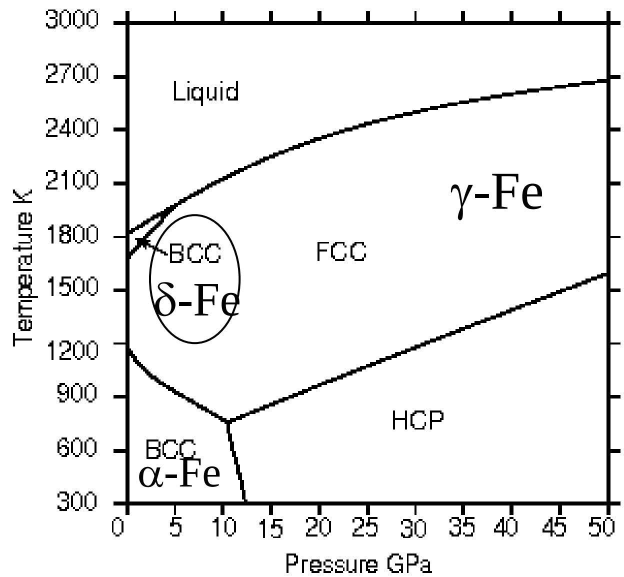
homework #1 (page 1 out of 2)

1. Calculate the molar enthalpy of pure iron at 1750 K and one atmosphere pressure.

The molar heats of phase transformations for iron are:
$\Delta H_{\alpha\to\gamma}$ = 670 J/mol;
$\Delta H_{\gamma\to\delta}$ = 840 J/mol;
$\Delta H_{\delta\to liquid}$ = 13770 J/mol.



The corresponding temperatures of the phase transformations are:
$T_{\alpha\to\gamma}$ = 1187 K;
$T_{\gamma\to\delta}$ = 1664 K;
$T_{\delta\to liquid}$ = 1809 K.

The constant pressure heat capacities of different phases of pure iron are:

$c_P^{\alpha} = 37.12 + 6.17\times10^{-3}\,T$ J/mol K
$c_P^{\gamma} = 24.47 + 8.45\times10^{-3}\,T$ J/mol K
$c_P^{\delta} = 37.12 + 6.17\times10^{-3}\,T$ J/mol K
$c_P^{liquid} = 41.8$ J/mol K

Make a plot of enthalpy vs temperature at one atmosphere pressure for pure iron in the temperature range from 298 K to 1750 K. In the plot, please use realistic scales for enthalpy and temperature. On the plot, please provide the values of enthalpies at T = 298 K, T = 1750 K, and at temperatures of all phase transformations that take place between 298 and 1750 K.

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2. Calculate enthalpy of Al_2O_3 at 3000 K. Assume a temperature-independent heat capacity in the liquid phase, c_p^{liquid} = 192.5 J/mol K.

3. Calculate heat of formation of Al_2O_3 (the enthalpy change for oxidation reaction 2Al + 3/2 O_2 = Al_2O_3) at 1500 K.

4. An absent-minded cook left a pot with water on a hot stove. There are 4 liters of water in the pot and the stove supplies about 1 kJ/s to the water. When the cook left the kitchen, the water was at 50°C. How long it will take before all the water will be gone from the pot? Latent heat of vaporization of water is ΔH_v = 2260 kJ/kg. You can assume a temperature-independent heat capacity of liquid water, c_p = 4.184 J/g K.

You can use thermodynamic/thermochemical data given in tables at the end of the book by Gaskell or any other *reliable and accessible* source). Please give all the data and formulas used in calculations as well as references to the source of data.