



## **FACULTY OF SCIENCE**

### **DEPARTMENT OF GEOLOGY**

<b>MODULE CODE</b>	<b>GLG1B10</b>
<b>MODULE NAME</b>	<b>Optical and Analytical Mineralogy</b>
<b>CAMPUS</b>	<b>APK</b>
<b>EXAM</b>	<b>November 2014</b>

<b>Date</b>	<b>November 2014</b>
<b>Assessor(S)</b>	<b>Mrs Lauren Blignaut &amp; Mr Mike Knoper</b>
<b>Internal Moderator</b>	
<b>External Moderator</b>	
<b>Duration</b>	<b>3 hours</b>
<b>Marks</b>	<b>180</b>

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<b>Number of pages</b>	<b>4 (including front page)</b>
<b>Instructions</b>	<b>Answer all the questions</b>

## **GLG1B10 Optical and Analytical Mineralogy exam questions 2014**

### **Section A: Optical Mineralogy (90 marks)**

#### **Question 1**

- (a) Give the definition of a mineral **(5 marks)**
- (b) How many crystallographic axes are needed in order to define the directions of a crystal? **(1 mark)**
- (c) Which crystal systems do sillimanite and beryl come from? Graphically explain these systems and clearly state what the relationships are between the lengths of the axes and the angles in-between them **(10 marks)**

#### **Question 2**

Explain how light waves interfere **(6 marks)**

#### **Question 3**

- (a) Why are isotropic minerals black? **(2 marks)**
- (b) Graphically explain a polarised atom **(6 marks)**
- (c) What are the vibration and propagation directions? **(2 marks)**
- (d) What is extinction? **(4 marks)**
- (e) Epidote has an epsilon value of 1.873 and an omega value of 1.890. The thickness of the thin section in  $\mu\text{m}$  is 25. Calculate the retardation value in nm, and explain what would happen if the gypsum plate was inserted and the colours increased **(7 marks)**

#### **Question 4**

Explain the Becke Line method **(4 marks)**

#### **Question 5**

- (a) Draw the indicatrix of a 2V- mineral. Indicate all the axes and the refractive indices, as well as the 2V angle. Indicate what BXO and BXA is **(10 marks)**
- (b) Mineral identification indicates that a mineral is 2V+. Draw the optic figure, indicating the 'quadrants', and respective colours and signs. Explain what is occurring in the figure in order for it to be a 2V+ mineral **(7 marks)**

### Question 6

- (a) What is albite twinning? Give 2 mineral examples (including their signs and angles) of this type of twinning **(7 marks)**
- (b) Explain, in detail, the three types of zoning **(15 marks)**

### Question 7

- (a) Give the name of the amphibole minerals that have the optic sign and angle below **(4 marks)**

- (1) 2V+; 70 - 90°
- (2) 2V-; 52 – 85°
- (3) 2V+; > 90°
- (4) 2V-; 0 - 68°

## **Section B: Analytical Mineralogy (90 marks)**

### Question 1

Describe, in detail, the 3 types of transparency **(9 marks)**

### Question 2

Indicate to which Family and Group each of the following minerals come from. Give the chemical formula and Si:O ratio of each mineral, and provide one example of a rock where the mineral commonly occurs **(36 marks)**

- (a) Fayalite
- (b) Spessartine
- (c) Epidote
- (d) Dravite
- (e) Pigeonite
- (f) Tremolite

### Question 3

Forsterite, in the presence of hydrous fluids, reacts to form which two minerals? Provide the chemical equation **(6 marks)**

### Question 4

- (a) Explain the garnet solid solution series **(6 marks)**

(b) Give the occurrence of clinozoisite, and state which minerals it is associated with **(5 marks)**

#### **Question 5**

Give a brief description of the occurrence and associations of glaucophane-riebeckite **(9 marks)**

#### **Question 6**

Describe chlorite in terms of its formation and occurrences **(4 marks)**

#### **Question 7**

Give the 3 most important polymorphs of the tectosilicates and their occurrences **(6 marks)**

#### **Question 8**

- (a) Give the definition of a phase diagram **(5 marks)**
- (b) What is fractional crystallization? **(4 marks)**