Quiz 2.2 – Enthalpy

Name: Key

Ideal Gas Heat Capacities

○ Give the constant pressure heat capacities (in the low temperature limit) for perfect gases with the following geometries:

1. Monoatomic $\frac{5}{2} R$
2. Linear Diatomic $\frac{7}{2} R$
3. Non-linear Polyatomic $4 R$

Definition of Enthalpy

○ What is the mathematical equation which relates enthalpy to internal energy?

$H = U + pV$

○ Under what conditions is $\Delta_{rxn}U \approx \Delta_{rxn}H$

$\Delta n_{gas} = \emptyset$, or even better, no gases at all involved

Pressure-Volume Work

○ A gas expands under isobaric conditions at $0.75\ atm$ from $0.50\ L$ to $2.75\ L$. What is the work done (from the perspective of the system)?

$w = -p\Delta V = -0.75 atm \cdot 2.25 L = -1.6875\ L\cdot atm \left(\frac{101.3 J}{1 L\cdot atm}\right) = -171\ J$

○ A pressurized tank with $V = 15.0\ L$ contains a gas at $140.0\ atm$. The tank is slowly leaking its gas into the atmosphere with a barometric pressure of $0.82\ atm$. The leak is slow enough that the temperature remains constant throughout. What is the total work (w_{sys}) for the gas as it leaks? (Note that although this process is isothermal, it is not reversible since $p \neq p_{ext}$)

$V_f = \frac{V_i P_i}{P_f} = \frac{15.0 L \cdot 140.0 atm}{0.82\ atm} = 2{,}561\ L \rightarrow \Delta V = 2546 L$

$w = -p\Delta V = -0.82 atm \cdot 2546 L = -2088\ L\cdot atm \left(\frac{101.3 J}{1 L\cdot atm}\right) = -211{,}000\ J$

○ A similar tank to the one above is mounted on the exterior of the international space station. This tank also experiences a leak like the one above. What is the total work (w_{sys}) for the gas as it leaks? ~~(Note that although this process is isothermal, it is not reversible since $p \neq p_{ext}$)~~

In space, $p_{ext} = \emptyset$, So NO work is done