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THERMODYNAMICS

ONE MARK QUESTIONS

1 Dissolution of ammonium chloride in water is endothermic yet it is a spontaneous process. Explain

2 When will heat change at constant volume and heat change at constant pressure be equal?

3 Discuss the role of temperature in determining the spontaneity of a process.

4 Give two examples of state functions.

5 Predict the change in internal energy for an isolated system at constant volume.

TWO MARK QUESTIONS

1 Derive the relationship between Cp and Cv

2 State

i. Hess's law of constant heat summation
ii. Second law of thermodynamics

3 Derive the relation $\Delta H = \Delta U + \Delta n_g RT$

4 What will be the sign of entropy change for the following changes?

a) In an isolated system, two identical gases are allowed to mix under identical conditions.
b) $I_2(g) \rightarrow I_2(s)$
c) $H_2(g) + I_2(g) \rightarrow 2HI(g)$
d) Dissolution of sugar in water contained in a thermos flask.

5 ΔH and ΔS for the reaction $Ag_2O \rightleftharpoons 2Ag + \frac{1}{2} O_2$ are 30.56 KJ/mole and 60 J/K respectively. Calculate the temperature at which the free energy change for this reaction will be zero. Predict whether the forward reaction will be favoured above/below this T.

6 Calculate the K_c at 298 K for the reaction $H_2 + I_2 \rightleftharpoons 2HI$, if ΔG°_f (HI) = 1.3kJ/mole

7 Differentiate between

a) heat of formation and heat of reaction

b) heat of hydration and heat of solution

8 Calculate heat change at constant pressure if heat change at constant volume for the reaction $NH_2CN(g) + 3/2\ O_2(g) \rightarrow N_2(g) + CO_2(g) + H_2O(l)$ at 298K is -742 kJ/mole

9 What would be the work done when the pressure of 2 moles of an ideal gas is changed

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from 2 bar to 5 bar isothermally and reversibly at 25^{o}C ?

THREE MARK QUESTIONS

1 Define

(i) Molar heat capacity (ii) Enthalpy of a reaction (iii) Residual entropy

2 Comment on the following statements

(i) An exothermic reaction is always thermodynamically spontaneous.
(ii) The entropy of a substance increases when going from liquid state to vapour state at any temperature.
(iii) A reaction with $\Delta G^0 > 0$ always has an equilibrium constant greater than one

3 (i) For the equilibrium $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ at 25 ^{0}C, K= 1.8 x 10^{-7}. Calculate ΔG° of reaction

(ii) For the reaction $2NO\ (g) + O_2(g) \rightleftharpoons 2NO_2(g)$, calculate the ΔG at 600 K if enthalpy and entropy changes are –110kJ/mole and 150 J/Kmole

4 For the synthesis of NH_3 ,$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, calculate K_p at 300K if ΔH°_f of NH_3 as -46.2 kJ/mole and ΔS° for the reaction is 198.3 J/Kmole.

5 (i) The ΔH_{vap} of water at 100^{o}C is 41kJ/mole. Calculate the internal energy change.

(ii) What is the work done on a gas when 10 lt of the gas is compressed to 4.5 lt under a constant pressure of 10^3kPa?

6 Calculate the ΔH^0_f of benzene if ΔH_{comb} of benzene, carbon and hydrogen are 3267, 393 and 286 kJ/mole respectively.

7 The mean bond enthalpies of N≡N and H-H are 946 and 436 kJ/mole respectively. If heat of formation of ammonia is -46kJ/mole, calculate the mean BE of N-H bonds in ammonia.

8 (i) Calculate the entropy change in surroundings when 36 g of water is formed under standard conditions. ΔH^0_f of water = -286kJ/mole

(ii) Calculate the work done when 2.5 moles of an ideal gas at 300K is isothermally and reversibly compressed from a volume of 5m^3 to a volume of 2 m^3

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