

**PART A / BAHAGIAN A**

- (1). (a). How thin section of a mineral is prepared and subsequently examined under polarizing microscope?

*Bagaimana keratan nipis bagi satu mineral itu disediakan dan seterusnya dikaji dibawah mikroskop terkutub?*

(10 marks/markah)

- (b). Differences between the two types of petrographic samples, and what are they each used for?

*Perbezaan antara dua jenis sampel petrografi, dan untuk apa ia digunakan?*

(4 marks/markah)

- (c). The standard thin section thickness?

*Ketebalan piawai keratan nipis?*

(2 marks/markah)

- (d). The refractive indices of the two common epoxies used to make a thin section?

*Indeks biasan bagi dua epoksi biasa yang digunakan untuk membuat keratan nipis?*

(4 marks/markah)

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- (2). (a). A massive crystalline Rock A from Main Range Province, Peninsular Malaysia is prepared for thin section analysis. Figure 1 shows the photomicrograph of the Rock A. Analyse the mineral composition of Rock A.

*Batu A berhablur masif dari Wilayah Banjaran Utama, Semenanjung Malaysia disediakan untuk analisis keratan nipis. Rajah 1 menunjukkan fotomikrograf Batu A. Analisis komposisi mineral Batuan A.*

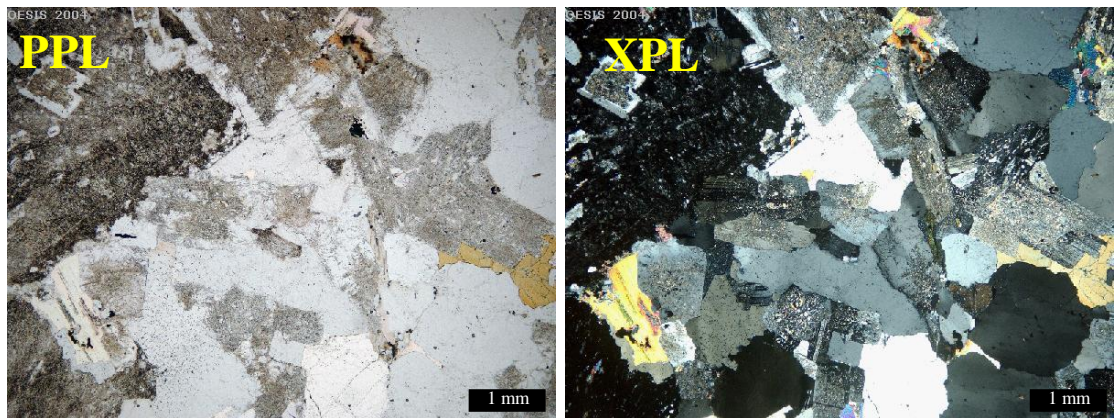


Figure 1/Rajah 1

(4 marks/markah)

- (b). A foliated Rock B from Tanah Merah, Kelantan is prepared for thin section analysis. Figure 2 shows the photomicrograph of the Rock B. Analyse the mineral composition of Rock B.

*Batu A berfoliasi dari Tanah Merah, Kelantan disediakan untuk analisis keratan nipis. Rajah 2 menunjukkan fotomikrograf Batu B. Analisis komposisi mineral Batuan B.*

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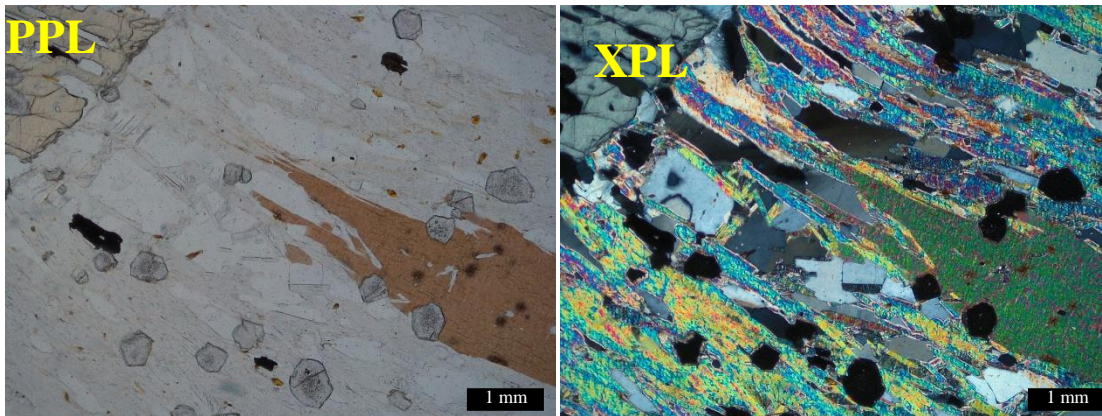


Figure 2/Rajah 2

(4 marks/markah)

- (c). Rock C reacts with an acid from Ipoh, Perak is prepared for thin section analysis. Figure 3 shows the photomicrograph of the Rock C. Analyse the mineral composition of Rock C.

*Batu C bertindak balas dengan asid dari Ipoh, Perak disediakan untuk analisis keratan nipis. Rajah 3 menunjukkan fotomikrograf Batu C. Analisis komposisi mineral Batuan C.*

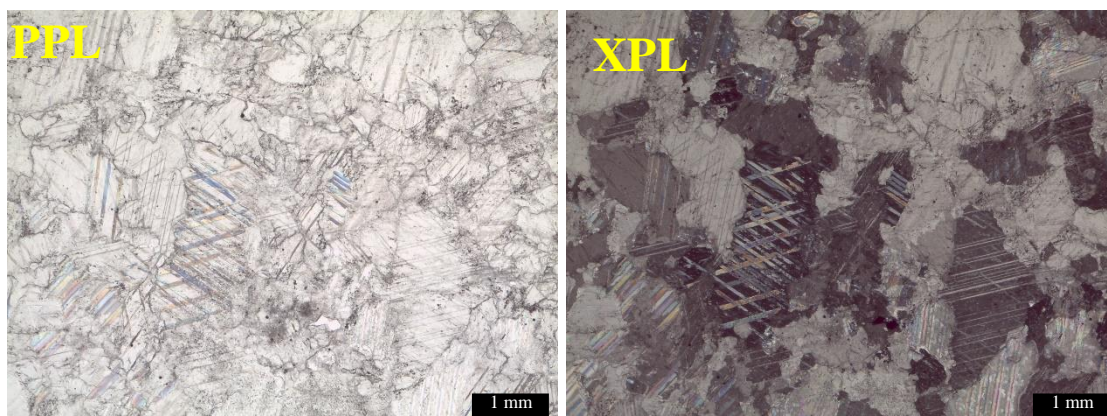


Figure 3/Rajah 3

(4 marks/markah)

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- (d). The rock texture covers the geometrical aspects of the constituent components of rocks: grains or particles and crystals, i.e., their size, shape, appearance, their arrangements, and sorting. Discuss with appropriate illustrations and/or examples of the following terms:

*Tekstur batuan meliputi aspek geometri bagi komponen konstituen batuan: butiran atau zarah dan hablur, iaitu saiz, bentuk, rupa, susunan dan isihannya. Bincangkan dengan ilustrasi atau/dan contoh yang sesuai tentang perkara berikut:*

- (i). Holocrystalline/ *Holohablur* (2 marks/markah)
- (ii). Subhedral/ *Subhedral* (2 marks/markah)
- (iii). Porphyritic/ *Porfiritik*. (2 marks/markah)
- (iv). Phaneritic/ *Faneritik*. (2 marks/markah)

**PART B / BAHAGIAN B**

- (3). Please define and describe the following:

*Takrif dan terangkan berikut:*

- (a). Anisotropic mineral, Biaxial mineral, Isotropic mineral and Uniaxial mineral

*Anisotropi mineral, Mineral dwipaksi, Mineral ekapaksi dan Isotropik mineral*

(8 marks/markah)

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- (b). Birefringence, Dispersion, Optical class, Optical orientation and Principal refractive index.

*Dwibalikan, Penyerakan, Kelas optik, Orientasi optik dan Indeks biasan utama*

(8 marks/markah)

- (c). What determines the retardation of mineral crystal and its governing factors? 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.

*Apakah yang menentukan nilai pembantutan hablur mineral dan faktor kebergantungannya? Tentukan nilai dwibalikan mineral augit yang mempunyai I.B. masing-masing  $n_s = 1.724$  and  $n_f = 1.700$  untuk keratan nipis piawai.*

(4 marks/markah)

- (4). Answer of the following questions.

*Jawab soalan-soalan berikut:*

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

*Secara genetik, batuan sedimen dikelaskan kepada beberapa kelas atau kategori utama. Nyatakan dan huraikan kelas ini dengan contoh (jenis batuan) yang sesuai.*

(8 marks/markah)

- (b). State and describe types of metamorphisms. What kind of process is responsible during those metamorphism processes with appropriate (rock types) examples.

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*Nyatakan dan huraikan jenis metamorfisme. Apakah jenis proses yang bertanggungjawab semasa proses metamorfisme tersebut dengan contoh (jenis batuan) yang sesuai.*

(9 marks/markah)

- (c). Discuss the concept of “bedding” and “lamination” structures in sedimentary rocks.

*Bincangkan konsep "perlapisan" dan "laminasi" struktur dalam batuan sedimen.*

(3 marks/markah)

- (5). (a). Briefly discuss the main differences and similarities between the properties of the following rocks pair (composition, texture, grain size and other distinguished features).
- (i). Obsidian and granite
  - (ii). Basalt and granite
  - (iii). Conglomerate and limestone

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

- (i). *Obsidian dan granit*
- (ii). *Basalt dan granit*
- (iii). *Konglomerat dan batu kapur*

(10 marks/markah)

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- (b). Figure 4 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 4 menunjukkan Siri Tindak Balas Bowen untuk menerangkan bagaimana magma mengubah komposisi kimianya apabila ia menyejuk. Bincangkan dan huraikan kegunaan siri dalam pembentukan batuan sedimen.*

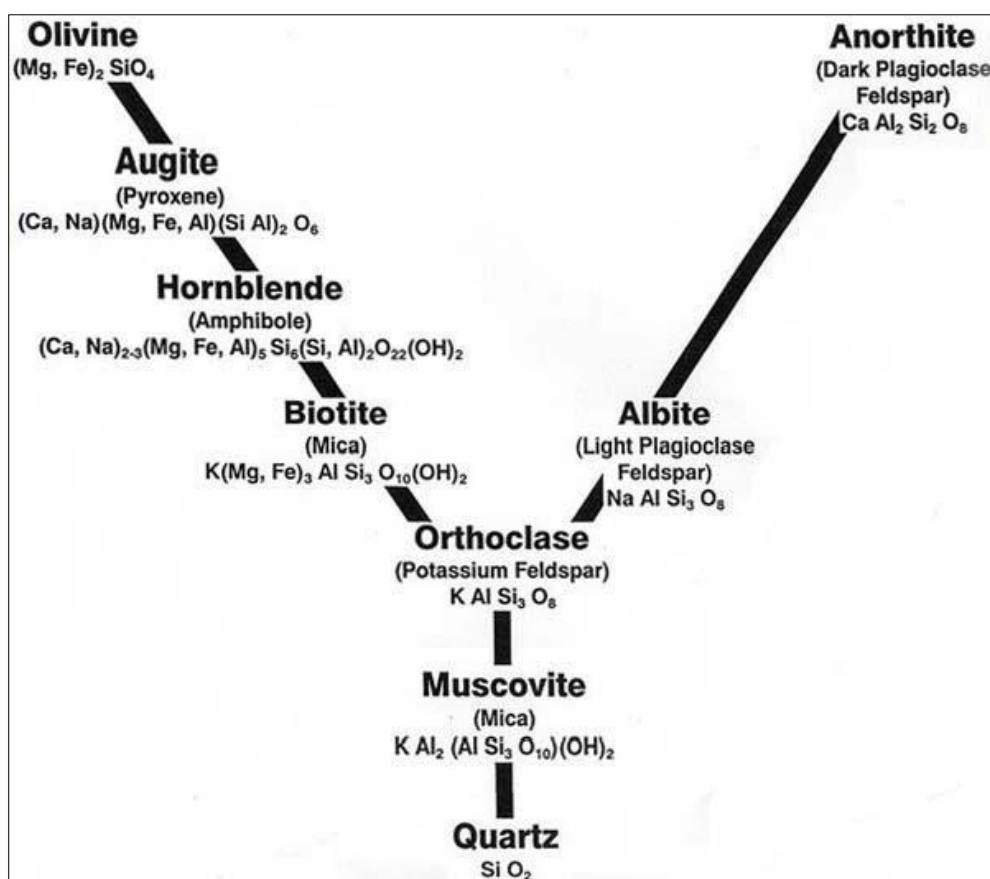


Figure 4/ Rajah 4

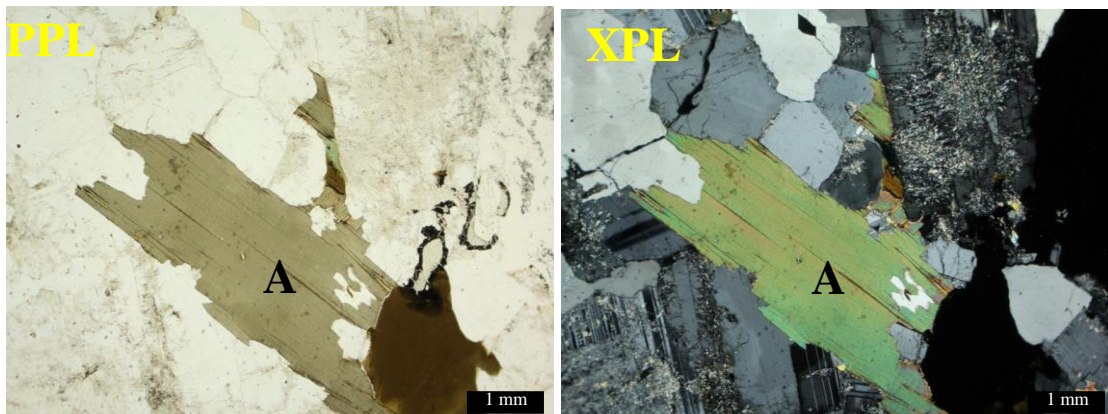
(10 marks/markah)

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- (6). (a). Identify Mineral A in Figure 5 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 5 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral A biasanya wujud?*



Rajah 5/ Rajah 5

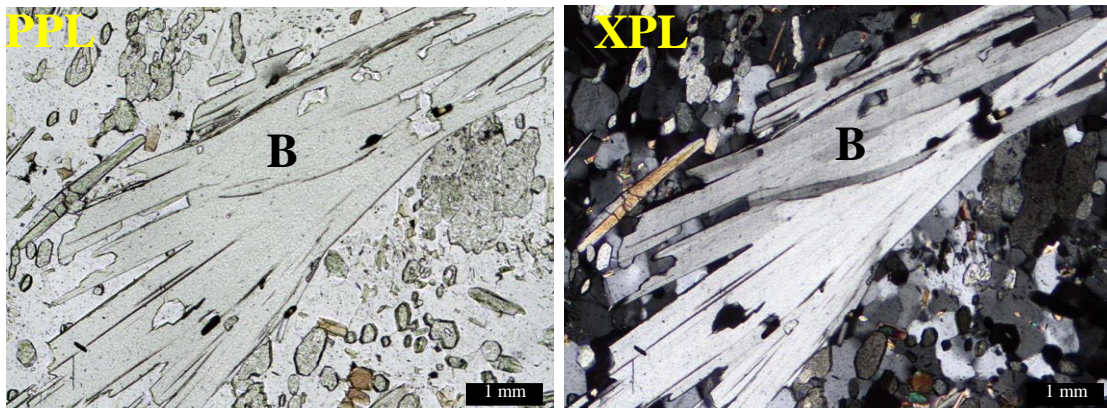
(4 marks/markah)

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

*Kenal pasti Mineral B dalam Rajah 6 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral B biasanya wujud?*

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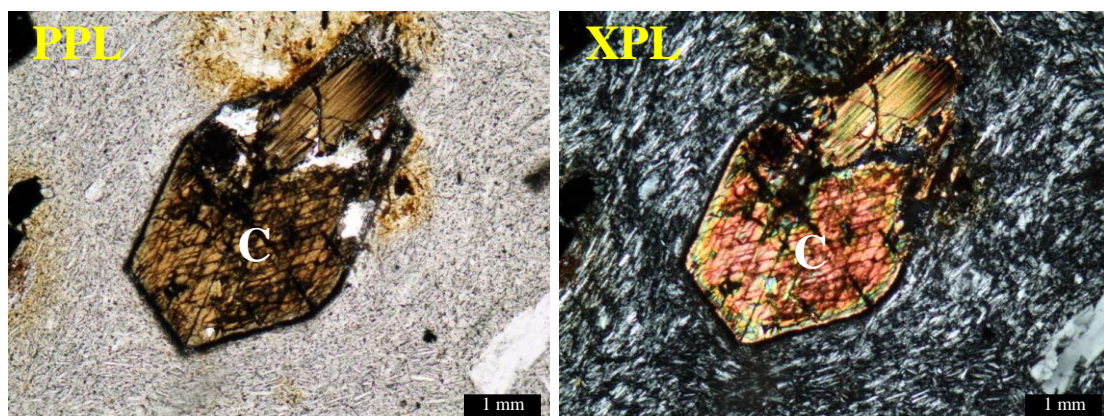


Rajah 6/ Rajah 6

(4 marks/markah)

- (c). Identify Mineral C in Figure 7 and discuss its optical properties and texture. Based on your understanding, which type and name of rock does Mineral C usually exist?

*Kenal pasti Mineral C dalam Rajah 7 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral C biasanya wujud?*



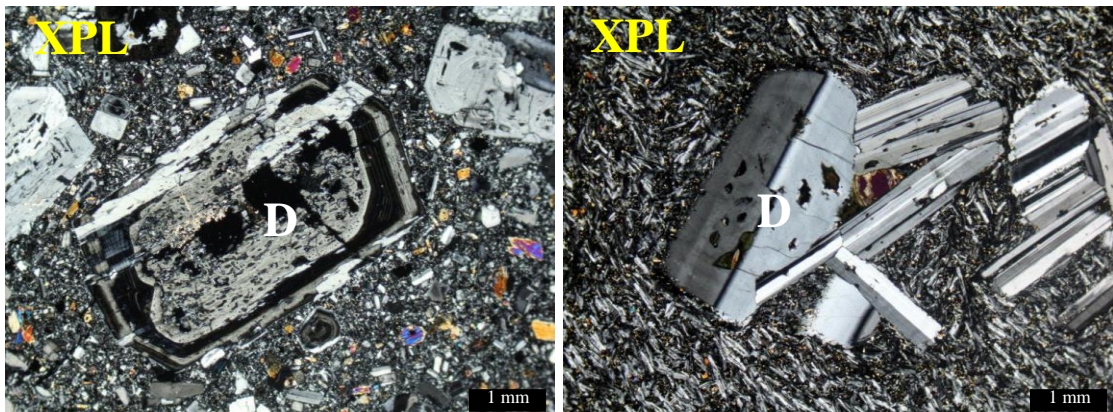
Rajah 7/ Rajah 7

(4 marks/markah)

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- (d). Identify Mineral D in Figure 8 and discuss its optical properties and texture. Based on your understanding, which type and name of rock does Mineral D usually exist?

*Kenal pasti Mineral D dalam Rajah 8 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral D biasanya wujud?*



Rajah 8/ Rajah 8

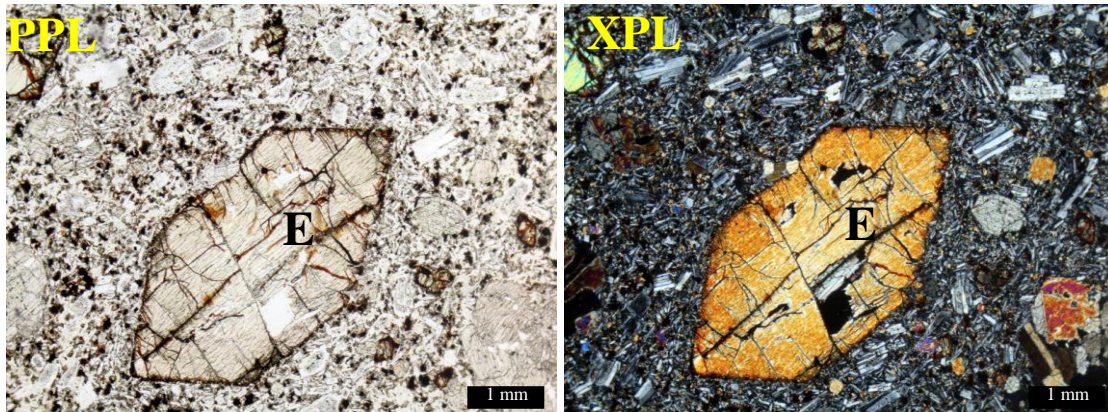
(4 marks/markah)

- (e). Identify Mineral E in Figure 9 and discuss its optical properties and texture. Based on your understanding, which type and name of rock does Mineral E usually exist?

*Kenal pasti Mineral E dalam Rajah 9 dan bincangkan sifat optik dan teksturnya. Berdasarkan pemahaman anda, jenis dan nama batuan manakah Mineral E biasanya wujud?*

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Rajah 9/ Rajah 9

(4 marks/markah)

- (7). (a). In order to determine the mineral types, petrography analysis will be carried out by cutting the rock sample into slices and attaching it on the glass thin section before observing it under polarized microscope. Outline the procedure on thin section preparation of granitic rocks.

*Bagi menentukan jenis-jenis mineral, analisis petrografi akan dijalankan dengan memotong sampel batu menjadi kepingan dan melekatkannya pada bahagian keratan nipis kaca sebelum memerhatikannya di bawah mikroskop terpolarisasi. Gariskan prosedur penyediaan keratan nipis bagi batuan granit.*

(5 marks/markah)

- (b). 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.*

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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)

(c). Ore microscopy generally applied to opaque mineral. Distinguish between opaque minerals and non-opaque minerals. Give the examples.

*Mikroskopi bijih biasanya digunakan untuk mineral legap. Bezakan antara mineral legap dan mineral bukan legap. Berikan contoh.*

(4 marks/markah)

(d). Metallic mineral is unique and need to be prepared 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 gilap bagi mineral emas.*

(5 marks/markah)

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