

National Exams December 2013

04-Geol-A1, Mineralogy and Petrology

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is a CLOSED BOOK EXAM.
Any approved calculator is permitted.
3. Most questions require an answer in paragraph or essay format. Clarity and organization of the answer are important. Point form is Ok if appropriate.

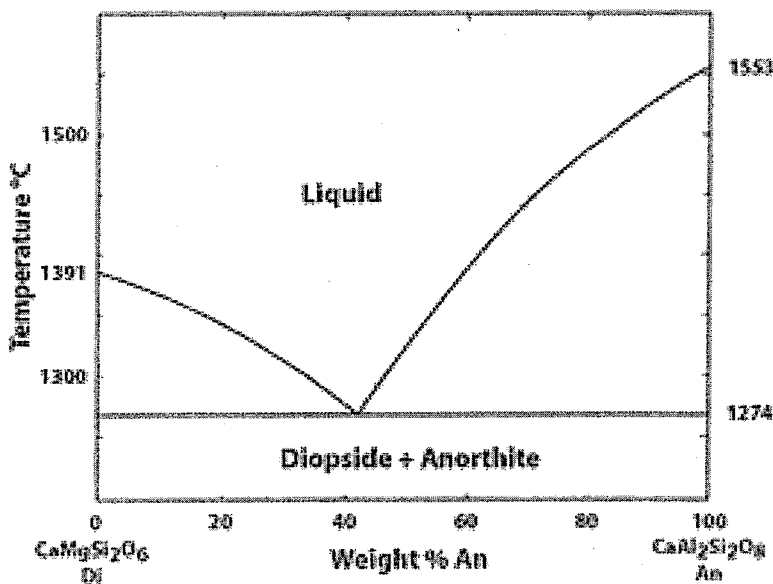
1) Fully explain 5 of the following. Use examples and diagrams where appropriate (4 marks each: 20 total)

- a) What is a mineral?
- b) Draw the arrangement of the SiO_4 tetrahedra for the inosilicates, and make sure it is fully labeled with the unit composition as well. Give two examples of an inosilicate and a physical property that is consistent amongst the group.
- c) What types of symmetry can a crystal possess? Please use diagrams and/or fully describe the differences.
- d) What is relief in optical mineralogy?
- e) What is a CIPW norm?
- f) Explain the mineralogical and compositional differences between basalt and andesite.
- g) What is the phase rule?
- h) What is a mudrock?

2) a) For the following minerals give the diagnostic properties you would use to identify them in hand specimen (1 mark each: 8 total):

- | | |
|--|-------------------------------|
| (a) Selenite | (b) KCl |
| (c) Citrine | (d) Fe_2SiO_4 |
| (e) $\text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$ | (f) An_{90-100} |
| (f) $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$ | (h) Antigorite |

b) Using the phase diagram below. Explain the crystallization sequence starting from a temperature of 1500C with a liquid composition of 20% anorthite and assuming equilibrium crystallization. What would be the sequence if fractional crystallization were occurring? (5 marks for each part: 10 marks total).



- 3) Answer any THREE of the following. Use diagrams and examples where appropriate (10 marks each: 30 marks total).
- a) Sketch a diagram showing the structure of the Earth, including each of the layers from the core to the surface of the Earth. How do we know the Earth's composition? Define the boundaries of each region by: depth, temperature, and pressure. List the important mineral phases that are found in each of the different regions.
 - b) How are sedimentary rocks classified?
 - c) Draw a centered biaxial negative interference figure for a mineral that is highly birefringent with a $2V = 10^\circ$. Show the isogyres in the northeast and southwest quadrants. On the diagram label the following: (a) melatope(s), (b) isogyres, (c) isochromes, and (d) the $2V$. Explain what defines whether a mineral is biaxial negative or biaxial positive and how you would determine this on the mineral.
 - d) Viscosity is one of the most important physical properties of magmas. What physical and chemical factors are most important in controlling viscosity?
 - e) Discuss the validity of the claim "Metamorphic mineral assemblages record peak metamorphic conditions". With the use of a P-T diagram, sketch the P-T evolution of rocks that encounter crustal thickening by pure shear, and describe the origin of this variation in terms of thermal models.
 - f) Sketch the relationship between depth of melting along/above a subducting slab and the igneous rock types behind the slab. Explain the relationship.

Marking Scheme: (Total Marks 68).

Question 1: 20 marks total (5 items worth 4 marks each)

Question 2: 18 marks in total

2a): 8 items worth 1 mark each: 8 marks total.

2b): 2 items worth 5 marks each: 10 marks total)

Question 3: 30 marks in total. 3 sections must be answered each worth 10 marks each. Make sure you provide detailed answers. Pont form is OK.