YAKEEN NEET 2.0

2026

Chemical Equilibrium

Physical Chemistry | **Lecture -03**

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Topics to be covered

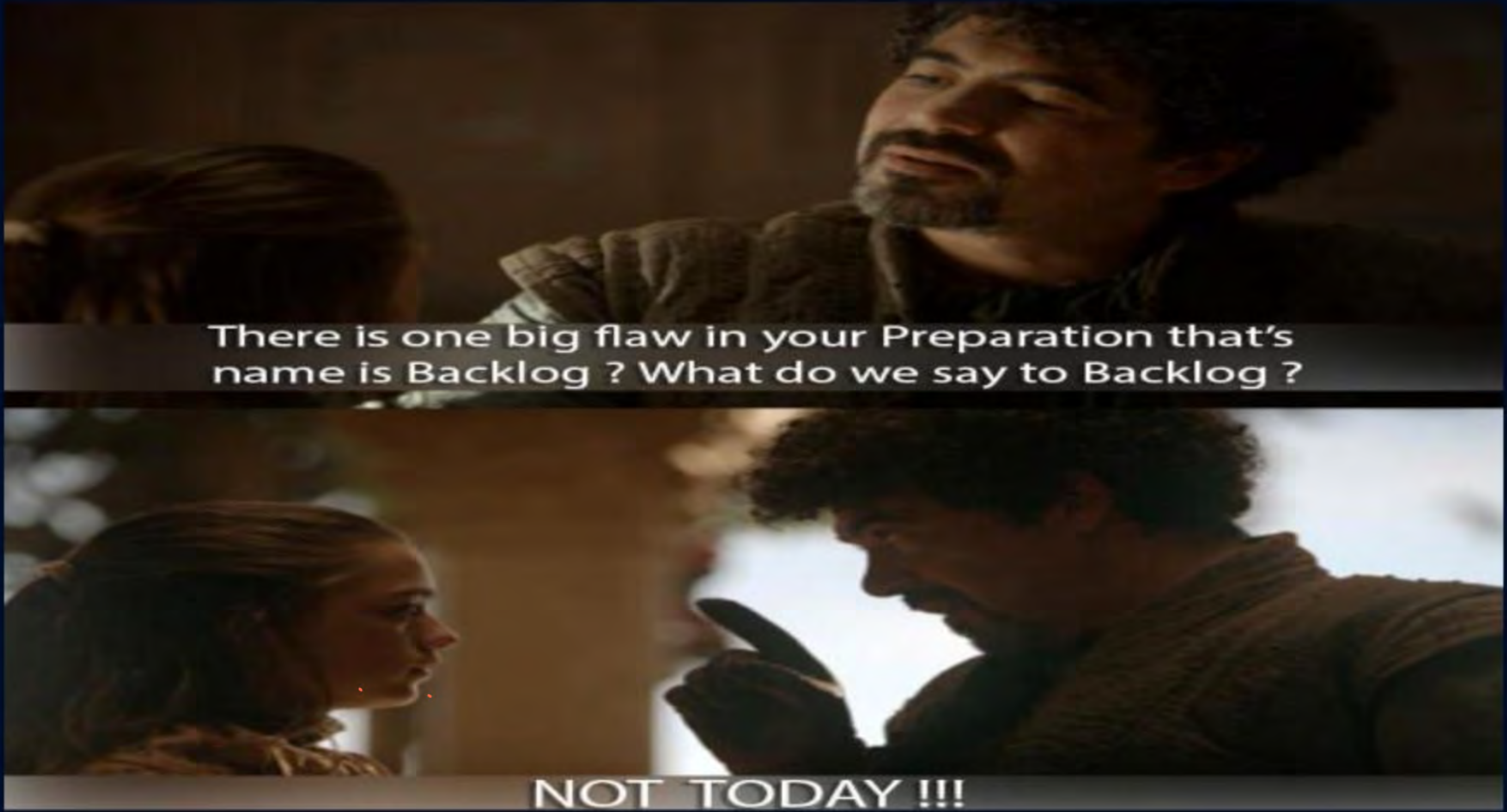
1. Revision of Last Class
2. Equilibrium constant numericals
3. Homogeneous and heterogeneous equilibrium
4. Degree of dissociation ★★★★★ Trick
5. Magarmach Practice Questions (MPQ) & Home work from modules

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

LOMA

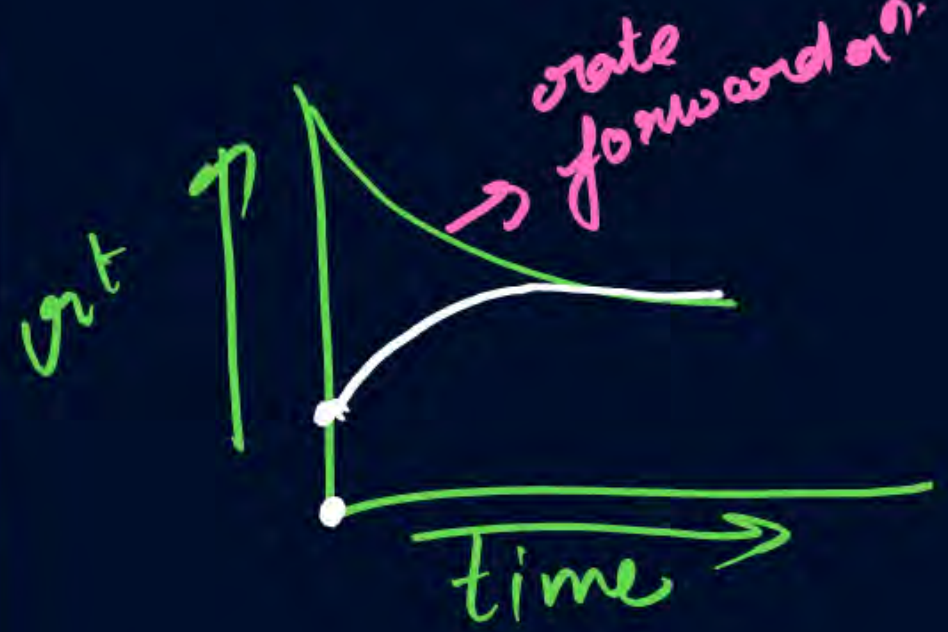
$$K_f[A]^a[B]^b = K_b[C]^c[D]^d$$

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

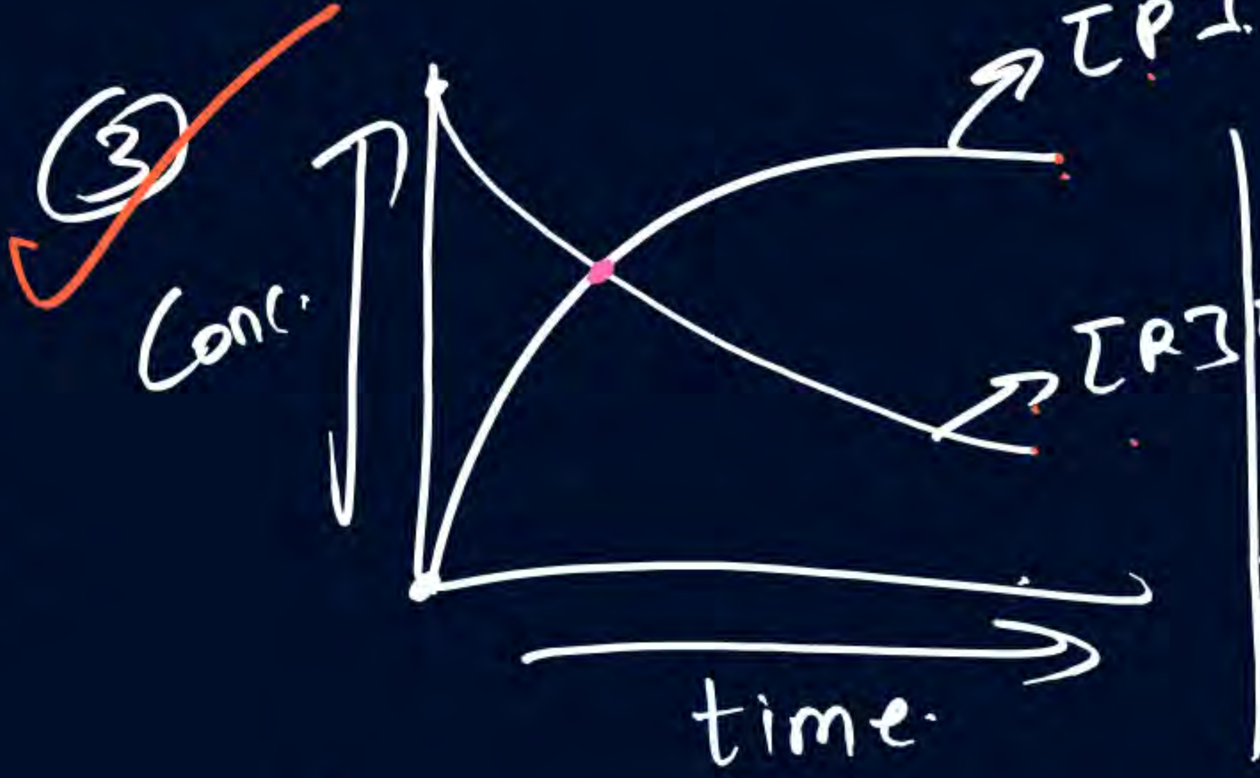
$$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$$

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

- 0
  - $K_p = K_c$
  - $T = 12\,K$
  - $RT \approx 1$
  - $K_p = K_c$
- $(+)ve$
  - $K_p > K_c$
- $(-)ve$
  - $K_p < K_c$

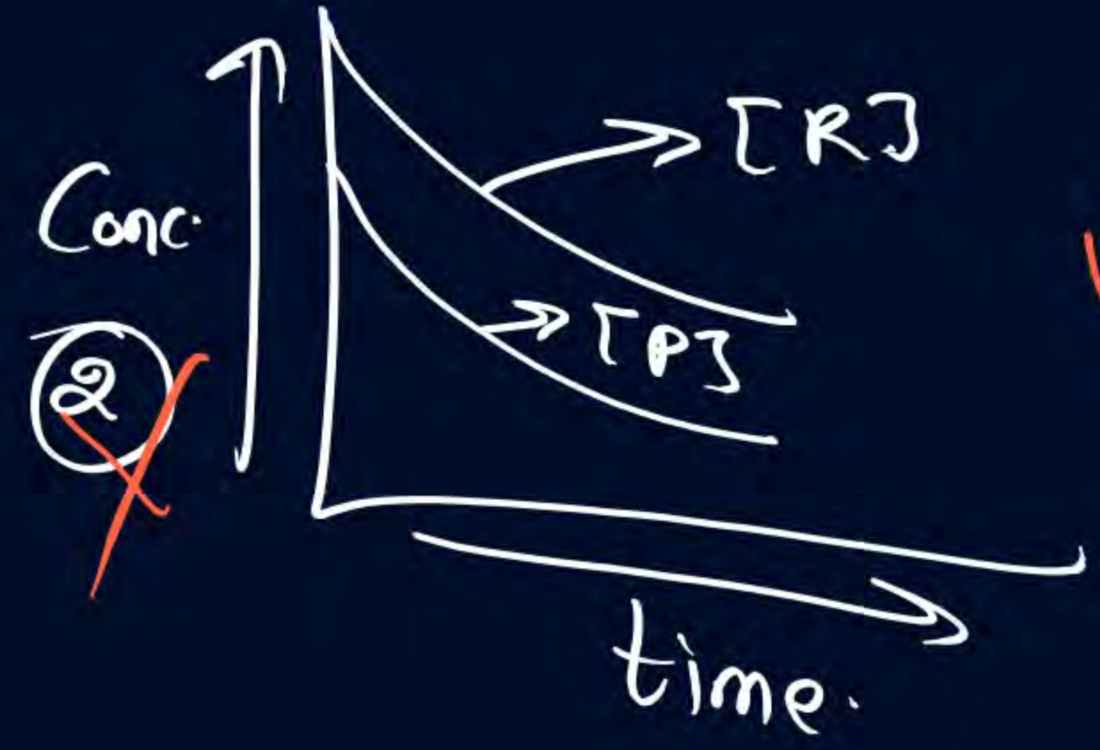


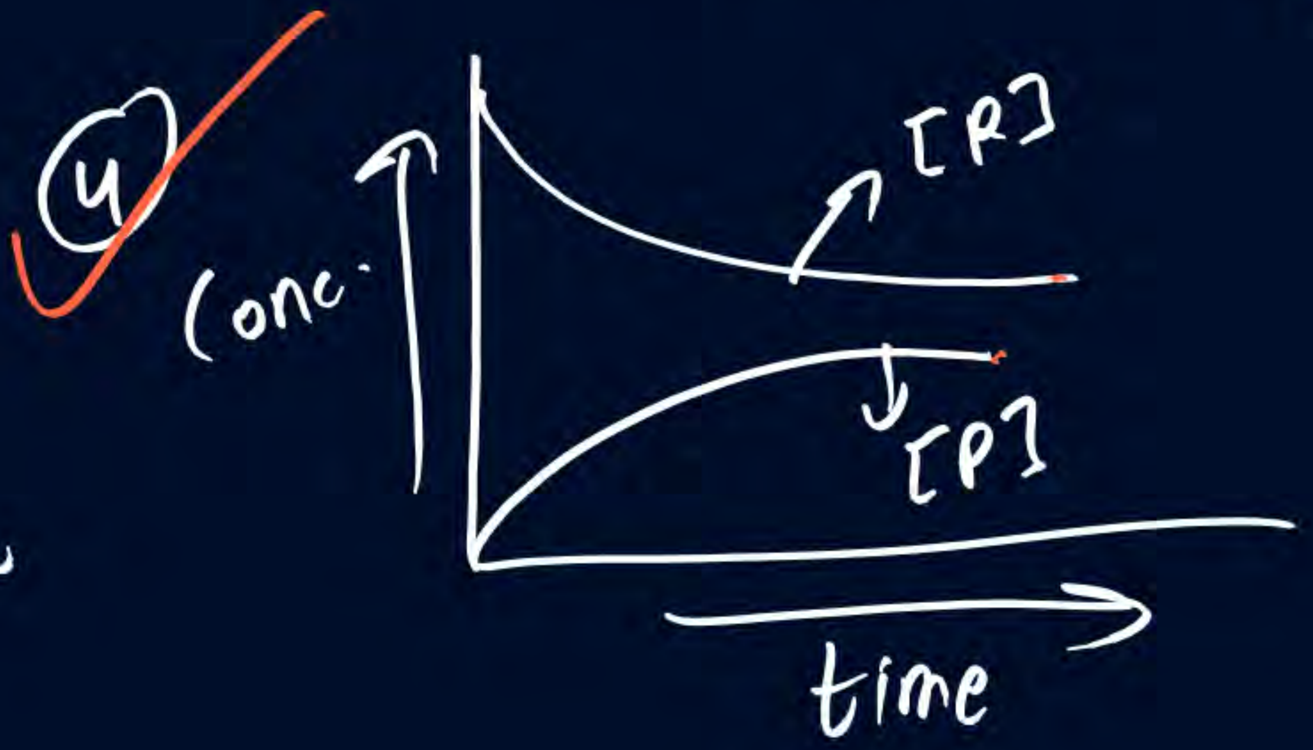
Q which graph possible?



	R $\rightarrow$	P
t=0	100	0
$t=t_{eq}$	100−90=10	90

t_{eq} ↓ 5 hr





Q2 Which oxide more stable?

(1) $M + \frac{1}{2}O_2 \rightarrow MO \quad K_c = .1$

(2) $M + O_2 \rightarrow MO_2 \quad K_c = 2$

$K_c \uparrow$ Prod. stable

2.5 lakh
↓
1 lac.

Q $A \rightleftharpoons B \quad \Delta H = 0$

if we inc. T from T_1 to T_2

$T_1 \rightarrow K_1$, $T_2 \rightarrow K_2$

(a) $K_1 > K_2$

(b) $K_1 < K_2$

(c) $K_1 = K_2$

(d) Cannot be predicted

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

$$\cancel{\log} K_2 = \cancel{\log} K_1$$

Characteristics of Equilibrium Constant

MIT

(1)

r^n is	effect on eq. Constt.
reverse.	$K' = \frac{1}{K}$
S.C. × x	$K' = (K)^x$
$\frac{1}{y}$ × S.C.	$K' = (K)^{\frac{1}{y}}$
r^n add.	$K' = K_1 \times K_2 \times K_3$

$A \rightleftharpoons B \quad K = \frac{[B]}{[A]}$

$B \rightleftharpoons A \quad K' = \frac{[A]}{[B]} = \frac{1}{K}$

$K' = \frac{[A]}{[B]}$

$3A \rightleftharpoons 2B$

$K' = \frac{[B]^2}{[A]^3}$

$K' = (K)^{\frac{2}{3}}$

$\frac{1}{2}A \rightleftharpoons \frac{1}{2}B$

$K' = \frac{[B]^{\frac{1}{2}}}{[A]^{\frac{1}{2}}} = (K)^{1/2}$

$A \rightleftharpoons B \quad K = \frac{[B]}{[A]}$

① $A \rightleftharpoons C \quad K_1$

② $C \rightleftharpoons D \quad K_2$

③ $D \rightleftharpoons B \quad K_3$

$A + \cancel{C} + \cancel{D} \rightleftharpoons \cancel{C} + \cancel{D} + B$ add eq ①, ② & ③

$A \rightleftharpoons B$

$K = K_1 \times K_2 \times K_3 = \frac{[\cancel{C}]}{[A]} \times \frac{[\cancel{D}]}{[\cancel{C}]} \times \frac{[B]}{[\cancel{D}]} = \frac{[B]}{[A]}$

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

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

r^n reverse $\times$ S.C. $= 2$

$$\left(\frac{1}{8}\right)^2 = \frac{1}{64}.$$

(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

$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$ K_1

$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$ K_2

The equilibrium constant for the reaction

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

$K = K_2 \times \frac{1}{K_1}$

eq. 2 + (– eq. 1)

= eq. 2 + reverse eq 1

$K = K_2 \times \frac{1}{K_1}$

(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:

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

$N_2 + O_2 \rightleftharpoons 2NO$; K_2

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O$; 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) $K_1K_2K_3$

reverse eq. 1 + eq. 2 + 3x eq. 3

$K = \frac{1}{K_1} \times K_2 \times (K_3)^3$

$\cancel{N_2} + O_2 + \cancel{3H_2} + \frac{3}{2}O_2 + 2NH_3 \rightleftharpoons 2NO + 3H_2O + \cancel{N_2} + \cancel{3H_2}$

$2NH_3 + \frac{5}{2}O_2 \rightarrow 2NO + 3H_2O$

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 ~~the~~ reactant at equilibrium? (K = equilibrium constant)

the

(A) $A \rightleftharpoons B; K = 0.001$

(B) $M \rightleftharpoons N; K = 10$

(C) $X \rightleftharpoons Y; K = 0.005$

(D) $R \rightleftharpoons P; K = 0.01$

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: $CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$ will be:

(A) 3.0×10^5

(B) 3.0×10^{-5}

(C) 3.0×10^{-4}

(D) 3.33×10^4

$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H^+$ (1)

$HCN + H_2O \rightleftharpoons CN^- + H^+$ (2)

eq (1) + reverse eq (2)

$K = K_1 \times \frac{1}{K_2}$

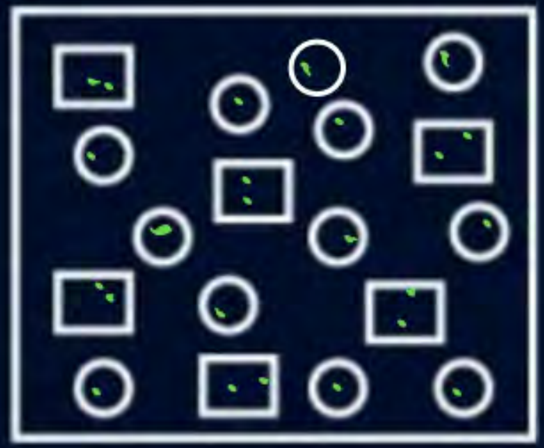
$= \frac{\cancel{1.5} \times 10^{-5}}{3\,\cancel{4.5} \times \cancel{10^{-10}}}\ 10^{-5}$

$\frac{1}{3} \times 10^5 = 0.33 \times 10^5$

$= 3.3 \times 10^4$

QUESTION

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



$K = \frac{12}{6} = 2.$

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

$3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$

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

QUESTION

A schematic plot of $\ln K_{eq}$ versus inverse of temperature for a reaction is shown in the figure. The reaction must be:

$\ln K = \ln A - \dfrac{\Delta H}{2.303RT}$ → (−)ve = rxn exo

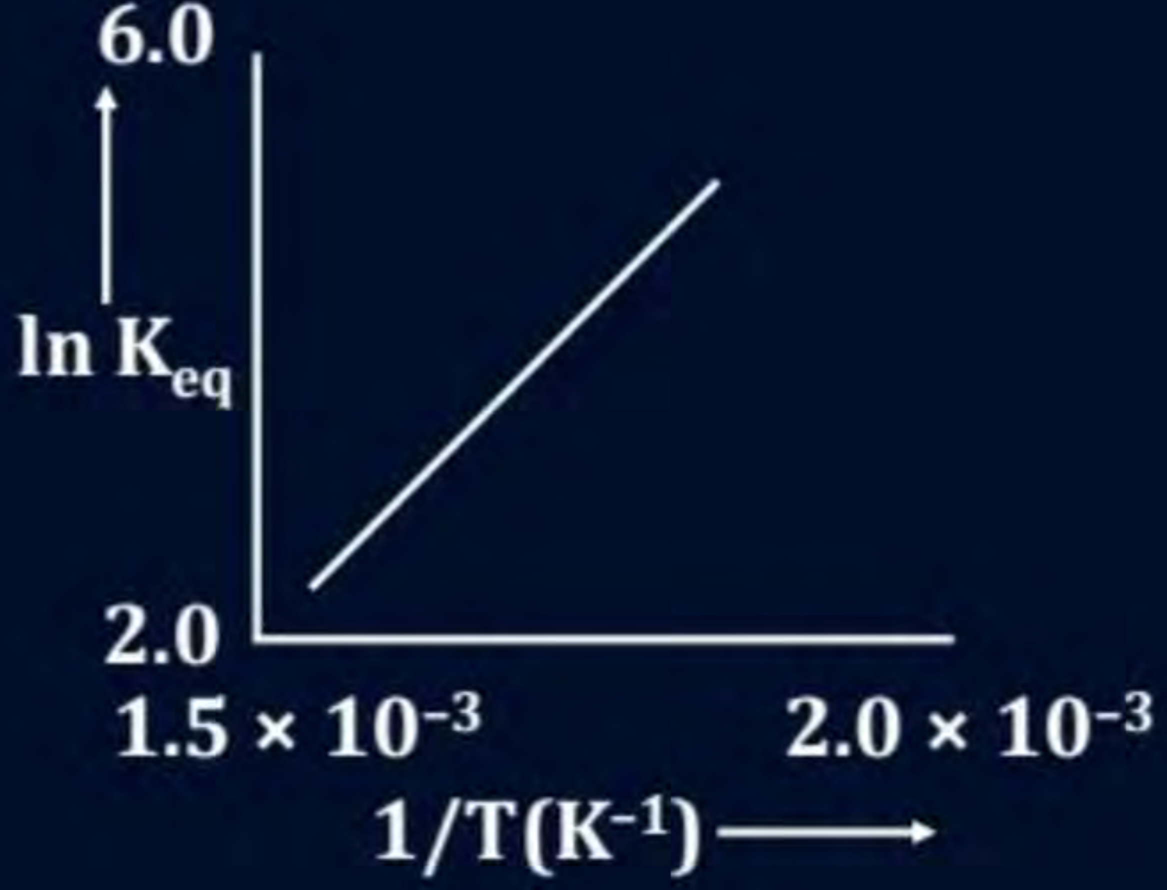
$y = c + mx$

(A) Exothermic

(B) Endothermic

(C) One with negligible enthalpy change

(D) Highly spontaneous at ordinary temperaure



Reaction Quotient (Q_c)

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

r.o.f r^n = r.o.b. r^n

$K_c = \dfrac{[C]^c[D]^d}{[A]^a[B]^b}$ → at eq

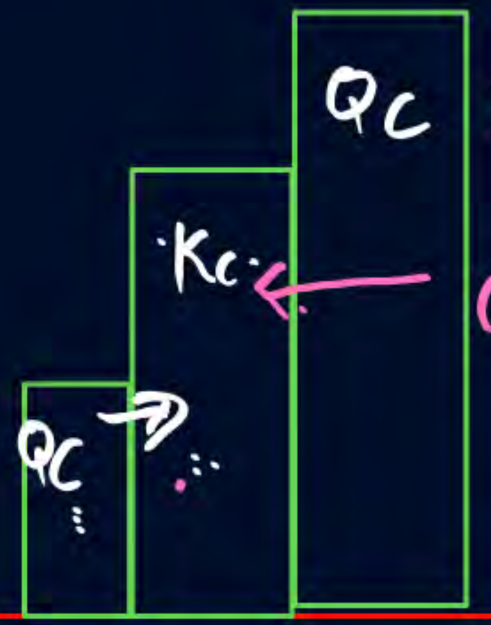
MIT

① $Q_c = \dfrac{[C]^c[D]^d}{[A]^a[B]^b}$ → at any instant.

② $t < t_{eq}$. $Q_c < K_c$.

$t = t_{eq}$. or $t > t_{eq}$. $Q_c = K_c$.

③



$Q_c < K_c$ eq. → shift forward r^n

$Q_c > K_c$ eq. → ~ backward r^n

QUESTION – (NEET 2024)

For the reaction $2A \rightleftharpoons B + C$, $K_c = 4 \times 10^{-3}$. At a given time, the composition of reaction mixture is:

$[A] = [B] = [C] = 2 \times 10^{-3}$ M $\longrightarrow$ $Q_c = \frac{\cancel{2 \times 10^{-3}} \times \cancel{2 \times 10^{-3}}}{\cancel{(2 \times 10^{-3})^2}} = 1$

$Q_c > K_c$

Then, which of the following is correct?

(A) Reaction is at equilibrium.

(B) Reaction has a tendency to go in forward direction.

(C) Reaction has a tendency to go in backward direction.

(D) Reaction has gone to completion in forward direction.

QUESTION

The equilibrium constant for a reaction is K and the reaction quotient is Q. For a particular reaction mixture, the ratio K/Q is 0.3. This means that

$\frac{K}{Q} = 0.3$

$K = \underline{0.3}\,Q$

$K < Q$

$\underline{Q_c > K_c}$

(A) The reaction mixture will equilibrate to form more reactant species

(B) The reaction mixture will equilibrate to form more product species

(C) The equilibrium ratio of reactant to product concentrations will be 3

(D) The equilibrium ratio of reactant to product concentrations will be 0.33

QUESTION – (AIIMS 2011)

Assertion: Reaction quotient is defined in the same way as equilibrium constant at any state of the reaction.

Reason: If Q_C (reaction quotient) < K_C (equilibrium constant) reaction moves in direction of reactants.

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

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

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

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

Homogeneous Equilibrium

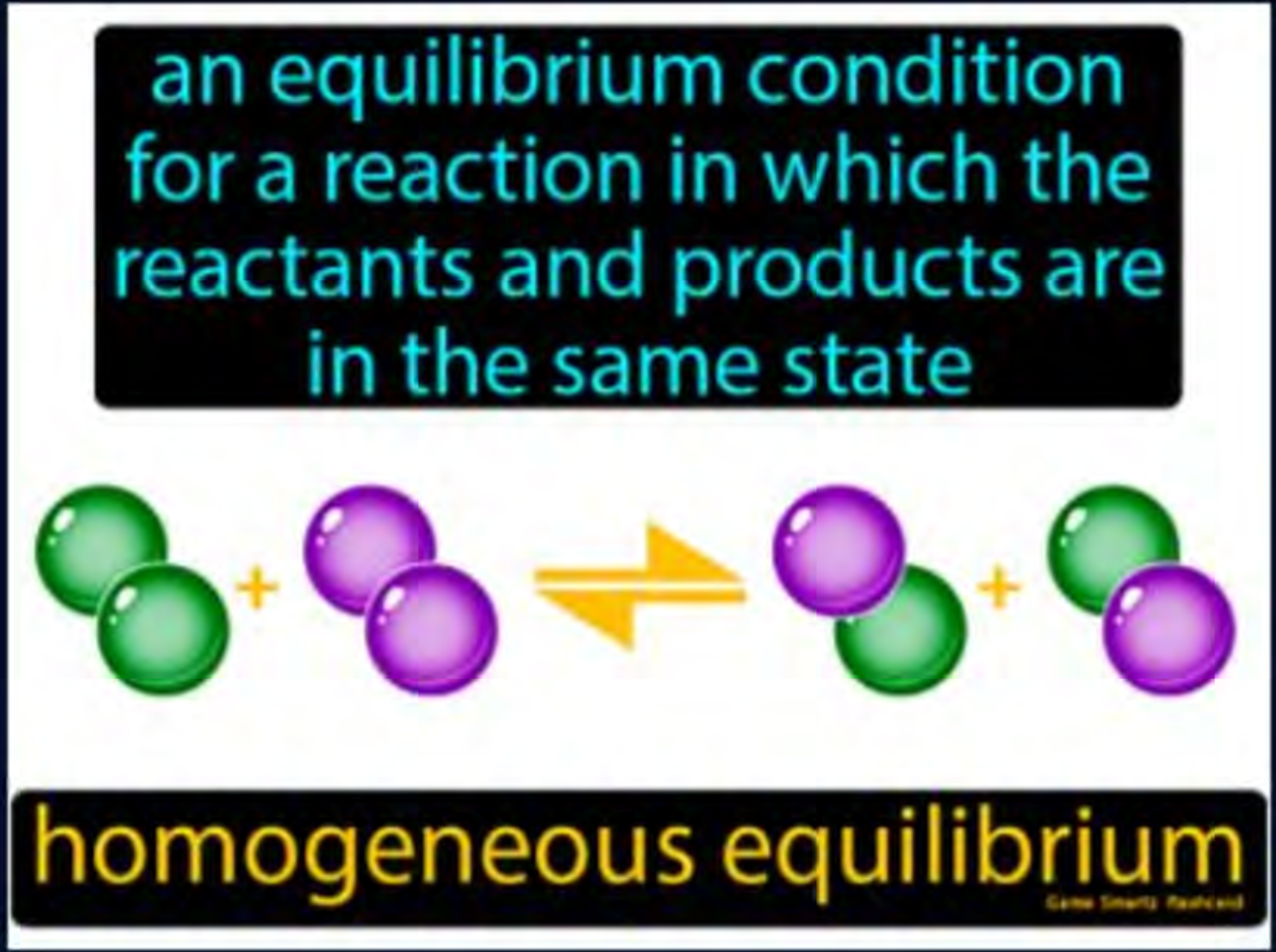
reactants & products are in same phase.

both gaseous.

miscible liquids.

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

$$C_2H_5OH(l) + H_2O(l) \rightarrow C_2H_5OH(aq)$$



Heterogeneous Equilibrium

reactants & product are in diff. phase.

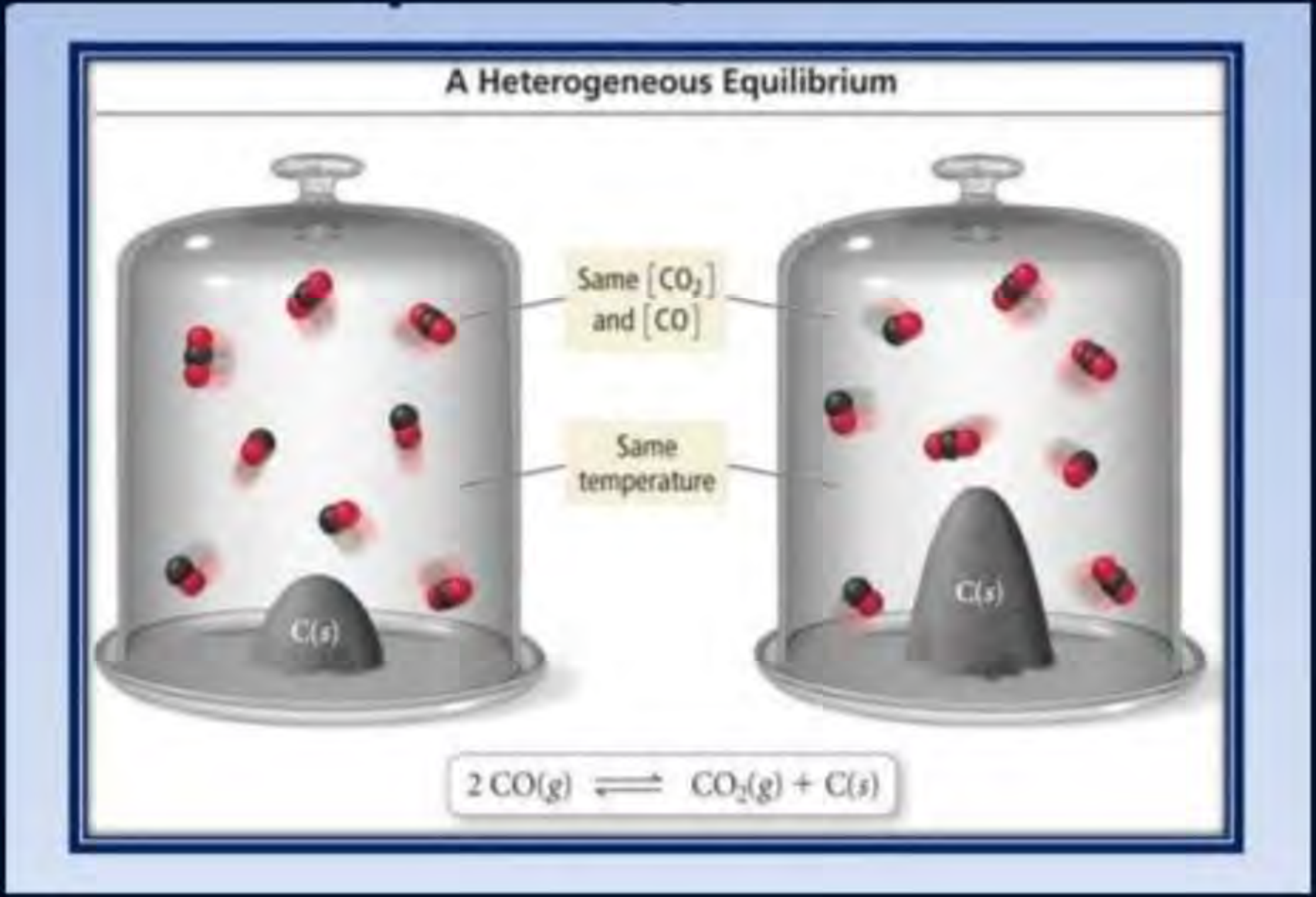
- immiscible liquids.
- different solid.
- different physical state.

$1A(s) \rightleftharpoons 1B(s)$

Phases = 2 | Heterogeneous eq.

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

Phases = 2



Degree of Dissociation (α)

MIT

① $\alpha = \dfrac{\text{moles dissociated } (x)}{\text{moles taken } (C)}$

②

% age dissociation $= \alpha \times 100$

$$1A(g) \rightleftharpoons 1B(g)$$

$t=0$ 1 moles   0

$t=t$ x moles A reacted.

$1-x$ x

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

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

$x = C\alpha$

$x = \alpha$

$$K_C = \frac{[B]}{[A]} = \frac{\alpha \times \cancel{V}}{\cancel{V}(1-\alpha)}$$

$$K_C = \frac{\alpha}{1-\alpha}$$

$$1A(g) \rightleftharpoons 1B(g)$$

$t=0$ C 0

$t=t$ $C-x$ x

$C - C\alpha$ $C\alpha$.

$\frac{C(1-\alpha)}{V}$ $\frac{C\alpha}{V}$

$$K_C = \frac{\cancel{C}\alpha \times \cancel{V}}{\cancel{V}(\cancel{C}(1-\alpha))} = \frac{\alpha}{1-\alpha}.$$

$$1A(g) \rightleftharpoons 2B(g)$$

$$\begin{array}{lll} t=0 & C & 0 \\ t=t & C-x & 2x \\ & \dfrac{C-C\alpha}{V} & \dfrac{2C\alpha}{V} \\ & \dfrac{C(1-\alpha)}{V} & \dfrac{2C\alpha}{V} \end{array}$$

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

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

$$1A(g) \rightleftharpoons 4B(g)$$

$$\begin{array}{ll} C & 0 \\ C-x & 4x \\ \dfrac{C-C\alpha}{V} & \dfrac{4C\alpha}{V} \end{array}$$

$$K_C = \frac{\left(\dfrac{4C\alpha}{V}\right)^4 \times V}{C(1-\alpha)} = \frac{256C^3\alpha^4}{V^3(1-\alpha)}$$

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

$$
\begin{array}{llll}
t=0 & C & 0 & 0 \\
t=t & C-x & 2x & 3x \\
 & C-C\alpha & 2C\alpha & 3C\alpha \\
 & \dfrac{C(1-\alpha)}{V} & \dfrac{2C\alpha}{V} & \dfrac{3C\alpha}{V}
\end{array}
$$

$$K_C = \frac{\left(\dfrac{2C\alpha}{V}\right)^2 \left(\dfrac{3C\alpha}{V}\right)^3 \times V}{C(1-\alpha)} = \frac{108\,C^4 \alpha^5}{V^4 (1-\alpha)}$$

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QUESTION

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

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)?

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

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

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

C. (RT)

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

QUESTION

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

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

(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 □ $A^+ + B^-$ and $AB + B^-$ □ 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:

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

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

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

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

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

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

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

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

(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

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

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

Trick

Stop watch on → 4p.m. → 4:30pm

Stop watch off

Comments tomorrow

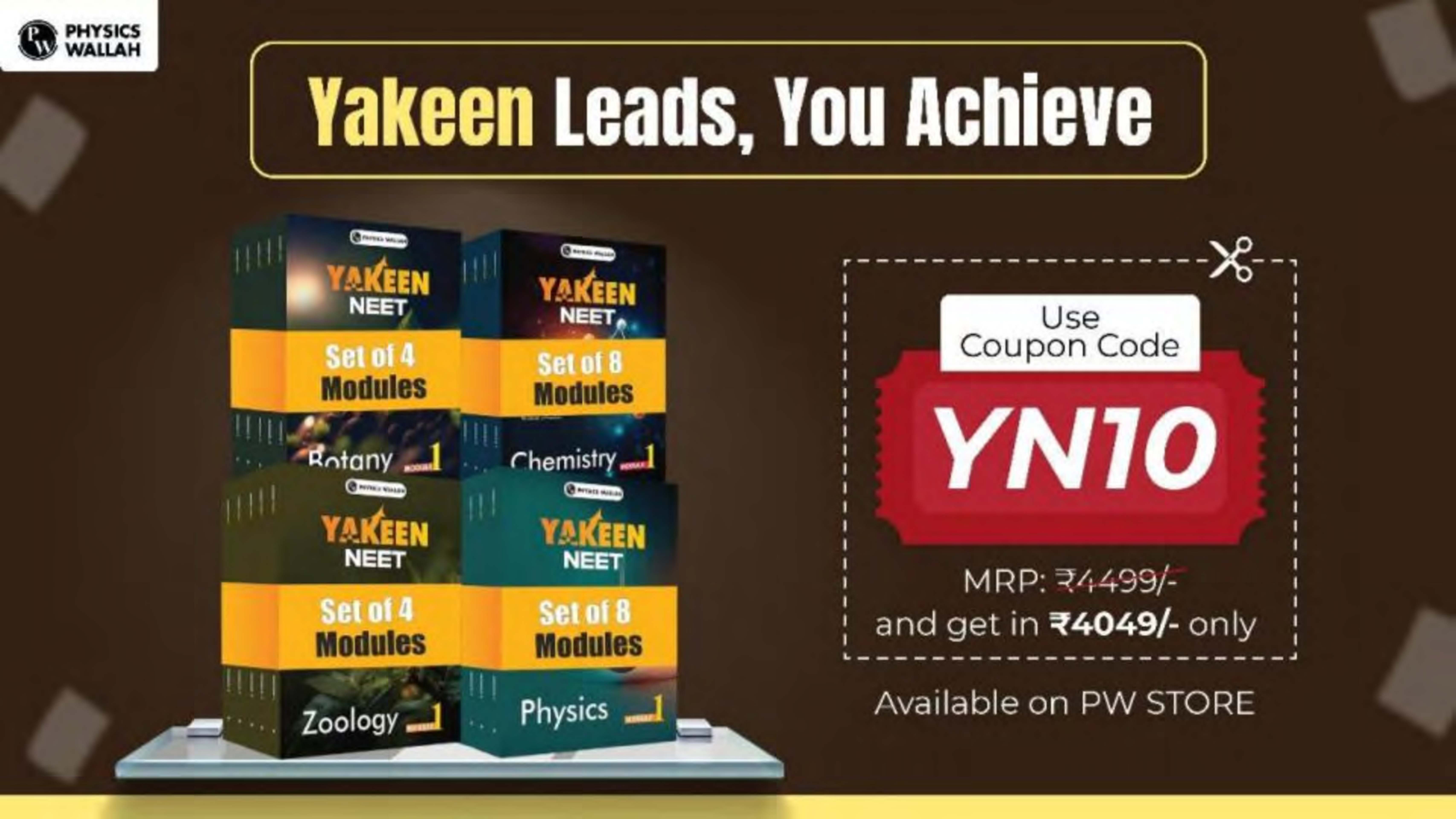
MEDICS Test → Thermodynamics

↳ Rog

Lec-1 to Lec-3

↓

Moderate level.


PHYSICS WALLAH
Yakeen Leads, You Achieve
YAKEEN NEET
Set of 4 Modules
Botany 1
YAKEEN NEET
Set of 8 Modules
Chemistry 1
YAKEEN NEET
Set of 4 Modules
Zoology 1
YAKEEN NEET
Set of 8 Modules
Physics 1
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