Homework 2

Answer the fallowing questions in details (systematically with laws and units):

1. Calculate the work needed for a bird of mass 120 g to fly to a height of 50 m from the surface of the Earth.

2. A sample consisting of 2.00 mol He is expanded isothermally at 22°C from 22.8 dm^3 to 31.7 dm^3 (a) reversibly, (b) against a constant external pressure equal to the final pressure of the gas, and (c) freely (against zero external pressure). For the three processes calculate q, w, ΔU, and ΔH.

3. A sample consisting of 2.00 mol of perfect gas molecules, for which $C_{V,m} = 5/2\ R$, initially at p_1 = 111 kPa and T_1 = 277 K, is heated reversibly to 356 K at constant volume. Calculate the final pressure, ΔU, q, and w.

4. A sample of argon of mass 6.56 g occupies 18.5 dm^3 at 305 K. (a) Calculate the work done when the gas expands isothermally against a constant external pressure of 7.7 kPa until its volume has increased by 2.5 dm^3. (b) Calculate the work that would be done if the same expansion occurred reversibly.

5. The constant-pressure heat capacity of a sample of a perfect gas was found to vary with temperature according to the expression $Cp\ /(\mathrm{J\ K^{-1}}) = 20.17 + 0.4001(T/\mathrm{K})$. Calculate q, w, ΔU, and ΔH when the temperature is raised from 0°C to 100°C (a) at constant pressure, (b) at constant volume.

6. Calculate the final pressure of a sample of carbon dioxide of mass 2.4 g that expands reversibly and adiabatically from an initial temperature of 287 K and a volume of 1.0 L to a final volume of 2.0 L. Take $\gamma = 1.4$.

7. A sample of 4.0 mol $O_2(g)$ is originally confined in 20 dm^3 at 270 K and then undergoes adiabatic expansion against a constant pressure of 600 Torr until the volume has increased by a factor of 3.0. Calculate q, w, ΔT, ΔU, and ΔH. (The final pressure of the gas is not necessarily 600 Torr.), C_p of O_2 = 29.355 JK^{-1}.

8. A sample of 5 mol of an ideal **monatomic** gas occupies a <u>fixed</u> volume of 5.0 L at T_i = 300 K. When it is supplied with 935 J of energy as heat, its temperature increases to some final temperature T_f. calculate The molar heat capacity at constant volume (C_v) and The final temperature T_f (in **K**).

9. A sample of 5.0 mol CO_2 is originally confined in 15 dm^3 at 280 K and then undergoes adiabatic expansion against a constant pressure of 78.5 kPa until the volume has increased by a factor of 4.0. Calculate *q*, *w*, ΔT, ΔU, and ΔH. (The final pressure of the gas is not necessarily 78.5 kPa.) C_p of CO_2 = 37.110 JK^{-1}.