Shiksha Classes Bhandara

Subject : Chemistry **Topic : Chemical Equilibrium** **M.M. : 100**

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 $2SO_2(g) + O_2(g) \rightleftharpoons 2SO$

If the partial pressure of SO_2, O_2 and SO_3 are 0.559, 0.101 and 0.331 atm respectively. What would be the partial pressure of O_2 gas, to get equal moles SO_2 & SO_3.

(A) 0.188 atm (B) 0.288 atm
(C) 0.388 atm (D) 0.488 atm

Q.2 Two system $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ and $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$ are simultaneously in equilibrium in a vessel at constant volume. If some CO is introduced into the vessel then at new equilibrium the concentration of –

(A) PCl_5 is greater
(B) PCl_3 remain unchanged
(C) PCl_5 is less
(D) Cl_2 is greater

Q.3 For the equilibrium $H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$, the standard Gibbs free energy change, ΔG^o at 2000 K is 32.34 kcal mol^{-1}. Calculate the equilibrium constant.

(A) 7.292×10^{-4} $atm^{1/2}$ (B) 9.272×10^{-4} $atm^{1/2}$
(C) 2.279×10^{-4} $atm^{1/2}$ (D) 2.927×10^{-4} $atm^{1/2}$

Q.4 At a certain temperature, the vapour density of PCl_5 in equilibrium with PCl_3 and Cl_2 is 90. The degree of dissociation of PCl_5 (m.w 208.5) is

(A) 0.185 (B) 0.058
(C) 0.158 (D) 0.258

Q.5 Ammonium hydrosulphide decomposes at 25°C according to $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

If the total pressure of the system at equilibriums is 0.5 atm, the equilibrium constant of the reaction is

(A) 0.625 (B) 1.25
(C) 0.5 (D) 0.25

Q.6 At temperature T, a compound $AB_2(g)$ dissociates according to the reaction

$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$

with degree of dissociation α, which is small compared with unity. The expression for K_p, in terms of α and the total pressure, P_T is

(A) $\frac{P_T\alpha^3}{2}$ (B) $\frac{P_T\alpha^3}{3}$
(C) $\frac{P_T\alpha^3}{3}$ (D) $\frac{P_T\alpha^2}{2}$

Q.7 The degree of dissociation, α of PCl_5 at a given temperature is

(A) Proportional to the pressure of the gas
(B) Inversely proportional to the pressure of the gas
(C) Independent of the pressure of the gas
(D) Inversely proportional to the square root of the pressure of the gas

Q.8 K_P for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 400ºC is 1.64×10^{-4}. Calculate K_C.

(A) 0.3 $mole^2$ $litre^{-2}$ (B) 0.4 $mole^2$ $litre^{-2}$
(C) 0.5 $mole^2$ $litre^{-2}$ (D) 0.6 $mole^2$ $litre^{-2}$

Q.9 The vapour density of N_2O_4 at a certain temperature is 30. The percentage dissociation of N_2O_4 at this temperature is-

(A) 55.5% (B) 60%
(C) 70% (D) 53.3%

Q.10 When two reactants, A & B are mixed to give product C & D, the reaction quotient at the initial stages of the reaction–

(A) is zero (B) decrease with time
(C) is independent of time (D) increase with time

Q.11 ΔH and ΔS for a reaction are 10000 J. mol^{-1} and 10 JK^{-1} mol^{-1} respectively. The reaction will be spontaneous

(A) above 1000 K (B) at 900 K
(C) below 1000 K (D) below 1200 K

Q.12 For the reversible reaction :

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500ºC , the value of K_p is 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of K_c, with concentration in mole $litre^{-1}$, is –

(A) $\frac{1.44\times10^{-5}}{(0.082\times500)^{-2}}$ (B) $\frac{1.44\times10^{-5}}{(8.314\times773)^{-2}}$

(C) $\frac{1.44\times10^{-5}}{(0.082\times773)^{2}}$ (D) $\frac{1.44\times10^{-5}}{(0.082\times773)^{-2}}$

Q.13 One mole of $CaCO_3(s)$ was taken in a 10 lit. container and heated to 727ºC. When equilibrium is reached, one third of the $CaCO_3(s)$ remained undecomposed. Find the value of the equilibrium constant, K_p ?

(A) 2.473 atm. (B) 3.173 atm.
(C) 7.212 atm. (D) 5.473 atm.

Q.14 When ethanol and acetic acid were mixed together in equilimolecular proportion 66.6% are converted into ethyl acetate. Calculate K_c. Also calculate quantity of ester produced if one mole of acetic acid is treated with 0.5 mole and 4 mole of alcohol respectively.

(A) 4, 0.93, 0.43 (B) 0.93, 4, 0.43
(C) 0.43, 0.93, 4 (D) 4, 0.43, 0.93

Q.15 Ammonium Hydrogen sulphide dissociates according to the equation, $NH_4HS \rightleftharpoons NH_3(g) + H_2S(g)$
if the observed pressure of the mixture is 1.12 atm at 106ºC. What is the K_P of the reaction-
(A) 0.2136 (B) 0.3136
(C) 0.4136 (D) 0.5126

Q.16 When 1.0 mole of N_2 and 3.0 moles of H_2 was heated in a vessel at 773 K and a pressure of 3.55 atm. 30% of N_2 is converted into NH_3 at equilibrium. Calculate K_P for the reaction.
(A) 3.1×10^{-2} atm^{-2} (B) 4.1×10^{-2} atm^{-2}
(C) 5.1×10^{-2} atm^{-2} (D) 6.1×10^{-2} atm^{-2}

Q.17 In the decomposition equilibrium of a certain metallic carbonate, the partial pressure of CO_2 becomes a hundred fold when the temperature increases from 400 K to 500 K. Calculate the mean value of ΔH^o for the given range of temperature.
(A) 18.304 kcal/mol (B) 13.84 kcal/mol
(C) 14.83 kcal/mol (D) 10.83 kcal/mol

Q.18 Starting with 3:1 mixture of H_2 and N_2 at 450ºC, the equilibrium mixture is found to be 9.6% NH_3; 22.6% N_2 and 67.8% H_2 by volume. The total pressure is 50 atm. What will be the value of K_P. the reaction is
$N_2 + 3H_2 \rightleftharpoons 2NH_3$
(A) 3.25×10^{-5} atm^{-2} (B) 5.23×10^{-5} atm^{-2}
(C) 6.23×10^{-5} atm^{-2} (D) 8×10^{-5} atm^{-2}

Q.19 The equilibrium constant of the reaction
$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$
at 100 ºC is 50. If a one-litre flask containing one mole of A_2 is connected to a two-litre flask containing two moles of B_2, what amount of AB will be formed at 373 K ?
(A) 0.168 mol (B) 2.128 mol
(C) 5.122 mol (D) 1.868 mol

Q.20 At constant temperature, the equilibrium constant (K_p) for the decomposition reaction $N_2O_4 \rightleftharpoons 2NO_2$ is expressed by $K_p = \frac{4x^2P}{(1-x^2)}$; where P = pressure, x = extent of decomposition.
Which one of the following statements is true?
(A) K_p increases with increase of P
(B) K_p increases with increase of x
(C) K_p increases with decrease of x
(D) K_p remains constant with change in P and x

For Q.21-Q.25 :
The answer to each question is a NUMERICAL VALUE.

Q.21 An equilibrium system for the reaction between hydrogen and iodine to give hydrogen iodide at 765K in a 5 litre volume contains 0.4 mole of hydrogen, 0.4 mole of iodine and 2.4 moles of hydrogen iodide. The equilibrium constant for the reaction is:
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$,

Q.22 For a gas phase reaction at equilibrium,
$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$,
the partial pressures of H_2 and N_2 are 0.4 and 0.8 atmosphere, respectively. The total pressure of the entire system is 2.8 atmosphere. The value of K_P (in atm^{-2}) if all the pressures are given in atmosphere is

Q.23 Ammonium carbamate when heated to 200ºC gives a mixture of vapours ($NH_2COONH_4 \rightleftharpoons 2NH_3 + CO_2$) with a density 13.0. What is the degree of dissociation of ammonium carbamate ?

Q.24 In equilibrium reaction, x moles of the reaction A decompose to give 1 mole each of C and D. If the fraction of A decomposed at equilibrium is independent of initial concentration, then the value of x would be

Q.25 At a certain temperature the following equilibrium is established, $CO(g) + NO_2(g) \rightleftharpoons CO_2(g) + NO(g)$.
One mole of each of the four gases is mixed in one litre container and the reaction is allowed to reach equilibrium state. When excess of baryta water is added to the equilibrium mixture, the weight of white precipitate obtained is 236.4 g. The equilibrium constant, K_C of the reaction is (X + 0.25). Find the value of X.