WEIRD CHEMIST

Hydrolysis Reactions — Answer Key & Solutions

Chapter: p-Block Elements —

DPP – 06

Topic: Hydrolysis (Halides & Xe Fluorides) **Questions:** 10 Questions **Exam:** JEE / NEET

▶ MASTER ANSWER KEY

Q.No	Focus	Answer	Ideal Time
1	Geometry of $[M(OH)_4]^-$	B	∼30 s
2	Hybridisation change on hydrolysis	B	∼25 s
3	CCl_4 vs $SiCl_4$ hydrolysis	B	∼30 s
4	First step of $SiCl_4$ hydrolysis	B	∼25 s
5	Final hydrolysis products of MCl_4	A	∼30 s
6	Analytical (XeF_4 redox)	C	∼50 s
7	Conceptual (XeF_6 partial)	B	∼30 s
8	Application (Xe oxidation states)	B	∼40 s
9	Diagram ($XeOF_4$ shape)	B	∼35 s
10	Time Management (incorrect stmt)	D	∼30 s

▶ PART A — Hydrolysis of Covalent Halides (Solutions)

Q1 — Geometry of $[M(OH)_4]^-$ [Ans: B] (∼30 s)

The ion (e.g. the aluminate $[Al(OH)_4]^-$) has four σ-bonds and no lone pair on M, so M is sp^3 hybridised and the ion is **tetrahedral**.

Q2 — Hybridisation change on hydrolysis [Ans: B] (∼25 s)

In the electron-deficient MCl_3, M is trigonal planar (sp^2). On forming $[M(OH)_4]^-$ it gains a fourth bond by accepting an OH^-, becoming sp^3. Hence $sp^2 \rightarrow sp^3$.

Q3 — CCl_4 vs $SiCl_4$ [Ans: B] (∼30 s)

Carbon (period 2) has *no* vacant d orbitals to accept a lone pair from water, so CCl_4 cannot begin hydrolysis. Si has accessible vacant $3d$ orbitals, so the attack proceeds and $SiCl_4$ hydrolyses

readily.

Q4 — First step of $SiCl_4$ hydrolysis [Ans: B] (∼25 s)

The first (rate-determining) step is nucleophilic attack: the oxygen lone pair of water is donated into a vacant $3d$ orbital of Si (octet expansion), giving a 5-coordinate intermediate.

Q5 — Final hydrolysis products of MCl_4 [Ans: A] (∼30 s)

Each M−Cl is replaced by M−OH: $MCl_4 + 4\,H_2O \longrightarrow M(OH)_4 + 4\,HCl$ (M = Si, Ge, Sn). So the products are $M(OH)_4$ and HCl.

▶ PART B — Hydrolysis of Xenon Fluorides (Solutions)

Q6 — Analytical Ability [Ans: C] (∼50 s)

Xe is $+4$ in XeF_4. In the products it appears as Xe (oxidation state 0) and XeO_3 (oxidation state $+6$). Some Xe is reduced ($+4 \to 0$) and some oxidised ($+4 \to +6$) — a **disproportionation**. **Skill:** track one element's oxidation state across several products at once.

Q7 — Conceptual Clarity [Ans: B] (∼30 s)

Complete hydrolysis: $XeF_6 + 3\,H_2O \longrightarrow XeO_3 + 6\,HF$. **Partial** hydrolysis replaces only some F by O, giving the oxyfluorides $XeF_6 + H_2O \longrightarrow XeOF_4 + 2\,HF$ and $XeF_6 + 2\,H_2O \longrightarrow XeO_2F_2 + 4\,HF$. **Skill:** distinguish "partial" from "complete" rather than defaulting to the final oxide.

Q8 — Application Skills [Ans: B] (∼40 s)

With O$= -2$, F$= -1$ in neutral molecules: $XeOF_4$: $x - 2 - 4 = 0 \Rightarrow x = +6$; XeO_2F_2: $x - 4 - 2 = 0 \Rightarrow x = +6$; XeO_3: $x - 6 = 0 \Rightarrow x = +6$. So $+6, +6, +6$. **Skill:** apply the oxidation-number rule consistently to three new species.

Q9 — Diagram-Based Visual Literacy [Ans: B] (∼35 s)

$XeOF_4$ has 5 bond pairs (one Xe=O, four Xe−F) + 1 lone pair = 6 electron domains $\Rightarrow sp^3d^2$, octahedral electron geometry. The lone pair occupies one apex, leaving a **square pyramidal** molecular shape. **Skill:** convert the described bonding picture into VSEPR geometry.

Q10 — Time Management & Strategic Thinking [Ans: D] (∼30 s)

Statement (4) is the false one: complete hydrolysis of XeF_4 *disproportionates* to give *both* Xe and XeO_3, so XeO_3 is not the only xenon-bearing product. Statements (1)–(3) are all standard and correct, so they are eliminated at a glance. **Skill:** scan for the single absolute word ("only") that makes a statement fail.