

Equilibrium — CBSE Pattern Test 1

Class 11 Chemistry · 90 minutes · 40 marks · Sections A–D with answer key · Narayan Gurukul Academy

Test 1 — CBSE Pattern (90 minutes, 40 marks)

Class 11 Chemistry · Equilibrium · Narayan Gurukul Academy (ClassApna)

General Instructions: (1) This paper has four sections — Section A (1×10), Section B (2×4), Section C (3×4) and Section D (5×2) — total 40 marks. Time allowed: 90 minutes.

(2) All questions are compulsory. No overall choice is given; internal choice, where allowed, is clearly marked.

(3) For MCQ questions choose the single correct option; for VSA answers write a single line.

(4) Take $g = 10 \text{ m/s}^2$. All symbols carry their usual meaning. Use of a calculator is not permitted.

Section A — MCQ & VSA ($10 \times 1 = 10$ marks)

- A reversible reaction reaches equilibrium when
 - the rate of the forward reaction equals the rate of the backward reaction
 - the forward reaction stops
 - all reactants are used up
 - the temperature becomes zero
- At equilibrium, the concentrations of reactants and products
 - remain constant
 - become equal
 - become zero
 - keep increasing
- The relation between K_p and K_c is
 - $K_p = K_c(RT)^{\Delta n}$
 - $K_p = K_c/(RT)$
 - $K_p = K_c$
 - $K_p = K_c(RT)^{-\Delta n}$ only
- Le Chatelier's principle states that a system at equilibrium shifts to
 - oppose the change imposed on it
 - accept the change
 - remain unchanged
 - go to completion
- According to Bronsted–Lowry theory, an acid is a
 - proton donor
 - proton acceptor
 - electron pair donor
 - electron pair acceptor
- The pH of a neutral solution at 25°C is
 - 7
 - 0
 - 14
 - 1
- A buffer solution resists a change in
 - pH

- (B) temperature
(C) volume
(D) pressure
8. The solubility product of AgCl is given by
(A) $[Ag^+][Cl^-]$
(B) $[AgCl]/[Ag^+][Cl^-]$
(C) $[Ag^+]/[Cl^-]$
(D) $[AgCl]$
9. State Le Chatelier's principle.
10. Define the solubility product.

Section B — Short Answer I ($4 \times 2 = 8$ marks)

11. Why is the equilibrium state called dynamic?
12. Write the relation between K_p and K_c .
13. What is the effect of a catalyst on the position of equilibrium?
14. State whether the solution of a salt of a weak acid and a strong base is acidic or basic.

Section C — Short Answer II ($4 \times 3 = 12$ marks)

15. Explain the nature of the equilibrium state and why it is dynamic, using $N_2O_4 \rightleftharpoons 2NO_2$.
16. Derive the relation $K_p = K_c(RT)^{\Delta n}$ for a general gaseous reaction.
17. State Le Chatelier's principle and predict the effect of changes in concentration, pressure and temperature on $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ ($\Delta H = -92$ kJ).
18. Define the solubility product and derive the relation between solubility and K_{sp} for a salt of the type AB_2 .

Section D — Long Answers ($2 \times 5 = 10$ marks)

19. Define pH and pOH and derive the relation $pH + pOH = 14$. Calculate the pH of 0.001 M HCl and of a 0.1 M acetic acid solution ($K_a = 1.8 \times 10^{-5}$).
20. Explain the mechanism of buffer action of an acidic buffer and derive the Henderson–Hasselbalch equation. Calculate the pH of a buffer made from 0.1 M acetic acid and 0.1 M sodium acetate ($pK_a = 4.74$).

Answer Key (Marking Scheme)

- Q1 — (A) the rate of the forward reaction equals the rate of the backward reaction. Q2 — (A) remain constant. Q3 — (A) $K_p = K_c(RT)^{\Delta n}$. Q4 — (A) oppose the change imposed on it.
- Q5 — (A) proton donor. Q6 — (A) 7. Q7 — (A) pH. Q8 — (A) $[Ag^+][Cl^-]$.
- Q9 — A system at equilibrium shifts to oppose the change imposed on it.
- Q10 — The product of the molar concentrations of the ions, each raised to its stoichiometric coefficient, in a saturated solution.
- Q11 — Both the forward and backward reactions continue at equal rates.
- Q12 — $K_p = K_c(RT)^{\Delta n}$.
- Q13 — A catalyst does not change the position of equilibrium.
- Q14 — Basic.

Q15 — Dynamic equilibrium as in notes.

Q16 — Derivation as in notes; Δn = change in moles of gaseous products – reactants.

Q17 — Increasing pressure and decreasing temperature favour NH_3 formation; increasing temperature shifts it backwards.

Q18 — $K_{sp} = 4s^3$ for AB_2 .

Q19 — $\text{pH} + \text{pOH} = 14$; pH of 0.001 M $\text{HCl} = 3$; pH of 0.1 M acetic acid ≈ 2.87 .

Q20 — Buffer mechanism and Henderson–Hasselbalch; buffer $\text{pH} = 4.74$.