plane polarized light and why is it used in optical mineralogy. Include in your answer at least two methods used to produce plane polarized light.

*Mikroskop petrografi menghasilkan cahaya polarisasi selari. Apakah selari terpolarisasi dan mengapa ia digunakan dalam mineralogi optik. Sertakan dalam jawapan anda sekurang-kurangnya dua kaedah yang digunakan untuk menghasilkan cahaya polarisasi selari.*

(5 marks/markah)

- (4). Answer the following question  
*Sila jawab semua soalan berikut*

- (a). What is meant by the term "lithification"?  
*Apakah yang dimaksudkan dengan istilah "lithification"?*

(2 marks/markah)

...8/-

- (b). Of the common elements that compose the minerals (that in turn compose the rocks) of the earth's crust, name 4 elements that in the weathering process tend to be carried away in solution. Where these elements do generally deposited?

*Daripada elemen-elemen biasa yang membentuk mineral (juga membentuk batuan) dari kerak bumi, namakan empat elemen di dalam proses luluhawa yang cenderung untuk di bawa dalam larutan. Di mana elemen-elemen ini biasanya terenap?*

*(2 marks/markah)*

- (c). What is (in general) the origin of the clay that is such a large constituent of most "shales"?

*Apakah (secara umum) asal-usul tanah liat yang menjadikannya konstituen yang paling besar dalam "syal"?*

*(2 marks/markah)*

- (d). What is (in general) the origin of the quartz that is so abundant in common sand deposits?

*Apakah (secara umum) asal-usul kuarza yang begitu banyak terdapat dalam deposit pasir biasa?*

*(2 marks/markah)*

- (e). Place the following minerals in order of increasing resistance to chemical weathering (place the least resistant on the left to most resistant to weathering on the right):

*Susun mineral berikut dalam arah peningkatan daya tahan terhadap luluhawa kimia (letakkan yang paling kurang tahan di sebelah kiri kepada paling tahan cuaca di sebelah kanan):*

**...9/-**



- Muscovite, calcic plagioclase, hornblende, biotite, quartz  
*Muscovite, calcic plagioclase, hornblende, biotite, kuarza*

(2 marks/markah)

- (f). Place listed minerals in the order of the most easily weathered to the least easily weathered:

*Letakkan senarai mineral dalam susunan yang paling mudah terluluhawa kepada kurangnya mudah terluluhawa:*

- Sodic plagioclase, alkali feldspar, clinopyroxene, olivine, hornblende  
*Sodic plagioclase, alkali feldspar, clinopyroxene, olivine, hornblende*

(2 marks/markah)

- (g). Sandstone A is said to be “well sorted”, while sandstone B is said to be “poorly sorted”. How would you describe the difference between sandstone A and B?

*Batu pasir A dikatakan "terisih baik", manakala batu pasir B dikatakan "terisih buruk". Bagaimana anda gambarkan perbezaan di antara batu pasir A dan B?*

(4 marks/markah)

- (h). What is the difference between a mudstone and a siltstone?

*Apakah perbezaan di antara batu lumpur dan batu lodak?*

(2 marks/markah)

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- (i). What is the main difference between a breccia and a conglomerate?  
What factors can contribute to clast roundness?

*Apakah perbezaan utama antara breksia dan konglomerat? Apakah faktor yang boleh menyumbang kepada klas yang membulat?*

(2 marks/markah)

- (5). Answer the following questions:

*Sila jawab semua soalan berikut*

- (a). Sandstone A is said to be “well sorted”, while sandstone B is said to be “poorly sorted”. How would you describe the difference between sandstone A and B?

*Batu pasir A dikatakan "terisih baik", manakala batu pasir B dikatakan "terisih buruk". Bagaimana anda gambarkan perbezaan di antara batu pasir A dan B?*

(4 marks/markah)

- (b). What is the difference between “recrystallization” and “neomineralization”?

*Apakah perbezaan di antara "penghabluran semula" dan "neomineralization"?*

(6 marks/markah)

- (c). What is a granoblastic texture?

*Apakah tekstur granoblas?*

(4 marks/markah)

- (d). Quite often in mica schists, staurolite or garnet, if present, occurs as porphyroblasts, giving the rock a porphyroblastic texture. What are “porphyroblasts”?

*Menjadi kebiasaan di dalam syis mika, staurolite atau garnet, jika hadir, wujud sebagai porfiroblas, menjadikan batu tersebut bertekstur porfiroblastik. Apakah porfiroblas?*

(6 marks/markah)

- (6). (a). Identify Mineral A in Figure 3 and discuss its optical properties and texture. Based on your understanding, which type and name of rock does Mineral A usually exist?

*Kenal pasti Mineral A dalam Rajah 3 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral A biasanya wujud?*

**Figure 3/Rajah 3**

(4 marks/markah)

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