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

Met 426/526 **Final (HQ #3)** **May 6, 2002**

Problems 1 – 3 refer to the following situation:
A 200 ton steel melt of 0.3 wt% C and 0.0067 wt% 0 at 1600°C needs to be deoxidized to remove 99 % of the oxygen.

Data:

$\underline{C} + \underline{0} = C0_{(g)}$ $K_{1600} = 500$

$\underline{Si} + 2\underline{0} = Si0_{2(s)}$ $K_{1600} = 3.5 \times 10^4$

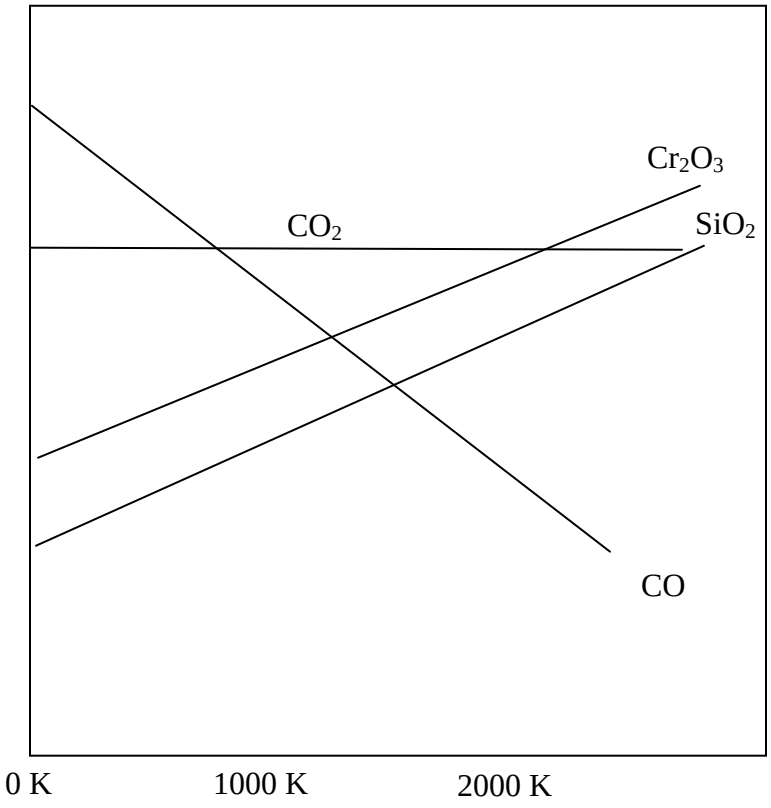
Activities of Si, 0, and C, in %, f_C, f_O, f_{Si} all unity.

1. What is the minimum amount of ferrosilicon (50% Si) that needs to be added? You may keep the current slag having an activity of SiO_2 of 0.1 or replace it with a slag that will have an activity of SiO_2 of 0.001, both relative to pure solid SiO_2.

2. What vacuum (pressure in atmospheres) must be reached in a vacuum degasser?

3. What volume (in liters, STP) of argon is needed?

4. Describe why argon and Si are used in the AOD process for making stainless steel. Use the Ellingham Diagram in your description.



5. Write the equations that describe a kinetic model (of your choice) for steel carburization that includes
    - solid diffusion resistance
    - gas diffusion, and
    - reaction kinetics.

    There is no need to derive an overall rate expression. Only write the mathematical expressions describing each part of the model and label each. A sketch would be a good idea.