# 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 $CO_2$ 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) $\underline{C}_{(\text{in Austenite})} + CO = CO_2$ at 927 °C
   d) What CO to $CO_2$ ratio would be required to achieve an equilibrium wt% C of 0.2 at 900 ºC? 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.
   $C_{(\text{graphite})} = \underline{C}$

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

Note: $\varepsilon_{Si}^{Si} \equiv \dfrac{\partial \ln f_{Si}}{\partial x_{Si}}$ and $e_{Si}^{Si} \equiv \dfrac{\partial \log f_{Si}}{\partial wt\%Si}$

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