

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/Fe₃O₄ 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 Fe₃O₄ pellet in H₂ 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 SiO₂ 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 SiO₂ = 40%. What is the
 - a) [%Si]/(%SiO₂)?
 - 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/V₂O₃ 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.