1.(a) A sample of 255 mg of neon occupies 3.00 dm^3 at 122 K. Use the perfect gas law to calculate the pressure of the gas.

(b) A homeowner uses 4.00 X 10^3 m^3 of natural gas in a year to heat a home Assume that natural gas is all methane, CH_4, and that methane is a perfect gas for the conditions of this problem, which are 1.00 atm and 20℃. What is the mass of gas used?

2. Equations (a) and (b) are expansions in *p* and $1/V_m$ respectively. Find the relation between B, C and B′, C′

$$pVm = RT(1 + B'p + C'p^2 + \cdots) \qquad \text{(a)}$$

$$pVm = RT(1 + \frac{B}{Vm} + \frac{C}{Vm^2} + \cdots) \qquad \text{(b)}$$

3. Express the vd*W* equation of state as a virial expansion in powers of $1/V_m$ and obtain expressions for *B* and *C* in terms of the parameters *a* and *b*. The expansion you will need is

$$(1 - x)^{-1} = 1 + x + x^2 + \ldots.$$

Measurements on argon gave $B = -21.7$ cm^3/mol and $C = 1200$ cm^6/mol^2 for the virial coefficients at 273 K. What are the values of *a* and *b* in the corresponding vd*W* equation of state?

4. Derive an expression for the compression factor of a gas that obeys the equation of state

$$p(V - nb) = nRT$$

Where b and R are constants. If the pressure and temperature are such that $V_m = 10b$, what is the numerical value of the compression factor?

5. The barometric formula relates the pressure of a gas of molar mass M at an altitude h to its pressure $p_0$at sea level. Derive this relation by showing that the change in pressure(dp) for an infinitesimal change in altitude(dh) where the density is ρ is $\mathrm{dp} = -\rho * \mathrm{g} * \mathrm{dh}$. Remember that ρ depends of the pressure. Evaluate (a) the pressure difference between the top and bottom of a laboratory vessel of height 15 cm, and (b) the external atmospheric pressure at typical cruising altitude of an aircraft (11km) when the pressure at ground level is 1.0 atm. (The air is ideal gas and It is assumed that g and T do not vary with h. T = 298K, g = 10m/s^2, M = 29 g/mol)

6. (a) Derive an expression for the critical condition $(P_c, T_c, V_c)$of a gas that obey the vdW equation.

(b) Express the vdW equation to reduce form.