YAKEEN NEET 2.0

2026

Chemical Equilibrium

Physical Chemistry | **Lecture -02**

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Topics to be covered

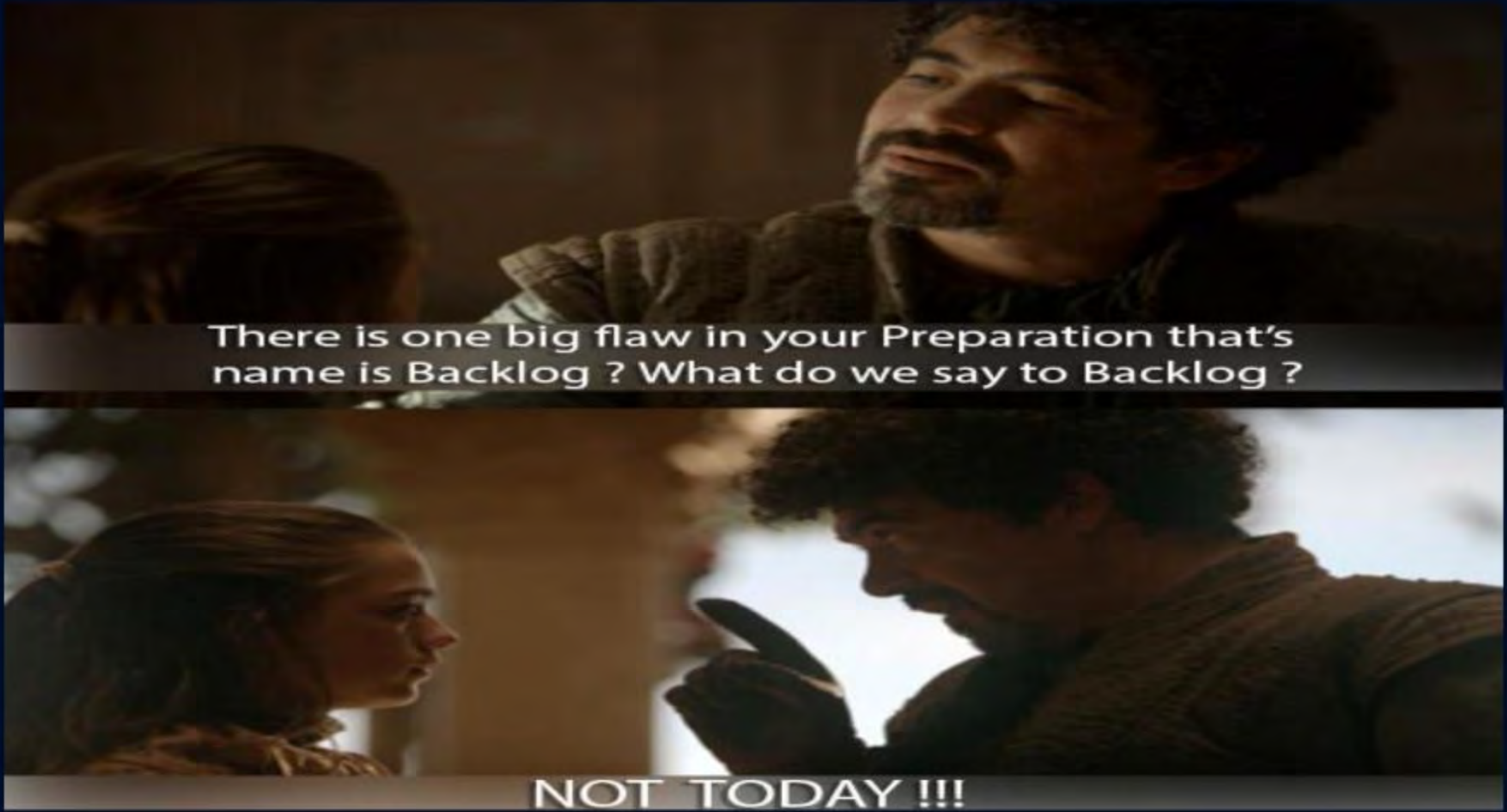
1. Revision of Last Class
2. Law of Mass Action
3. Equilibrium constants and their relation
4. Reaction Quotient
5. Magarmach Practice Questions (MPQ) & Home work from modules

Rules to Attend Class

1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your Magarmach Practice Questions.
4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.

Rules to Attend Class

5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Revision of Last Class

Physical Equilibrium

Solid-Gas Equilibrium

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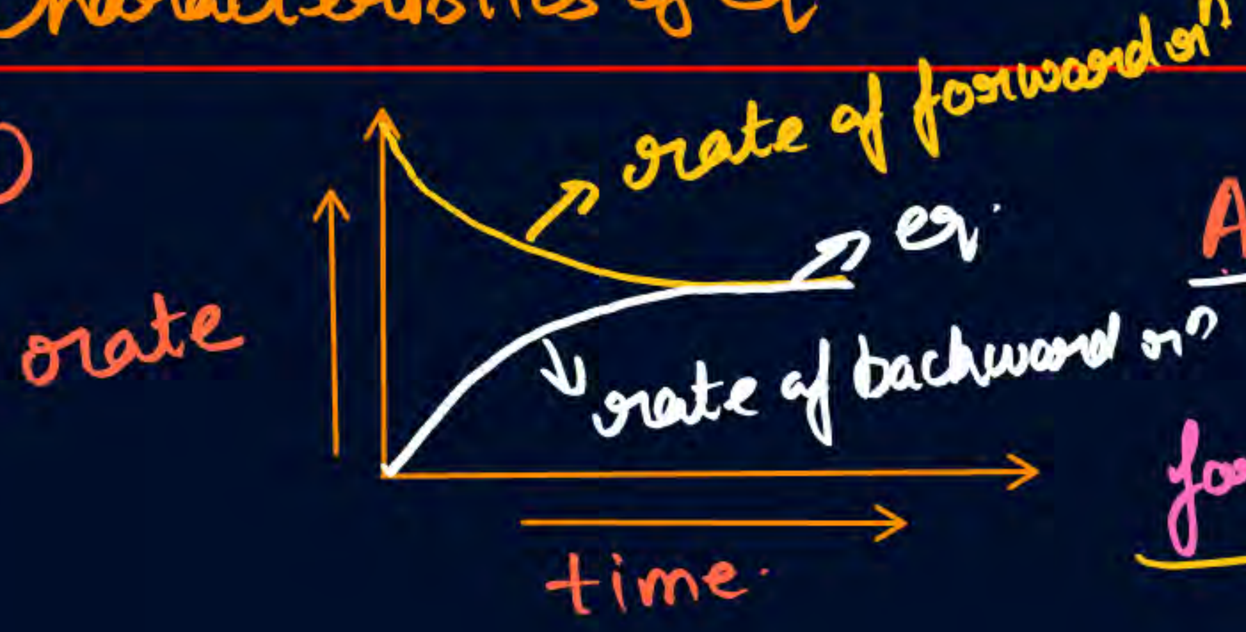
Characteristics of eq.

①

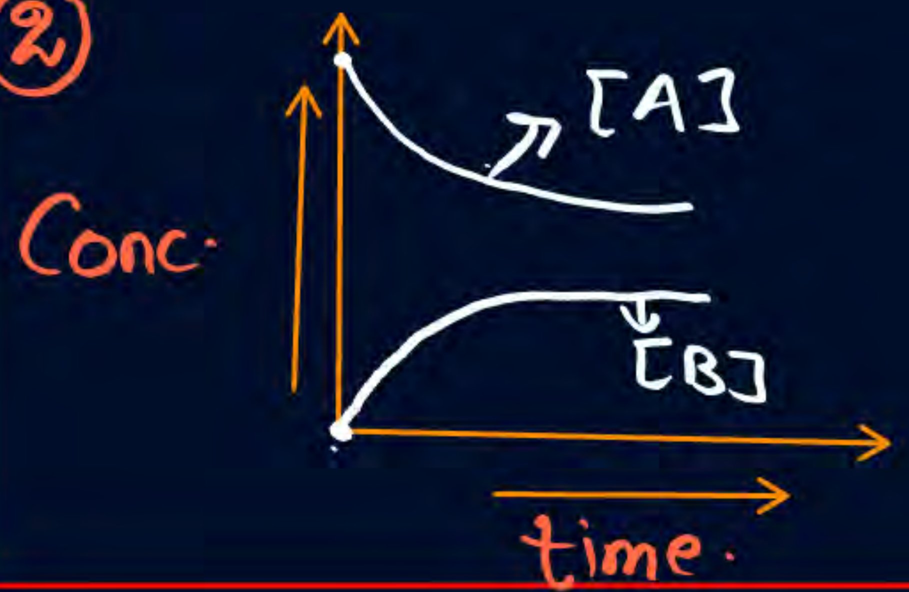


$$A + B \underset{\text{backward } r^n}{\overset{\text{forward } r^n}{\rightleftharpoons}} C + D \uparrow$$

forward r^n take place ÷ reactant Conc. ↓

Product Conc. ↑

②



backward r^n take place ÷ product Conc. ↓

reactant Conc. ↑

$$A(g) \rightleftharpoons B(g)$$

Law of Mass Action (LOMA)

$$aA(g) + bB(g) \underset{\text{backward } r^n}{\overset{\text{forward } r^n}{\rightleftharpoons}} cC(g) + dD(g)$$

rate of r^n $\propto$ Product of active mass of reacting species, raise to power S.C.

active mass = Conc.

rate of forward $r^n \propto [A]^a[B]^b$

rate forward $r^n = K_f[A]^a[B]^b$

K_f = rate constt forward r^n

rate backward $r^n \propto [C]^c[D]^d$

$= K_b[C]^c[D]^d$

K_b = rate constt backward r^n

at eq.

$$K_f [A]^a [B]^b = K_b [C]^c [D]^d$$

$$\frac{K_f}{K_b} = K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b}$$

eq. Constt.

in Conc.

ratio of K_f & K_b

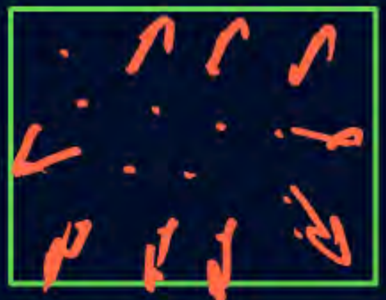
ratio of $\frac{(\text{Conc. of Prod.})^x}{(\text{—— react})^y}$

Relation Between K_P & K_C

$$aA(g) + bB(g) \rightleftharpoons cC(g) + dD(g)$$

$$K_C = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$



$$P = \frac{n}{V}RT$$

$$P_A = \frac{n_A}{V}RT$$

$$P_A = [A]RT$$

$$P_B = [B]RT$$

$$P_C = [C]RT$$

$$P_D = [D]RT$$

$$K_p = \frac{([C]RT)^c([D]RT)^d}{([A]RT)^a([B]RT)^b}$$

$$K_p = \frac{[C]^c[D]^d}{[A]^a[B]^b}\frac{(RT)^{c+d}}{(RT)^{a+b}}$$

$$K_p = K_C(RT)^{\underbrace{(c+d)}_{n_{p(g)}} - \underbrace{(a+b)}_{n_{r(g)}}}$$

$$K_p = K_C(RT)^{\Delta n_g}$$

\# MIT

① $K_p = K_c (RT)^{\Delta n_g}$

$\Delta n_g = n_{p(g)} - n_{r(g)}$

if $n_{p(g)} > n_{r(g)} \Rightarrow K_p > K_c$.

$n_{p(g)} < n_{r(g)} \Rightarrow K_p < K_c$

$n_{p(g)} = n_{r(g)} \Rightarrow K_p = K_c$

if $T \approx 12\,K \Rightarrow RT \approx 1 \Rightarrow K_p = K_c$

QUESTION

In which one of the following equilibria, $K_p \neq K_c$?

Δn_g

(A) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$ 1

(B) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ 0

(C) $NO_2(g) + SO_2(g) \rightleftharpoons NO(g) + SO_3(g)$ 0

(D) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ 0

QUESTION – (AIIMS 2018, 27 May)

K_C for the reaction $N_2(g) + O_2(g) \leftrightharpoons 2NO(g)$ at 300 K is 4.0×10^{-6}. K_p for the above reaction will be (R = 2 cal mol^{-1} K^{-1})

$T = 300 K$ $K_c = 4 \times 10^{-6}$

$\Delta n_g = 2 - 2 = 0$

$K_p = K_c (RT)^{\Delta n_g}$

$K_p = K_c$

(A) 2.4×10^{-3}

(B) 4×10^{-6}

(C) $4 \times 10^{-6} (RT)^2$

(D) 16×10^{-12}

Characteristics of Equilibrium Constant

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① K_c high ⇒ Product conc. ↑ ∴ product more stable

K_c low ⇒ ~~~~ ↓ ∴ reactant " "

② While writing eq. constt. ⇒ we write only gaseous substance or aq. sol^n, don't write pure solids & liquids → active mass constt.

active mass = conc. $= \frac{n}{V} = \frac{m}{M \times V} = \frac{\text{density}}{M}$ → pure solid or liquid constt.

③ unit of $K_c = (\text{mol L}^{-1})^{\Delta n_g \text{ or sol}^n}$

$K_p = (\text{atm})^{\Delta n_g \text{ or sol}^n}$

$A(g) \rightleftharpoons B(g)$

$\downarrow K_c = \frac{[B]^1 \downarrow}{[A] \uparrow}$

$1C(s) + 1O_2(g) \rightarrow 1CO_2(g)$

$K_c = \frac{[CO_2]^1}{[O_2]^1}$

$K_p = \frac{(P_{CO_2})^1}{(P_{O_2})}$

$d = \frac{PM}{RT}$

$1N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$\Delta n_g = 2 - 4 = -2$

$K_c = (mol\,L^{-1})^{-2}$

$= L^2/mol^2$

$K_c = \dfrac{[NH_3]^2}{[N_2]^1[H_2]^3}$

$= \dfrac{(mol\,L^{-1})^2}{(mol\,L^{-1})^4}$

$2H_2(g) + 1O_2(g) \rightarrow 2H_2O(l)$

$K_c = \dfrac{1}{[H_2]^2[O_2]^1}$

$K_p = \dfrac{1}{(P_{H_2})^2(P_{O_2})^1}$

$= (mol\,L^{-1})^{-2}$

$CH_3COOH(aq.) + C_2H_5OH(aq.)$

$\downarrow \quad 2 - 2 = 0$

$CH_3COOC_2H_5(aq.) + H_2O(aq.)$

$K_c = \dfrac{[CH_3COOC_2H_5]^1[H_2O]^1}{[CH_3COOH]^1[C_2H_5OH]^1}$

$\downarrow$

No unit.

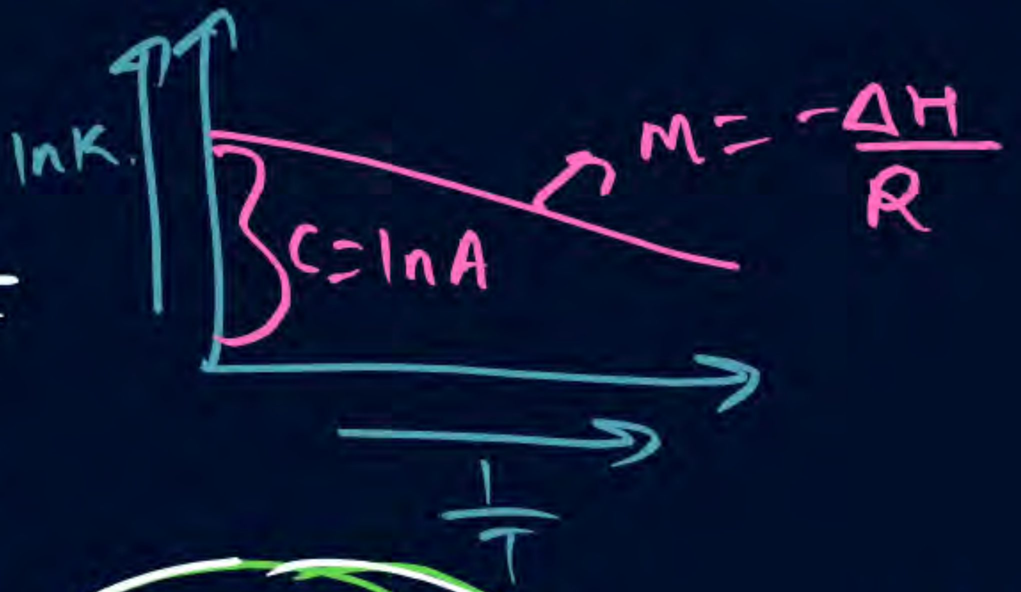
MIT

(4) K_p or K_c Change only when T is Changed.

$$\underline{K} = A e^{-\frac{\Delta H}{RT}}$$

$$\ln K = \ln A - \frac{\Delta H}{RT}$$

$$y = C + mx$$



$$\log_{10} \frac{K_2}{K_1} = \frac{\Delta H}{2.303R} \left(\frac{T_2 - T_1}{T_1 T_2} \right)$$

Van't hoff eqn.

(5) (a) endothermic rxn.

$K \propto T$

$T\uparrow \; K\uparrow$

$T\downarrow \; K\downarrow$

(b) exothermic rxn.

$K \propto \frac{1}{T}$

$T\uparrow \; K\downarrow$

$T\downarrow \; K\uparrow$

exo

$\Delta H = (-)ve$

$T_2 > T_1$

$\log \frac{K_2}{K_1} = -x$

$\log K_2 = \log K_1 - x$

$K_2 < K_1$

$A \underset{T\uparrow}{\overset{T\downarrow}{\rightleftharpoons}} B \quad \Delta H = (+)ve$

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QUESTION

The value of equilibrium constant of the reaction:

$$HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2 \text{ is } 8.0.$$

The equilibrium constant of the reaction

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \text{ will be:}$$

(A) 16

(B) 1/8

(C) 1/16

(D) 1/64

QUESTION – (AIIMS 2013)

If K_1 and K_2 are respective equilibrium constants for the two reactions

$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$

$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$

The equilibrium constant for the reaction

$XeO_4(g) + 2HF \rightleftharpoons XeO_3F_2(g) + H_2O\ (g)$ will be

(A) $\frac{K_1}{K_2^2}$

(B) $K_1 . K_2$

(C) $\frac{K_1}{K_2}$

(D) $\frac{K_2}{K_1}$

QUESTION – (AIIMS 2012)

The following equilibria are given:

$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad ; \quad K_1$

$N_2 + O_2 \rightleftharpoons 2NO \quad ; \quad K_2$

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O \quad ; \quad K_3$

The equilibrium constant of the reaction

$2NH_3 + \frac{5}{2}O_2 \rightleftharpoons 2NO + 3H_2O$ in terms of K_1, K_2 and K_3 is:

(A) $\frac{K_1K_2}{K_3}$

(B) $\frac{K_1K_3^2}{K_2}$

(C) $\frac{K_2K_3^3}{K_1}$

(D) $K_1K_2K_3$

QUESTION

If the value of equilibrium constant for a particular reaction is 1.6×10^{12}, then at the equilibrium system will contain:

(A) Mostly products

(B) Similar amounts of reactants and products

(C) All reactants

(D) Mostly reactants

QUESTION – (AIIMS 2008)

In which of the following reactions, the concentration of the product is higher than the concentration of die reactant at equilibrium? (K = equilibrium constant)

(A) A B; $K = 0.001$

(B) M N; $K = 10$

(C) X Y; $K = 0.005$

(D) R P; $K = 0.01$

QUESTION

On doubling P and V with constant temperature, the equilibrium constant will:

(A) Remain constant

(B) Become double

(C) Become one-fourth

(D) None of these

QUESTION

The dissociation constants for acetic acid and HCN at 25°C are 1.5×10^{-5} and 4.5×10^{-10}, respectively. The equilibrium constant for the equilibrium: $CN^- + CH_3COOH$ □ $HCN + CH_3COO^-$ will be:

(A) 3.0×10^{5}

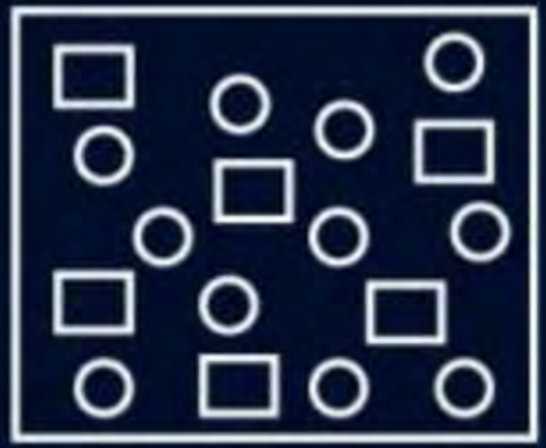
(B) 3.0×10^{-5}

(C) 3.0×10^{-4}

(D) 3.33×10^{4}

QUESTION

In the figure shown below, reactant A (represented by square) is in equilibrium with product B (represented by circle). The equilibrium constant is:



(A) 4

(B) 2

(C) 8

(D) 1

QUESTION – (AIIMS 2013)

Steam reacts with iron at high temperature to give hydrogen gas and $Fe_3O_4(s)$. The correct expression for the equilibrium constant is:

(A) $\dfrac{P_{H_2}^2}{P_{H_2O}^2}$

(B) $\dfrac{(P_{H_2})^4}{(P_{H_2O})^4}$

(C) $\dfrac{(P_{H_2})^4[Fe_3O_4]}{(P_{H_2O})^4[Fe]}$

(D) $\dfrac{[Fe_3O_4]}{[Fe]}$

Magarmach Practice Questions (MPQ)

QUESTION – (NEET 2024)

In which of the following equilibria, K_p and K_c are NOT equal?

(A) $PCl_{5(g)}$ □ $PCl_{3(g)} + Cl_{2(g)}$

(B) $H_{2(g)} + I_{2(g)}$ □ $2HI_{(g)}$

(C) $CO_{(g)} + H_2O_{(g)}$ □ $CO_{2(g)} + H_{2(g)}$

(D) $2BrCl_{(g)}$ □ $Br_{2(g)} + Cl_{2(g)}$

QUESTION – (AIIMS 2005)

For reaction, $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$; K_c at 427° C is 3×10^{-6} L mol^{-1}. The value of K_p is nearly:

(A) 7.50×10^{-5}

(B) 2.50×10^{-5}

(C) 2.50×10^{-4}

(D) 1.75×10^{-4}

QUESTION – (AIIMS 2017)

For the following reaction in gaseous phase

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g), K_p / K_c$ **is**

(A) $(RT)^{1/2}$

(B) $(RT)^{-1/2}$

(C) (RT)

(D) $(RT)^{-1}$

QUESTION

For the reaction

$$Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons 2Fe(s) + NH_3(g)$$

(A) $K_c = K_p(RT)$

(B) $K_c = K_p(RT)^{-1/2}$

(C) $K_c = K_p(RT)^{1/2}$

(D) $K_c = K_p(RT)^{3/2}$

QUESTION – (NCERT Exemplar)

We know that the relationship between K_c and K_p is

$K_p = K_c\,(RT)^{\Delta n}$

What would be the value of Δn for the reaction

$NH_4Cl\,(s) \rightleftharpoons NH_3\,(g) + HCl\,(g)$

(A) 1

(B) 0.5

(C) 1.5

(D) 2

THANK YOU