

### [tex33] Effects of first virial correction on ideal gas properties

The ideal gas equation of state supplemented by the first virial correction reads  $p = (nRT/V)[1 + (n/V)B(T)]$ . The associated heat capacity at constant volume can be written in the form  $C_V = \frac{3}{2}nR - (n^2R/V)F(T)$ , where  $F(T)$  and  $B(T)$  are related by thermodynamic consistency conditions.

(a) Express  $F(T)$  as a function of  $B(T)$ .

(b) Find the function  $U(T, V)$  (internal energy) and  $S(T, V)$  (entropy) for this system.

(c) Find the first virial correction  $B(T)$  for the van der Waals gas,  $[p + a(n/V)^2](V - nb) = nRT$ , and calculate the associated virial correction  $F(T)$  to the heat capacity  $C_V$ .

**Solution:**