GEO2-1205 Tentamen: MINERALS **19 March 2015**

Name [redacted] Student nummer [redacted]

YOU MUST ANSWER ALL PARTS OF QUESTIONS 1-5

QUESTION 1

a) Amphiboles and pyroxenes are both what type of silicate mineral?
[1 mark]

b) How do they differ in their structure with respect to their silica tetrahedra? [1 mark]

c) Describe how you could identify between amphibole and pyroxene minerals in thin section in a light microscope with plane polarized light.
[3 marks]

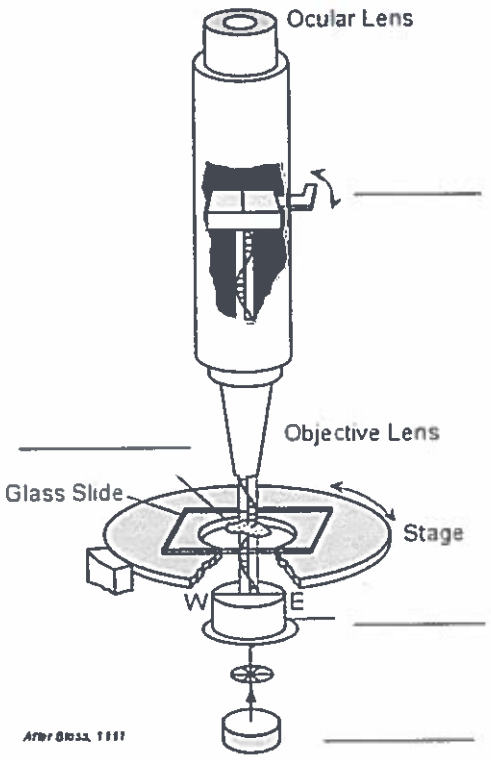
d) Explain how this is related to the crystal structures of pyroxene and amphibole.
[5 marks]

QUESTION 2

a) On the image of the light microscope below fill in the missing labels.
[2 marks]

b) Explain how we get double refraction when light travels through the calcite crystal. How is this related to the calcite structure?
[5 marks]

c) What would garnet (isotropic) look like under cross polars?
[1 mark]

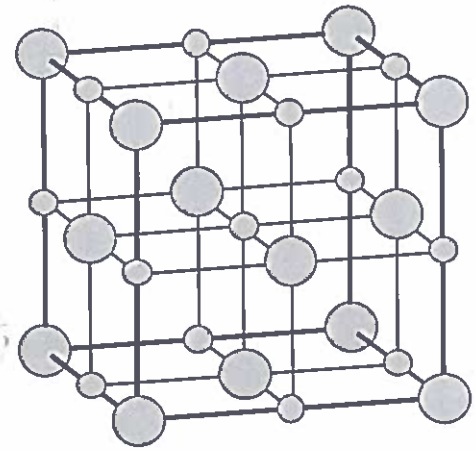


d) How [redacted] crystal structure of isotropic materials produce this effect in cross polarized light?

[3 marks]

QUESTION 3

The following is a type of close packed structure



a) Which interstitial sites are occupied in this structure? [1 mark]

b) What kind of close packed structure is this? [1 mark]

c) How many layers of close packed atoms are there before the structure repeats?
[1 mark]

d) What is the co-ordination number of the cations in this structure?
[1 mark]

e) Give an example of a mineral that adopts this structure and its chemical formula.
[1 mark]

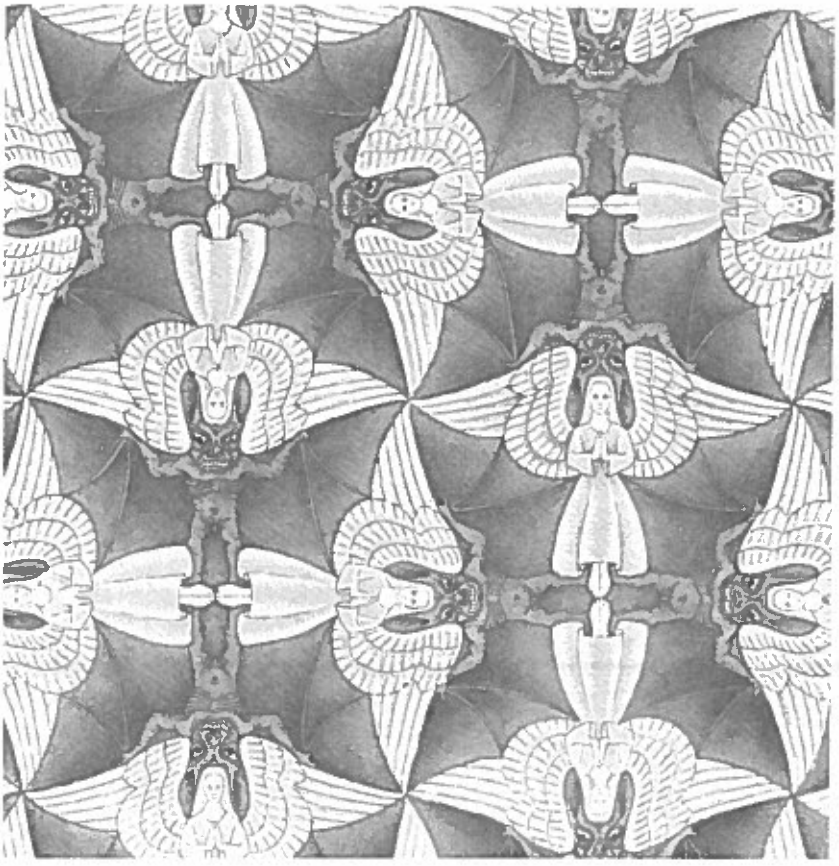
Fluorite (CaF_2) has a similar structure to that given above but the interstitial sites are filled in a different way

f) Which is the close packed ion in fluorite and why? [3 marks]

g) Which interstitial sites are occupied in fluorite? [1 mark]

h) What is the structural difference between the close packed structures of fluorite and sphalerite (ZnS)? [1 mark]

QUESTION 4



Look at the Escher pattern above and answer the following questions.
Give your answers for parts a) and b) on ~~tracing paper.~~ draw on the answerbook

a) Show the 2D symmetry elements using the official symbols for rotation axes, mirror planes and glide planes on the tracing paper. [5 marks]

b) Draw the boundary of the unit cell [1 mark]

c) What is the plane group? *Use Appendix A at the end of this exam paper to help you.* [1 mark]

_____

d) What is the multiplicity of the motif? [1 mark] _____

e) Explain the difference between a special and a general position: [2 marks]

QUESTION 5

a) What are the three mechanisms that produce colour in minerals? Give some examples of coloured and colourless minerals.
[5 marks]

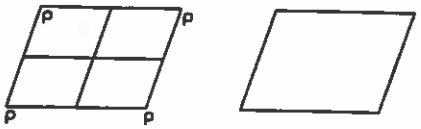
b) Describe what is meant by *pleochroism* and give an example of a mineral that is pleochroic.
[3 mark]

c) Would you expect to see the same amount of pleochroism on all of its crystal faces? If not ,why not?
[2 marks]

Appendix A: *Two dimensional plane groups*

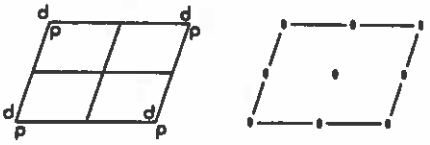
1 Oblique

p1



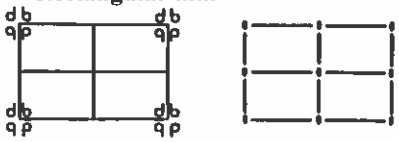
2 Oblique

p2

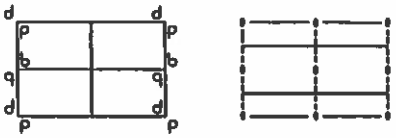


Rectangular mm

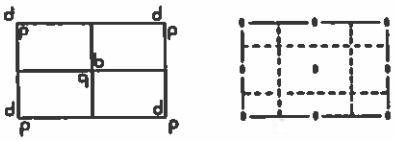
pmm



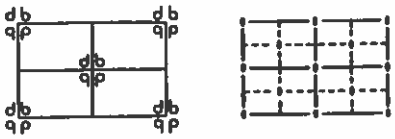
pmg



pgg

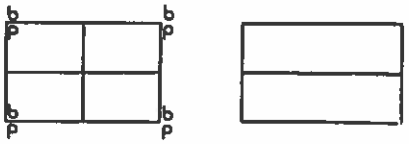


cmm

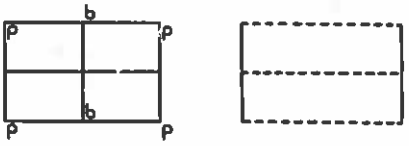


Rectangular m

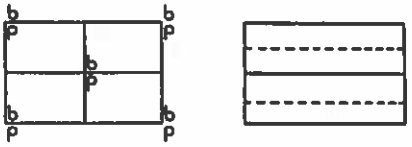
pm



pg

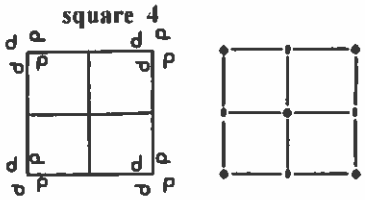


cm



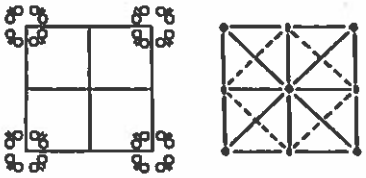
square 4

p4

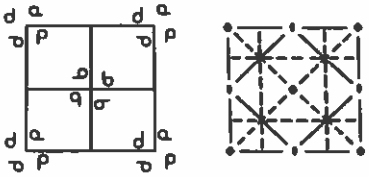


square 4mm

p4m

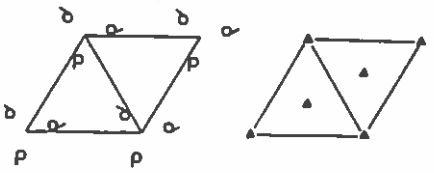


p4g



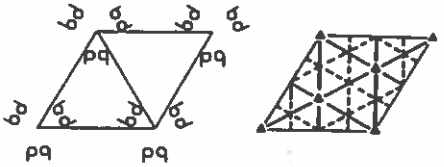
Hexagonal 3

p3

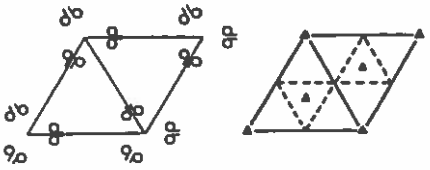


Hexagonal 3m

p3m1

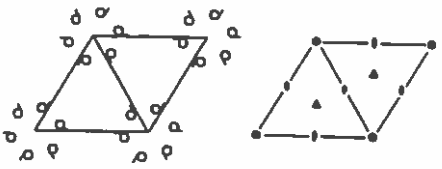


p31m



Hexagonal 6

p6



Hexagonal 6 mm

p6m