

Thermal Physics, Autumn 2019 CMI

Problem set 2

Due by the beginning of lecture on Tuesday, Sep 3, 2019

Exact & Inexact differentials, First Law of Thermodynamics

1. **⟨9⟩** Consider the Pfaffian differential expression in two variables $\omega(x, y) = y dx - x dy$. Find whether it satisfies the integrability condition to be exact. If it does, find a function $\sigma(x, y)$ such that $\omega = d\sigma$. If not, find an integrating denominator $\tau(x, y)$ and function $\sigma(x, y)$ such that $\omega/\tau = d\sigma$ is exact. In the latter case comment whether τ is unique/not unique.
2. **⟨3⟩** Taking p and V as independent variables for the internal energy U of a gas, use the first law of thermodynamics to obtain an expression for the infinitesimal heat δQ added reversibly to a fixed mass of a gas. We do not assume the gas to be ideal.