PROGRAM	**: B ENG TECH**
	ENGINEERING METALLURGY
SUBJECT	**: FOUNDRY TECHNOLOGY A3**
CODE	**: FOUMTA3**
DATE	**: SSA EXAMINATION**
	JULY 2019
DURATION	**: (X-PAPER) 8:30 – 12:30**
WEIGHT	**: 40: 60**
TOTAL MARKS	**: 90**
FULL MARKS	**: 90**

EXAMINER	**: MR KKC KYALU**
MODERATOR	**: MR I KILONGOZI (EXTERNAL)**
NUMBER OF PAGES	**: 4 PAGES**

INSTRUCTIONS:

QUESTION PAPER MUST BE HANDED IN.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1 (15 Marks)

1.1 In greensand technology, compactibility and permeability are two of the properties of the sand. What are the two properties sensitive to? (4)

1.2 What are the critical characteristics of moulding sand? (6)

1.3 Which critical characteristic of mould sand affects refractoriness? (1)

1.4 Which properties are affected by grain shape and distribution? (2)

1.5 Which properties are affected by grain shape? (2)

QUESTION 2 (20 Marks)

The input and outputs flows of a greensand mullor are schematically shown in Figure 1. The mullor supplies two automatic high-pressure squeeze-moulding machines. One moulding machine is dedicated for the production of copes while the other machine is for the production of drags. The cope and the drag are assembled at a rate of 250 complete moulds/ hour. The moulding machines have the following characteristics:

- Flask dimensions: 600 X 400 X 110 mm3
- Weight of the greensand for the cope: 35 kg
- Weight of the greensand to produce the drag: 40 kg
- Average casting weight in the mould: 13.6 kg
- Density of casting: 7.8 kg/m3

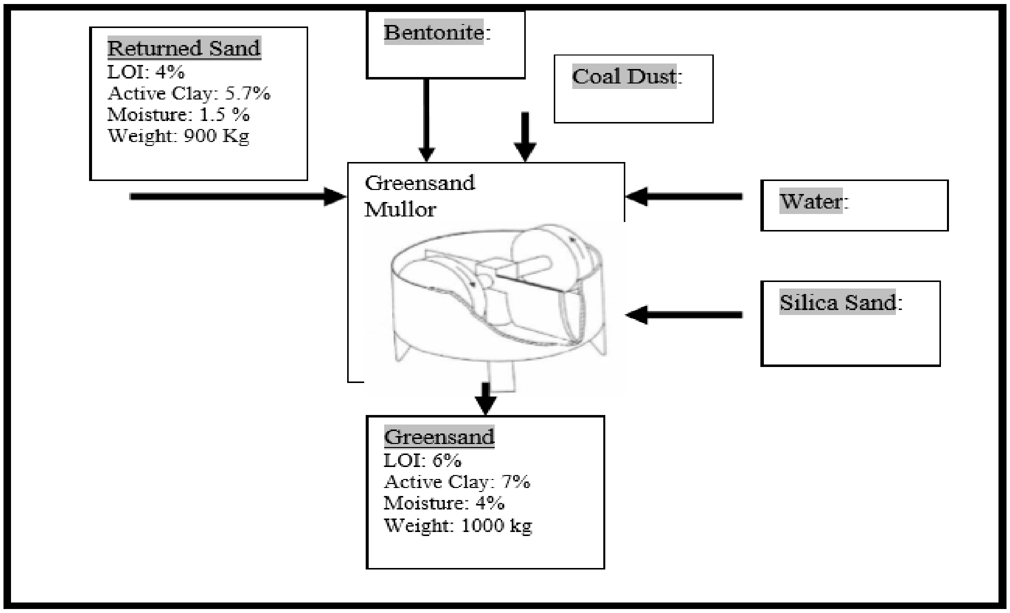

Figure 1. Additions of raw materials around a greensand mullor

2.1 Determine the following:

2.1.1 The monthly requirements of greensand raw materials: bentonite, coaldust and silica sand for this foundry. Consider that a month has 20 working days and a working day has 8 hours. Show all the calculation steps (10)

2.1.2 The burn-off of bentonite and carbonaceous material applicable in the foundries. (5)

2.1.3 If the casting weight is reduced from 13.6 kg to 9.8 Kg, predicts and justify the variation of the following greensand properties:

2.1.3.1 Compactibility (2.5)

2.1.3.2 Green strength (2.5)

QUESTION 3 (20 Marks)

A foundry using a coreless induction furnace with a capacity of 10 tons has requested a MA2 manganese steel with a chemical composition shown in table 1 to cast 2 pin cages with a gross weight of 4500 kg each made of chemical bonded sand. The ladle must use a 48 mm nozzle.

Table 1. Chemical composition of MA2 (%)

C	Si	Mn	Cr	S	P	Al
1.05	0.8	12.25	0.45	0.01	0.02	0.04

3.1 Explain one core making process of your choice belonging to the gas-triggered chemical bonded system. Your answer should include:

3.1.1 The name of the process (1)

3.1.2 The resin (2)

3.1.3 The catalyst (2)

3.1.4 Advantages and disadvantages of the process (4)

3.1.5 Name 1 main chemical bonded sand systems used in foundries that is self-hardening (1)

3.2 Between a Kaltek and a castable ladle, which one will you use for this exercise and give reasons for your answer? (5)

3.3 Using the CLS methods as per table 2 below, calculate the liquidus temperature of MA2, the liquidus temperature to be considered for 1.05 C is 1531°C? (5)

Table 2. CLS Methods

Alloying Element X	**Al**	**Cr**	**Mn**	**Mo**	**Ni**	**P**	**S**	**Si**	**C**	**V**
Coefficient α	-2.5	-1.5	-4	-5	-3.5	-30	-45	-14	73.1	-4

QUESTION 4 (35 Marks)

A foundry operates a coreless induction furnace lined with a silica refractory material. The capacity of the melting furnace is 5 tons. The foundry produces two heats per days. The melting characteristics of raw materials available for the furnace charge are listed in Table 1.

Table 1. Chemical compositions of melting raw materials.

Material		Addition Rate [%]	Price [R/kg]	C [%]	Si [%]	Mn [%]	S [%]	P [%]	Fe [%]
Primary melting	Pig Iron	10	5	4.5	1.5	0.1	0.1	0.08	Remainder
	Steel Scrap	30	1.1	0.3	0.2	0.8	0.05	0.05	Remainder
	Foundry returns	Remainder	-	3.2	2.0	0.6	0.1	0.2	Remainder
Additions	Graphite	(b)	8	99.5	-	-	0.09	-	-
	FeSi	(c)	25	-	75	-	-	-	25
	FeMn	(d)	19	-	-	80	-	-	20

4.1 Calculate the following:

4.1.1 The monthly requirement of graphite, FeSi and FeMn addition for the melting to produce a grade 150 grey cast iron alloy with the chemical composition shown in Table 2. Assume there is no loss of elements during melting. Show all the steps.

Table 2. Chemical composition of grey iron grade 150

C	Si	Mn	S	P
3.1-3.4	2.5-2.8	0.5-0.7	0.15 Max	0.5 Max

(10)

4.2 Determine the cost in Rand/ton of producing the alloy in the foundry (5)

4.3 Explain the functioning principle of a coreless induction melting furnace (6)

4.4 Explain two functions of the Alumina refractory lining of the furnace (4)

4.5 With the aid of appropriate diagram, explain the effect of inoculation on the microstructure of gray cast iron (10)