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

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

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

The constant pressure heat capacities of different phases of pure iron are:
\[ c_p^{\alpha} = 37.12 + 6.17 \times 10^{-3} T \text{ J/mol K} \]
\[ c_p^{\gamma} = 24.47 + 8.45 \times 10^{-3} T \text{ J/mol K} \]
\[ c_p^{\delta} = 37.12 + 6.17 \times 10^{-3} T \text{ J/mol K} \]
\[ c_p^{\text{liquid}} = 41.8 \text{ J/mol K} \]

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 \( T = 298 \text{ K} \), \( T = 1750 \text{ K} \), and at temperatures of all phase transformations that take place between 298 and 1750 K.
2. Calculate enthalpy of Al₂O₃ at 3000 K. Assume a temperature-independent heat capacity in the liquid phase, \( c_p^{\text{liquid}} = 192.5 \text{ J/mol K} \).

3. Calculate heat of formation of Al₂O₃ (the enthalpy change for oxidation reaction \( 2\text{Al} + \frac{3}{2} \text{O}_2 = \text{Al}_2\text{O}_3 \)) 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 \( \Delta H_v = 2260 \text{ kJ/kg} \). You can assume a temperature-independent heat capacity of liquid water, \( c_p = 4.184 \text{ J/g K} \).

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.