

National Exams May 2012

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.
A Casio or Sharp approved calculator is permitted.
3. Most questions require an answer in paragraph or essay format.
Clarity and organization of the answer are important.

1) Fully explain 5 of the following. Use examples and diagrams, define each term and explain the difference between the two where appropriate (4 marks each: 20 total)

- a) What is a mineral?
- b) Prograde vs retrograde
- c) Pleochroism vs birefringence
- d) Mohs scale of hardness
- e) Solidus vs liquidus
- f) Habit vs form
- g) Point group vs crystal system
- h) Cleavage vs fracture

2) Calculate the mineral formula from the following chemical analyses (wt% oxide). Give the name of the mineral. (15 marks total).

| | Olivine | Pyroxene | | Sulphide |
|--------------------------------|---------|----------|----|----------|
| SiO ₂ | 40.84 | 54.66 | Cu | 35.20 |
| TiO ₂ | 0.04 | 0.0 | Fe | 30.77 |
| Al ₂ O ₃ | 0.19 | 0.07 | S | 35.05 |
| Fe ₂ O ₃ | 0.13 | 0.68 | | |
| FeO | 8.18 | 0.07 | | |
| MnO | 0.17 | 0.02 | | |
| MgO | 50.27 | 18.78 | | |
| CaO | 0.0 | 25.85 | | |
| H ₂ O ⁺ | 0.37 | 0.22 | | |
| H ₂ O ⁻ | 0.0 | 0.00 | | |
| Total | 100.38 | 100.35 | | 101.02 |

Atomic Weights: Cu (63.54), Fe (55.85), S (32.07), O (16.0). Si (28.09), Al (26.98), Ti (47.90), Ca (40.08), Mg (24.31), Mn (54.94), H (1.00).

3) Answer any THREE of the following. Use diagrams and examples where appropriate (10 marks each: 30 marks total).

- a) Summarize the ways that trace elements and isotopes can be used to track the processes of magma contamination and mixing.
- b) How are igneous rocks classified?
- c) Fully explain the structural differences between Phyllosilicate minerals. Give examples of each including possible industrial applications.

- d) Viscosity is one of the most important physical properties of magmas. What physical and chemical factors are most important in controlling viscosity?
- e) Explain the concept of Metamorphic facies, including what they are, how they are defined and the principal reactions involved in them.
- f) Fully explain the concept of relief, what is the Becke white line test and how do you perform it (7 marks)? You have the following three minerals in a thin section:

Mineral A: high relief, RI = 1.32

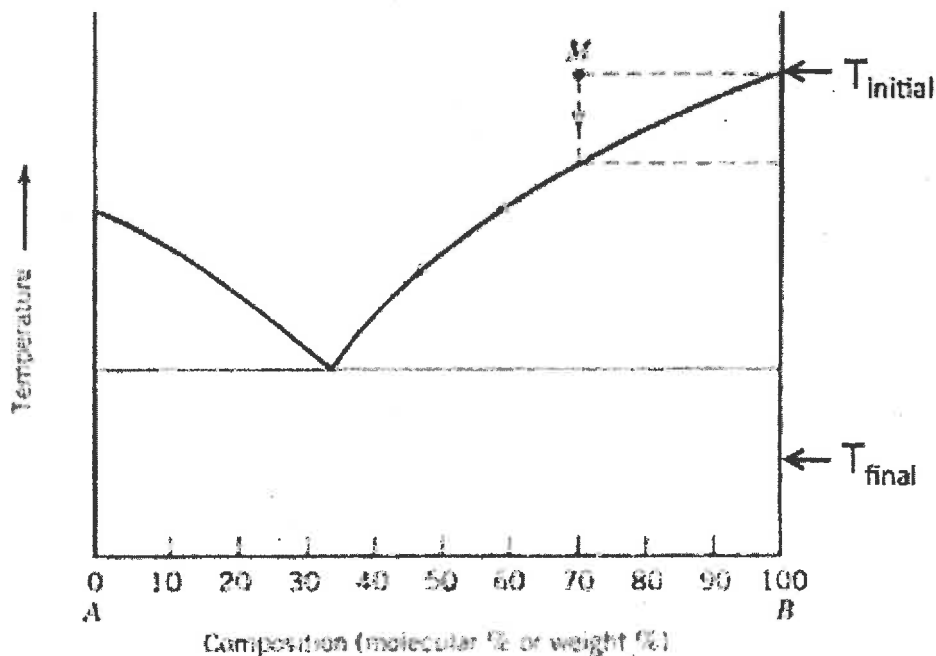
Mineral B: high relief, RI = 1.66

Mineral C: low relief, RI = 1.56

How would you identify them based on the test (3 marks)?

- g) Sketch the phase diagram below in your answer booklet. Clearly label the following terms on the phase diagram (1 mark each; 5 marks).

- field of solid A + B
- solidus
- field of melt + solid A
- eutectic
- field of melt + solid B



Explain the crystallization path of a liquid with composition M as the temperature drops from T_{initial} to T_{final} (5 marks).

Marking Scheme: (Total Marks 65).

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

Question 2: 15 marks in total (5 marks per mineral)

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

3f): 7 marks for the first part and 3 marks for the second part.

3g): 5 items worth 1 mark each, second part worth 5 marks.