[tex15] **Thermodynamic potentials of the classical ideal gas with $N$ = const**

The classical ideal gas for a fixed number $N$ of particles is specified by the equation of state $pV = Nk_BT$ and the constant heat capacity $C_V = \alpha N k_B$ [$\alpha = \frac{3}{2}$ (monatomic), $\alpha = \frac{5}{2}$ (diatomic), $\alpha = 3$ (polyatomic)].

From the functions $U(T)$ and $S(T, V)$ determined in [ex14] calculate the thermodynamic potentials $U(S, V)$ (internal energy), $E(S, p)$ (enthalpy), $A(T, V)$ (Helmholtz potential) and $G(T, p)$ (Gibbs potential).