1. Case A: 1 mol of helium is placed a rigid 5 L container with pressure 2 atm. The container is initially at is initially at 200 °C and is heated to 250 °C.

   Case B: 1 mol of helium is placed a flexible 5 L container with pressure 2 atm. The container is initially at is initially at 200 °C and is heated to 250 °C.

   (a) Which case has the higher q?

   (b) Which case has the higher ΔU?

2. 0.6192 g of sulfur is combusted in a calorimeter with a heat capacity of 5.270 kJ/°C. Both $SO_2(g)$ and $SO_3(g)$ are formed, as shown in the equations below. The temperature of the calorimeter increases by 1.140 °C. Determine the molar ratio of $SO_3(g)/SO_2(g)$ produced.

$$\mathrm{S(s) + O_2(g) \rightarrow SO_2(g)} \qquad \Delta H^\circ_{\mathrm{rxn}} = -296.83\,\mathrm{kJ}$$

$$\mathrm{S(s) + \frac{3}{2}\,O_2(g) \rightarrow SO_3(g)} \qquad \Delta H^\circ_{\mathrm{rxn}} = -395.72\,\mathrm{kJ}$$

3. Show that for a reversible adiabatic expansion of an ideal gas:

$$PV^{\gamma} = constant$$

4. The heat from the reaction

$$2\,\mathrm{Al\,(s)} + 6\,\mathrm{HBr\,(aq)} \longrightarrow 2\,\mathrm{AlBr_3\,(aq)} + 3\,\mathrm{H_2\,(g)} \qquad \Delta H^{\circ}_{\mathrm{rxn}} = -1061\ \mathrm{kJ}$$

is completely transferred to water that is initially at 25 °C. How many grams of water can be converted to steam at 110 °C when 191 g of aluminum is added to excess HBr (aq)?

Quantity	Value
$\Delta H_{\mathrm{vap,\ H_2O}}$	$2.261\ \frac{\mathrm{kJ}}{\mathrm{g}}$
$C_{s,\ \mathrm{H_2O\,(l)}}$	$4.184\ \frac{\mathrm{J}}{\mathrm{g}\cdot^{\circ}\mathrm{C}}$
$C_{s,\ \mathrm{H_2O\,(g)}}$	$2.09\ \frac{\mathrm{J}}{\mathrm{g}\cdot^{\circ}\mathrm{C}}$

Homework Problem 14

1. Show that for a reversible adiabatic expansion of an ideal gas:

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}}$$

Start from the adiabatic relation $P_1 V_1^{\gamma} = P_2 V_2^{\gamma}$