

Department of Earth and Planetary Sciences

EPSC-220 Principles of Geochemistry

Assignment # 2

Fall term, 2017

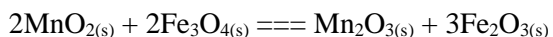
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September 25, 2017 (due date October 4, 2017)

Q. 1 Equilibrium phases

Using the thermodynamic data below, determine which of the two mineral pairs, pyrolusite and magnetite or manganite and hematite, are stable at a) 298K and 1 atm, b) 800K and 1 atm?



| | $\Delta H_f^\circ, \text{kJ mol}^{-1}$ | $\Delta G_f^\circ, \text{kJ mol}^{-1}$ |
|------------------------------|--|--|
| $\text{MnO}_{2(s)}$ | -520.03 | -465.14 |
| $\text{Mn}_2\text{O}_{3(s)}$ | -958.97 | -881.07 |
| $\text{Fe}_3\text{O}_{4(s)}$ | -1115.73 | -1012.57 |
| $\text{Fe}_2\text{O}_{3(s)}$ | -824.64 | -742.68 |

$\text{MnO}_{2(s)}$

$$C_p^\circ = 57.665 + 1.3383 \times 10^{-2} T + 2.6688 \times 10^2 T^{-0.5} - 2.0526 \times 10^6 T^{-2}$$

$\text{Mn}_2\text{O}_{3(s)}$

$$C_p^\circ = 61.943 + 0.10847 T + 1.4552 \times 10^6 T^{-2}$$

$\text{Fe}_3\text{O}_{4(s)}$

$$C_p^\circ = -293.32 + 4.1009 T$$

$\text{Fe}_2\text{O}_{3(s)}$

$$C_p^\circ = 76.331 + 0.1056 T$$

Question 2

The gauge pressure in an automobile tire when measured during the winter at 32°F was 0.206MPa (or 2.06×10^5 pascals). The gauge reads the difference between the tire pressure and atmospheric pressure (0.103 MPa). In other words, the tire pressure is the gauge reading (MPa) plus 0.103 MPa. The same tire was used during the summer, and its temperature rose to 122°F. If we assume that the volume of the tire did not change, and no air leaked out between winter and summer, what is the new pressure as measured on the gauge in pounds per square inches?

Question 3

You are hired by an environmental protection agency to study the poisonous effects of nicotine ($C_{10}H_{14}N_2$). Your preliminary library search shows that this compound has a vapor pressure of 2.27kPa at 124°C. What is its vapor density at these conditions, in g/liter?

Question 4

The virial equation that has been given for 1 mole of methane at 20°C is:

$$PV/RT = 1 - 2.024 \times 10^{-3} P + 3.72 \times 10^{-6} P^2 + 4.26 \times 10^{-12} P^3$$

- i) Calculate the pressure for the minimum in this curve of PV/RT versus P and compare the value of PV/RT at this point with that of an ideal gas (i.e., determine Z).
- ii) At what two pressures is PV/RT = 1?