UNIVERSITY OF PRETORIA

GLY 251 – CRYSTAL CHEMISTRY AND OPTICS

1. Semester test

Answer all the questions and use sketches where applicable.

Theory questions [5 marks each]

1 Explain the difference between the generation of continuous X-rays and of characteristic X-rays.

2 Explain why there is a finite number of specific wavelengths for a given element.

3 Discuss how solid solution and exsolution are related and what controls them.

4 What stacking order does cubic densest packing have?

5 What is the difference between the orthorhombic, monoclinic, and triclinic systems?

6 Sketch a rough triangular diagram and label the apices as Na (bottom left), K (bottom right) and Ca (top). Plot the feldspar minerals in terms of their molar proportions.

7 If CuKα = 1.54178Å and the 2 Θ angle is 45°, what d-spacing would be represented in an XRD pattern?

8 Explain the law on which question 7 is based.

9 Discuss whether a 2-fold rotation axis and a mirror plane can have the same effect in a crystal lattice.

10 What does (111) mean and what is described ?

Practical questions

1 An analysis of a garnet gives

SiO2	37.233
TiO2	0.021
Al2O3	20.877
FeO	25.277
MnO	6.663
MgO	2.186
CaO	7.334
TOTAL	99.591

MOLECULAR WEIGHTS

SiO2	60.08
TiO2	79.88
Al2O3	101.96
FeO	71.85
MnO	70.94
MgO	40.3
CaO	56.08

t silicate) and to what group garnet belongs [5]

An oxide mineral gives the analysis:

	Wt%
SiO2	0.345
TiO2	6.577
Cr2O3	2.5
V2O3	0.150
FeO	81.800
MgO	3.3
TOTAL	94.672

MOLECULAR WEIGHTS	
SiO2	60.08
TiO2	79.88
Cr2O3	151.99
V2O3	149.88
FeO	71.85
MgO	40.3

Calculate the mineral chemical formula of this spinel [10] and give a revised analysis if necessary [10].

3. Is the following analysis an example of maucherite ($Ni_{11}As_8$) or of nickeline (NiAs)? Give your arguments [10]

Element	Mass %	Mass
Fe	29.4	55.847
As	69.8	74.922
S	0.21	32.066
Total	99.71	

	Mol. weight	Wt-%	cation equiv	Mol of O	TO 4 O
* Cr_2O_3	75.995	2.5	0.032897	0.01645	0.1145
* FeO	71.81	81.800	1.13912	1.13912	3.964
				1.14936	4

factor = 1.149365

$\therefore (Fe_{3.964}Cr_{0.1145})O_4$ $\div 3.458$