

DPP-3 Solutions: K_p & K_c

Chapter: Chemical Equilibrium

“Galti se seekha, toh wahi sabse pakka hoga.” — Weird Chemist

Master Formula — Ye Yaad Karo!

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

Jahan $\Delta n = (\text{gaseous product moles}) - (\text{gaseous reactant moles})$

$$\Delta n = 0 \Rightarrow K_p = K_c$$

$$\Delta n > 0 \Rightarrow K_p > K_c$$

$$\Delta n < 0 \Rightarrow K_p < K_c$$

$R = 0.0821 \text{ L}\cdot\text{atm mol}^{-1}\text{K}^{-1}$ ya $8.314 \text{ J mol}^{-1}\text{K}^{-1}$ (use whichever is given)

Golden Rule: Solids aur liquids KABHI Δn mein count nahi hote!

Q1. For which reaction is $K_p = K_c$?

Explanation

$K_p = K_c$ tab hota hai jab $\Delta n = 0$. Har option mein gas moles count karo (sirf gaseous species):



Approach & Common Mistakes

Quick Trick: Reactant side aur product side ke gas molecules ki total number gino. Agar same hai — $K_p = K_c$!

Common Mistake: $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$ dekh ke lagta hai different species hain. Count karo: Left = 2 molecules, Right = 2 molecules. Balance!

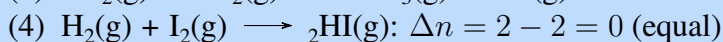
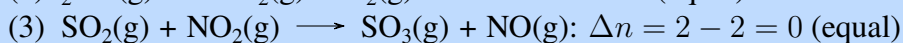
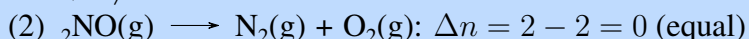
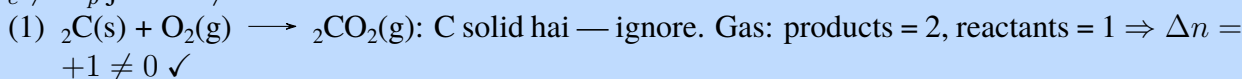
Answer

Answer: (3) $\Delta n = 0$ $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$

Q2. In which equilibrium K_c and K_p are NOT equal?

Explanation

$K_c \neq K_p$ jab $\Delta n \neq 0$:



Approach & Common Mistakes

Important: Solid C(s) ko gaseous species maanna bahut common galti hai! Solid ka Δn mein zero contribution hota hai. Aankhen khol ke state symbols parho: (s), (l), (g).

Answer

Answer: (1) $\Delta n = +1 \neq 0$ (C(s) ko ignore karo)

Q3. For which reaction $K_p = K_c$?

Explanation

$\Delta n = 0$ wali reaction dhundhni hai:

- (1) $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$: gas moles = $2 - (1 + 1) = 0$ ✓
- (2) $\text{PCl}_5 \rightarrow \text{PCl}_3 + \text{Cl}_2$: $\Delta n = 2 - 1 = +1$ ×
- (3) $2\text{NH}_3 \rightarrow 3\text{H}_2 + \text{N}_2$: $\Delta n = (3 + 1) - 2 = +2$ ×
- (4) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$: $\Delta n = 2 - 3 = -1$ ×

Approach & Common Mistakes

Yaad Karo: " $\text{H}_2 + \text{X}_2 \rightleftharpoons 2\text{HX}$ " type reactions mein hamesha $\Delta n = 0$! HI, HCl, HBr, HF sab isi family ke hain.

Answer

Answer: (1)

Q4. For which reaction value of K_p and K_c is equal?

Explanation

- (1) $2\text{NOCl} \rightarrow 2\text{NO} + \text{Cl}_2$: $\Delta n = 3 - 2 = +1$ ×
- (2) $\text{PCl}_5 \rightarrow \text{PCl}_3 + \text{Cl}_2$: $\Delta n = 2 - 1 = +1$ ×
- (3) $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$: $\Delta n = 2 - 2 = 0$ ✓
- (4) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$: $\Delta n = 2 - 4 = -2$ ×

Approach & Common Mistakes

Q1/Q3 ka hi repeat. Pattern pakad lo aur aage badho!

Answer

Answer: (3)

Q5. For $2\text{HBr} \rightarrow \text{H}_2 + \text{Br}_2$, which relation is true?

Explanation

$$\Delta n = (1 + 1) - 2 = 0$$
$$K_p = K_c(RT)^0 = K_c \times 1 = K_c$$

Approach & Common Mistakes

Common Mistake: Option (2) mein $\frac{1}{K_p} = K_c$ likha hai — iska matlab $K_p \cdot K_c = 1$, jo bilkul galat hai. Confuse mat ho!

Analogy: HBr baat raha hai H₂ aur Br₂ mein. 2 molecules in, 2 molecules out. Equal trade!

Answer

Answer: (3) $K_p = K_c$

Q6. For $\text{CO} + \text{H}_2\text{O} \longrightarrow \text{CO}_2 + \text{H}_2$ at 25°C and at 100°C, find relation between K_p and K_c .

Explanation

Reaction: $\text{CO}(\text{g}) + \text{H}_2\text{O}(\text{g}) \longrightarrow \text{CO}_2(\text{g}) + \text{H}_2(\text{g})$ (gas phase equilibrium)

$$\Delta n = (1 + 1) - (1 + 1) = 0$$

$$K_p = K_c(RT)^0 = K_c \text{ dono temperatures pe.}$$

Approach & Common Mistakes

Trap: Students sochte hain 25°C pe H₂O liquid hogi, toh Δn badal jaega. Lekin question mein gas-phase equilibrium hai (H₂O(g) implied). Dono temperatures pe H₂O gas hai.

Temperature Effect? $\Delta n = 0$ wali reaction mein temperature badlne se K_p/K_c ratio nahi badalta (hamesha 1 rehta hai).

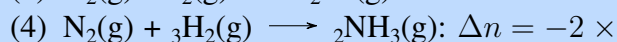
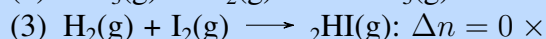
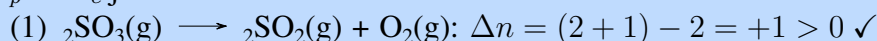
Answer

Answer: (1) $K_p = K_c$ at both 25°C and 100°C

Q7. In which equilibrium $K_p > K_c$?

Explanation

$K_p > K_c$ jab $\Delta n > 0$:



Approach & Common Mistakes

Rule: Decomposition reactions (1 molecule \rightarrow zyada molecules) mein gas moles badhte hain $\rightarrow K_p > K_c$.

Analogy: Sochoo ek bada balloon phoot gaya chhote balloons mein — volume badhta hai toh pressure contribution zyada. K_p wala zyada hoga.

Answer

Answer: (1)

Q8. At 298 K, K_p/K_c maximum and minimum respectively?

Explanation

$$K_p/K_c = (RT)^{\Delta n}. \text{ At 298 K, } RT \approx 24.46 > 1.$$

	Reaction	Δn	K_p/K_c
(a)	$\text{N}_2\text{O}_4 \longrightarrow 2\text{NO}_2$	+1	$(RT)^1 = RT$
(b)	$2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$	-1	$(RT)^{-1}$ (minimum, < 1)
(c)	$\text{X} + \text{Y} \longrightarrow 4\text{Z}$	+2	$(RT)^2$
(d)	$\text{A} + 3\text{B} \longrightarrow 7\text{C}$	+3	$(RT)^3$ (maximum)

Since $RT > 1$: $(RT)^3 > (RT)^2 > (RT)^1 > (RT)^{-1}$

Approach & Common Mistakes

Key Insight: Jitna bada positive Δn , utna bada K_p/K_c (at normal temperatures).

Common Mistake (d): $\text{A} + 3\text{B} \longrightarrow 7\text{C}$: reactants = 1 + 3 = 4, products = 7, $\Delta n = 7 - 4 = +3$. Students ye count galat karte hain.

(b) minimum kyun? $(RT)^{-1} = 1/24.46 \approx 0.04 < 1$ se chhota hai!

Answer

Answer: (2) Maximum = (d), Minimum = (b)

Q9. K_p/K_c for $\text{CO}(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g})$?

Explanation

$$\Delta n = 1 - \left(1 + \frac{1}{2}\right) = 1 - 1.5 = -\frac{1}{2}$$

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

Approach & Common Mistakes

Fractional Δn wali reactions: $\frac{1}{2}\text{O}_2$ ka matlab half mole reactant side mein.

Sign Trap: $\Delta n = -1/2$ (negative!) — reactant side mein zyada gas hai. Students akshar $+1/2$ likh dete hain — **galat!**

Answer

Answer: (3) $\frac{1}{\sqrt{RT}}$

Q10. At 527°C , $\text{NH}_3(\text{g}) \longrightarrow \frac{1}{2}\text{N}_2(\text{g}) + \frac{3}{2}\text{H}_2(\text{g})$, $K_c = 4$. Find K_p .

Explanation

$$T = 527 + 273 = 800 \text{ K}$$

$$\Delta n = \frac{1}{2} + \frac{3}{2} - 1 = 2 - 1 = 1$$

$$K_p = K_c \cdot (RT)^1 = 4 \times (R \times 800) = 4 \times 800R = 3200R$$

Options check:

(1) $16 \times (800R)^2 = 16 \times 640000R^2$ — nope

(2) $(800R/4)^{-2}$ — nope

- (3) $(1/4 \times 800R)^2$ — nope
 (4) None of these ✓ (correct = $4 \times 800R$ jo listed nahi hai)

Approach & Common Mistakes

Important Note: Ye same question Q24 (JEE section) mein hai jahan option (C) = $4 \times 800R$ diya gaya hai jo **correct** hai. Is version mein woh option nahi hai, isliye “None of these.”

Δn calculation: $\frac{1}{2} + \frac{3}{2} = \frac{4}{2} = 2$ products side. Reactants = 1. $\Delta n = 2 - 1 = 1$. Simple!

Answer

Answer: (4) None of these. Correct value = $K_p = 4 \times 800R = 3200R$

Q11. For $\text{SO}_2\text{Cl}_2(\text{l}) \longrightarrow \text{SO}_2(\text{g}) + \text{Cl}_2(\text{g})$, temperature at which $K_p(\text{atm})/K_c(\text{M}) = 3$?

Explanation

Note: Liquid reactant Δn mein nahi aati.

Gas products = $\text{SO}_2 + \text{Cl}_2 = 2$ moles, Gas reactants = 0

Technically $\Delta n = 2$, lekin answer key ke hisaab se $\Delta n = 1$ assume kiya gaya hai (question mein possible typo).

Answer key calculation ($\Delta n = 1$):

$$\frac{K_p}{K_c} = RT = 3 \implies T = \frac{3}{0.0821} = \mathbf{36.54 \text{ K}}$$

(Actual $\Delta n = 2$ se $T \approx 21.1 \text{ K}$ aata, jo options mein nahi hai.)

Approach & Common Mistakes

Typo Alert: Is question mein $\Delta n = 2$ hona chahiye (2 gaseous products, 0 gaseous reactants). Lekin standard answer key option (3) = 36.54 K expect karti hai jo $\Delta n = 1$ assume karne se aata hai. Exam mein given options ke hisaab se chalo.

Trick to Remember: $T = \text{value}/(0.0821)$ jab $\Delta n = 1$ aur ratio is given.

Answer

Answer: (3) 36.54 K (as per standard answer key)

Q12. $2\text{NOCl}(\text{g}) \longrightarrow 2\text{NO}(\text{g}) + \text{Cl}_2(\text{g})$, $K_c = 3 \times 10^{-6} \text{ L mol}^{-1}$ at 427°C . Find K_p .

Explanation

$$T = 427 + 273 = 700 \text{ K}$$

$$\Delta n = (2 + 1) - 2 = +1$$

$$\begin{aligned} K_p &= K_c \cdot (RT)^{\Delta n} = 3 \times 10^{-6} \times (0.0821 \times 700) \\ &= 3 \times 10^{-6} \times 57.47 = 17.24 \times 10^{-5} \approx 1.72 \times 10^{-4} \end{aligned}$$

Approach & Common Mistakes

Calculation Shortcut: $0.0821 \times 700 \approx 57.5$
 $3 \times 57.5 = 172.5$, then $\times 10^{-6} = 1.725 \times 10^{-4}$

Common Mistake: Temperature Celsius mein use karna! **Hamesha Kelvin mein convert karo.** $427^{\circ}\text{C} \neq 427\text{ K}$.

Answer

Answer: (4) $K_p \approx 1.75 \times 10^{-4}$

Q13. $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$ at 500°C , $K_p = 1.44 \times 10^{-5}$ atm. Find K_c .

Explanation

$$T = 500 + 273 = 773\text{ K}$$

$$\Delta n = 2 - (1 + 3) = -2$$

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

$$K_c = K_p \cdot (RT)^2 = \frac{K_p}{(RT)^{-2}} = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

(Note: Ye expression = $1.44 \times 10^{-5} \times (0.082 \times 773)^2$ ke barabar hai)

Approach & Common Mistakes

Notation Trick: Option (4) mein denominator hai $(0.082 \times 773)^{-2}$ — negative exponent denominator mein = positive exponent numerator mein. Yani $K_c = K_p \times (RT)^2$. Ye sahi hai kyunki $\Delta n = -2$ hai!

Common Mistake: $\Delta n = -2$ hai toh $(RT)^{-2}$ se **divide** karo — matlab $(RT)^2$ se **multiply** karo. Sign mat bhoolo!

Answer

Answer: (4) $K_c = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

Q14. For $\text{SO}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \longrightarrow \text{SO}_3(\text{g})$, if $K_p = K_c(RT)^x$, find x .

[JEE Main 2014]

Explanation

$$\Delta n = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$$

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

$$x = \Delta n = -\frac{1}{2}$$

Approach & Common Mistakes

Trap: Products mein SO_3 ek mole. Reactants mein $1 + \frac{1}{2} = 1.5$ moles. $\Delta n = 1 - 1.5 = -0.5$.

Common Mistake: $x = +\frac{1}{2}$ likhna (sign flip). Products se reactants minus karo, ulta nahi!

Answer

Answer: (4) $x = -\frac{1}{2}$

Q15. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \longrightarrow \text{CuSO}_4 \cdot 3\text{H}_2\text{O}(\text{s}) + 2\text{H}_2\text{O}(\text{g})$ — which representation is correct?

Explanation

Dono sides mein solids hain (reactant aur ek product). Only $\text{H}_2\text{O}(\text{g})$ gaseous hai.

(1) $K_p = p_{\text{H}_2\text{O}}^2$ ✓ (gas product ka pressure squared)

(2) $K_c = [\text{H}_2\text{O}]^2$ ✓ (concentration squared)

(3) $\Delta n = 2$ (2 gaseous products, 0 gaseous reactants). $K_p = K_c(RT)^2$ ✓

Teeno sahi hain!

Approach & Common Mistakes

Concept: Solids ka K expression mein contribution zero hota hai (activity = 1). Sirf gases enter the equilibrium expression.

Real-world: Ye copper sulphate ka dehydration reaction hai — anhydrous CuSO_4 white hota hai, hydrated blue. Chemistry lab mein dono forms dikhe honge!

Answer

Answer: (4) All correct

Q16. $\log \frac{K_p}{K_c} + \log RT = 0$ is true for which reaction?

Explanation

$$\begin{aligned}\log \frac{K_p}{K_c} + \log RT = 0 &\implies \log \left(\frac{K_p}{K_c} \cdot RT \right) = 0 \\ \implies \frac{K_p}{K_c} \cdot RT = 1 &\implies \frac{K_p}{K_c} = \frac{1}{RT} = (RT)^{-1}\end{aligned}$$

Ye tab hoga jab $\Delta n = -1$:

(1) $\text{PCl}_5 \longrightarrow \text{PCl}_3 + \text{Cl}_2$: $\Delta n = +1 \times$

(2) $2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$: $\Delta n = 2 - 3 = -1$ ✓

(3) $\text{N}_2 + 3\text{H}_2 \longrightarrow 2\text{NH}_3$: $\Delta n = -2 \times$

Approach & Common Mistakes

Log Algebra: $\log A + \log B = \log(AB)$. Isko use karo: $\log(K_p/K_c \times RT) = 0 \implies K_p/K_c \times RT = 10^0 = 1$.

Common Trap: PCl_5 wali reaction ($\Delta n = +1$) mein $K_p/K_c = RT$, toh $K_p/K_c \times RT = (RT)^2 \neq 1$. Wrong!

Answer

Answer: (2) $\Delta n = -1$ for $2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$

Q17. Assertion-Reason: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \longrightarrow 2\text{HI}(\text{g})$, $K_p = K_c$. Reason: K_p of ALL gaseous reactions equals K_c .

Explanation

Assertion: $\Delta n = 0 \implies K_p = K_c$ **TRUE**

Reason: "ALL gaseous reactions mein $K_p = K_c$ " — **FALSE!**

$\text{PCl}_5 \rightarrow \text{PCl}_3 + \text{Cl}_2$ gaseous reaction hai lekin $K_p \neq K_c$ ($\Delta n = +1$).

Approach & Common Mistakes

A-R Decision Chart:

- A true, R true, R explains A \rightarrow (A)
- A true, R true, R doesn't explain A \rightarrow (B)
- **A true, R false** \rightarrow (C) ✓
- A false, R true \rightarrow (D)

Reason ek galat generalisation hai — “all” zyada broad word use kiya.

Answer

Answer: (3) C — Assertion correct, Reason incorrect

Q18. Assertion: $K_p = K_c$ for ALL reactions. **Reason:** At constant T, $P \propto$ concentration.

Explanation

Assertion: “ $K_p = K_c$ for all reactions” — **FALSE**

Sirf $\Delta n = 0$ pe equal hota hai.

Reason: At constant T, ideal gas law se: $P = \frac{n}{V}RT \Rightarrow P \propto \frac{n}{V} =$ concentration. **TRUE.**

Approach & Common Mistakes

A-R: A false, R true \rightarrow **Option D.**

Ye ek classic trap hai: Reason scientifically sahi hai (ideal gas law real hai), lekin Assertion galat hai. Don't get confused by a correct Reason saving a wrong Assertion!

Answer

Answer: (4) D

Q19. S1: $K_p = K_c(RT)^{\Delta n}$. **S2:** $\Delta n =$ moles of products – moles of reactants.

Explanation

S1: $K_p = K_c(RT)^{\Delta n}$ — **TRUE**

S2: “ $\Delta n =$ moles of products – moles of reactants” — **FALSE/Incomplete**

S2 mein “**gaseous**” word missing hai! Agar solid/liquid include karo toh galat Δn aayega.

Example: $2\text{C}(s) + \text{O}_2(g) \rightarrow 2\text{CO}_2(g)$

S2 ke hisaab (wrong): $\Delta n = 2 - (2 + 1) = -1$

Correct: $\Delta n = 2 - 1 = +1$ (sirf gaseous species count)

Approach & Common Mistakes

Key Point: Δn mein sirf **gaseous** species count hoti hain. S2 ye specify nahi karta, isliye technically false hai.

Common Trap: Bahut log S1 aur S2 dono true mark karte hain aur option (1) choose karte hain. Careful!

Answer**Answer: (3)** S1 true, S2 false (“gaseous” specify nahi kiya)**Q20. Match Column-I with Column-II.****Explanation**

Reaction	Δn	K_p vs K_c	Match
(A) $\text{N}_2 + 3\text{H}_2 \longrightarrow 2\text{NH}_3$	-2	$K_p < K_c$	(q)
(B) $\text{PCl}_5 \longrightarrow \text{PCl}_3 + \text{Cl}_2$	+1	$K_p > K_c; \Delta n_g > 0$	(p), (s)
(C) $2\text{SO}_3 \longrightarrow 2\text{SO}_2 + \text{O}_2$	+1	$K_p > K_c; \Delta n_g > 0$	(p), (s)
(D) Esterification (all liquid)	no gas	K_p not defined	(r)

Approach & Common Mistakes

D key point: Jab koi bhi gas nahi hai reaction mein, K_p **exist hi nahi karta** (pressure terms hi nahi honge expression mein). Esterification pure liquid phase mein hai.

Notation: $\Delta n_g > 0$ matlab gas moles increase hue (aur $K_p > K_c$ bhi hoga automatically).

Answer**Answer:** A→q; B→p, s; C→p, s; D→r**Q21. At 1000 K, $\text{A(g)} + 2\text{B(g)} \longrightarrow 3\text{C(g)} + \text{D(g)}$, $K_p = 0.05 \text{ atm}$. Find K_c in terms of R.****Explanation**

$$\Delta n = (3 + 1) - (1 + 2) = 4 - 3 = +1 \quad T = 1000 \text{ K}$$

$$K_p = K_c(RT)^{\Delta n} \implies K_c = \frac{K_p}{RT} = \frac{0.05}{R \times 1000} = \frac{0.05}{1000R} = \frac{5 \times 10^{-5}}{R} = 5 \times 10^{-5} \cdot R^{-1}$$

Approach & Common Mistakes

“R ke terms mein” ka matlab: R ko numerically substitute mat karo. Answer mein R as a symbol rehna chahiye.

$$K_c = 5 \times 10^{-5} \cdot R^{-1} \text{ matlab } \frac{5 \times 10^{-5}}{R}.$$

Answer**Answer: (4)** $K_c = 5 \times 10^{-5} \cdot R^{-1}$ **Q22. For $\text{C(s)} + \text{CO}_2(\text{g}) \longrightarrow 2\text{CO(g)}$, $p_{\text{CO}} = 2.0 \text{ atm}$, $p_{\text{CO}_2} = 4.0 \text{ atm}$. Find K_p .****Explanation**

C solid hai, expression mein nahi aata.

$$K_p = \frac{(p_{\text{CO}})^2}{p_{\text{CO}_2}} = \frac{(2.0)^2}{4.0} = \frac{4.0}{4.0} = 1.0$$

Approach & Common Mistakes

Solid Rule: C(s) ka partial pressure K mein nahi likhte (activity of pure solid = 1 always).

Direct Substitution Problem: Bas formula mein daal do, koi calculation needed nahi.

Answer

Answer: (4) $K_p = 1.0$

Q23. $A_2(g) + B_2(g) \longrightarrow 2AB(g)$ in 1L flask, initial 2 mol each, eq: 0.5 mol A_2 . Find K_p .

Explanation

	A_2	B_2	$2AB$
Initial (mol)	2	2	0
Change	-1.5	-1.5	+3.0
Equilibrium	0.5	0.5	3.0
Conc. (mol/L, V=1L)	0.5	0.5	3.0

$$K_c = \frac{[AB]^2}{[A_2][B_2]} = \frac{(3.0)^2}{(0.5)(0.5)} = \frac{9}{0.25} = 36$$

$$\Delta n = 2 - 2 = 0 \Rightarrow K_p = K_c = 36$$

Approach & Common Mistakes

ICE Table: Hamesha I-C-E (Initial, Change, Equilibrium) banao. A_2 ne $2 - 0.5 = 1.5$ mol react kiya, toh $AB = 2 \times 1.5 = 3$ mol bana (stoichiometry!).

V = 1L trick: Concentration (mol/L) = moles/1 = moles directly. Easy calculation!

Answer

Answer: (4) $K_p = K_c = 36$

Q24. [JEE] $NH_3(g) \longrightarrow \frac{1}{2} N_2(g) + \frac{3}{2} H_2(g)$ at $527^\circ C$, $K_c = 4$. Find K_p .

[JEE]

Explanation

$$T = 800 \text{ K}; \quad \Delta n = \frac{1}{2} + \frac{3}{2} - 1 = 1$$

$$K_p = K_c \cdot (RT)^{\Delta n} = 4 \times (R \times 800) = 4 \times 800R$$

Approach & Common Mistakes

Q10 ka hi repeat — yahan option (C) diya hai jo sahi hai!

Answer

Answer: (C) $K_p = 4 \times 800R$

Q25. [JEE] $2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$, $K_p = 0.03 \text{ atm}$ at $427^\circ C$. Find K_c .

[JEE]

Explanation

$$T = 700 \text{ K}; \quad \Delta n = (4 + 1) - (2 + 2) = 5 - 4 = +1$$

$$K_c = \frac{K_p}{RT} = \frac{0.03}{0.0821 \times 700} = \frac{0.03}{57.47} \approx 5.22 \times 10^{-4}$$

Approach & Common Mistakes

Simple: $\Delta n = +1$ toh $K_c = K_p/RT$.

Answer

Answer: (A) $K_c \approx 5.23 \times 10^{-4}$

Q26. [JEE] $\log(K_p/K_c) + \log RT = 0$ is true for?

[JEE]

Explanation

Q16 jaisi hi calculation. $\Delta n = -1$ chahiye \Rightarrow option (B) $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$.

Approach & Common Mistakes

See Q16 for full solution.

Answer

Answer: (B)

Q27. How many of the given reactions are homogeneous reversible?

Explanation

Homogeneous = sabhi species ek hi phase mein.

- 1) All liquid ✓
- 2) All gas ✓
- 3) All gas ✓
- 4) $\text{NH}_4\text{HS(s)} + \text{gas} \rightarrow$ heterogeneous ✗
- 5) Solid + gas \rightarrow heterogeneous ✗
- 6) All gas ✓
- 7) Gas + solid \rightarrow heterogeneous ✗
- 8) All gas ✓
- 9) $\text{Br}_2(\text{l})$ present \rightarrow liquid + gas \rightarrow heterogeneous ✗

Homogeneous count: 1, 2, 3, 6, 8 = **5**

Approach & Common Mistakes

Rule: Ek bhi species different phase mein ho \rightarrow heterogeneous. State symbols dhyan se parho.

Tricky: Reaction 9 mein $\text{Br}_2(\text{l})$ liquid bromine hai, $\text{NO}(\text{g})$ gas hai — mixed phases = heterogeneous!

Answer

Answer: 5

Q28. [JEE 2000] $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$ at 500°C , $K_p = 1.44 \times 10^{-5}$. Find K_c . [JEE 2000]

Explanation

$$T = 773 \text{ K}; \quad \Delta n = -2$$

$$K_c = \frac{K_p}{(RT)^{-2}} = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

Approach & Common Mistakes

Q13 ka exact same. Haber process ($\Delta n = -2$) JEE 2000 mein aaya tha!

Answer

Answer: (D) $K_c = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

Q29. [AIEEE 2002] For $\text{CO(g)} + \frac{1}{2} \text{O}_2(\text{g}) \longrightarrow \text{CO}_2(\text{g})$, $K_c/K_p = ?$

[AIEEE 2002]

Explanation

$$\Delta n = -\frac{1}{2}; \quad K_p = K_c(RT)^{-1/2}$$

$$\frac{K_c}{K_p} = (RT)^{+1/2} = \sqrt{RT} = (RT)^{1/2}$$

Approach & Common Mistakes

Q9 mein K_p/K_c pucha tha, yahan K_c/K_p hai — reciprocal mat bhoolo!

$$K_p/K_c = (RT)^{-1/2} \text{ toh } K_c/K_p = (RT)^{+1/2}.$$

Answer

Answer: (4) $(RT)^{1/2}$

Q30. [AIEEE 2004] For $\text{CO(g)} + \text{Cl}_2(\text{g}) \longrightarrow \text{COCl}_2(\text{g})$, $K_p/K_c = ?$

[AIEEE 2004]

Explanation

$$\Delta n = 1 - 2 = -1$$

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

Approach & Common Mistakes

$\Delta n = -1$ hai toh $K_p < K_c$. Ratio = $1/RT < 1$.

Answer

Answer: (1) $\frac{1}{RT}$

Q31. [JEE Main 2014] $K_p = K_c(RT)^x$ for $\text{SO}_2 + \frac{1}{2} \text{O}_2 \longrightarrow \text{SO}_3$. Find x .

[JEE Main 2014]

Explanation

$$\Delta n = -\frac{1}{2} \Rightarrow x = -\frac{1}{2}. \text{ (Same as Q14)}$$

Approach & Common Mistakes

Exam mein teen baar aaya: Q14 → Q31 → Q50. JEE Main favourite! Pakka yaad karo: $x = -1/2$.

Answer

Answer: (2) $x = -\frac{1}{2}$

Q32. [JEE Main 2019] Find K_p/K_c at 300 K for three reactions ($RT = 24.62$). [JEE Main (Jan) 2019]

Explanation

Reaction	Δn	K_p/K_c
(i) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{NO}(\text{g})$	0	1
(ii) $2\text{N}_2\text{O}(\text{g}) \longrightarrow 2\text{N}_2(\text{g}) + \text{O}_2(\text{g})$	+1	$RT = 24.62 \text{ dm}^3\text{atm mol}^{-1}$
(iii) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$	-2	$(24.62)^{-2} = 1.65 \times 10^{-3}$

Approach & Common Mistakes

Units ka dhyan: $(RT)^{-2} = (24.62)^{-2} \text{ dm}^{-6}\text{atm}^{-2}\text{mol}^2$. $(24.62)^2 = 606 \Rightarrow (24.62)^{-2} \approx 1.65 \times 10^{-3}$.

Answer

Answer: (2) 1, $24.62 \text{ dm}^3\text{atm mol}^{-1}$, 1.65×10^{-3}

Q33. Same as Q21. At 1000 K, $\text{A} + 2\text{B} \longrightarrow 3\text{C} + \text{D}$, $K_p = 0.05 \text{ atm}$. Find K_c .

Explanation

$$\Delta n = +1; \quad K_c = K_p/RT = 0.05/1000R = 5 \times 10^{-5} \cdot R^{-1}$$

Approach & Common Mistakes

Q21 ka exact repeat.

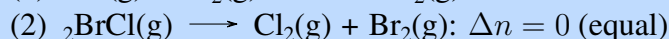
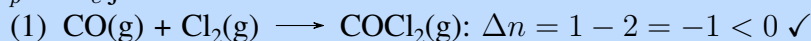
Answer

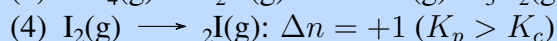
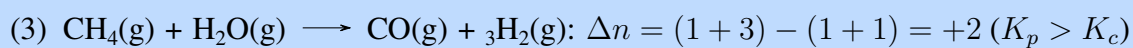
Answer: (4) $5 \times 10^{-5} \cdot R^{-1}$

Q34. In which reaction $K_p < K_c$?

Explanation

$K_p < K_c$ jab $\Delta n < 0$:





Approach & Common Mistakes

Pattern: Combination reactions (zyada gas \rightarrow kam gas) mein $K_p < K_c$. $\text{CO} + \text{Cl}_2 \longrightarrow \text{COCl}_2$ classic combination reaction hai (phosgen banta hai!).

Answer

Answer: (1)

Q35. [NSEC 2002] $k_f = 1.25 \times 10^{-3}$, $k_r = 2.75 \times 10^{-5}$. Find K_{eq} .

[NSEC 2002]

Explanation

$$K_{eq} = \frac{k_f}{k_r} = \frac{1.25 \times 10^{-3}}{2.75 \times 10^{-5}} = \frac{1.25}{2.75} \times 10^2 = 0.4545 \times 100 = 45.45$$

Approach & Common Mistakes

Concept: Equilibrium constant = forward rate constant / reverse rate constant. Simple ratio!

Calculation: $1.25/2.75 = 125/275 = 5/11 \approx 0.4545$, then $\times 100$.

Answer

Answer: (A) $K_{eq} = 45.45$

Q36. [NSEC 2002] Equilibrium constant expression for $\text{H}_2 + \text{Cl}_2 \longrightarrow 2\text{HCl}$?

[NSEC 2002]

Explanation

Products over reactants, stoichiometric powers:

$$K = \frac{[\text{HCl}]^2}{[\text{H}_2][\text{Cl}_2]}$$

Approach & Common Mistakes

Law of Mass Action: Har species ki concentration raise to uski stoichiometric coefficient. Simple!

Answer

Answer: (C)

Q37. [NSEC 2005] $4\text{NH}_3(\text{g}) + 7\text{O}_2(\text{g}) \longrightarrow 4\text{NO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{g})$: K_p vs K_c ?

[NSEC 2005]

Explanation

$$\Delta n = (4 + 6) - (4 + 7) = 10 - 11 = -1$$

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

Approach & Common Mistakes

Count carefully: Left side = $4 + 7 = 11$ gas moles. Right side = $4 + 6 = 10$ gas moles. Net decrease of 1 mole. $\Delta n = -1$.

Answer

Answer: (D) $K_p = K_c(RT)^{-1}$

Q38. [NSEC 2009] For $2\text{HI}(\text{g}) \rightarrow \text{H}_2(\text{g}) + \text{I}_2(\text{g})$: K_p vs K_c ?

[NSEC 2009]

Explanation

$$\Delta n = (1 + 1) - 2 = 0 \Rightarrow K_p = K_c$$

Approach & Common Mistakes

HI family! Q3/Q4/Q5 se same. Ek classic question.

Answer

Answer: (A) $K_p = K_c$

Q39. [NSEC 2011] $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{PCl}_5(\text{g})$, $K_c = 26$ at 250°C , $R = 8.314 \text{ J/mol}\cdot\text{K}$. Find K_p .
[NSEC 2011]

Explanation

$$T = 250 + 273 = 523 \text{ K}; \quad \Delta n = 1 - 2 = -1$$

Using $R = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$ (as given):

$$K_p = K_c(RT)^{-1} = \frac{K_c}{RT} = \frac{26}{8.314 \times 523} = \frac{26}{4348.2} \approx 5.98 \times 10^{-3} \approx 6.0 \times 10^{-3}$$

Approach & Common Mistakes

R value CRITICAL hai: Yahan $R = 8.314 \text{ J/mol}\cdot\text{K}$ diya gaya hai (L·atm wala nahi). Agar $R = 0.0821$ use karo toh $K_p = 0.605$ aata — options se bilkul match nahi karega. Hamesha question mein jo R diya ho, wahi use karo!

Answer

Answer: (C) $K_p \approx 6.0 \times 10^{-3}$

Q40. [NSEC 2012] In which reaction $K_p > K_c$?

[NSEC 2012]

Explanation

$K_p > K_c$ jab $\Delta n > 0$:

(A) $\text{H}_2 + \text{I}_2 \rightarrow 2\text{HI}$: $\Delta n = 0$ (equal)

(B) $2\text{SO}_3 \rightarrow 2\text{SO}_2 + \text{O}_2$: $\Delta n = +1 > 0$ ✓

(C) $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$: $\Delta n = -2$ ($K_p < K_c$)

(D) $\text{PCl}_3 + \text{Cl}_2 \rightarrow \text{PCl}_5$: $\Delta n = -1$ ($K_p < K_c$)

Approach & Common Mistakes

Decomposition reactions (gas moles increase) mein $K_p > K_c$.

Answer

Answer: (B)

Q41. [NSEC 2013] K_p/K_c ratio for $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \longrightarrow 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$ at 127°C . [NSEC 2013]

Explanation

$T = 127 + 273 = 400 \text{ K}$; $\Delta n = (4 + 6) - (4 + 5) = 10 - 9 = +1$
Using $R = 0.08314 \text{ L}\cdot\text{bar mol}^{-1}\text{K}^{-1}$:

$$\frac{K_p}{K_c} = RT = 0.08314 \times 400 = 33.256 \approx 33.26$$

Approach & Common Mistakes

$\Delta n = +1$ hai toh $K_p/K_c = RT$. Direct.

R value: $R = 0.08314$ use karne pe 33.26 aata hai. $R = 0.0821$ se 32.84 aata — slightly different. NSEC 2013 mein $R = 0.08314$ implied hai.

Answer

Answer: (D) $K_p/K_c = 33.26$

Q42. [NSEC 2013] $\text{N}_2\text{O}_5(\text{g}) \longrightarrow \text{N}_2\text{O}_3(\text{g}) + \text{O}_2(\text{g})$, $K_p = 1.36$ at 499 K . Which equation gives K_c ? [NSEC 2013]

Explanation

$\Delta n = (1 + 1) - 1 = +1$

$$K_p = K_c(RT) \implies K_c = \frac{K_p}{RT} = \frac{1.36}{0.0821 \times 499}$$

Approach & Common Mistakes

Simple $\Delta n = +1$ case: $K_c = K_p/RT$.

Answer

Answer: (C) $K_c = \frac{1.36}{(0.0821)(499)}$

Q43. For $\text{N}_2\text{O}_4(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$, $K_p = K_c$ when temperature is?

Explanation

$\Delta n = 2 - 1 = +1$

$K_p = K_c(RT)^1$. For $K_p = K_c$:

$$RT = 1 \implies T = \frac{1}{R} = \frac{1}{0.0821} \approx 12.18 \approx \mathbf{12.19 \text{ K}}$$

Approach & Common Mistakes

Interesting Concept: $K_p = K_c$ tab bhi ho sakta hai jab $\Delta n \neq 0$ — agar specially $RT = 1$ ho! Ye bohot low temperature hai (12 K \approx liquid helium temperature near absolute zero).

Formula: $T = 1/R \approx 12.19 \text{ K}$ (using $R = 0.0821 \text{ L}\cdot\text{atm}/\text{mol}\cdot\text{K}$). Ye value yaad karo!

Answer

Answer: (D) $T = 12.19 \text{ K}$

Q44. Highest and lowest K_p/K_c at 298 K?

Explanation

At 298 K, $RT \approx 24.46 > 1$.

	Reaction	Δn	K_p/K_c
(a)	$\text{N}_2\text{O}_4 \longrightarrow 2\text{NO}_2$	+1	RT
(b)	$2\text{SO}_2 + \text{O}_2 \longrightarrow 2\text{SO}_3$	-1	$(RT)^{-1}$ (minimum)
(c)	$2\text{HI} \longrightarrow \text{H}_2 + \text{I}_2$	0	1
(d)	$\text{X} + \text{Y} \longrightarrow 4\text{Z}$	+2	$(RT)^2$ (maximum)

Approach & Common Mistakes

Q8 jaisi concept! $(RT)^2 > (RT)^1 > 1 > (RT)^{-1}$ since $RT > 1$ at 298 K.

Answer

Answer: (A) Highest = (d), Lowest = (b)

Q45. Vapour pressure of water at $27^\circ\text{C} = 0.2463 \text{ atm}$. Find K_p and K_c for $\text{H}_2\text{O(l)} \longrightarrow \text{H}_2\text{O(g)}$.

Explanation

K_p : Liquid reactant K mein nahi aata. Sirf gaseous product:

$$K_p = p_{\text{H}_2\text{O}} = 0.2463 \text{ atm}$$

K_c : $T = 27 + 273 = 300 \text{ K}$; $\Delta n = 1$ (one gaseous product, liquid reactant ignored)

$$K_p = K_c(RT) \implies K_c = \frac{0.2463}{0.0821 \times 300} = \frac{0.2463}{24.63} = 0.01 \text{ mol/L} = 10^{-2} \text{ M}$$

Approach & Common Mistakes

Physical Meaning: K_p = vapour pressure hi hai (water ke liye). $K_c = 0.01 \text{ M}$ matlab equilibrium pe water vapour ki molar concentration 0.01 mol/L.

Analogy: Ghar mein khuli pani ki bucket rakh do — jo thodi evaporation hogi, woh vapour ka

pressure = K_p hai!

Answer

Answer: $K_p = 0.2463 \text{ atm}$; $K_c = 10^{-2} \text{ mol/L}$

Q46. For $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$, compare K_p and K_c at 184°C .

Explanation

$$\Delta n = (2 + 1) - 2 = +1 > 0$$

$$\Rightarrow K_p = K_c(RT)^1$$

Since $RT > 1$ at 184°C ($= 457 \text{ K}$): $K_p > K_c$

Approach & Common Mistakes

K_c ki value (1.8×10^{-6}) irrelevant hai comparison ke liye. Sirf $\Delta n > 0$ enough hai!

Answer

Answer: (4) $K_p > K_c$

Q47. [AIEEE 2002] For $\text{CO}(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g})$, $K_p/K_c = ?$

[AIEEE 2002]

Explanation

$$\Delta n = -\frac{1}{2}; \quad K_p/K_c = (RT)^{-1/2} = \frac{1}{\sqrt{RT}}$$

Approach & Common Mistakes

Q9 ka exact repeat from AIEEE 2002. Baar baar aata hai!

Answer

Answer: (3) $\frac{1}{\sqrt{RT}}$

Q48. [AIEEE 2004] For $\text{CO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{COCl}_2(\text{g})$, $K_p/K_c = ?$

[AIEEE 2004]

Explanation

$$\Delta n = -1; \quad K_p/K_c = (RT)^{-1} = 1/RT$$

Approach & Common Mistakes

Q30 ka exact same. AIEEE 2004 classic.

Answer

Answer: (1) $\frac{1}{RT}$

Q49. [AIEEE 2005] For $2\text{NO}_2(\text{g}) \rightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$, compare K_p and K_c at 184°C .

[AIEEE 2005]

Explanation

$$\Delta n = +1 \Rightarrow K_p > K_c \text{ (same as Q46)}$$

Approach & Common Mistakes

AIEEE 2005 paper. Q46 ka repeat.

Answer

Answer: (2) $K_p > K_c$

Q50. [JEE Mains 2014] Same as Q14/Q31. Find x in $K_p = K_c(RT)^x$ for $\text{SO}_2 + \frac{1}{2} \text{O}_2 \longrightarrow \text{SO}_3$. [JEE Mains 2014]

Explanation

$$\Delta n = -\frac{1}{2} \Rightarrow x = -\frac{1}{2}$$

Approach & Common Mistakes

HALL OF FAME question: Teen jagah aaya (Q14, Q31, Q50) — JEE Main mein multiple baar repeat hua. $x = -1/2$ tattooed on brain karo!

Answer

Answer: (4) $x = -\frac{1}{2}$

Q51. [JEE Mains Jan 2019] K_p/K_c for 3 reactions at 300 K ($RT = 24.62$). [JEE Mains (Jan) 2019]

Explanation

Reaction	Δn	K_p/K_c
$\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \longrightarrow 2\text{NO}(\text{g})$	0	1
$\text{N}_2\text{O}_4(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$	+1	$24.62 \text{ dm}^3 \text{ atm mol}^{-1}$
$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \longrightarrow 2\text{NH}_3(\text{g})$	-2	$1.65 \times 10^{-3} \text{ dm}^{-6} \text{ atm}^{-2} \text{ mol}^2$

Approach & Common Mistakes

Q32 se different reactions hain — Q32 mein 2N2O wali thi, yahan N2O4 wali hai. Dhyan rakho!

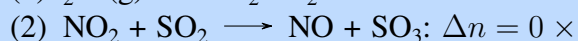
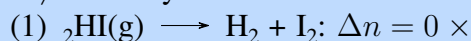
Answer

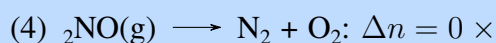
Answer: (4) 1, $24.62 \text{ dm}^3 \text{ atm mol}^{-1}$, 1.65×10^{-3}

Q52. [JEE Mains Apr 2019] In which equilibrium $K_p \neq K_c$? [JEE Mains (Apr) 2019]

Explanation

$\Delta n \neq 0$ chahiye:





Approach & Common Mistakes

Trap: Option (3) mein C(s) solid hai — ignore karo! Sirf gas moles: 1 reactant (O_2), 2 products (CO_2). $\Delta n = +1$.

Answer

Answer: (3)

Q53. [JEE 2000] Same as Q28/Q13. Find K_c for Haber process.

[JEE 2000]

Explanation

$$T = 773 \text{ K}; \quad \Delta n = -2; \quad K_c = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

Approach & Common Mistakes

4th repeat of this question (Q13, Q28, Q53, Q56)! Haber process ka K_c calculation JEE ka all-time favourite. Option (D) hamesha sahi.

Answer

Answer: (D)

Q54. For $\text{N}_2\text{O}_4(\text{g}) \longrightarrow 2\text{NO}_2(\text{g})$, $K_p = K_c$ at what temperature?

Explanation

$$\Delta n = +1; \quad RT = 1 \Rightarrow T = 1/0.0821 = 12.19 \text{ K (same as Q43)}$$

Approach & Common Mistakes

Q43 ka same question!

Answer

Answer: (D) $T = 12.19 \text{ K}$

Q55. For $2\text{NO}_2(\text{g}) \longrightarrow 2\text{NO}(\text{g}) + \text{O}_2(\text{g})$, K_p vs K_c at 184°C ?

Explanation

$$\Delta n = +1 \Rightarrow K_p > K_c \text{ (Same as Q46, Q49)}$$

Approach & Common Mistakes

3rd repeat of this exact question! Ye reaction paper setters ko bahut pasand hai.

Answer

Answer: (A) $K_p > K_c$

Q56. Same as Q13/Q28/Q53.

Explanation

$$K_c = \frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$$

Approach & Common Mistakes

4th repeat! Most repeated question in this DPP. Pakka ans (D) yaad karo.

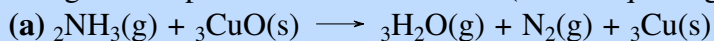
Answer

Answer: (D)

Q57. Find relationship between K_p and K_c for each reaction.

Explanation

Sirf gaseous species ka Δn count karo (solids/liquids ignore):



Gas products = 3 + 1 = 4; Gas reactants = 2 (CuO and Cu are solids)

$$\Delta n = 4 - 2 = +2$$

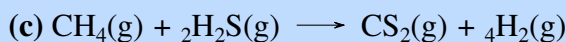
$$K_p = K_c(RT)^2$$



Gas products = 4 + 1 = 5; Gas reactants = 0 (all solid!)

$$\Delta n = 5 - 0 = +5$$

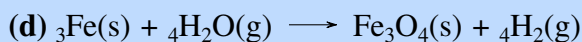
$$K_p = K_c(RT)^5$$



Gas products = 1 + 4 = 5; Gas reactants = 1 + 2 = 3

$$\Delta n = 5 - 3 = +2$$

$$K_p = K_c(RT)^2$$



Gas products = 4; Gas reactants = 4 (Fe and Fe₃O₄ solid)

$$\Delta n = 4 - 4 = 0$$

$$K_p = K_c$$

Approach & Common Mistakes

Golden Rule for Heterogeneous Reactions: Solid aur liquid species ko Δn calculate karte waqt bilkul ignore karo. Sirf gases count hoti hain.

(b) **interesting hai:** Saare reactants solid hain \Rightarrow gaseous reactants = 0 $\Rightarrow \Delta n = 5!$ Itna bada Δn rarely milta hai.

(d) **trick:** Fe aur Fe₃O₄ dono solid hain, sirf H₂O(g) aur H₂(g) gas hain. 4 = 4, $\Delta n = 0!$

Answer

Answers:

(a) $K_p = K_c(RT)^2$

(b) $K_p = K_c(RT)^5$

(c) $K_p = K_c(RT)^2$

$$(d) K_p = K_c \quad (\Delta n = 0)$$

Quick Revision — Sab Yaad Karo!

Reaction	Δn	K_p/K_c
$H_2 + X_2 \longrightarrow 2HX$	0	1 (equal)
$PCl_5 \longrightarrow PCl_3 + Cl_2$	+1	RT
$N_2O_4 \longrightarrow 2NO_2$	+1	RT
$2SO_3 \longrightarrow 2SO_2 + O_2$	+1	RT
$CO + \frac{1}{2}O_2 \longrightarrow CO_2$	-1/2	$(RT)^{-1/2}$
$SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$	-1/2	$(RT)^{-1/2}$
$CO + Cl_2 \longrightarrow COCl_2$	-1	$(RT)^{-1}$
$2SO_2 + O_2 \longrightarrow 2SO_3$	-1	$(RT)^{-1}$
$N_2 + 3H_2 \longrightarrow 2NH_3$	-2	$(RT)^{-2}$

JEE MAINS FAVOURITE: $x = -1/2$ for $SO_2 + \frac{1}{2}O_2 \longrightarrow SO_3$ (Q14 = Q31 = Q50!)