April 8, 2020. Exercise 1: The entropy is an extensive state function for large systems and both the internal energy and the entropy are homogenuous functions of order 1

$$U(\lambda S, \lambda V, \lambda N) = \lambda U(S, V, N)$$
$$S(\lambda U, \lambda V, \lambda N) = \lambda S(U, V, N)$$

Using this, derive for extensive systems

1. the Euler relation:
$$U = TS - PV + \mu N\,,$$
2. and the Gibbs Duhem relation:
$$0 = SdT - VdP + Ndp\,.$$