PROGRAM	**: B ENG TECH** **ENGINEERING METALLURGY**
SUBJECT	**: FOUNDRY TECHNOLOGY A3**
CODE	**: FOUMTA3**
DATE	**: MAIN EXAMINATION** **03 JUNE 2019**
DURATION	**: (Y-PAPER) 12:30 – 16:30**
WEIGHT	**: 40: 60**
TOTAL MARKS	**: 100**
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 (30 Marks)

The input and output flows of a greensand mullor is schematically shown in Figure 1. The mullor supplies a High Pressure (HP) moulding machine producing 250 moulds per hour. The moulding machine have the following characteristics:

- Flask dimensions: 600 X 400 X 220 mm3
- Achieved mould compaction density: 1.5g/cm3
- Average casting weight in the mould: 13.6 kg
- Casting density: 7.2 g/cm3

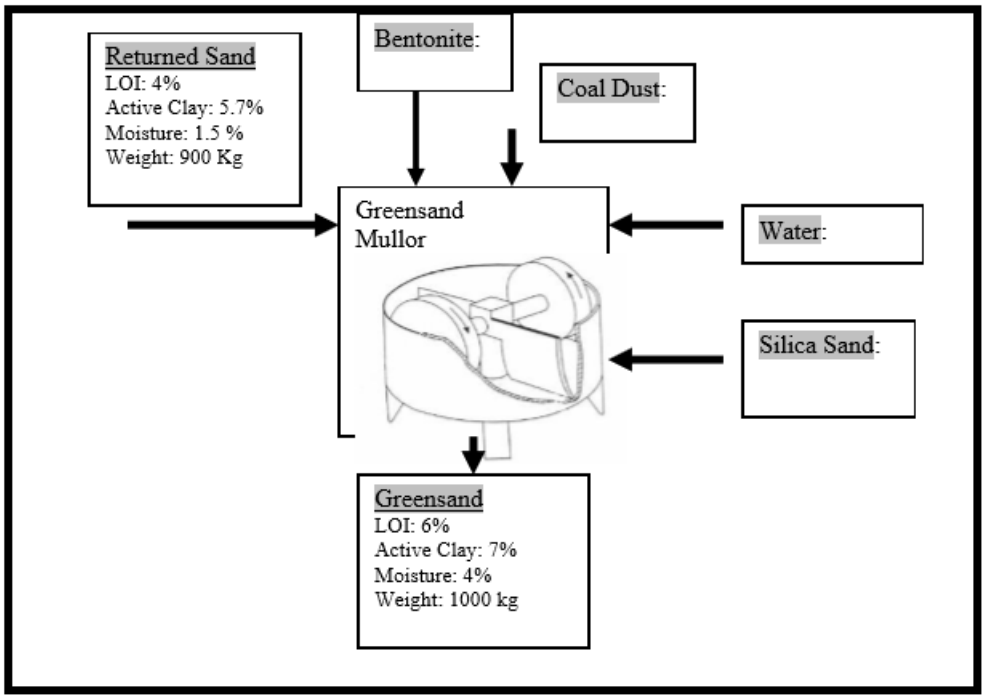


Figure 1. Additions of raw materials around a greensand mullor

1.1 Determine the following:

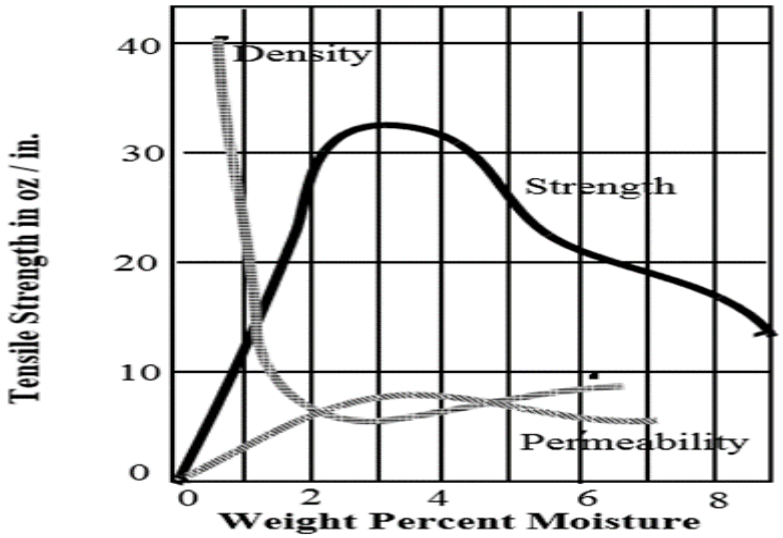
1.1.1 The requirements of bentonite, coaldust and silica sand for the sand plants for a shift production corresponding at 11 tons of casting. Show all the calculation steps (10)

1.1.2 If the casting weight increases from 13.6 kg to 18 Kg, predict and justify the variation trends of the following greensand properties:

1.1.2.1 Permeability (2.5)

1.1.2.2 LOI (2.5)

1.2 Based on the Graph below



1.2. what is the most sensitive strength measurement in green sand and why? (5)

1.2.2 If the percentage of clay in the sand is 6%, determine the percentage of moisture at which strength increases to maximum and what happen to the density and permeability? (10)

QUESTION 2 (20 Marks)

Your foundry is faced with a dilemma between investing in a reclamation system that is quoted at R1200000 or keeping operating without any reclamation system.

Your foundry uses an alkaline phenolic system with the following inputs:

- Chromite sand R1200/ton
- Resin R16/kg
- Catalyst R28/kg
- You are producing 40 ton of cast iron (net produced per month)
- The sand to metal ratio is 4:1
- The resin to sand ratio is 1%
- The catalyst to resin ratio is 60%
- Sand dumping cost R20000/month
- The core shop uses 5% of sand

2.1 Work out how much it will cost you per month if you don't have a sand reclamation system? (6)

2.2 If you decide to invest in a reclamation system, it has a recovery efficiency of 80%

2.2.1 Determine the percentage of new sand will you be adding to the system? (1)

2.2.2 Estimate the cost savings if you invest in a new reclamation system assuming that the costs related to chemicals and labour are very minimal? (2)

2.2.3 How long will it take to repay the equipment? (2)

2.3 What are the objectives of the sand reclamation system? (3)

2.4 Differentiate between thermal and mechanical sand reclamation systems (6)

QUESTION 3 (20 Marks)

The foundry using an Electric Arc Furnace (EAF) with a capacity of 10 tons has requested a MN1 steel with a chemical composition shown in table 1 to cast a mantle with a gross weight of 8600 kg made of chemical bonded sand. The ladle must use a 51mm nozzle.

Table 1. Chemical composition of MN1 (%)

C	Si	Mn	Cr	S	P	Al
1.15	0.8	12	0.5	0.01	0.02	0.04

3.1 What are the 3 main chemical bonded sand systems used in foundries. In your response, indicate which system is triggered or self-hardening? (6)

3.2 Explain one sand moulding process out of the 3 in 3.1, your answer should include:

3.2.1 The name of the process (1)

3.2.2 The resin (2)

3.2.3 The catalyst (2)

3.2.4 Advantages and disadvantages of the process (4)

3.3 Using the CLS methods as per table 2 below, calculate the liquidus temperature of MN1, the liquidus temperature to be considered for 1.15 C is 1531^{o}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 (30 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 (20 days) cost of graphite, FeSi and FeMn addition to produce a grade 250 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 250

C	Si	Mn	S	P
3.0-3.2	1.6-1.9	0.5-0.7	0.15 Max	0.3 Max

(10)

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

4.2 List and explain three advantages of coreless induction melting furnaces (6)

4.3 What refractory lining is suitable refractory lining for the melting of gray iron and give 2 reasons (4)

4.4 What are the consideration factors of a melting unit? (5)