

Exam January 1998

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The course was 9 ects points, and the exam an open book exam. The full exam consisted of 3 problems of equal weight.

Problem 3

3.1)

Show that the pressure dependency of C_p , the specific heat at constant pressure for a given amount of substance, can be expressed as following:

$$\left(\frac{\partial c_P}{\partial P}\right)_T = -TV \left(\alpha_P^2 + \left(\frac{\partial \alpha_P}{\partial T}\right)_P \right)$$

3.2)

The following equation of state describes a specific system:

$$PV + A\frac{P}{T^2} = RT$$

A is a constant and R is the gas constant.

C_p can be found in a tabular at the pressure P_1 and temperature T_1 (you do not need any value, just the information that this can be found).

The system is now going through a isochoric process changing the pressure from P_2 to P_3 and temperature from T_1 to T_2 . The specific heat can be assumed constant under the process $(T_1, P_2) \rightarrow (T_2, P_3)$, but P_2 is very different from P_1 .

Calculate the change in the thermal energy during the process $(T_1, P_2) \rightarrow (T_2, P_3)$.

HINT: you may use the following relation without proof

$$C_V = C_P - T \left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial V}{\partial T}\right)_P \quad (1)$$