



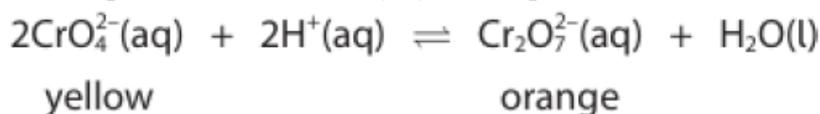
INDIAN SCHOOL AL WADI AL KABIR



CLASS: XI	DEPARTMENT: SCIENCE 2025-2026 SUBJECT: CHEMISTRY	DATE: 30-01-2026
WORKSHEET NO: 09 WITH ANSWERS	TOPIC: EQUILIBRIUM	NOTE: A4 FILE FORMAT
CLASS & SEC:	NAME OF THE STUDENT:	ROLL NO:

MULTIPLE CHOICE QUESTIONS :

- Which of the following factors does NOT affect the equilibrium constant K_c of a reaction?
 - Temperature
 - Concentration
 - Pressure
 - Catalyst
- If $Q_c < K_c$, in which direction will the reaction proceed?
 - Forward direction
 - Backward direction
 - The system is at equilibrium
 - Cannot be determined
- What is the relation between K_p and K_c for the reaction: $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$?
 - $K_p = K_c(RT)$
 - $K_p = K_c(RT)^2$
 - $K_p = K_c$
 - $K_p = K_c/RT$
- Which of the following is a buffer solution?
 - NaOH and HCl
 - HNO_3 and NH_4NO_3
 - NH_4Cl and NH_4OH
 - NaOH and CH_3COONa
- A mixture of potassium chromate (VI) and sulphuric acid forms the equilibrium shown.



What would be the effect on the colour of the solution if sodium hydroxide solution is added?

- no visible change
- the mixture becomes colourless

15. Why is a catalyst used?

VERY SHORT ANSWER TYPE OF QUESTIONS (2M):

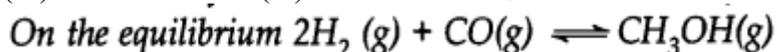
16. What is the concentration of H_3O^+ and OH^- ions in water at 298K?

17. For the following equilibrium, $K = 6.3 \times 10^{14}$ at 1000 K. $\text{NO}(\text{g}) + \text{O}_3 \rightleftharpoons \text{NO}_2(\text{g}) + \text{O}_2(\text{g})$. Both the forward and reverse reactions in the equilibrium are elementary bimolecular reactions. What is K_c for the reverse reaction?

18. What is the effect of:

(i) addition of H_2 (ii) addition of CH_3OH

(iii) removal of CO (iv) removal of CH_3OH



19. Define the common ion effect.

20. What is a Buffer solution? Give an example.

21. Arrange the following in the increasing order of acidic strength:

i) HBr , HCl , HF , HI

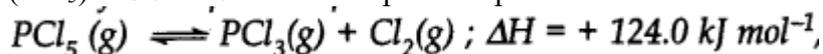
ii) H_2O , HF , CH_4 , NH_3

SHORT ANSWER TYPE OF QUESTIONS (3M):

22. Calculate the pH of:

a) 0.001 M HCl b) 1 M HNO_3 c) 0.01M KOH

23. At 473 K, the equilibrium constant K_c for the decomposition of phosphorus pentachloride (PCl_5) is 8.3×10^{-3} . if decomposition proceeds as:



(a) Write an expression for K_c for the reaction

(b) What is the value of K_c for the reverse reaction at the same temperature?

(c) What would be the effect on K_c if

(i) More of PCl_5 is added. (ii) Temperature is increased.

24. Equilibrium constant, K_c , for the reaction at 500 K: $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ at 500K is 0.061. At a particular time, the analysis shows that the composition of the reaction mixture is 3 mol/L N_2 , 2 mol/L H_2 , and 5 mol/L NH_3 . Is the reaction at equilibrium? If not, in which direction does the reaction tend to proceed to reach equilibrium?

25. What is meant by the conjugate acid-base pair? Find the conjugate acid/base for the following species:



26. PCl_5 , PCl_3 and Cl_2 are at equilibrium at 550K and have concentration

$[\text{PCl}_3] = [\text{Cl}_2] = 1.6 \text{ M}$ and $K_c = 2.0$. Calculate $[\text{PCl}_5]$



27. The ionisation of hydrochloric acid in water is given below:



Label two conjugate acid-base pairs in this ionisation.

28. The values of K_{sp} of two sparingly soluble salts $\text{Sr}(\text{OH})_2$ and AuCN , are 4.0×10^{-6} and 1×10^{-8} respectively. Which salt is more soluble? Explain.

Q.no	Answers
1	d) Catalyst
2	a) Forward direction
3	c) $K_p = K_c$
4	c) NH_4Cl and NH_4OH
5	c) the mixture becomes more yellow
6	c) Lewis concept
7	b) 4.0×10^{-6}
8	d) $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$
9	b) high temperature and high pressure
10	d) The equilibrium will remain unaffected in all three cases
11	a. Both Assertion and Reason are correct statements, and Reason is the correct explanation of the Assertion.
12	b. Both Assertion and Reason are correct statements, but Reason is not the correct explanation of the Assertion.
13	High pressure shifts the equilibrium to the right, increasing yield.
14	As it is an exothermic reaction, a rise in temperature decreases K_c and favours the backward reaction.
15	A catalyst does not change the equilibrium position, but helps to attain equilibrium faster
16	$1 \times 10^{-7} \text{ mol L}^{-1}$
17	For the reverse reaction $K_c = \frac{1}{K_c} = \frac{1}{6.3 \times 10^{14}} = 1.59 \times 10^{-15}$.
18	(i) Equilibrium will be shifted in the forward direction. (ii) Equilibrium will be shifted in the backward direction. (iii) Equilibrium will be shifted in the backward direction. (iv) Equilibrium will be shifted in the forward direction.
19	A shift in equilibrium on adding a substance that provides more of an ionic species already present in the dissociation equilibrium.
20	Solutions that resist change in pH upon dilution or with the addition of small amounts of acid or alkali are called Buffer Solutions. Eg:- A mixture of acetic acid and sodium acetate, A mixture of ammonium chloride and ammonium hydroxide, etc.
21	i) $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$ ii) $\text{CH}_4 < \text{NH}_3 < \text{H}_2\text{O} < \text{HF}$
22	$\text{pH} = -\log [\text{H}^+]$ a) 3 b) 0 c) 12
23	(a) The expression for $K_c = \frac{[\text{PCl}_3(\text{g})][\text{Cl}_2(\text{g})]}{[\text{PCl}_5(\text{g})]}$ (b) For reverse reaction (K_c') = $\frac{[\text{PCl}_5(\text{g})]}{[\text{PCl}_3(\text{g})][\text{Cl}_2(\text{g})]} = \frac{1}{8.3 \times 10^{-3}} = 120.48$ (c) (i) By adding more of PCl_5 , the value of K_c will remain constant because there is no change in temperature. (ii) By increasing the temperature, the forward reaction will be favoured since it is

	endothermic in nature. Therefore, the value of the equilibrium constant will increase.																
24	$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$ <p>At a particular time, the concentration of N_2 is 3.0 molL^{-1}, for H_2 is 2.0 molL^{-1} and for NH_3 is 0.5 molL^{-1}.</p> <p>Now, we know that:</p> $Q_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3} = \frac{(0.5)^2}{(3.0)(2.0)^3} = 0.0104$ <p>It is given that $K_c = 0.061$</p> <p>Since $Q_c \neq K_c$, the reaction is not at equilibrium.</p> <p>Since $Q_c < K_c$, the reaction will proceed in the forward direction to reach equilibrium.</p>																
25	<p>A conjugate acid-base pair varies from one other by only one proton.</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Species</th> <th>Conjugate Acid-Base</th> </tr> </thead> <tbody> <tr> <td>HNO_2</td> <td>NO_2^- (base)</td> </tr> <tr> <td>CN^-</td> <td>HCN (acid)</td> </tr> <tr> <td>HClO_4</td> <td>ClO_4^- (base)</td> </tr> <tr> <td>F^-</td> <td>HF (acid)</td> </tr> <tr> <td>OH^-</td> <td>H_2O (acid) / O^{2-} (base)</td> </tr> <tr> <td>CO_3^{2-}</td> <td>HCO_3^- (acid)</td> </tr> <tr> <td>S^{2-}</td> <td>HS^- (acid)</td> </tr> </tbody> </table>	Species	Conjugate Acid-Base	HNO_2	NO_2^- (base)	CN^-	HCN (acid)	HClO_4	ClO_4^- (base)	F^-	HF (acid)	OH^-	H_2O (acid) / O^{2-} (base)	CO_3^{2-}	HCO_3^- (acid)	S^{2-}	HS^- (acid)
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26	$[\text{PCl}_5] = \frac{[\text{PCl}_3][\text{Cl}_2]}{K_c}$ $= \frac{1.6 \times 1.6}{2}$ $= 1.28 \text{ M}$																
27	<p style="text-align: center;"> $\text{HCl}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_3\text{O}^+(\text{aq}) + \text{Cl}^-(\text{aq})$ </p> <p style="text-align: center;"> acid base conjugate acid conjugate base </p>																
28	<p>For $\text{Sr}(\text{OH})_2$, molar solubility, $4S^3 = 4.0 \times 10^{-6}$ $S = 1 \times 10^{-2}$</p> <p>For AuCN, molar solubility, $S^2 = 1 \times 10^{-8}$ $S = 1 \times 10^{-4}$</p> <p>Since molar solubility of $\text{Sr}(\text{OH})_2$ is greater than that of AuCN, $\text{Sr}(\text{OH})_2$ is more soluble</p>																

<i>Prepared by:</i> Ms Shyni Vinod	<i>Checked by:</i> HOD Science
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