1. Estimate the molar volume of CO_2 at 500 K and 100 atm by treating it as a van der Waals gas. The van der Waals coefficients for CO_2 are $a = 3.592$ dm^6 atm mol^{-2} and $b = 4.267 \times 10^{-2}$ dm^3 mol^{-1}. Under the stated conditions, $RT/p = .0410$ dm^3 mol^{-1}. (Hint: $p = nRT/(V-nb) - a(n/V)^2$) (20%)

2. Water is heated to boiling under a pressure of 1.0 atm. When an electric current of 0.50 A from a 12 V supply is passed for 300 s through a resistance in thermal contact with it, it is found that 0.798 g of water is vaporized. Calculate the molar internal energy and enthalpy changes at the boiling point (373.15 K). The molar mass of water is 18.02 g mol^{-1}. (20%)

3. Calculate the entropy change when argon at 25°C and 1.00 bar in a container of volume 0.500 dm^3 is allowed to expand to 1.000 dm^3 and is simultaneously heated to 100°C. (20%)

4. Calculate the effect on the chemical potentials of ice and water of increasing the pressure from 1.00 bar to 2.00 bar at 0 °C. The density of ice is 0.917 g cm^{-3} and that of liquid water is 0.999 g cm^{-3} under these conditions. (20%)

5. The data below show the temperature variation of the equilibrium constant of the reaction $Ag_2CO_{3(s)} \leftrightarrows 5 Ag_2O_{(s)} + CO_{2(g)}$. Calculate the standard reaction enthalpy of the decomposition. (20%)

T/K	350	400	450	500
K	3.98×10^{-4}	1.41×10^{-2}	1.86×10^{-1}	1.48