●不可使用電子計算機

1. A Carnot cycle, which is named after the French engineer Sadi Carnot, consists of four reversible stages as shown below. Please describe what is happening in these 4 steps (25 pt)

2. Calculate the lattice enthalpy (ΔH) of KCl(s) using a Born–Haber cycle and the following data (25 pt)

Process	$\Delta H^{\ominus}/(\text{kJ mol}^{-1})$
Sublimation of K(s)	+89
Ionization of K(g)	+418
Dissociation of Cl_2(g)	+244
Electron attachment to Cl(g)	−349
Formation of KCl(s)	437

3. The Nernst equation applied for a glass pH electrode at 25 °C can be expressed as $E = E^0 - 0.059 \log[H^+]$, which is exactly the basis how a pH meter reads pH. What the E would be at (a) pH 0; (b) pH 3; (c) pH 5; (d) pH 7; (e) pH 14 (25 pt)

4. The ionization energy of hydrogen atom is 13.6 eV. What is the second ionization energy of He atom? Hint: quantized ionization energy of hydrogen-like atom can be expressed as $E_n = -\dfrac{Z^2 \mu e^4}{32\pi^2 \varepsilon_0^2 \hbar^2 n^2}$ where Z is the atomic number and n is the quantum number. In the case of the ionization energy of hydrogen, $\dfrac{\mu e^4}{32\pi^2 \varepsilon_0^2 \hbar^2}$ can be approximated to 13.6 eV. (25 pt)

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