**Problem 1.** According to the equation of state, $P = \frac{NRT}{(NA)V}$, pressure is proportional to the number of particles and to the temperature. When the latter triples, the number of particles doubles (as molecules dissociate into atoms). The resulting pressure will, thus, be $6P_0$.

**Problem 2.** According to Sect. (3-9) of the textbook, work in a cyclic process is equal to the net heat flow. There is no heat along $CA$ part. Heat along $BC$ is simply equal to the change in internal energy,

$$Q_{BC} = \frac{3}{2}R(T_C - T_A).$$

Heat along $AB$ is given by the work along $AB$ and is negative,

$$Q_{AB} = -RT_A \ln \frac{V_A}{V_B}.$$ 

Finally, we can find $T_C$ from the adiabatic equation,

$$T_C V_B^{2/3} = T_A V_A^{2/3}.$$ 

As a result we obtain,

$$W = Q_{AB} + Q_{BC} = \frac{3}{2}RT_A \left( \frac{V_A^{2/3}}{V_B^{2/3}} - 1 - \ln \frac{V_A^{2/3}}{V_B^{2/3}} \right).$$

**Problem 3.** Extra credit.

To find specific heat we have to relate increase in temperature $dT$ to the heat supplied $dQ$. According to the first law,

$$dQ = \frac{3}{2}RdT + PdV.$$ 

To express $dV$ via $dT$, we first differentiate the equation of state,

$$PdV + VdP = RdT.$$ 

Second, we make use of the fact that $PV^3 = const$, written in the differential form as,

$$V^3dP + 3V^2PdV = 0.$$ 

Excluding $dP$ from the last two equations, we obtain, $PdV = -RdT/2$. Therefore, with the help of the first law, we find $C = dQ/dT = R$. 