UNIVERSITY
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JOHANNESBURG

PROGRAM	: NATIONAL DIPLOMA
	ENGINEERING METALLURGY
SUBJECT	: **EXTRACTIVE METALLURGY II**
CODE	: **TEX2111**
DATE	: SUMMER EXAMINATION 2014
	07 NOVEMBER 2014
DURATION	: (X – PAPER) 8:30 – 11:30
WEIGHT	: 40:60
TOTAL MARKS	: 101

EXAMINER	: Dr. SC DU PLESSIS
MODERATOR	: Mr M. KALENGA
NUMBER OF PAGES	: 3

INSTRUCTIONS	: QUESTIONS PAPERS MUST BE HANDED IN.
REQUIREMENTS	: ONE CALCULATOR

INSTRUCTION TO CANDIDATES:

1. PLEASE ANSWER ALL QUESTIONS.
2. CALCULATORS ARE ALLOWED.

Question 1

A zinc flotation concentrate, substantially pure ZnS, is roasted to ZnO without fuel. The roaster gases contains 6 % SO_2 and 1 % SO_3, balance N_2 and O_2.

1.1 Calculate the quantity of dry air fed to the roasting apparatus, in standard ft³/short ton of ZnS.

(25 marks)

Question 2

Moisture in the air is determined by measuring the dew point and barometric pressure, which are found to be 16.5 °C and 752 mm, respectively. The air temperature is 240 ° C. Calculate

2.1 % H_2O by volume in the air,
2.2 Humidity, lb H_2O/lb dry air
2.3 Relative humidity, %
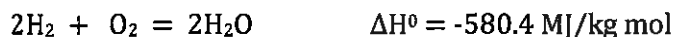2.4 Grains moisture per actual cu ft   (16 marks)

Question 3

3.1 List the different processes of fire refining of metals commonly used in extractive metallurgy. Give two examples of application for each process.

(10 marks)

3.2 A coal has the following composition ultimate analysis (on moisture free basis): 79.86 % C, 5.02 % H, 1.18 S, 1.86 % N, 7.81 % ash, 3 % moisture. Calculate the heating value of this coal and the adiabatic flame temperature if the coal (25 °C) is burned with 125 % of the stoichiometric amounts of air.

$2H_2 + O_2 = 2H_2O$ $\Delta H^0 = -580.4$ MJ/kg mol

$C + O_2 = CO_2$ $\Delta H^0 = -398.8$ MJ/kg mol

$S + O_2 = SO_2$ $\Delta H^0 = -297$ MJ/kg mol

Atomic masses: C=12, O=16, N=14, S=32, H=1

Specific heats Cp:

CO_2: 44.17 +9.04 10^{-3} T, kJ/mol K

H_2O: 30.02 +10.72 10^{-3} T, kJ/mol K

Question 3.2 (continued)

SO_2 : 37.25 +8.31 10^{-3} T, kJ/mol K

Ash: 1.08, kJ/kg

O_2 : 29.98 + 4.19 10^{-3} T, kJ/mol K

N_2 : 27.88 +4.27 10^{-3} T, kJ/mol K

(20 marks)

Question 4

A copper ore contains 14 % copper combined as Cu_2S, 15 % silica and the rest pyrite. It is smelted in a reverberatory furnace, oil fired, together with copper concentrates containing 35 % Cu_2S, 40 % silica and 25 % pyrite. Fluxes used are iron ore containing 80 % hematite, 20 % silica and pure limestone.

4.1 What is the primary function of a slag in pyrometallurgy **process ?**   (4 marks)

4.2 What are the practical requirements of a good slag ?   (7 marks)

4.3 Calculate the matte grade if a ton of of charge is made of 294 kg of crude ore, 458 kg of copper concentrates, 176 kg of iron-ore flux and 73 kg of pure limestone flux.

(15 marks)

4.4 In this particular situation, suggest and motivate a way to improve the matte grade beyond 50 %.

(4 marks)

TOTAL MARKS: 101