

**CBSE TEST PAPER 02**  
**CLASS XI CHEMISTRY (Equilibrium)**

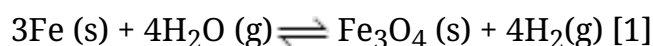
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1. State the law of chemical equilibrium. [1]
2. Write the equilibrium constant for the following equation :  
 $aA + bB \rightleftharpoons cC + dD$  [1]
3. Write the expression for the equilibrium constant for the reaction :  
 $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$  [2]
4. Write the chemical equation for the following chemical constant.

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \quad [1]$$

5. When the total number of moles of product and reactants are equal, K has no unit. Give reason. [2]
6. What is the unit of equilibrium for the reaction  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ . [2]
7. Give the relation  $K_p = K_c (RT)^{\Delta n}$ . [2]
8. Write the relationship between  $K_p$  and  $K_c$  for the following reactions:
  - (a)  $PCl_5 \rightleftharpoons PCl_3(g) + Cl_2(g)$
  - (b)  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
  - (c)  $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
  - (d)  $2H_2O(g) \rightleftharpoons 2H_2O(g) + O_2(g)$  [2]

9. Write the expression for equilibrium constant  $K_p$  for the reaction



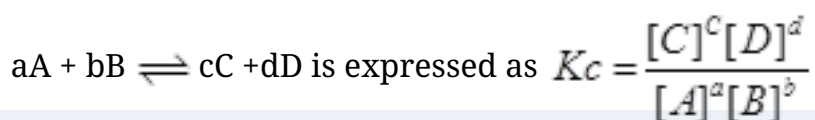
10. The equilibrium constant for the reaction  $H_2O + CO \rightleftharpoons H_2 + CO_2$

Is 0.44 at 1260K. What will be the value of the equilibrium constant for the reaction :  $2H_2(g) + 2CO(g) \rightleftharpoons 2CO(g) + 2H_2O(g)$  at 1260 K [1]

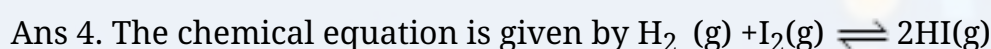
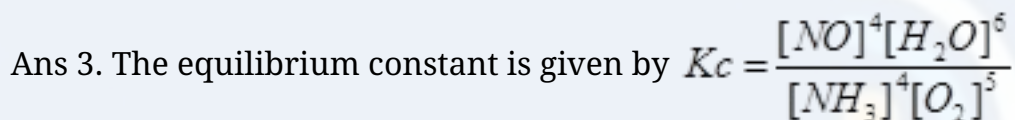
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**[ANSWERS]**

Ans 1. At a given temperature, the product of concentrations of the reaction products raised to the respective stoichiometric coefficient in the balanced chemical equation divided by the product of concentrations of the reactants raised to their individual stoichiometric coefficients has a constant value. This is known as the equilibrium law or law of chemical equilibrium.

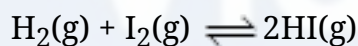
Ans 2. The equilibrium constant for a general reaction



Where [A], [B], [C] and [D] are the equilibrium concentrations of the reactants and products.

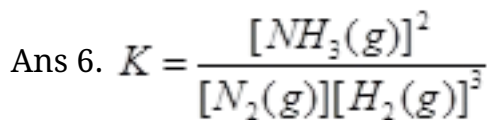


Ans 5. When the total number of moles of products is equal to the total number of moles of reactants the equilibrium constant  $k$  has no unit for eg.



$$K = \frac{[HI(g)]^2}{[H_2(g)][I_2(g)]}$$

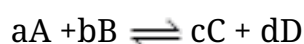
$$\text{Units of } K = \frac{\text{mol/L} \times \text{mol/L}}{\text{mol/L} \times \text{mol/L}} = \text{No units.}$$



$$\text{units of } K = \frac{(\text{mol/L})^2}{(\text{mol/L})(\text{mol/L})^3} = \frac{1}{(\text{mol/L})^2}$$

$$= (\text{mol/L})^{-2} = \underline{\underline{L^2 \text{mol}^{-2}}}$$

Ans 7. Let us consider a reaction



$$K_c = \frac{[C]^c [D]^d}{[A]^a [B]^b} \dots (i) < K_p = \frac{p_C^c p_D^d}{p_A^a p_B^b}$$

Assuming the gaseous components to behave ideally,

$$P_i V_i = n_i RT \dots$$

$$\text{Or, } p_i = \frac{n_i}{V_i} RT = C_i RT = [C] RT \dots (iv).$$

Where [i] is the molar concentration of the species i

Then,

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

$$= \frac{[C]^c [D]^d}{[A]^a [B]^b} \times (RT)^{(\overline{c+d} - \overline{a+b})} \dots (v)$$

$$\Delta n = (\overline{c+d} - \overline{a+b})$$

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

$$\text{Ans 8. (a) } \Delta n = 1+1-1=1$$

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

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

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

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

$$\therefore K_p = K_c (RT)^0 = K_c$$

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

$$\therefore K_p = K_c (RT)^1 = K_c RT.$$

$$\text{Ans 9. } K_p = \frac{(PH_2)^4}{(PH_2O)^4} = \frac{PH_2}{PH_2O}.$$

Ans 10. The reaction is reversed and also doubled,

$$\therefore K_c = \left( \frac{1}{0.44} \right)^2 = \underline{\underline{5.16}}.$$