1) 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%)

2) (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%)

3). 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 pressures of the two isomers. (15%)

4). 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%)

5). 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%)

129

(讀下頁)

6). A sodium lamp of 50-W power emits yellow light at 550 nm. How many photons does it emit each second? What is the momentum of each photon? (14%)

7) 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 $\partial E^\circ / \partial T = -5.00 \times 10^{-5}\ V K^{-1}$. Calculate ΔG°, ΔH°, and ΔS°. (14%)