DPP-2 [Equilibrium Constant Expression]

Chapter: Chemical Equilibrium

"Tu sochta hai 'kaise karu?' Main kehta hoon: Pen uthaa aur likhna shuru kar—baaki khud ho jayega."

NEET

A) Active Mass: Definition & Calculations (pure phases, solutions, gases)

Q1: **Assertion–Reason on active mass of pure phases**

Assertion (A): The active mass of pure solids and pure liquids is taken as unity.

Reason (R): The active mass of pure solids and pure liquids depends on density and molecular mass. The density and molecular mass of pure solids and pure liquids are constant.

Choose:

(A) A and R are true; R is the correct explanation of A

(B) A and R are true; R is not the correct explanation of A

(C) A is true, R is false

(D) A is false, R is true

Q2: **8.5 g of ammonia is present in a vessel of 0.5 L. Find the *active mass* (molar concentration) of NH_3.**

Answer as a number: _____ M

Q3: **Active mass of 2 mol NaCl kept in a 4 L vessel at NTP is:**

(1) 1

(2) 2

(3) $\frac{1}{2}$

(4) Not defined

Q4: **Active mass of 5 g CaO is:**

(1) 56

(2) 1

(3) 3.5

(4) 2

Q5: **Ratio of active masses of 22 g CO_2, 3 g H_2 and 7 g N_2 in a gaseous mixture is:**

(1) 22 : 3 : 7

(2) 2 : 3 : 1

(3) 1 : 2 : 1

(4) 1 : 3 : 0.5

B) Equilibrium Constant & Rate Constants (K, k_f, k_b)

Q6: **Equilibrium constant is:**

(1) k_b/k_f

(2) k_f/k_b

(3) $k_f k_b$
(4) $1/(k_f k_b)$

Q7: In a chemical equilibrium, $k_b = 7.5 \times 10^{-4}$ s^{-1} and $K = 1.5$. The forward rate constant k_f is:
(1) 2×10^{-3}
(2) 2.5×10^{-4}
(3) 1.12×10^{-3}
(4) 9.0×10^{-4}

Q8: For $\mathrm{A} \rightleftharpoons \mathrm{B}$, the equilibrium concentration $[B]_e$ equals:
(1) $K_c[A]_e^{-1}$
(2) $k_f/k_b\,[A]_e$
(3) $k_f k_b^{-1}\,[A]_e$
(4) $k_f k_b\,[A]^{-1}$

C) Writing the Correct K_c Expression

Q9: For $2\mathrm{A} + 3\mathrm{B} \rightleftharpoons 2\mathrm{C}$, the correct expression for K_c is:
(1) $\dfrac{[\mathrm{A}]^2[\mathrm{B}]^3}{[\mathrm{C}]^2}$
(2) $\dfrac{[\mathrm{C}]}{[\mathrm{A}][\mathrm{B}]}$
(3) $\dfrac{[\mathrm{C}]^2}{[\mathrm{A}]^2[\mathrm{B}]^3}$
(4) $\dfrac{[\mathrm{C}]^2}{[\mathrm{A}]^3[\mathrm{B}]^2}$

D) Numerical Problems Using K_c

Q10: For $\mathrm{Ag}^+ + 2\mathrm{NH_3} \rightleftharpoons \mathrm{Ag(NH_3)_2^+}$ at 298 K, with $[\mathrm{Ag}^+] = 10^{-1}$ M, $[\mathrm{NH_3}] = 10^{-3}$ M, $[\mathrm{Ag(NH_3)_2^+}] = 10^{-1}$ M at equilibrium ,the value of K_c is:
(1) 10^6
(2) $10^{6.5}$
(3) 2×10^3
(4) 2×10^6

Q11: For $\mathrm{A_2(g)} + \mathrm{B_2(g)} \rightleftharpoons 2\mathrm{AB(g)}$ at 527°C with $[\mathrm{A_2}] = 3.0 \times 10^{-3}$ M, $[\mathrm{B_2}] = 4.2 \times 10^{-3}$ M, $[\mathrm{AB}] = 2.8 \times 10^{-3}$ M at equilibrium, the value of K_c is:
(1) 0.62
(2) 4.5
(3) 2.0
(4) 1.9

Q12: For $2\mathrm{A} + \mathrm{B} \rightleftharpoons \mathrm{BA_2}$ with $[\mathrm{A}] = 4$, $[\mathrm{B}] = 2$, $[\mathrm{BA_2}] = 2$ (mol L^{-1}) at equilibrium, the value of K_c is:
(1) 0.0625
(2) 0.625
(3) 6.280
(4) 6.250

Q13: $2\mathrm{A} + \mathrm{B} \rightleftharpoons 3\mathrm{C} + \mathrm{D}$ **starts with** $[\mathrm{A}]_0 = [\mathrm{B}]_0 = 1.00$ **M. At equilibrium,** $[\mathrm{D}] = 0.25$ **M. The equilibrium constant** K_c **equals:**

(1) $\dfrac{(0.75)^3(0.25)}{(0.50)^2(0.75)}$

(2) $\dfrac{(0.75)^3(0.25)}{(1.00)^2(0.75)}$

(3) $\dfrac{(0.50)^2(0.25)}{(0.75)^3(0.75)}$

(4) $\dfrac{(1.00)^2(0.25)}{(0.75)^3(0.75)}$

JEE

A) Active Mass & Basic Concentration

Q1: **What is the active mass of 5.6 L of O_2 at STP?**

Answer: _____ M

Q2: **Molar concentration of 96 g of O_2 in a 2 L vessel is:**

(A) 16 mol L^{-1}

(B) 1.5 mol L^{-1}

(C) 4 mol L^{-1}

(D) 24 mol L^{-1}

B) Relations between K, k_f, k_b

Q3: **In $A + B \rightleftharpoons C + D$, $k_f = 2 \times 10^{-4}$ s^{-1} and $k_b = 5 \times 10^{-5}$ s^{-1}. Find the equilibrium constant K.**

Answer: _____

Q4: **In a reversible reaction $A \rightleftharpoons B$, initial concentrations are a and b mol L^{-1}. Rate constants are k_1 (forward) and k_2 (backward). At equilibrium, concentrations are $(a - x)$ and $(b + x)$. Express x in terms of k_1, k_2, a, b.**

(A) $\dfrac{k_1 a - k_2 b}{k_1 + k_2}$

(B) $\dfrac{k_1 a - k_2 b}{k_1 - k_2}$

(C) $\dfrac{k_1 a - k_2 b}{k_1 k_2}$

(D) $\dfrac{k_1 a + k_2 b}{k_1 + k_2}$

Q5: **Gas-phase hydration:** $(CF_3)_2CO(g) + H_2O(g) \rightleftharpoons (CF_3)_2C(OH)_2(g)$. **At 76°C, $k_f = 0.15$ $M^{-1}\,s^{-1}$, $k_r = 6 \times 10^{-4}$ s^{-1}. Calculate K_c.**

Answer: _____

Q6: $CH_3Cl(aq) + OH^-(aq) \rightleftharpoons CH_3OH(aq) + Cl^-(aq)$ **at 25°C: $k_f = 6 \times 10^{-6}$ $M^{-1}\,s^{-1}$, $K_c = 1 \times 10^{16}$. Find k_r at 25°C.**

Answer: _____

Q7: **In a chemical equilibrium, the backward rate constant is 2×10^{-4} s^{-1} and $K = 1.5$. The forward rate constant is:**

(A) 2×10^{-3}

(B) 5×10^{-4}

(C) 3×10^{-4}

(D) 9×10^{-4}