

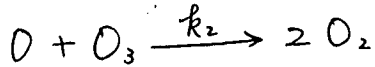
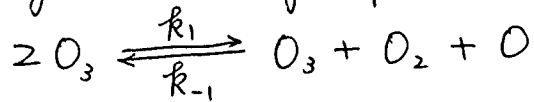
- 1) The heat of vaporization of water at 25°C is 44.01 kJ mol⁻¹, and the equilibrium vapor pressure at that temperature is 0.0313 atm. Calculate ΔS , ΔH , and ΔG when 1 mol of liquid water at 25°C is converted into vapor at 25°C and a pressure of 10⁻⁵ atm, assuming the vapor to behave ideally. (14%)
- 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: $C_p = 25.895 + 32.999 \times 10^{-3} T - 30.46 \times 10^{-7} T^2$ 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. $(p + \frac{a}{V^2})V = RT$ (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 \rightarrow 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 | CdSO₄ · $\frac{2}{3}$ H₂O (cr), saturated solution | Hg₂SO₄ (cr), Hg.
- (a) Write the cell reaction
 (b) At 25°C, its emf is 1.01832 V, and $\frac{\partial E^\circ}{\partial T} = -5.00 \times 10^{-5} \text{ V K}^{-1}$. Calculate ΔG° , ΔH° , and ΔS° . (14%)

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



Derive the rate equation.

(14%)

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

(14%)