Thermodynamics (MP460) Assignment 3

Please hand in your solutions no later than Monday, October 17, 10:05 am. Late assignments will not be accepted. If you have questions about this assignment, please ask your lecturer,
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Ex. 3.1 and 3.2

Ex. 3.1 is exercise 2 on page 28 of the book by Fermi.
Ex. 3.2 is exercise 3 on page 28 of the book by Fermi.

Ex. 3.3: Useful identities for derivatives

In this exercise, you will derive a number of identities for derivatives which are very useful in thermodynamic calculations. Let A, B and C be three thermodynamic variables related by a single equation of state, so that we can choose two of the variables as the independent variables and then the other will be a function of the first two. For example, we can choose A and B to be independent and then $C = C(A, B)$ is a function of A and B, but we could also choose A and C or B and C as the independent variables. The canonical example would have A, B and C equal to the pressure, temperature and volume of a gas, but the equations below will work for any triple of quantities.

a. We take A and B as independent quantities. In some process, these are varied by infinitesimal amounts dA and dB. Write an equation for dC in terms of dA, dB and derivatives of $C(A, B)$.

b. Derive the following three identities

$$\begin{aligned}
\left(\frac{\partial C}{\partial A}\right)_B \left(\frac{\partial A}{\partial B}\right)_C + \left(\frac{\partial C}{\partial B}\right)_A &= 0 \\
\left(\frac{\partial A}{\partial B}\right)_C \left(\frac{\partial B}{\partial A}\right)_C &= 1 \\
\left(\frac{\partial A}{\partial B}\right)_C \left(\frac{\partial B}{\partial C}\right)_A \left(\frac{\partial C}{\partial A}\right)_B &= -1
\end{aligned}$$

Hint: *One way to do this is to use the result of part* ***a.*** *for the case of a process in which C is constant.*