140a HW 2, 1/15/19

⋆ All numbered exercises are from Blundell and Blundell. Due 1/24/19.

1. 6.3

2. 6.4.

3. 6.5.

4. 11.1.

5. (a) A system initially with volume 10 liters and temperature $T = 0^C$ is compressed **adiabatically** (i.e. no heat transfer, $\not{d}Q = 0$) to a state with volume 5 liters and temperature $T = 100^oC$. In this process, 1000J of work is done on the system. By how much does the internal energy of the system change in this process?

   (b) Instead, we start from the same initial state as above, and end at the same final state as above, by going through the following two steps. Step 1: the system is first heated **isochorically** (i.e. constant volume) to the final temperature $T = 100^oC$. Step 2: the system is then compressed **isothermally** (i.e. constant temperature) to the final volume of 5 liters. In the first step, 800J of heat had to be added to the system. In the second step, 1900J of heat flowed out of the system. Compute the energy changes and amounts of work done in each of these two steps.

   (c) Can this system be regarded as an ideal gas? Why or why not?

6. The temperature of an ideal gas at initial pressure P_1 and volume V_1 is increased isochorically until the pressure has doubled. The gas is then expanded isothermally (constant temperature) until the pressure drops to its original value. Then it is compressed **isobarically** (i.e. constant pressure) until the volume returns to its initial value.

   (a) Sketch these processes in the P-V plane and the P-T plane.

   (b) Compute the work done in each process, and the net work done in the cycle, if $n = 2$ kilomoles, $P_1 = 10^5 PA$, and $V_1 = 2m^3$.

7. **QUESTION 7 WAS DEFERRED FROM HW, SINCE I DID NOT GET TO THE M.B. VELOCITY DISTRIBUTION**

   Containers A and B are in thermal contact and in equilibrium with each other. Container A contains an ideal gas of oxygen molecules, while container B contains an ideal gas of nitrogen molecules. Suppose that $N_A/N_B = 3$ and $V_A/V_B = 5$, and $P_A = 90Pa$.

(a) What is P_B?

(b) What is v^A_{RMS}/v^B_{RMS} the ratio of the RMS speeds of molecules?

(c) Suppose that the thermal contact between the two containers suddenly dissolves, so now all the molecules can explore the container of volume $V_A + V_B$ (whose external walls are secure, and thermally insulated). Will v_{RMS} change? Why / why not?

(d) What is the pressure in the container $A + B$ after the wall dissolved?