SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

Met 426/526 Final Exam 5/2/11

Reference all Equations, Tables, and Figures, page numbers, etcetera used in your work.

1. Show how to compute the FeO/Fe_3O_4 line on the Fe-O-C Diagram.

2. What reaction controls the oxygen potential in
   a) the BF?
   b) Steelmaking processes?

3. Verify the numbers in Eq. (2.4.9) in Table 2.9 given for ppm hydrogen dissolved in molten Fe as a function of pressure. Note: 1 ppm = 10^{-4} %.

4. Approximately how long would it take to reduce an Fe_3O_4 pellet in H_2 at 800 °C if the pellet diameter is
   a) 1.5 cm?
   b) 4.5 cm?

5. Calculate the [%O] in a steel heat at 1550 °C in equilibrium with a slag that contains equal molar amounts of CaO and SiO_2 and 20 mole percent FeO.

6. A BF is operating at P_{CO} = 0.5 atm, 1500 °C and a slag of composition CaO = 45%, MgO = 15%, and SiO_2 = 40%. What is the
   a) [%Si]/(%SiO_2)?
   b) [%Mn]/(%MnO)?

7. What are the major reactions that control the deposition of C at the steel surface during carburization?

8. A 100 ton steel melt at 1600°C containing 0.5 wt% C in equilibrium with CO at 0.8 atm needs to be deoxidized to remove 99 % of the dissolved oxygen.
   a) What vacuum (pressure in atmospheres) must be reached in a vacuum degasser?
   b) What volume (in liters, STP) of argon is needed?

9. A V/V_2O_3 reference electrode is to be used to measure the oxygen potential of molten steel heats. Describe how to construct a plot of cell potential vs. [wt %O] at 1600 °C.

10. A 100 Ton steel melt at 1600 C is covered by a slag containing 12 wt% FeO. If the steel heat contains 10 wt% Cr, what percentage of the total Cr is in the slag? There are 10 tons of slag.