YAKEEN NEET 2.0

2026

Chemical Equilibrium

Physical Chemistry | Lecture -04

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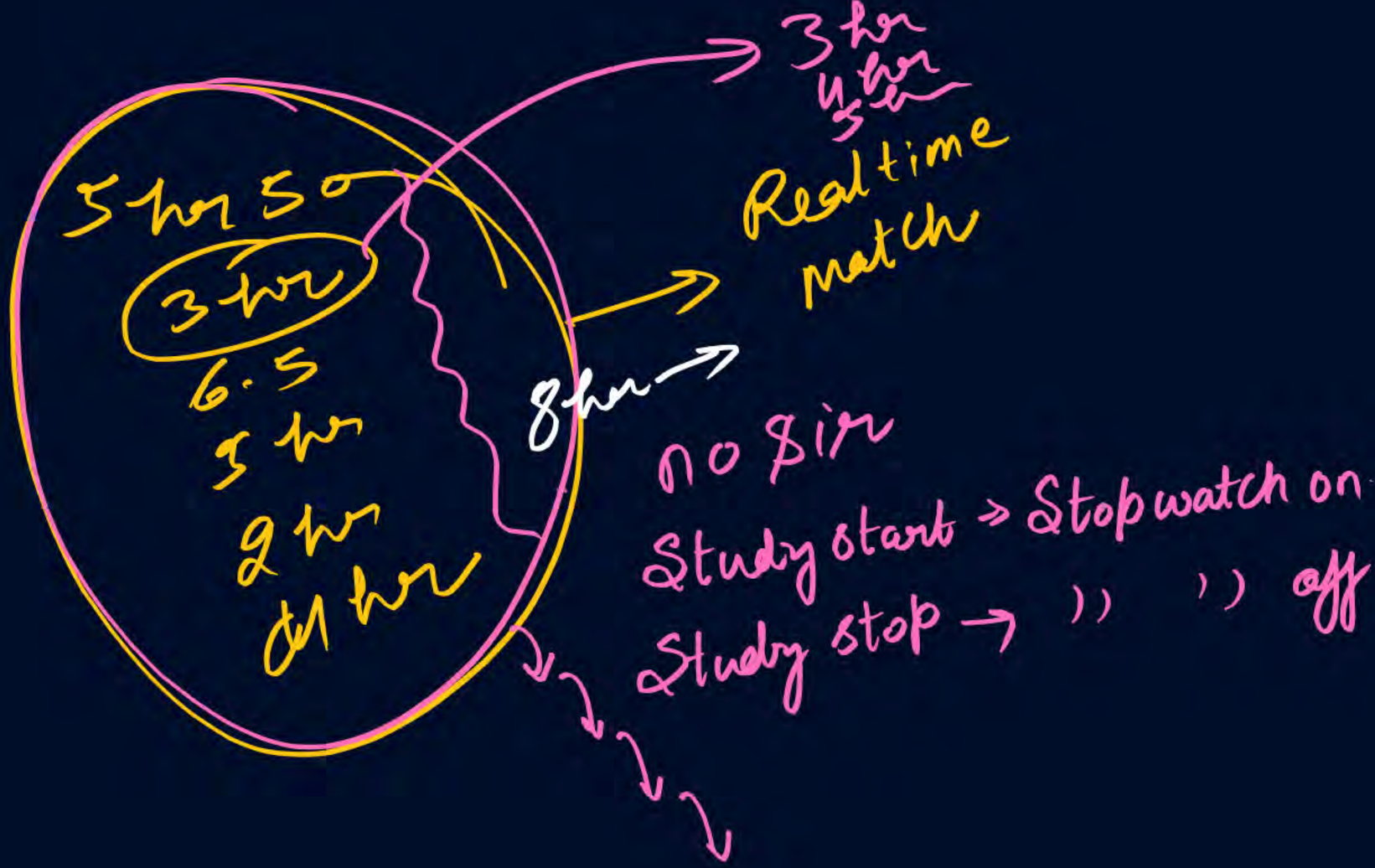
Topics to be covered

1. MEDICS TEST, Revision of Last Class
2. Degree of dissociation
3. Numericals
4. Degree of Association
5. Magarmach Practice Questions (MPQ) & Home work from modules

21 days
↓
Stopwatch



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 !!!

MEDICS

Mastery
Checks your grasp over NEET-level concepts

Evaluation
Judging both knowledge and test-smartness

Decision Making
Testing your speed + accuracy under pressure

Intuition
Some answers need gut + logic – can you spot the trick?

Concepts
It's all about strong basics – no shortcuts here

Strategy
The MEDICS test – built for those who heal, hustle, and hope.

QUESTION

Which of the following options consist of only intensive parameters?

A. pH of solution, Temperature and volume.

B. Δp , Specific heat capacity, Molar internal energy, E.M.F.

C. Resistance, Molar mass, Vapour density.

D. Density, Mass and Temperature.

QUESTION

A real gas follows PV = nRT at a temperature of 30°C Which of the following statements is true when it is subjected to adiabatic free expansion at a temperature of 70°C.

(A) It will not undergo any change in temperature.

(B) It will undergo increase in temperature

(C) It will undergo decrease in temperature

(D) It will undergo first increase and then decrease in temperature

Real gas temp. ideal gas behave = T

gas Temp > 2 T

adiabatic free exp. ⇒ inc. in temp.

gas temp < 2 T

⇒ dec. in temp

QUESTION

Identify the options in which $\Delta H > \Delta U$. [Assume gases to behave as ideal] :

$\Rightarrow \Delta n_g = (+)ve$.

(A) Polymerisation of ethene (g) into polyethene (g). $n(CH_2=CH_2)_{(g)} \longrightarrow (-(CH_2-CH_2)-)_{n\,(g)}$

Polyethene

(B) $H_2O(g) \longrightarrow H_2(g) + \frac{1}{2}O_2(g)$ $\Delta n_g = (+)ve$.

(C) $HCl(g) \longrightarrow \frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g)$

(D) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

QUESTION

For which of the following processes $|\Delta H| < |\Delta E|$:

$-5 < -3$ (ΔH < ΔU)

$|-5| > |-3|$

$I_2(l) \rightarrow I_2(g)$

(A) ✗ Vaporisation of liquid bromine at constant pressure

(B) ✗ Dissociation of $NH_3(g)$ to give $N_2(g)$ and $H_2(g)$ at constant pressure

$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$

$\Delta n_g = 4 - 2 = (+)ve$

(C) ✗ Adiabatic free expansion of ideal gas $\rightarrow q = 0$ | $\Delta U = w = nC_{v,m}\Delta T$, $\Delta H = nC_{p,m}\Delta T$, $C_{p,m} > C_{v,m}$

(D) ✓ Conversion of graphite to diamond occurring at constant pressure condition

$C(\text{graphite}) \longrightarrow C(\text{diamond})$ $\quad \Delta V = (-)ve$

$\rho_{graphite} < \rho_{diamond}$

$V_{graphite} > V_{diamond}$

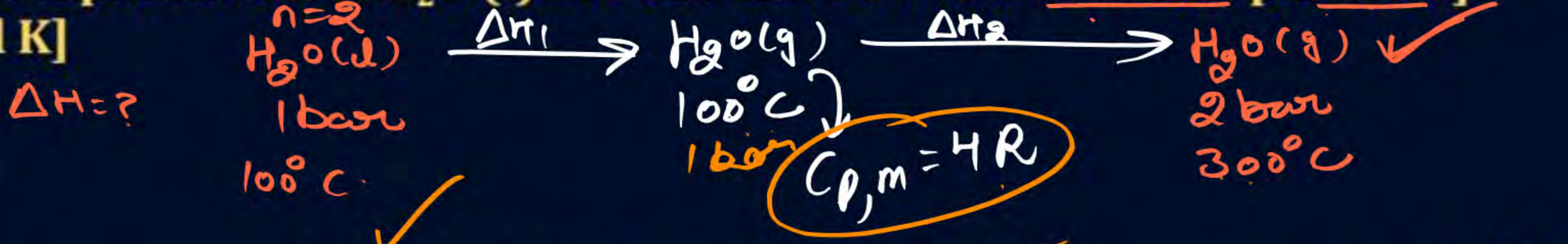
$\Delta U = w = -P\Delta V$

$\Delta U = P\Delta V$

$|\Delta H| < |\Delta U|$

QUESTION

Calculate change in enthalpy when 2 moles of liquid water at 1 bar and 100° C is converted into steam at 2 bar and 300° C. Assume H_2O vapours to behave ideally. [Latent heat of vaporisation of H_2O (l) at 1 bar and 100° C is 10.8 Kcal per mole] [R = 2 cal/mol K]



A) 21.6 kcal

B) 11.8 kcal

C) 24.8 kcal

D) 23.6 kcal

$\Delta H_{vap} = 10.8$ KCal/mol

$\Delta H_1 = 2 \times 10.8$ KCal

$= 21.6$ KCal

$\Delta H_2 = n C_{p,m} \Delta T$

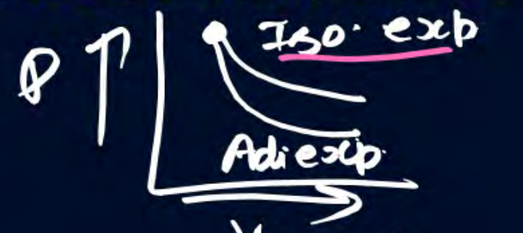
$= \frac{2 \times 4 \times 2 \times 200}{1000} = \frac{16}{5} = 3.2$ KCal

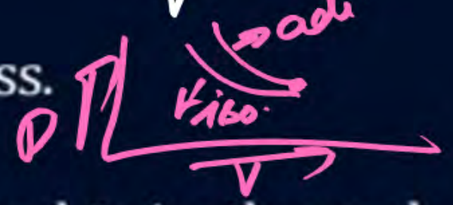
$\Delta H = 21.6 + 3.2$

$= 24.8$ KCal

QUESTION

Which of the following statement is incorrect regarding adiabatic and isothermal processes for an ideal gas, starting from same initial state to same final volume?





A ✗ In expansion, more work is done by the gas in isothermal process.

B ✗ In compression, less work will be done on the gas in isothermal process.

C ✗ The magnitude of slope of adiabatic P-V graph will be more as compared to isothermal P-V graph.

$$\text{Iso. } \frac{dP}{dV} = \left|-\frac{P}{V}\right| \qquad \text{Adi } \frac{dP}{dV} = \left|-\gamma\frac{P}{V}\right|$$

D ✓ In expansion, final temperature of adiabatic will be more as compared to isothermal.

Lec-1 to Lec-5 Thermo. → level moderate.

Revision of Last Class

Degree of Dissociation (α)

$$\alpha = \frac{x}{C} \Rightarrow x = C\alpha$$

% age dissociation $= \alpha \times 100$

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

	$PCl_5(g)$	$PCl_3(g)$	$Cl_2(g)$
$t=0$	C	0	0
$t=t$	$C-x$	x	x
	$\frac{C-C\alpha}{V}$	$\frac{C\alpha}{V}$	$\frac{C\alpha}{V}$

$$K_c = \left(\frac{C\alpha}{V}\right)^2 \times \frac{V}{C(1-\alpha)} = \frac{C\alpha^2}{V(1-\alpha)}$$

if $\alpha \ll\ll 1 \Rightarrow 1-\alpha \approx 1$

$$K_c = \frac{C\alpha^2}{V}$$

$$\alpha = \sqrt{\frac{K_c V}{C}}$$

$$K_p = \frac{(P_{PCl_3})^1 (P_{Cl_2})^1}{(P_{PCl_5})^1}$$

$$P_{Cl_2} = \chi_{Cl_2} \times P$$

$$= \frac{\alpha}{1+\alpha} \times P$$

$$P_{PCl_3} = \frac{\alpha}{1+\alpha} \times P$$

$$P_{PCl_5} = \frac{C - C\alpha}{C + C\alpha} \times P$$

$$= \frac{\cancel{C}(1-\alpha)}{\cancel{C}(1+\alpha)} \times P$$

$$\chi_{Cl_2} = \frac{x}{C - x + x + x} = \frac{C\alpha}{C - C\alpha + C\alpha + C\alpha} = \frac{\cancel{C}\alpha}{\cancel{C}(1+\alpha)}$$

$$K_p = \frac{\left(\frac{\alpha}{1+\alpha}\right)^2 \times P^2 \times (1+\alpha)}{\left(\frac{1-\alpha}{1+\alpha}\right) \times (1-\alpha) \times P}$$

$$= \frac{\alpha^2 P}{(1+\alpha)(1-\alpha)}$$

if $\alpha << 1$ $\quad 1-\alpha \approx 1$, $\quad 1+\alpha \approx 1$

$$K_p = P\alpha^2$$

$$\alpha^2 = \frac{K_p}{P} \Rightarrow \alpha = \sqrt{\frac{K_p}{P}}$$

$PCl_5(g) \rightarrow 1PCl_3(g) + 1Cl_2(g)$

$\alpha = \sqrt{\frac{K_C V}{C}} \Rightarrow \alpha \propto V^{1/2}$

$\alpha = \sqrt{\frac{K_P}{P}} \Rightarrow \alpha \propto \frac{1}{(P)^{1/2}}$

MIT

$\frac{\Delta n_g}{n_{P(g)}} = \frac{1}{2}$

$\Delta n_g = 2 - 1 = 1$

$\alpha \propto V^{\frac{\Delta n_g}{n_{P(g)}}}$

$\alpha \propto P^{-\frac{\Delta n_g}{n_{P(g)}}}$

if $\Delta n_g = 0 \Rightarrow \alpha$ is not effected by P or V

$1N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta n_g = 2 - 4 = -2$, $n_{P(g)} = 2$

$\alpha \propto V^{\frac{-2}{2}}$

$\alpha \propto \frac{1}{V}$

$\alpha \propto P^{\frac{2}{2}}$

$\alpha \propto P^1$

$$\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightleftharpoons 2HI(g)$$

$\Delta n_g = 2 - 2 = 0$

$n_p(g) = 2$

$$\propto \propto V^{\frac{0}{2}}$$

$$\propto \propto V^0$$

$$\propto \propto P^{0/2}$$

$$\propto \propto P^0$$

Q

$2 \rightarrow 1$

$1 \rightarrow \frac{1}{2}$

$x \rightarrow \frac{x}{2}$

$x \rightarrow \frac{2\alpha}{2}$

$x = c\alpha$

$= 2\alpha$

$$2AB(g) \rightarrow A_2(g) + B_2(g) \qquad K_c = 36$$

find $\alpha = ?$

	$2AB(g)$	$A_2(g)$	$B_2(g)$
	$\frac{2}{2}$	0	0
	$2-x$	$\frac{x}{2}$	$\frac{x}{2}$
	$\frac{2-2\alpha}{V}$	$\frac{2\alpha}{2V}$	$\frac{2\alpha}{2V}$
	$\frac{2(1-\alpha)}{V}$	$\frac{\alpha}{V}$	$\frac{\alpha}{V}$

$$K_c = \frac{\left(\frac{\alpha}{V}\right)^2 \times V^2}{4(1-\alpha)^2}$$

$$K_c = \frac{\alpha^2}{4(1-\alpha)^2}$$

$$36 = \frac{\alpha^2}{4(1-\alpha)^2}$$

$$(6)^2 = \left(\frac{\alpha}{2(1-\alpha)}\right)^2$$

$$6 = \frac{\alpha}{2(1-\alpha)}$$

$$12 - 12\alpha = \alpha$$

$$12 = 13\alpha$$

$$\alpha = \frac{12}{13}$$

$PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$

1	0	0
$1-x$	x	x
$1-\alpha$	α	α

$x = \frac{1}{\alpha}$

Conservation of mass

acc. to law of ~~mass~~ action:

$(\text{mass})_{t=0} = (\text{mass})_{t=t_{eq}}$

$(\text{moles} \times \text{molar mass})_{t=0} = (\text{moles} \times \text{molar mass})_{t=t_{eq}}$

$(1 \times \mathcal{Q} \times D) = ((1+\alpha) \times \mathcal{Q} \times d)$

$D = d(1+\alpha) \Rightarrow \frac{D}{d} = 1+\alpha \Rightarrow \alpha = \frac{D}{d} - 1 \Rightarrow \alpha = \frac{D-d}{d}$

Molar mass $= 2 \times V.D.$

$1 + \alpha + \alpha + \alpha$

$= 1 + \alpha$

	$1A(g) \rightleftharpoons n\,B(g)$
$t=0$	$c=1$, 0
	$1-x$, nx
$t=t_{eq}$	
	$1-\alpha$, $n\alpha$

$n \geq 2$

$$\text{moles} = \frac{\text{mass}}{\text{Molar mass}}$$

$$\text{Mass} = \text{moles} \times \text{Molar mass}$$

$$\alpha = \frac{x}{c}$$

$$\alpha = \frac{x}{1}$$

Law of Conservation of mass

$$(\text{total mass})_{t=0} = (\text{total mass})_{t=eq}$$

$$(\text{moles} \times \text{Molar mass})_{t=0} = (\text{moles} \times \text{Molar mass})_{t=eq}$$

$$1 \times 2 \times V.D_{reactant} = (1-\alpha+n\alpha) \times 2 \times V.D_{eq.mix}$$

$$D = (1-\alpha+n\alpha) \times d$$

$$G.M.M = 2 \times V.D.$$

$$V.D._{reactant} = D$$

$$V.D._{eq.mix} = d$$

$$\frac{D}{d} = 1 - \alpha + n\alpha$$

$$\frac{D}{d} - 1 = \alpha(n-1)$$

$$\frac{D-d}{d} = \alpha(n-1)$$

Molar mass reactant $= M_t = 2 \times D$ → theoretical molar mass

eq. mix. $= M_o = 2 \times d$ → obs. molar mass

$$\alpha = \frac{\frac{M_t}{2} - \frac{M_o}{2}}{\frac{M_o}{2}(n-1)}$$

MIT ①

$$\alpha = \frac{D-d}{d(n-1)}$$

$$\alpha = \frac{M_t - M_o}{M_o(n-1)}$$

D = V.D. of reactant

d = V.D. of eq. mix.

n = molecules formed by dissociation of 1 molecule

QUESTION

^{31}P, $^{35.5}Cl$

For PCl_5, dissociation, molar mass is 120 g. Find α and %age of dissociation.

Ans $PCl_5(g) \xrightarrow{\Delta} PCl_3(g) + Cl_2(g)$ $\quad n = 2$.

$M_t = M_{PCl_5} = 1 \times 31 + 5 \times 35.5$

$= 31 + 177.5$

$= 208.5\ g$

$M_0 = 120\ g$

% age dissociation $\approx \frac{88.5}{120} \times 100$

$$\alpha = \frac{M_t - M_0}{M_0(n-1)}$$

$$= \frac{208.5 - 120}{120(2-1)}$$

$$= \frac{88.5}{120}$$

QUESTION

At a fixed temperature, the volume of the reaction container is halved. For this change, which of the following statements hold true regarding the equilibrium constant (K_p) and degree of dissociation (α)?

$V_1 = V$, $V_2 = \frac{V}{2}$

K_p will not change

$\alpha \propto V^{\frac{\Delta n_g}{n_{p(g)}}}$

(A) Neither K_p nor α changes

(B) Both K_p and α change

(C) K_p changes but α does not change

(D) ✓ K_p does not change but α changes

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**

$\frac{1+\frac{1}{2}}{\frac{2+1}{2}} = \frac{3}{2}$

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

$\Delta n_g = 1 - (1 + \frac{1}{2})$

$= 1 - \frac{3}{2} = \frac{-1}{2}$

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

$= (RT)^{-\frac{1}{2}} = \frac{1}{(RT)^{1/2}}$

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

B. $(RT)^{-1/2}$ ✓

C. (RT)

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

QUESTION

For the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$. What is K for the reaction:

$$NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$$

$1NO_2(g) + 1NO \rightarrow 1NO(g) + \frac{1}{2}O_2$

$\frac{1}{2}N_2 + \frac{1}{2}O_2$

$2 \times \frac{1}{2} = 1$

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ ① K_1

$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ ② K_2

$\left(\frac{1}{K_1}\right)^{1/2} \times \left(\frac{1}{K_2}\right)^{1/2}$

(A) $\frac{1}{2K_1K_2}$

(B) $\frac{1}{4K_1K_2}$

(C) $\left[\frac{1}{K_1K_2}\right]^{1/2}$

(D) $\frac{1}{K_1K_2}$

QUESTION – (AIIMS 2016)

Two equilibria, $AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are simultaneously maintained in a solution with equilibrium constants, K_1 and K_2 respectively. The ratio of $[A^+]$ to $[AB_2^-]$ in the solution is:

$\frac{[A^+]}{[AB_2^-]}$

$K_1 = \frac{[A^+][B^-]}{[AB]}$

(A) directly proportional to $[B^-]$ ✗

(B) inversely proportional to $[B^-]$ ✗

$K_2 = \frac{[AB_2^-]}{[AB][B^-]}$

(C) directly proportional to the square of $[B^-]$ ✗

$\frac{K_1}{K_2} = \frac{[A^+][B^-][AB][B^-]}{[AB_2^-][AB]}$

(D) ✓ inversely proportional to the square of $[B^-]$

$\frac{[A^+]}{[AB_2^-]} \propto \frac{1}{[B^-]^2}$

QUESTION – (AIIMS 2015)

The reaction $2A(g) + B(g) \rightleftharpoons 3C(g) + D(g)$ is began with the concentrations of A and B both at an initial value of 1.00 M. When equilibrium is reached, the concentration of D is measured and found to be 0.25 M. The value for the equilibrium constant for this reaction is given by the expression

(A) $[(0.75)^3(0.25)] \div [(0.75)^2(0.25)]$

(B) $[(0.75)^3(0.25)] \div [(1.00)^2(1.00)]$

(C) $[(0.75)^3(0.25)] \div [(0.50)^2(0.75)]$

(D) $[(0.75)^3(0.25)] \div [(0.50)^2(0.25)]$

$$2A(g) + 1B(g) \rightleftharpoons 3C(g) + 1D(g)$$

$[D]_{eq.} = 0.25M$

$t=0$	1	1	0	0
$t=t$	$1-x$	$\frac{x}{2}$	$\frac{3}{2}x$	$\frac{x}{2} = 0.25$
	$1-0.5=0.5$	$\frac{0.5}{2}=0.25$		$x = 0.5$

$2 \rightarrow 1$

$1 \rightarrow \frac{1}{2}$

$x \rightarrow \frac{1}{2} \times x = \frac{x}{2}$

$2 \rightarrow 3$

$1 \rightarrow \frac{3}{2}$

$x \rightarrow \frac{3}{2}x$

$$K_C = \frac{\left(\frac{3}{2} \times \frac{0.25}{0.5}\right)^3 (0.25)^1}{(0.5)^2 \times (0.25)^1}$$

$$= (0.75)^3 (0.25) \div (0.5)^2 (0.25)$$

QUESTION – (AIIMS 2008)

Assertion: For reaction

$N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$

Unit of $K_C = L^2\ mol^{-2}$

Reason: For the reaction

$N_2(g) + 3H_2(g) \leftrightharpoons 2NH_3(g)$

Equilibrium constant, $K_C = \frac{[NH_3]^2}{[N_2][H_2]^3}$

$K_C = (mol/L)^{\Delta ng}$ $\quad \Delta ng = 2 - 4 = -2$

$= \left(\frac{mol}{L}\right)^{-2} = \frac{L^2}{mol^2}$

(A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(C) If the Assertion is correct but Reason is incorrect.

(D) If both the Assertion and Reason are incorrect.

(E) If the Assertion is incorrect but the Reason is correct.

QUESTION

For the reaction

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

$\Delta n_g = 1 - \frac{3}{2}$

$= \frac{2-3}{2} = \frac{-1}{2}$

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

$= K_c (RT)^{-\frac{1}{2}}$

$K_p = \frac{K_c}{(RT)^{\frac{1}{2}}}$ $\Rightarrow$ $K_c = K_p (RT)^{\frac{1}{2}}$

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

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

$\Delta n_g = 2 - 0 = 2$

A) 1

B) 0.5

C) 1.5

D) 2

QUESTION – (NCERT Exemplar)

PCl_5, PCl_3 and Cl_2 are at equilibrium at 500K in a closed container and their concentrations are 0.8×10^{-3} mol L^{-1}, 1.2×10^{-3} mol L^{-1} and 1.2×10^{-3} mol L^{-1} respectively. The value of K_c for the reaction PCl_5 (g) □ PCl_3 (g) + Cl_2 (g) will be

A. 1.8×10^{3} mol L^{-1}

B. 1.8×10^{-3}

C. 1.8×10^{-3} L mol^{-1}

D. 0.55×10^{4}

QUESTION – (NEET 2022)

$3O_2(g) \rightleftharpoons 2O_3(g)$ for the given reaction at 298 K, K_c is found to be 3.0×10^{-59}. If the concentration of O_2 at equilibrium is 0.040 M, then concentration of O_3 in M is:

(A) 1.20×10^{21}

(B) 4.38×10^{-32}

(C) 1.90×10^{-63}

(D) 2.40×10^{31}

QUESTION – [NCERT: PL-178 | JEE Mains April 2, 2025 (II)]

Consider the following chemical equilibrium of the gas phase reaction at a constant temperature:

A(g) □ B(g) + C(g); If p being the total pressure, K_p is the pressure equilibrium constant and a is the degree of dissociation, then which of the following is true at equilibrium?

A. If p value is extremely high compared to K_p, $\alpha \approx 1$

B. When p increases α decreases

C. If K_p value is extremely high compared to p, α becomes much less than unity

D. When p increases α increases

QUESTION – [NCERT: PL-178 | JEE Mains Jan. 29, 2025 (1)]

At temperature T, compound $AB_{2(g)}$ dissociates as $AB_{2(g)} \square AB_{(g)} \frac{1}{2}B_{2(g)}$ having degree of dissociation x (small compared to unity). The correct expression for x in terms K_p and p is

A $\sqrt[3]{\frac{2K_p}{p}}$

B $\sqrt[4]{\frac{2K_p}{p}}$

C $\sqrt[3]{\frac{2K_p^2}{p}}$

D $\sqrt{K_p}$

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