1. An ideal gas initially at 2.25 L and 1.33 bar is compressed isothermally in two steps: first to 1.50 L at a constant external pressure of 2.00 bar, then to 0.800 L at a constant external pressure of 3.75 bar.

   (a) Calculate the total work in units of L·bar.

   (b) Compare to the work for a reversible isothermal compression from 2.25 L to 0.800 L.

2. A rigid container has 6.544 g of oxygen at 298 K. 6.12 g of H_2S at 278 K are added to the container and the gases mix.

   Write <, >, =, or X (cannot be determined).

   (a) Temp O_2 before H_2S is added _____ Temp of the gas mixture

   (b) P_{oxygen} before adding H_2S _____ P_{oxygen} after adding H_2S

   (c) Work associated with adding H_2S _____ 0

   (d) internal energy before adding H_2S _____ internal energy after adding H_2S

3. 2.0 moles of oxygen gas in an insulated container with a moveable, frictionless piston at 298 K under a constant external pressure. 2 moles of H_2S(g) at 298 K are added, causing the piston to move up.

   Write <, >, =, or X (cannot be determined).

   (a) Work associated with the addition of H_2S _____ 0 J

   (b) Temperature of the oxygen before H_2S is added _____ temperature of the gases after H_2S is added

   (c) P_{oxygen} before H_2S is added _____ P_{oxygen} after H_2S is added

4. Zinc metal can be recovered from Zinc Sulfide by the following reaction:

$$2\,\mathrm{ZnS(s)} + 3\,\mathrm{O_2(g)} \rightarrow 2\,\mathrm{ZnO(s)} + 2\,\mathrm{SO_2(g)}$$

Zinc sulfide and oxygen are added to a flexible reaction vessel, not necessarily in stoichiometric ratios, and the reaction goes to completion with a constant $P_{ext} = 126300$ Pa while maintaining a constant temperature of 679 K. The amount of work is is +812.4 J. Some conversions:

$1\text{ atm} = 101325\text{ Pa} \quad 1\text{ L}\cdot\text{atm} = 101.325\text{ J} \quad 1\text{ m}^3 = 1000\text{ L} \quad R = 8.314\ \frac{\text{J}}{\text{mol}\cdot\text{K}} = 0.0821\ \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}$

(a) Find the change in volume, in liters, of the reaction vessel.

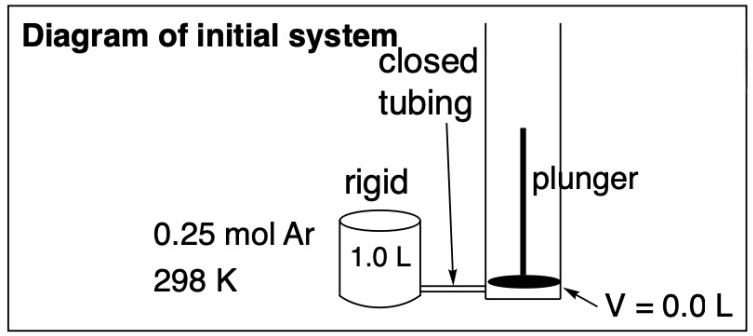
(b) If the volume of the vessel after the reaction is 19.5 L, determine the change in moles of gas during the reaction.

(c) Determine the mole fraction of oxygen after the reaction.

(d) What mass of ZnS reacted?

Homework Problem 12

1. A 1.0 L rigid container holds 0.25 moles of Argon at 298 K as shown below:



The tubing is opened and the argon from the 1.0 L container spreads into the second container with the plunger. The pressure in the system comes to equal the external pressure of 1.0 atm. The temperature of the system also equilibrates with the external temperature so that both are equal to 298 K.

(a) What is the final volume, in liters, of just the container with the plunger? You may ignore the volume of the tubing.

(b) Find the work associated with this process.