

## Thermodynamics (MP460) Assignment 7

Please hand in your solutions no later than Thursday, November 21, 10:05 am. Late assignments will not be accepted. If you have questions about this assignment, please ask your lecturer, Joost Slingerland, ([joost-at-thphys-dot-nuim-dot-ie](mailto:joost-at-thphys-dot-nuim-dot-ie)), Office 1.7D, Mathematical Physics

### Ex. 7.1

- (a) For a system with thermodynamic coordinates  $(p, V, T)$ , give expressions for  $\left(\frac{\partial S}{\partial V}\right)_T$  and  $\left(\frac{\partial S}{\partial T}\right)_V$  in terms of  $(p, V, T)$  and derivatives of the internal energy with respect to some of these variables.
- (b) A certain gas satisfies the equation of state  $p(V - nb) = nR(T + aT^2)$ . Here  $a$  and  $b$  are constants,  $n$  is the number of *mol* of gas and  $R$  is the gas constant. Show that the energy of this gas satisfies

$$\left(\frac{\partial U}{\partial V}\right)_T = \frac{anRT^2}{(V - nb)}.$$

- (c) The gas undergoes an isothermal, quasistatic expansion from an initial volume  $V_i$  to a final volume  $V_f$ . Show that the heat  $Q$  absorbed by the gas in this process is given by

$$Q = nRT(1 + 2aT) \log \left( \frac{V_f - nb}{V_i - nb} \right).$$