UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *(ENGINEERING METALLURGY)*
SUBJECT	:	**PRODUCTION OF IRON AND STEEL 2**
CODE	:	**PRS21-1**
DATE	:	08 JUNE 2019 (Main Exam)
DURATION	:	(3 HOURS) 12:30 - 15:30
WEIGHT	:	40:60
TOTAL MARKS	:	100

ASSESSOR	:	**Mr MB MOLALA**
MODERATOR	:	**Mr M Kalenga**
NUMBER OF PAGES	:	3

INSTRUCTIONS

- First read carefully through all questions; only then
- Answer all questions in any sequence – but
- Please start answering each question on a new page
- One Calculator per student

Question 1

1.1 Taking into consideration the whole overview process from Run off mine (ROM) to continuous casting in the steel plant:

1.1.1 Show by using a flow diagram (draw) and explain/discuss key points from ROM to continuous casting. (20)

1.1.2 List five (5) raw input materials for blast furnace iron making. (5)

[25]

Question 2

2.1 Describe processes of each of the following and their purpose that occur prior to iron making:

2.1.1 Mineral dressing (5)

2.1.2 Stacking and reclaiming (5)

2.1.3 Crushing and screening of iron ore (5)

2.1.4 Sintering (5)

2.1.5 Coke making (5)

[25]

Question 3

3.1 Efficiency of the blast furnace depends on the reactions at carious zones of the blast furnace:

3.1.1 Show using sketches and colour zones to explain efficient and inefficient reductions in the upper zone of the blast furnace (4)

3.1.2 Explain why calcination & reduction is concluded in the middle zone (2)

3.1.3 Use a suitable reaction explaining how the furnace is cooled when it overheats (2)

3.1.4 Use a suitable equation explaining the refining reactions in the hearth (2)

[10]

Question 4

4.1 The temperatures of the different zones of the blast furnace determine the reactions that occur:

4.1.1 Determine the temperature range and zone in the blast furnace where the calcination reaction **[$CaCO_3 = CaO + CO_2$]** occurs (4)

4.1.2 Determine the temperature range and zone in the blast furnace where the reduction reaction **[MnO + C = Mn + CO]** occurs (4)

4.1.3 At which temperature range does the 'Water-Gas shift' and 'Carbon deposition' occur. (2)

[10]

Question 5

5.1 With reference to the carbon boil equation: [C] + [O] = $CO_{(g)}$

5.1.1 Write an expression of the equilibrium constant 'K' for the carbon boil reaction (1)

5.1.2 Write an expression of [C] in terms of 'K' (1)

5.1.3 Use the above expression to derive conditions for the decarburization of metal (4)

5.1.4 Why is decarburization to ultra-low carbon not possible in the LD vessel (4)

[10]

Question 6

6.1 Explain the correctness of each of the following views by a plant metallurgist:

6.1.1 LD slag is a suitable raw material for sinter and not blast furnace slag (2)

6.1.2 Excess Mn in blast furnace iron is beneficial but excess Si is not. (3)

6.1.3 16 minutes after blowing, the turn down analysis was 0.001 Si and 0.0004 Mn (3)

6.1.4 Cast pig iron first then spray water on hot pigs and not cast liquid iron on water, explain the correctness. (2)

[10]

Question 7

7.1 Pertaining particular to the steel-making process and LD process:

7.1.1 Explain what is meant by a basic process and an acidic process in steel making (3)

7.1.2 What are the effects of slag carry over from the blast furnace and from the LD (4)

7.1.3 What is meant by Vessel slopping with respect to the LD process (1)

7.1.4 What is meant by Vessel rocking with respect to the LD process (1)

7.1.5 What is meant by Ladle purging with respect to the LD process (1)

[10]

TOTAL MARKS: [100]

Thermodynamic data:

$C + 0.5O_2 + CO_{(g)}$	$\Delta G^o = -111700 - 88T$ J/mol
$C + O_2 = CO_{2(g)}$	$\Delta G^o = -394100 - 0.8T$ J/mol
$Mn + 0.5O_2 = MnO$	$\Delta G^o = -403000 + 90T$ J/mol
$CaO + CO_2 = CaCO_3$	$\Delta G^o = -168400 + 144T$ J/mol