

Name _____ Student number _____

YOU MUST ANSWER ALL PARTS OF ALL SIX QUESTIONS

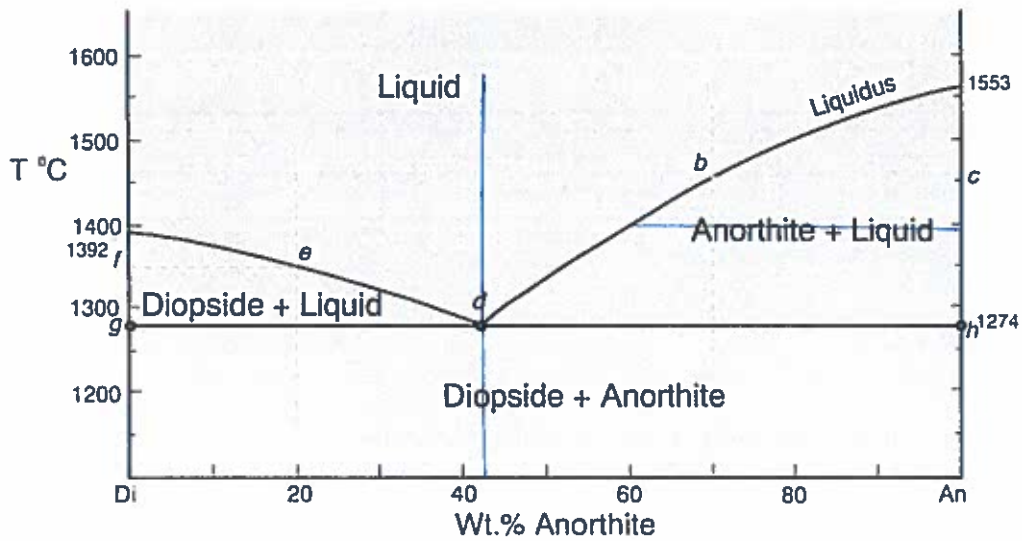
QUESTION 1

- a) What is meant by a **porphyritic** texture in an igneous rock?
[2 marks]
- b) Would you expect a porphyritic igneous rock be intrusive or extrusive?
[1 mark]
- c) Give an example of a rock type that is porphyritic
[1 mark]
- d) Give the definitions of **primary**, **primitive** and **parental** magmas. In your answer be clear about the differences between these three magma types, and how they might be related to one another by fractional crystallization. Give as much detail as you can.
[6 marks]

QUESTION 2

- a) Why do rocks typically only partially melt in nature and not melt to completion?
[2 marks]
- b) What are the three main processes that cause melting of the Earth's mantle?
[3 marks]
- c) Imagine you can view a mantle rock under the microscope as it starts to melt. Where in the rock does melting first begin? Explain why the first melt that forms can be enriched in incompatible trace elements
[5 marks]

QUESTION 3



Use the phase diagram above to answer the following questions:

(a) A rock, consisting of 70% anorthite and 30% diopside is heated up, until it starts melting. What is the composition, expressed in % An and Di, of the melt that forms first?

[1 marks]

(b) What are the proportions of solid and liquid that are in equilibrium at the moment when the liquid has reached a temperature of 1400 °C?

[2 marks]

(c) How many degrees of freedom are there at this temperature?
(Note that in this isobaric case $F = c - v + 1$)

[2 marks]

(d) What is the composition of the liquid, expressed in % An and Di, when the temperature has reached 1600 °C?

[2 marks]

(e) In what kind of rock or geological environment would this phase diagram be used to model melting and why?

[3 marks]

QUESTION 4

Suppose that Sr has the following distribution coefficients for olivine, plagioclase and orthopyroxene: 0.01, 1.8 and 0.015 respectively.

(a) For which mineral(s) is Sr a compatible element?

[1 mark]

(b) Which mineral(s) would have to crystallize in order to increase the Sr concentration of the remaining liquid?

[2 marks]

(d) Explain in as much detail as you can how you would distinguish olivine, plagioclase and orthopyroxene under the optical microscope

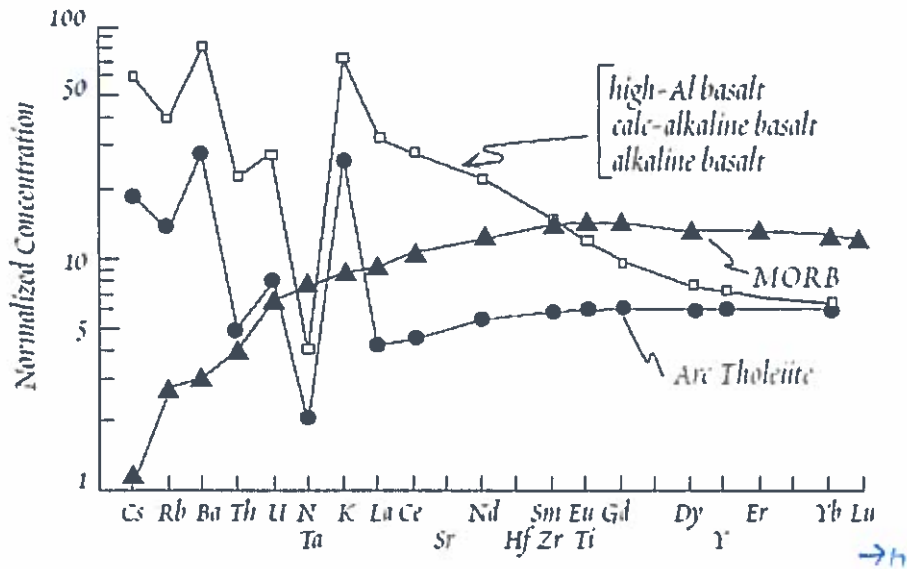
[4 marks]

(e) In which igneous rocks would you expect to find abundant plagioclase: granite or basalt or both? Why is this?

[3 marks]

QUESTION 5

Use the following diagram to answer the questions below:



(a) Why are only rocks of basaltic-composition (low SiO₂) plotted on this diagram?

[3 Marks]

(b) Why does the abundance of the trace elements in MORB decrease as you go from right to left?

[4 Marks]

(c) Why are the shapes of the curves for the other basalts different to MORB? What processes were responsible?

[3 Marks]

QUESTION 6

(a) What are the two main types of **basaltic lava flow** that can be seen in the field? Give as much detail as you can about the structure and features of the lava flows

[4 marks]

(b) Explain why volcanic eruptions become more explosive as magma viscosity increases

[3 marks]

(c) Which scale is used to determine the potential impact of a volcanic eruption on its surroundings? In your answer list the parameters that can be measured to define this scale

[3 marks]