1st law of thermodynamics

P10. How much work does it take to expand 1.00 mol of a perfect gas to five times its original volume in a piston cylinder? How much is the heat in the process and the change in the internal energy and enthalpy of the gas? During expansion, the temperature is kept at constant 20 ° C. *[w = -3923 J, q = 3923 J, ΔU = 0 J, ΔH = 0 J]*

P11. How much is the work when 5.00 mol of a monatomic perfect gas is heated from 0 °C to 500 °C at 1.00×10^5 Pa constant pressure? How much is the heat in the process and the change in the internal energy and enthalpy? For a monatomic perfect gas, molar heat capacity at constant volume is $C_{V,\mathrm{m}} = \frac{3}{2}R$. *[w = -20.8 kJ, q = 52.0 kJ, ΔU = 31.2 kJ, ΔH = 52.0 kJ]*

P12. 1.00 mol of argon gas with a pressure of 1.00×10^5 Pa is heated from 25 °C to 100 °C at a constant volume. Then, the temperature is kept constant and the gas is pressed to reach 5.00×10^5 Pa pressure. Calculate the work, the heat and the change in the internal energy and enthalpy. Under these conditions, argon is a perfect gas with $C_{V,\mathrm{m}} = \frac{3}{2}R$. *[w = 4301 J, q = -3366 J, ΔU = 935 J, ΔH = 1559 J]*

P13. At 1.00 dm^3 volume, 1.2×10^5 Pa pressure and 298 K temperature, a perfect gas is expanded in an adiabatic way to 1.0×10^5 Pa. The piston is then fixed, and the gas is warmed up to its initial temperature. The pressure of the gas will then be 1.076×10^5 Pa. Determine the ratio of the two heat capacities and decide whether the gas is monatomic or diatomic. Calculate q, w and ΔU for both steps. *[γ = 1.67; the gas is monatomic; w_1 = -12.7 J, q_1 = 0 J, ΔU_1 = -12.7 J, w_2 = 0 J, q_2 = 12.7 J, ΔU_2 = 12.7 J]*

P14. The following changes of state are performed with 1.00 mol of argon:

a) it is heated at a constant 5.0×10^5 Pa pressure from 25 °C to 100 °C,
b) its pressure is decreased to 1.0×10^5 Pa at constant temperature,
c) it is cooled to 25 °C at constant pressure,
d) finally, it is pushed back to its original pressure (5.0×10^5 Pa) at a constant 25 °C temperature.

Calculate the work, heat, ΔU and ΔH for this four-step cycle.

	w (J)	q (J)	ΔU (J)	ΔH (J)
a)	−624	1559	935	1559
b)	−4993	4993	0	0
c)	624	−1559	−935	−1559
d)	3990	−3990	0	0
cycle	−1004	1004	0	0