UNIVERSITY OF JOHANNESBURG

PROGRAM	:	MAIN EXAM FOR NATIONAL DIPLOMA *ENGINEERING METALLURGY*
SUBJECT	:	**PRODUCTION OF IRON AND STEEL 3**
CODE	:	**PRS302**
DATE	:	SUMMER EXAMINATION 2017 24 NOVEMBER 2017
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

EXAMINER	:	DR X PAN
MODERATOR	:	M HENDERSON
NUMBER OF PAGES	:	5 PAGES

INSTRUCTIONS	:	ANSWER ALL QUESTIONS
REQUIREMENTS	:	CALCULATOR, RULER

QUESTION 1 (8 marks)

Give the full names of the following short terms used widely in process control:

- PLC
- PID
- SCADA
- DCS
- MES
- MPC
- APC
- ERP

QUESTION 2 (8 marks)

Please draw a diagram and use percentage to explain how the chromite resources/reserves are used in world market.

QUESTION 3 (14 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 4 (10 marks)

Electrode breakage is one of the main challenges facing the production of charge chrome in submerged arc furnace in South Africa. Describe different types of breakages with main causes.

QUESTION 5 (26 marks)

Conventional submerged arc furnace process (SAF) 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 3 raw materials used as inputs
2. Give the details of 3 main outputs
3. Give 10 names of equipment
4. Draw the process flow-sheet

QUESTION 6 (10 marks)

Outokumpu and Premus are two of the production processes used to produce charge chrome in South Africa. Give 10 differences between Premus process and Outokumpu process.

QUESTION 7 (24 marks)

Charge recipe is part of the process design required to produce ferrochrome in a ferroalloy plant. Please use the required conditions below to answer the following questions:

1. How many kg of quartz?
2. How many kg of coke?
3. Final chemical composition of metal in weight percentage?

The required conditions are as the followings:

- **13 535 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 a SiO2-MgO-Al2O3 phase diagram is given in Figure 1.

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

Table 1. Raw Material Composition

Name	Cr2O3%	FeO%	Fe2O3%	MgO%	SiO2%	Al2O3%	H2O%	C%
Ore	39	15	8	14	9	10	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

Total = 100

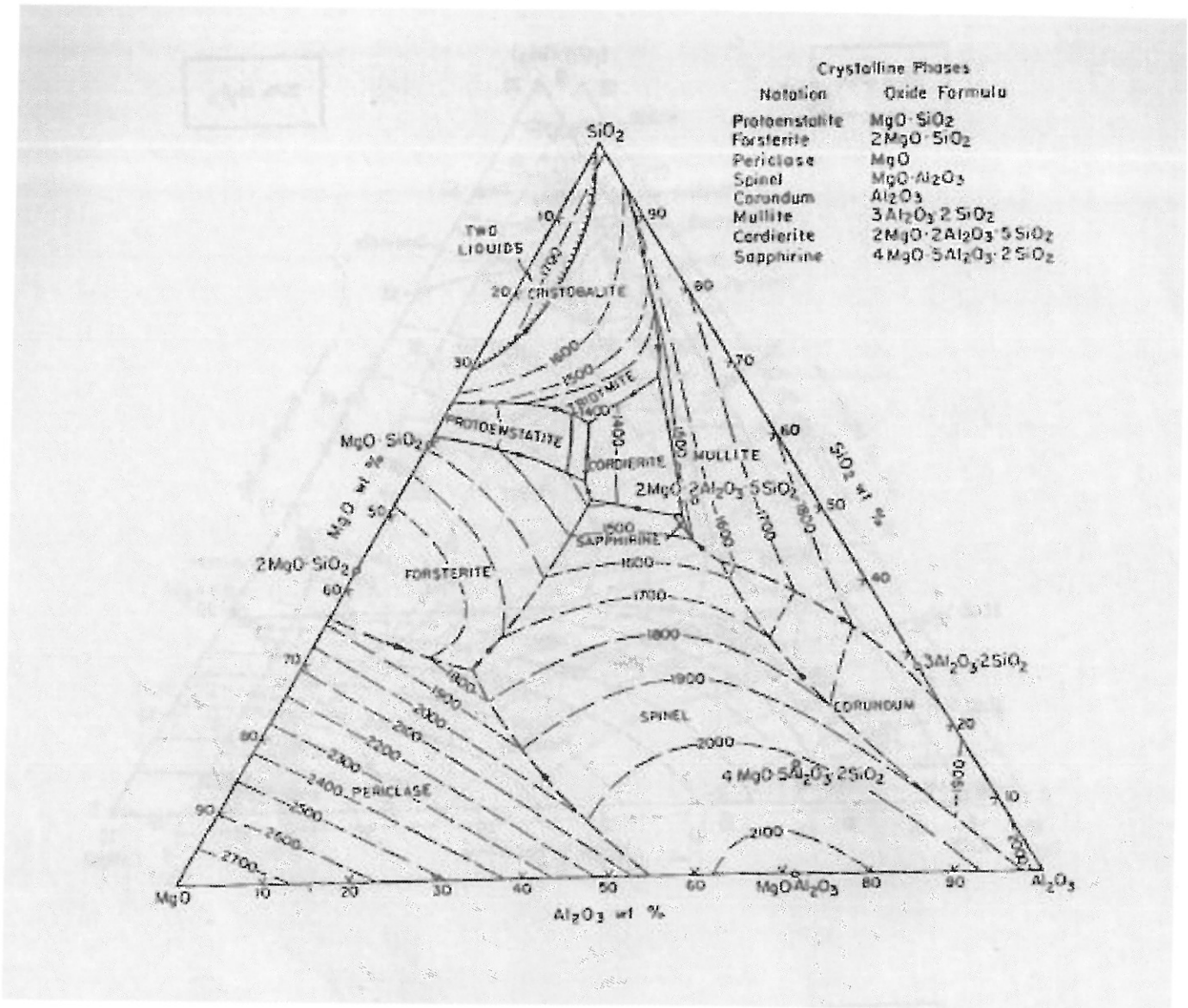

Figure 1. SiO2-MgO-Al2O3 Phase Diagram