

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: $C_p = 25.895 + 32.999 \times 10^{-3} T - 30.46 \times 10^{-7} T^2$ in JK 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 $(P + \frac{a}{V^2})V = RT$ (14%)

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

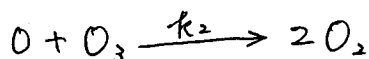
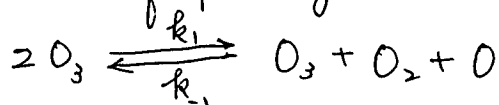
	Enthalpy of Formation, ΔH_f° kJ mol^{-1}	Entropy, S° $\text{JK}^{-1} \text{mol}^{-1}$
n-Pentane (g)	-146.44	349.0
Neopentane (g)	-165.98	306.4

(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 pressures of the two isomers. (15%)

4) The heat of vaporization of water at 25°C is $44.01 \text{ kJ mol}^{-1}$, 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:



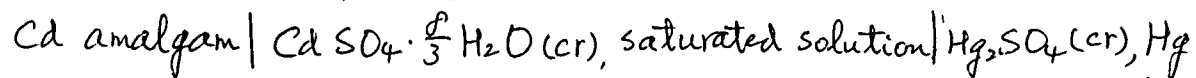
Derive the rate equation

(14%)

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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



(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%)