UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: METALLURGY*
SUBJECT	:	**FOUNDRY TECHNOLOGY 3**
CODE	:	**FTY302**
DATE	:	NOVEMBER EXAMINATIONS 06 NOVEMBER 2014
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40:60
TOTAL MARKS	:	75
FULL MARKS	:	75

ASSESSOR	:	MR. K. NYEMBWE	
MODERATOR	:	Mr. C.L. JONES MR. J DAVIES	FILE: NO 5100
NUMBER OF PAGES	:	8 PAGES	

INSTRUCTIONS	:	ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.
	:	RETURN THE NOMOGRAM ON **PAGE 8** WITH YOUR NAME AND STUDENT NUMBER
	:	ANSWER ANY **3 QUESTIONS** OF YOUR CHOICE

QUESTION 1

The production trial of a new iron casting reveals that it has a particular type of defect shown in figure 1. This defect seems to appear mainly on the top surface of the cast component. This casting is produced in a silica sand based greensand mould. The methoding of the casting consists of an aided feeding method using Kalminex 2000 insert sleeves and an unpressurized bottom gating system. As the junior metallurgist, you are asked to:

1.1 Identify the casting defect and provide a short description of this type of defect (5)

1.2 From experience, it is known that this type of casting defect can be due to various factors including the type of refractory sand, the moulding compaction and the methoding used to cast the metal. Give and explain two possible causes of the defect related to the methoding of the casting (feeding or gating) (10)

1.3 Fully explain the possible effects (if any) of the following changes to the methoding system in alleviating the casting defect problem:

1.3.1 Side gating system	(2)
1.3.2 Increase number of feeders	(2)
1.3.3 Increase of metal superheat	(2)
1.3.4 Casting filtration using cellular filters	(2)
1.3.5 Increase filling time	(2)

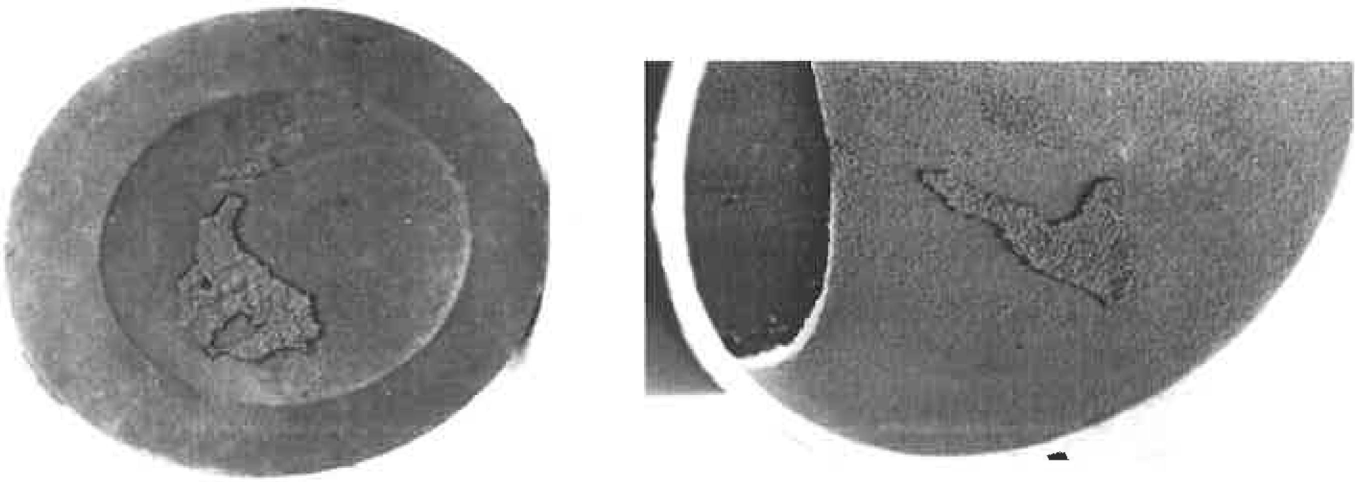

Figure 1. Views of the defect of the cast component

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QUESTION 2

Your foundry manufactures **brake disk castings in gray iron grade 250** for an international automobile company. You are asked to investigate the advantages of acquiring an **image analysis software programme and a dye penetrant testing facility** to be used for the production of quality castings. If your motivation is convincing, the required funding will be made available by the management of the foundry therefore the cost of the software is not issue. By means of short notes, argue the importance of these acquisitions for the foundry. Include in your motivation the following aspect:

2.1 The functioning principle of the above-mentioned technologies (6)

2.2 What will the technologies be used for? (5)

2.3 The implementation and integration of these technologies in the existing quality assessment and control system in place in the foundry (in relation to a gray iron foundry) in order to improve the casting quality. (5)

2.4 Your ideas on how image analysis will complement existing melt testing techniques including thermal analysis and spectroscopy. (5)

2.5 One example of commercial brand for image analysis and spectroscopy equipment. (4)

[25]

QUESTION 3

3.1 The cooling curve of a sample of gray iron melt is shown in figure 2. Describe and explain the transformation at the various inflection points indicated on the graph (8)

3.2 Suppose that this gray iron melt has been fully inoculated. With the aid of graph, explain the cooling curve of a non-inoculated cast iron. Fully explain the difference between the non-innoculated cooling curve and the cooling curve in figure 2 (10)

3.3 The chemical composition of the melt is shown in Table 1 (page 6). Use the graphs shown in Figure 3 and 4 to estimate the following:

3.3.1 The fluidity of the alloy (3)

3.3.2 The UTS of the alloy (confirm the grade of the gray iron) (Justify) (4)

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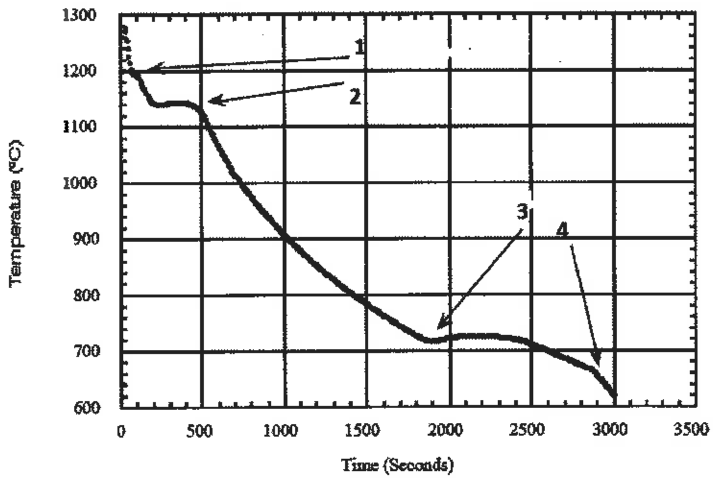

Figure 2. Thermal analysis result of the gray iron melt

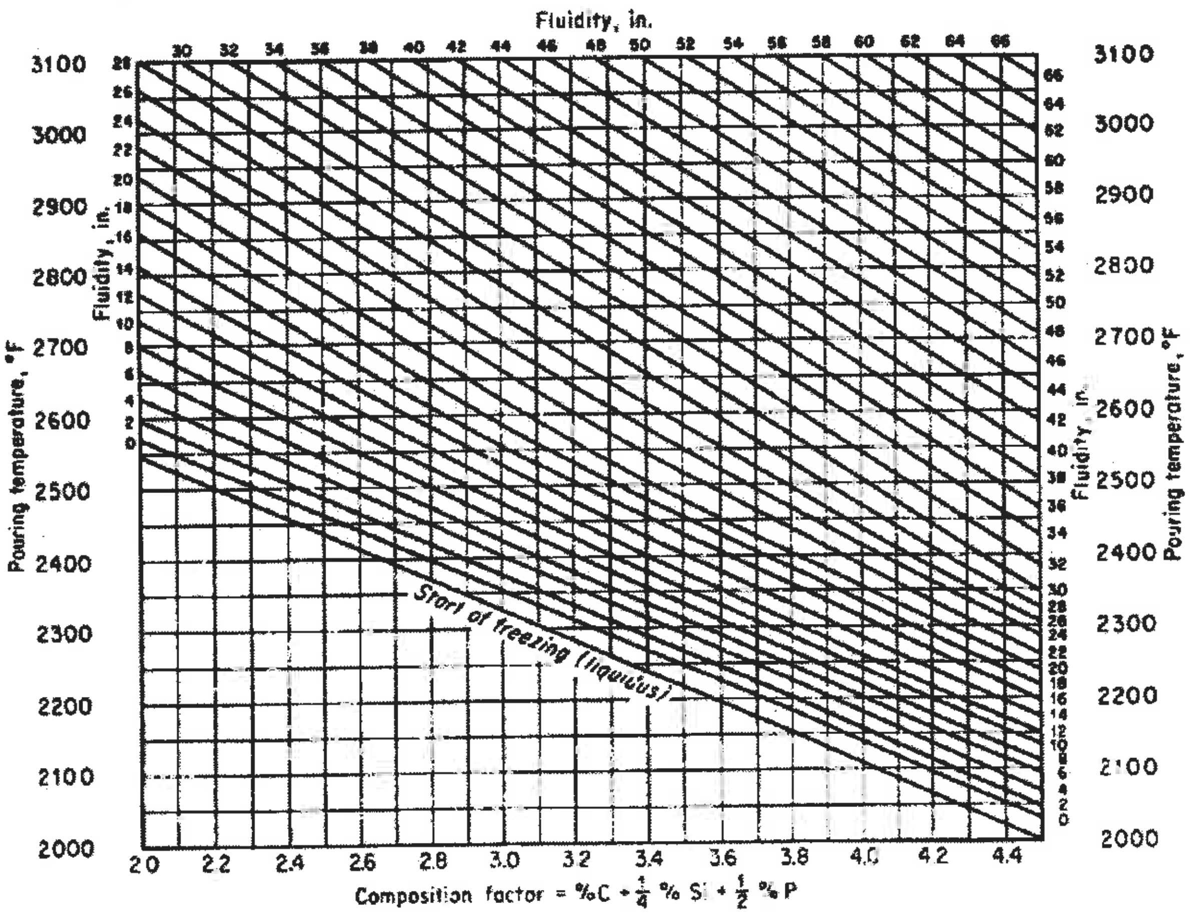

Figure 3- Fluidity related to chemical composition and temperature of grey iron

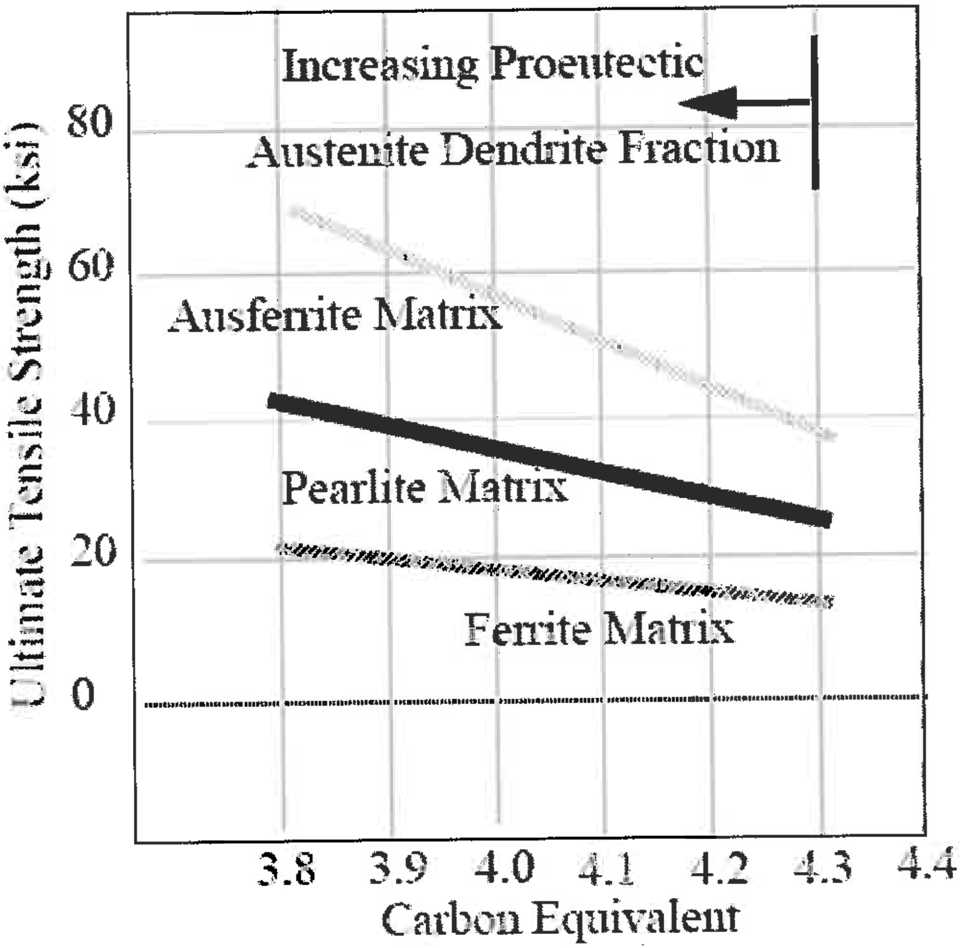

Figure 3 UTS of gray iron as a function of Carbon equivalent

QUESTION 4

Sketch the **mounted pattern plate** with the gating system attached to produce the cylindrical casting described below. The plate is 800 X 800. **On your drawings, clearly indicate all the dimensions** considering that the contraction allowance for gray iron is 0.8% and the machining allowance is 2 mm. Make use of Equation 1 to determine the appropriate gating system. (Return the nomogram on page 5)

Casting geometry

H= 500

D= 200

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Chemical composition

Table 1

Equation 1- Pouring time for Grey Iron

- For grey cast iron up to 450 Kg

Pouring time, $t = K\left(1.41 + \frac{T}{14.59}\right)\sqrt{W}$ seconds

Where K = Fluidity of iron in inches / 40

T = Average section thickness, mm

W = Mass of the casting, Kg

- For grey cast iron greater than 450 Kg

Pouring time, $t = K\left(1.236 + \frac{T}{16.65}\right)\sqrt[3]{W}$ seconds

Table 1- Chemical composition of cast alloy: Grey Iron Grade 300 (Density of this alloy is 7.3 g/cm^3)

	Total Carbon (%)	Silicon (%)	Manganese (%)	Sulphur (%)	Phosphorous (%)	Molydbdenum (%)	Copper (%)
Composition	3.1	2.8	0.60	0.10	0.01	0.50	-

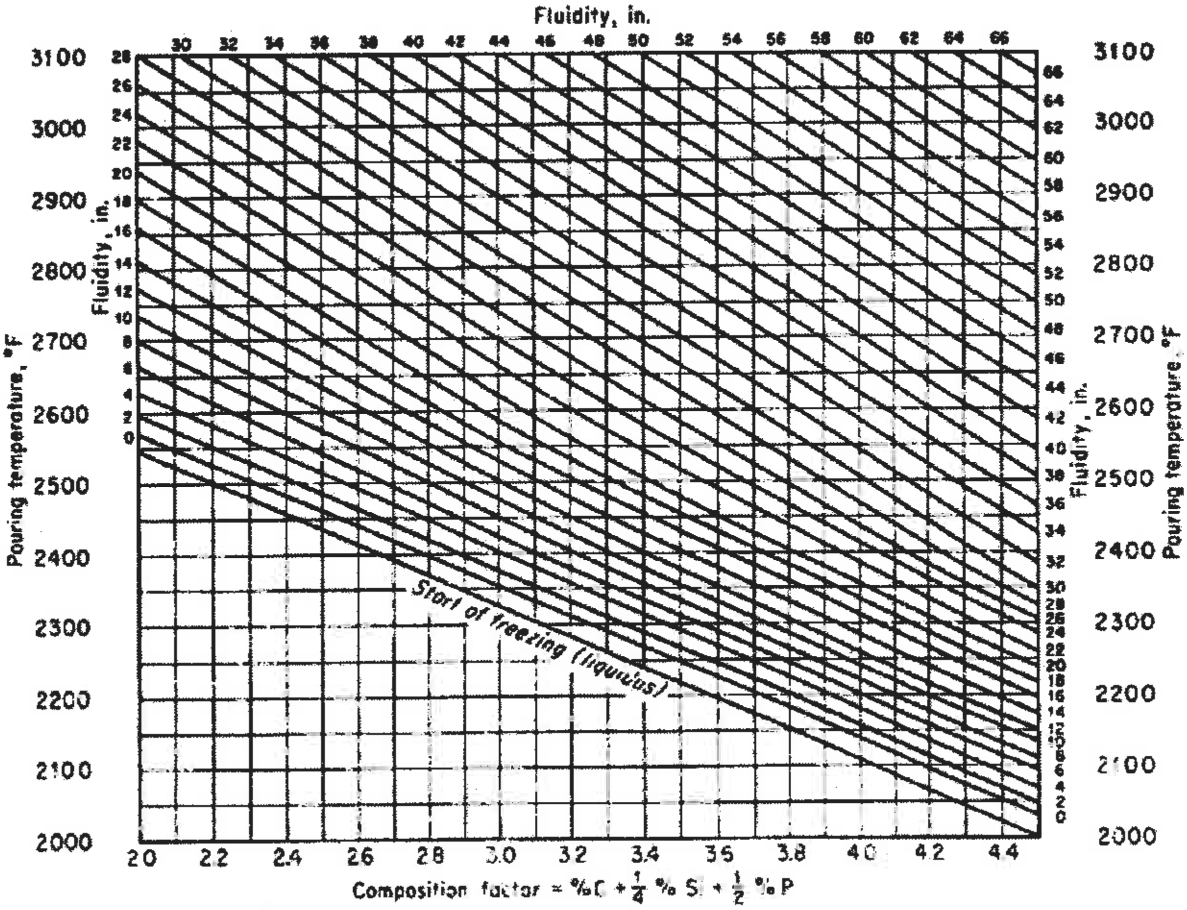

Figure 2- Fluidity related to chemical composition and temperature of grey iron

Name & Surname

Student Number:

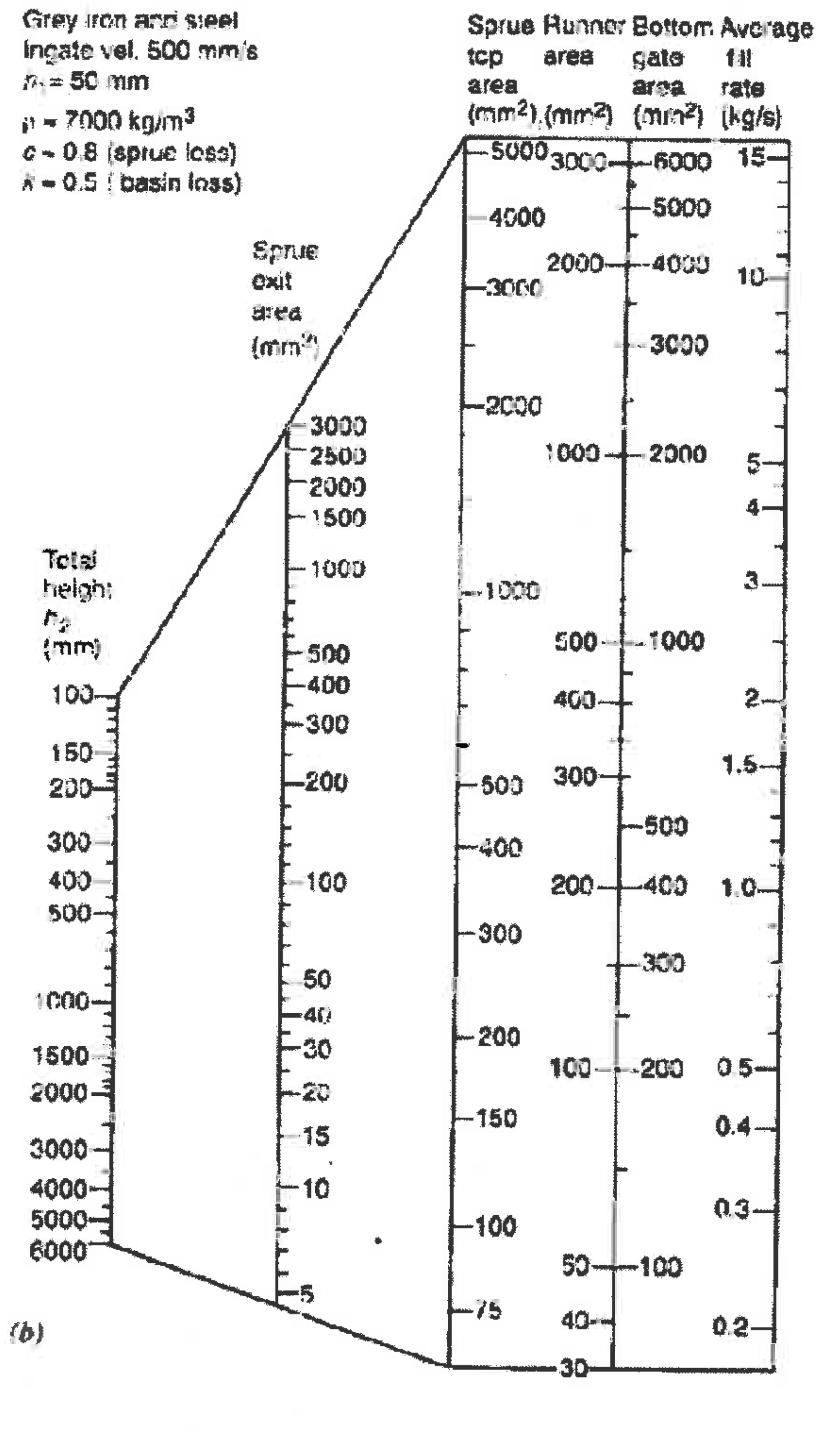

Figure 3 - Nomogram for the calculation of running systems of grey irons