

South Dakota School of Mines and Technology
Department of Materials and Metallurgical Engineering

Met 426/526

HQ 1

March 6, 2009

Reference Data are attached. Clearly include (show) with your work all data used from the reference sheets. A Show all work in the space provided. Turn in no other paper.

1. Sketch an iron blast furnace (shape is important) and
 - a) Label **five** parts of the blast furnace with proper technical jargon.
 - b) Give proper technical jargon for **three** terms used to describe the input/output flows.
 - c) List the primary impurities and their approximate wt% in the product.

2. Sketch a label a partially reduced pellet of magnetite reduced at temperatures above 567 °C.
 - a) Describe at least four possible resistances in the series reduction process and
 - b) Write the overall driving force of the process in terms of the surrounding gases CO and CO₂ pressures: P_{CO}^B and $P_{CO_2}^B$.

3. Using the attached Fe-O-C Diagram, show how to find ΔG° for the reactions
 - a) $3Fe + 4CO = Fe_3O_4 + 4 CO_2$ at 527 °C
 - b) $C + CO = CO_2$ at 527 °C
 - c) $\underline{C}_{(in\ Austenite)} + CO = CO_2$ at 927 °C
 - d) What CO to CO₂ ratio would be required to achieve an equilibrium wt% C of 0.2 at 900 °C? Assume that $f_C = 1$.

4. Show how to find ΔG° at 1873 K for below reaction USING ONLY the appropriate provided data for the Partial Molar Quantities for Liquid Alloys at 1873 K.
$$C_{(graphite)} = \underline{C}$$

5. Show how to calculate **either** the Interaction Parameter, ϵ_{Si}^{Si} , or the Interaction Coefficient, e_{Si}^{Si} , from the provided data for liquid Fe-Si alloys at 1873 K.

$$\text{Note: } \epsilon_{Si}^{Si} \equiv \frac{\partial \ln f_{Si}}{\partial x_{Si}} \text{ and } e_{Si}^{Si} \equiv \frac{\partial \log f_{Si}}{\partial wt\%Si}$$

Attached: 1) Standard Met 426/526 data sheet Fe-C and Si-Fe solution data, 2) Fe-O-C Diagram