

5.60/20.110: Thermodynamics and Kinetics (r08) Recitation Handout for 9/12/2006

Main course:

An ideal gas ($\overline{C}_v = \frac{5}{2}R$) is expanded adiabatically against a constant pressure of 1 atm until it doubles in volume. If the initial temperature is 25°C , and the initial pressure is 5 atm, calculate T_2 (the final temperature after expansion). Then, calculate q , w , and ΔU for the process.

Dessert:

1. (First law) In a given change in state, 44J of work is obtained *from* a system and the internal energy increases by 170J. If the temperature of the system rises by 10K, what is the heat capacity of the system?

(Is the heat capacity measured here C_v or C_p ? Or, is there not enough information given?)

2. (Gas expansion/compression) Three moles of an ideal gas expand isothermally against a constant external pressure of 100kPa from 20dm^3 to 60dm^3 . Compute q , w , ΔU .
3. (Gas expansion/compression) Three moles of an ideal gas expand isothermally and reversibly from 60dm^3 to 20dm^3 . Compute q , w , ΔU .

4. (Euler's exactness criterion; state function) Show that the differential df is inexact:

$$df = dx - \frac{x}{y} dy$$

Hence, f is *dependent on the path of integration* and is *not* a state function. However, we can define a new function g by:

$$dg = \frac{1}{y} df$$

Which has the property that dg is exact (i.e. $\oint dg = 0$). Prove that dg is exact.

Hints for the problem set:

- For problem 2(b), consult SAB:
 - Section 1.7: Critical phenomena (p.16)
 - Section 1.8: van der Waals equation (p.17)
 - *Especially* Examples 1.7 and 1.8 (p.20-21)