

Lab3

The ideal gas law is given by: $PV=nRT$ where P is the absolute pressure, V the volume, n the number of moles, R the universal gas constant and T the absolute temperature.

It is only accurate over a limited range of pressure and temperature.

An alternative equation of state for gases is given by the Walls equation

$$\left(P + \frac{a}{v^2}\right)(v - b) = RT$$

Where $v=V/n$ is the modal volume, a and b are empirical constants depending on the nature of the gas.

A chemical engineering design process requires accurately estimating the modal volume of oxygen for a given temperature and pressuring so that appropriate containment vessels can be selected.

$R = 0.082054 \text{ atm/(mol K)}$

$a = 1.360$

$b = 0.03183$

The design pressures of interest are: *1, 10 and 100 atm* for temperature combination of *300, 500 and 700 K*

- a) For $P=10 \text{ atm}$ and $T=300K$ find the modal volume using all open methods seen in class.
- c) Plot the approximate error done at each iteration for all the methods and decide which one performs better.
- d) Use the best method to evaluate the modal volume for each combination of pressure/temperature, compare your results with the ideal gas law.
- e) Write a **proper** report explaining your methods, how you implemented them, discussing your results and your convergence rates.