



WEIRD CHEMIST

Inert Pair Effect

Chapter: p-Block Elements — Groups 13, 14 & 15

DPP – 03

Topic: Inert Pair Effect (Groups 13–15)

Questions: 15 Questions

Exam: JEE / NEET

► TYPE 1 : Analytical Ability

Q1. Among the tripositive ions Ga^{3+} , In^{3+} and Tl^{3+} , which is expected to behave as the strongest oxidising agent? [JEE]

- (1) Ga^{3+} , because it has the smallest ionic size
- (2) Tl^{3+} , because its +3 state is the least stable in the group, so it readily accepts electrons to revert to the +1 state
- (3) In^{3+} , because it lies midway and is most “balanced”
- (4) All three are equally strong oxidisers

Q2. The species Sn^{2+} acts as a reducing agent while Pb^{4+} acts as an oxidising agent. Taken together, what do these two facts imply about the stability of the +4 state on going from Sn to Pb? [JEE]

- (1) The +4 state becomes *more* stable from Sn to Pb
- (2) The +4 state becomes *less* stable from Sn to Pb (Sn favours +4, Pb favours +2)
- (3) The stability of the +4 state is unchanged from Sn to Pb
- (4) Both Sn and Pb prefer the +2 state to an equal extent

Q3. Down Group 15 the stability of the +5 state decreases while that of the +3 state increases (inert pair effect). Combining these two trends, which pentavalent species is expected to be the strongest oxidising agent? [JEE]

- (1) The +5 compound of N (top of the group), since +5 is most stable there
- (2) The +5 compound of Bi (bottom of the group), since +5 is least stable there and most readily reverts to +3
- (3) The +5 compound of P, since it lies in the middle
- (4) All +5 compounds of the group oxidise to an equal extent

► TYPE 2 : Conceptual Clarity

Q4. The inert pair effect in heavier p-block elements is *primarily* caused by:

[NEET]

- (1) The ns^2 pair being held tightly due to poor shielding by intervening d and f orbitals (high effective nuclear charge)
- (2) Complete removal of the ns^2 electrons from the valence shell
- (3) Increasing atomic size down the group making the ns electrons easier to lose
- (4) Pairing of np electrons with the ns electrons

Q5. The increasing tendency to show the +2 oxidation state in Group 14 in the order $\text{Ge} < \text{Sn} < \text{Pb}$ is due to: [NEET]

- (1) The inability of the ns^2 (inert pair) electrons of the valence shell to participate in bonding
- (2) Increasing atomic size, which makes it easier to lose all four valence electrons down the group
- (3) A decrease in effective nuclear charge on moving down the group
- (4) The increasing availability of vacant d -orbitals for bond formation

Q6. The increasing stability of the +3 state relative to the +5 state down Group 15 is attributed to: [NEET]

- (1) The inert pair effect — the ns^2 electrons increasingly resist participation in bonding
- (2) An increase in electronegativity on moving down the group
- (3) The greater ease of removing all five valence electrons in the heavier elements
- (4) An increase in the strength of $p\pi-p\pi$ bonding down the group

► TYPE 3 : Application Skills

Q7. When solid TlCl_3 is gently heated, it tends to decompose. The most likely product (and reason) is: [NEET]

- (1) TlCl_5 , as Tl expands its valence shell
- (2) TlCl , because Tl^+ with its stable $6s^2$ inert pair is more stable than Tl^{3+}
- (3) Tl_2Cl_3 , a stable intermediate oxidation state
- (4) Tl metal + Cl_2 , since Tl prefers the 0 oxidation state

Q8. In the laboratory, which one of the following Group 14 compounds is most likely to reduce Fe^{3+} to Fe^{2+} ? [NEET]

- (1) PbO_2 , because Pb^{4+} readily releases oxygen
- (2) SnCl_2 , because Sn^{2+} is a reducing agent and is oxidised to Sn^{4+}
- (3) GeO_2 , because Ge is stable in the +4 state
- (4) CO_2 , because carbon prefers the +4 state

Q9. Sodium bismuthate (NaBiO_3) contains Bi in the +5 state. In a redox reaction NaBiO_3 is expected to: [NEET]

- (1) Act as a strong oxidising agent, with Bi(V) being reduced to Bi(III)
- (2) Act as a strong reducing agent, with Bi(III) being oxidised to Bi(V)
- (3) Be completely redox-inert because Bi is a heavy metal
- (4) Disproportionate into Bi metal and Bi_2O_5

► TYPE 4 : Diagram-Based Visual Literacy

Q10. Picture this graph: the x-axis lists Ga, In, Tl left → right (going down the group); the y-axis is labelled “Relative stability of oxidation state.” Curve X rises steadily from Ga to Tl; Curve Y falls steadily from Ga to Tl. Which curve represents the +3 oxidation state? [JEE]

- (1) Curve X, since +3 is always the dominant state
- (2) Curve Y, because +3 stability decreases down the group as the inert pair effect strengthens
- (3) Both curves are +3, measured at two temperatures
- (4) Curve X, because Tl strongly prefers +3

Q11. Picture this graph: the x-axis lists C, Si, Ge, Sn, Pb (top → bottom of the group); the y-axis is labelled “Stability of oxidation state.” Curve P starts high at C and falls steadily to Pb; Curve Q starts low at C and rises steadily to Pb; the two curves cross near Sn. Which interpretation is correct? [JEE]

- (1) Curve P is the +2 state and Curve Q is the +4 state
- (2) Curve P is the +4 state (most stable for C/Si) and Curve Q is the +2 state (most stable for Pb)
- (3) Both curves represent the +4 state at two temperatures
- (4) The crossover means C and Pb have identical oxidation-state chemistry

Q12. Picture this graph: the x-axis lists N, P, As, Sb, Bi (top → bottom of the group); the y-axis is labelled “Relative stability of oxidation state.” Curve X rises steadily from N to Bi; Curve Y falls steadily from N to Bi. Which curve represents the +5 oxidation state? [JEE]

- (1) Curve X, since +5 is the dominant state for every member
- (2) Curve Y, because +5 stability decreases down the group as the inert pair effect strengthens
- (3) Both curves represent the +5 state at two different pressures
- (4) Curve X, because Bi strongly prefers the +5 state

► TYPE 5 : Time Management & Strategic Thinking

Q13. Which one statement is correct? (Group 13) [JEE]

- (1) AlCl is more stable than AlCl_3
- (2) GaCl_3 is more stable than TlCl_3
- (3) Tl^+ is a stronger reducing agent than Ga^+

(4) The stability of the +3 state increases from Ga to Tl

Q14. Which one of the following statements is correct? (Group 14)

[JEE]

(1) PbCl_4 is more stable than PbCl_2

(2) Sn^{2+} is a stronger oxidising agent than Pb^{4+}

(3) Lead in the +4 state (e.g. PbO_2) is a strong oxidising agent

(4) The stability of the +4 state increases from Ge to Pb

Q15. Which one of the following statements is correct? (Group 15)

[JEE]

(1) BiCl_5 is more stable than BiCl_3

(2) The +5 state becomes more stable on going from N to Bi

(3) Among the +5 species of the group, that of Bi is the strongest oxidising agent

(4) The +3 state becomes less stable on going down the group

— End of question paper. Answers & solutions are provided separately. —