1). The heat of vaporization of water at 25°C is 44.01 $kJ\,mol^{-1}$, and the equilibrium vapor pressure at that temperature is 0.0313 atm. Calculate ΔS, ΔH, and ΔG when 1 mol of liquid water at 25°C is converted into vapor at 25°C and a pressure of 10^{-5} atm, assuming the vapor to behave ideally. (14%)

2). One mole of ammonia (considered to be a perfect gas) initially at 25°C and 1 bar pressure is heated at constant pressure until the volume has trebled. Calculate (a) q, (b) w, (c) ΔH, (d) ΔU, and (e) ΔS. Given: $C_p = 25.895 + 32.999\times10^{-3}T - 30.46\times10^{-7}T^2$ in $JK^{-1}mol^{-1}$. (15%)

3). (a) Show that $C_p - C_v = T\left(\frac{\partial P}{\partial T}\right)_V\left(\frac{\partial V}{\partial T}\right)_P$

(b) Derive the expression for $C_p - C_v$ for a gas with the following equation of state. $\left(p + \frac{a}{V^2}\right)V = RT$ (14%)

4). Thermodynamic data for n-pentane (g) and neopentane (g) (standard state: 1 atm and 25°C) are as follows

	Enthalpy of Formation ΔH_f°, $kJ\,mol^{-1}$	Entropy S°, $JK^{-1}mol^{-1}$
n-Pentane (g)	-146.44	349.0
Neopentane (g)	-165.98	306.4

(a) Calculate ΔG° for n-pentane ⟶ neopentane.

(b) Pure n-pentane is in a vessel at 1 atm and 25°C, and a catalyst is added to bring about the equilibrium between n-pentane and neopentane. Calculate the final partial pressure of the two isomers. (15%)

5). The Weston standard cell is

Cd amalgam | $CdSO_4\cdot\frac{8}{3}H_2O$(cr), saturated solution | Hg_2SO_4(cr), Hg

(a) Write the cell reaction

(b). At 25°C, its emf is 1.01832 V, and $\partial E^\circ/\partial T = -5.00\times10^{-5}\,VK^{-1}$. Calculate ΔG°, ΔH°, and ΔS° (14%)

(讀下頁)

6) The following mechanism has been proposed for the thermal decomposition of pure ozone in the gas phase:

$$2O_3 \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} O_3 + O_2 + O$$

$$O + O_3 \xrightarrow{k_2} 2O_2$$

Derive the rate equation. (14%)

7) If a first-order reaction has an activation energy of 104,600 J mol^{-1}, and the pre-exponential factor, A, has a value of 5×10^{13} s^{-1}. At what temperature will the reaction have a half-life of (a) 1 min, and (b) 30 days? (14%)