1. **Virial equations.**
   (a) Give the Virial 1 equation (power series in $V_m^{-1}$) through the term that includes the fourth virial coefficient.

   (b) Obtain an expression for the compressibility factor $Z$ for a gas that obeys the Virial 1 equation.

   (c) Give the three analytic conditions that hold on the critical isotherm at the critical point. Then apply them to the Virial 1 equation, keeping terms through the term containing $C(T)$ in the latter. Solve these equations to show that under these conditions the critical compressibility factor $Z_c = 1/3$.

2. A gas obeys the equation of state, $PV_m = RT + cP$. Derive an expression for its fugacity coefficient $\phi$ as a function of $P$ and $T$. [Note: For full credit, you must show the derivation, not just the result.]