UNIVERSITY OF JOHANNESBURG

PROGRAM	:	MAIN EXAM FOR BENG DEGREE *EXTRACTION METALLURGY*
SUBJECT	:	**FERROALLOY PRODUCTION**
CODE	:	**FAPMT 3B**
DATE	:	11 NOVEMBER 2019
DURATION	:	3 HOURS
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

EXAMINER	:	DR X PAN
MODERATOR	:	K SEDUMEDI
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS
REQUIREMENTS	:	CALCULATOR, RULER

29/09/19

03/10/2019

QUESTION 1 (7 marks)

Answer the following questions:

What is the chemical formula of chromite?
Give all names and chemical formulas of the 9 minerals that may exist in chrome ores

QUESTION 2 (13 marks)

A diagram of O-C-Fe-Cr is used to help understand the smelting process of charge chrome, produced in a submerged arc furnace. Please draw the diagram with all names of the products.

QUESTION 3 (10 marks)

Control of electrode penetration in a submerged arc furnace is one of the main challenges facing the production of charge chrome in South Africa. Please give 5 reasons and explain how they affect the penetration of an electrode.

23/09/19

Dr Kaelo Seduemedi
26/09/2019

QUESTION 4 (20 marks)

Outokumpu is one of the production processes used to produce charge chrome in South Africa. Please use I-P-O process model to answer the following questions of the process:

1. Give the details of 5 raw materials used as inputs
2. Give the details of 3 main outputs
3. Draw the process flow-sheet

QUESTION 5 (50 marks)

(1) Using charge recipe calculation with the attached conditions, please answer the following questions:

1. SiO2 wt-% in SiO2-MgO-Al2O3 slag?
2. How many kg of quartz?
3. How many kg of coke?

(2) Using the 5-zone model of Dr Pan with the attached conditions, please calculate the mass balance in each zone

The required conditions are as the followings:

- **985 kg of ore**
- Final alloy with **3-5% Si, and 6-8% C**
- Final slag with **12-14%Cr2O3, and 6-8%FeO**

- The chemical compositions of raw materials are given in Table 1. The required liquidus temperature is 1700 °C for the slag of SiO2-MgO-Al2O3.

- The atomic weights of some elements are listed in Table 2, and the SiO2-MgO-Al2O3 phase diagram is given in Figure 1.

Please submit the Figure 1 together with your answer sheet/s.

23/09/19

Dr Kaela Sedumedi
26/09/2019

Table 1. Raw Material Composition

Name	Cr2O3%	FeO%	Fe2O3%	MgO%	SiO2%	Al2O3%	H2O%	C%
Ore	39	23	0	12	9	12	5	0
Quartz	0	0		0	100	0	0	0
Coke	0	0		0	7	4	0	89

Table 2. Atomic Weight

Element	Fe	Cr	Si	Al	Mg	O	C	H
Weight	56	52	28	27	24	16	12	1

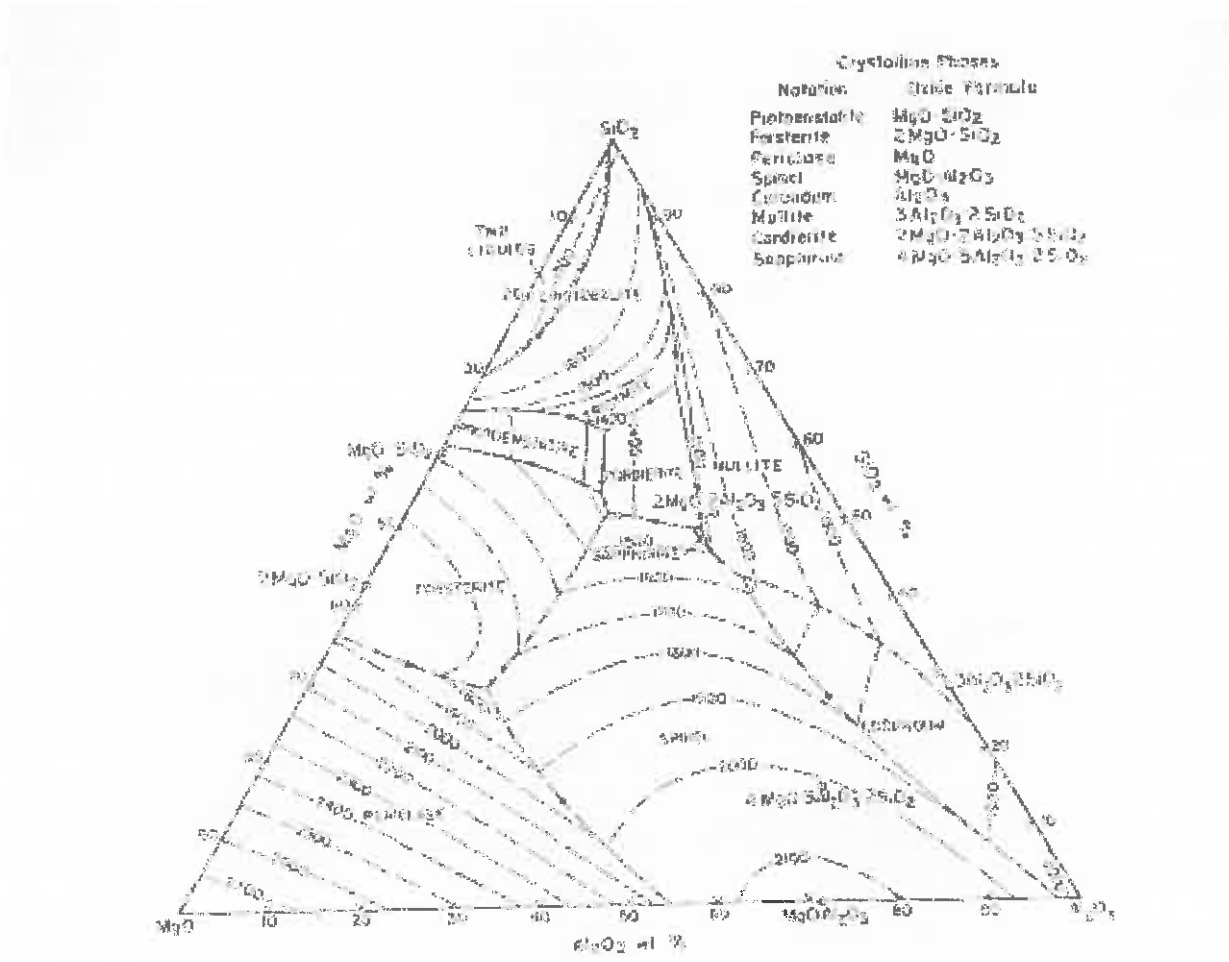

Figure 1. SiO2-MgO-Al2O3 Phase Diagram

Total = 100%

23/09/19

Dr Kaelo Sedumedi
26/09/2019