ABC CHEMISTRY

Mr. Aniket Bhardwaj · 15+ Years Mentorship

Main Group Elements

Premium CSIR-NET PYQ Book

97 CSIR-NET Previous-Year Questions · Fully Solved with Distractor Analysis

3-Slide Solutions | Distractor Analysis | Exam Tricks | Revision Sheets

CSIR-NET · GATE · IIT-JAM — 11 Topics · 97 Real PYQs

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Course Contents

11 Topics · 97 PYQs · tap a topic to jump

1 **Alkali Metals (Group 1)** — 6 Qs E 6 · M 0 · H 0 — 6%

2 **Alkaline Earth Metals (Group 2)** — 2 Qs E 1 · M 0 · H 1 — 2%

3 **Boron & Aluminium Group (Group 13)** — 20 Qs E 0 · M 1 · H 19 — 21%

4 **Carbon & Silicon Group (Group 14)** — 29 Qs E 0 · M 0 · H 29 — 30%

5 **Nitrogen & Phosphorus Group (Group 15)** — 21 Qs E 0 · M 1 · H 20 — 22%

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7 **Halogens (Group 17)** — 9 Qs E 0 · M 9 · H 0 — 9%

8 **Periodic Trends & General Properties** — 2 Qs E 2 · M 0 · H 0 — 2%

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Legend: **E** Easy **M** Medium **H** Hard · **%** = exam weightage (share of the chapter)

TOPIC 1

Alkali Metals (Group 1)

6 questions · Easy 6 | Medium 0 | Hard 0 · PYQ frequency: Occasional

Q32 *DEC 2013*

Among the molten alkali metals, the example of an immiscible pair (in all proportions)is

(a) K and Na

(b) K and Cs

(c) Li and Cs

(d) Rb and Cs

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer C Li and Cs

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O_2 they give oxides (Li_2O), peroxides (Na_2O_2), or superoxides (KO_2, RbO_2, CsO_2). In liquid NH_3, they produce solvated electrons – powerful reductants that reduce O_2 to O_2^-.

↓

LOGIC / WORKING

- Lithium, with its much smaller atom and higher melting point, is immiscible with the heavy alkali metals; molten Li and Cs (also Li/K, Li/Rb) separate into two layers, while Na–K, K–Cs and Rb–Cs mix freely.
- Therefore the answer is (C).

FINAL: (C) Li and Cs

SHORTCUT / EXAM TRICK

Li → Li_2O, Na → Na_2O_2, K/Rb/Cs → MO_2 with O_2. Diagonal relationship: Li behaves like Mg (forms Li_3N directly, Li_2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O_2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH_3: M → $[M(NH_3)_n]^+ + e^-$(solvated). These reduce O_2 to superoxide. Alkali metals in liq. NH_3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li^+ (tiny) → oxide, Na^+ (medium) → peroxide, $K^+/Rb^+/Cs^+$ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **C**

A — **K and Na**

Why (C) is the key — Lithium, with its much smaller atom and higher melting point, is immiscible with the heavy alkali metals; molten Li and Cs (also Li/K, Li/Rb) separate into two layers, while Na–K, K–Cs and Rb–Cs mix freely.

B — **K and Cs**

Option (B) is ruled out by the same reasoning: Lithium, with its much smaller atom and higher melting point, is immiscible with the heavy alkali metals; molten Li and Cs (also Li/K, Li/Rb) separate into two…

D — **Rb and Cs**

Option (D) is ruled out by the same reasoning: Lithium, with its much smaller atom and higher melting point, is immiscible with the heavy alkali metals; molten Li and Cs (also Li/K, Li/Rb) separate into two…

Q35 *DEC 2013*

35. Commonly used scintillator for measuring radiation is
(a) Nal(AI)
(b) Nal(TI)
(c) CsI(TI)
(d) Csl(AI)
Correct answer is (b)
Cesium iodide (CsI) in crystalline form is used as the scintillator for the detection of protons and alpha particles. Sodium iodide (NaI) containing a small amount of thallium is used as a scintillator for the detection of gamma waves and zinc sulfide (ZnS) is widely used as a detector of alpha particles.

Since in the question, it is asked about radiations (that means gamma rays) thus answer should be NaI

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer B NaI(Tl)

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O_2 they give oxides (Li_2O), peroxides (Na_2O_2), or superoxides (KO_2, RbO_2, CsO_2). In liquid NH_3, they produce solvated electrons – powerful reductants that reduce O_2 to O_2^-.

↓

LOGIC / WORKING

- Key principle: alkali metal reactivity and superoxide/peroxide/solvated electron chemistry. Correct answer is (B).

FINAL: (B) NaI(Tl)

SHORTCUT / EXAM TRICK

Li → Li_2O, Na → Na_2O_2, K/Rb/Cs → MO_2 with O_2. Diagonal relationship: Li behaves like Mg (forms Li_3N directly, Li_2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O_2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH_3: M → $[M(NH_3)_n]^+ + e^-$(solvated). These reduce O_2 to superoxide. Alkali metals in liq. NH_3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li^+ (tiny) → oxide, Na^+ (medium) → peroxide, $K^+/Rb^+/Cs^+$ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **B**

A **NaI(Al)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (B). See worked explanation.

C **CsI(Tl)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (B). See worked explanation.

D **CsI(Al)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (B). See worked explanation.

Q51 *JUNE 2014*

51. 12-Crown-4 binds with the alkali metal ions in the following order :
$Li^+ >> Na^+ > K^+ > Cs^+$. It is due to the
(a) Right size of cation crown ether
(b) Change in entropy being positive
(c) Conformational flexibility of crown ether
(d) Hydrophobicity of crown ether
Correct answer is (a)

The crown ether binds metal cation in their cavity. They are selective as they have fixed ring size.

Crown ether	
Crown-4	Li^+
crown-5	Na^+
crown-6	K^+
crown-7	Rb^+
crown-8	Cs^+

Therefore, 12-crown-4 is best suited for Li^+ cation. After then as the size increases binding capacity decreases.

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer A Right size match of cation to crown ether cavity

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O_2 they give oxides (Li_2O), peroxides (Na_2O_2), or superoxides (KO_2, RbO_2, CsO_2). In liquid NH_3, they produce solvated electrons – powerful reductants that reduce O_2 to O_2^-.

↓

LOGIC / WORKING

- Key principle: alkali metal reactivity and superoxide/peroxide/solvated electron chemistry. Correct answer is (A).

FINAL: (A) Right size match of cation to crown ether cavity

SHORTCUT / EXAM TRICK

Li → Li_2O, Na → Na_2O_2, K/Rb/Cs → MO_2 with O_2. Diagonal relationship: Li behaves like Mg (forms Li_3N directly, Li_2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O_2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH_3: M → $[M(NH_3)_n]^+ + e^-$(solvated). These reduce O_2 to superoxide. Alkali metals in liq. NH_3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li^+ (tiny) → oxide, Na^+ (medium) → peroxide, $K^+/Rb^+/Cs^+$ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **A**

B — **Change in entropy being positive**

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

C — **Conformational flexibility of crown ether**

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

D — **Hydrophobicity of crown ether**

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

Q58 *DEC 2015*

The ring size and the number of linked tetrahedral present in $[Si_6O_{18}]^{12-}$ are, respectively

(a) 6 and 6

(b) 12 and 6

(c) 12 and 12

(d) 6 and 12

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer B 12 and 6

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O2 they give oxides (Li2O), peroxides (Na2O2), or superoxides (KO2, RbO2, CsO2). In liquid NH3, they produce solvated electrons – powerful reductants that reduce O2 to O2-.

↓

LOGIC / WORKING

- The cyclic silicate $[Si_6O_{18}]^{12-}$ (beryl-type) is a ring of six SiO_4 tetrahedra linked by six bridging O, i.e. a 12-membered Si–O ring (b).
- Therefore the answer is (B).

FINAL: (B) 12 and 6

SHORTCUT / EXAM TRICK

Li → Li2O, Na → Na2O2, K/Rb/Cs → MO2 with O2. Diagonal relationship: Li behaves like Mg (forms Li3N directly, Li2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH3: M → [M(NH3)n]+ + e-(solvated). These reduce O2 to superoxide. Alkali metals in liq. NH3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li+ (tiny) → oxide, Na+ (medium) → peroxide, K+/Rb+/Cs+ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **B**

A — **6 and 6**

Why (B) is the key — The cyclic silicate $[Si_6O_{18}]^{12-}$ (beryl-type) is a ring of six SiO_4 tetrahedra linked by six bridging O, i.e. a 12-membered Si–O ring (b).

C — **12 and 12**

Option (C) is ruled out by the same reasoning: The cyclic silicate $[Si_6O_{18}]^{12-}$ (beryl-type) is a ring of six SiO_4 tetrahedra linked by six bridging O, i.e. a 12-membered Si–O ring

D — **6 and 12**

Option (D) is ruled out by the same reasoning: The cyclic silicate $[Si_6O_{18}]^{12-}$ (beryl-type) is a ring of six SiO_4 tetrahedra linked by six bridging O, i.e. a 12-membered Si–O ring

Q89 *DEC 2019*

89. The common heptacity observed for coordination of C_{60} to a metal center is
(1) 2
(2)4
(3)5
(4)6

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer A Option A (see PDF)

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O2 they give oxides (Li2O), peroxides (Na2O2), or superoxides (KO2, RbO2, CsO2). In liquid NH3, they produce solvated electrons – powerful reductants that reduce O2 to O2-.

↓

LOGIC / WORKING

- Key principle: alkali metal reactivity and superoxide/peroxide/solvated electron chemistry. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

Li → Li2O, Na → Na2O2, K/Rb/Cs → MO2 with O2. Diagonal relationship: Li behaves like Mg (forms Li3N directly, Li2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH3: M → [M(NH3)n]+ + e-(solvated). These reduce O2 to superoxide. Alkali metals in liq. NH3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li+ (tiny) → oxide, Na+ (medium) → peroxide, K+/Rb+/Cs+ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

Q97 *DEC 2019*

97. The energies of interaction for (i) ion pair, (ii) ion-dipole, and (iii) dipole-dipole interactions are inversely proportional to
(a) r, r^2 and r^3 respectively
(b) r^2, r and r^3 respectively
(c) r, r^2 and r^6 respectively
(d) r^2, r and r^6 respectively

Correct option is (a)
The table below defines energies and their proportional interactins

Type of interaction	Strength	Energy-distance function

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship

PYQ FREQUENCY
Occasional · 4 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Bigger alkali cation stabilises bigger anion: Li+ (tiny)→oxide, Na+ (medium)→peroxide, K+/Rb+/Cs+ (big)→superoxide.

Correct Answer A r, r_2 and r_3 respectively

CONCEPT

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O2 they give oxides (Li2O), peroxides (Na2O2), or superoxides (KO2, RbO2, CsO2). In liquid NH3, they produce solvated electrons – powerful reductants that reduce O2 to O2-.

↓

LOGIC / WORKING

- Key principle: alkali metal reactivity and superoxide/peroxide/solvated electron chemistry. Correct answer is (A).

FINAL: (A) r, r_2 and r_3 respectively

SHORTCUT / EXAM TRICK

Li → Li2O, Na → Na2O2, K/Rb/Cs → MO2 with O2. Diagonal relationship: Li behaves like Mg (forms Li3N directly, Li2O not peroxide, LiF insoluble in water).

COMMON MISTAKE

Thinking all alkali metals form peroxides with O2 – only Na does; heavier ones give superoxides.

EXAM TIP

Solvated electrons in liq. NH3: M → [M(NH3)n]+ + e-(solvated). These reduce O2 to superoxide. Alkali metals in liq. NH3 are one-electron reducing agents.

MEMORY TRICK

Bigger alkali cation stabilises bigger anion: Li+ (tiny) → oxide, Na+ (medium) → peroxide, K+/Rb+/Cs+ (big) → superoxide.

Why the Other Options Are Wrong

Correct answer: **A**

B

r_2, r and r_3 respectively

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

C

r, r^2 and r_6 respectively

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

D

r_2, r and r_6 respectively

Inconsistent with alkali metal reactivity and superoxide/peroxide/solvated electron chemistry; correct choice is (A). See worked explanation.

TOPIC REVISION

Alkali Metals (Group 1)

6 PYQs · Last-minute revision

TOPIC SUMMARY

Group 1 metals (Li–Cs) have one valence electron and form +1 ions. With O_2 they give oxides (Li_2O), peroxides (Na_2O_2), or superoxides (KO_2, RbO_2, CsO_2). In liquid NH_3, they produce solvated electrons – powerful reductants that reduce O_2 to O_2^-.

IMPORTANT FORMULA SHEET

$Li + O_2 \rightarrow Li_2O$

$Na + O_2 \rightarrow Na_2O_2$

$K/Rb/Cs + O_2 \rightarrow MO_2$

- $M + nNH_3 \rightarrow [M(NH_3)n]^+ + e^-$(solvated)

FREQUENTLY ASKED CONCEPTS

Superoxide vs peroxide formation
Diagonal Li–Mg relationship
Solvated electrons in liq. NH_3

- Ionization energy trend

COMMON MISTAKES & QUICK NOTES

Watch out:
Thinking all alkali metals form peroxides with O_2 – only Na does; heavier ones give superoxides.
Last-minute:
$Li \rightarrow Li_2O$, $Na \rightarrow Na_2O_2$, $K/Rb/Cs \rightarrow MO_2$ with O_2. Diagonal relationship: Li behaves like Mg (forms Li_3N directly, Li_2O not peroxide, LiF insoluble in water).

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q32 Q35 Q51 Q58 Q89 Q97

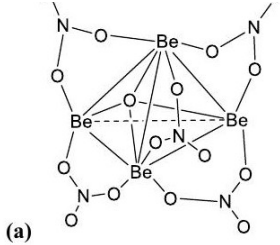
Expect **1 question(s)** next session on **Superoxides, peroxides, solvated electrons, diagonal Li–Mg relationship.**

TOPIC 2

Alkaline Earth Metals (Group 2)

2 questions · Easy 1 | Medium 0 | Hard 1 · PYQ frequency: Rare

Q14 *JUNE 2012*



(a)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Diagonal Be–Al relationship, solubility trends, amphoteric BeO, BeF2 structure

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Sulphates – solubility goes South (decreases). Hydroxides – Happy going Down (increases).

Correct Answer A Be cluster with 5 NO3 units and one bridging O (correct — see structure)

CONCEPT

Group 2 metals (Be–Ba): Be is anomalous (diagonal with Al), forms covalent compounds and amphoteric BeO. Sulfate solubility decreases down (BaSO4 insoluble); hydroxide solubility increases down.

↓

LOGIC / WORKING

- Key principle: alkaline earth metal periodic trends and anomalous Be behaviour. Correct answer is (A).

FINAL: (A) Be cluster with 5 NO3 units and one bridging O (correct — see structure)

SHORTCUT / EXAM TRICK

Be anomalous: covalent, amphoteric oxide, no reaction with cold water. BeF2 is a covalent chain polymer. Sulfates decrease, hydroxides increase in solubility down the group.

COMMON MISTAKE

Confusing BeF2 (covalent polymer) with ionic compounds; Be does not react with cold water unlike Mg.

EXAM TIP

BeO is amphoteric: reacts with HCl and NaOH. BeF2 has linear Be with bridging F (chain polymer). Be does not react with cold water but Mg does slowly.

MEMORY TRICK

Sulphates – solubility goes South (decreases). Hydroxides – Happy going Down (increases).

Why the Other Options Are Wrong

Correct answer: **A**

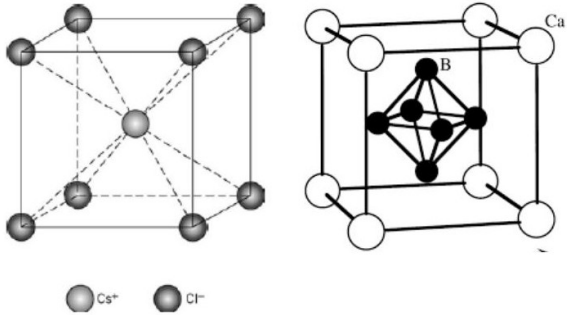
B **Discrete Be(NO3)2 ionic pairs**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

C **Polymeric chain -Be-NO3- units**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

D **Tetrahedral BeO4 core with NO3 groups**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

Q73 *JUNE 2018*

73. The structure of CaB_6 is close to that of
1. Cesium chloride
2. Nickel arsenide
3. Rock salt
4. Zinc blende
Correct option is (a)
The structures of CsCl and CaB_6 are as follows



CaB_6 and CsCl both have BCC like structure, the B_6 cluster is present at the body center of Ca lattice.

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
Diagonal Be–Al relationship, solubility trends, amphoteric BeO, BeF2 structure

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
Sulphates – solubility goes South (decreases). Hydroxides – Happy going Down (increases).

Correct Answer A Option A (see PDF)

CONCEPT

Group 2 metals (Be–Ba): Be is anomalous (diagonal with Al), forms covalent compounds and amphoteric BeO. Sulfate solubility decreases down (BaSO4 insoluble); hydroxide solubility increases down.

↓

LOGIC / WORKING

- Key principle: alkaline earth metal periodic trends and anomalous Be behaviour. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

Be anomalous: covalent, amphoteric oxide, no reaction with cold water. BeF2 is a covalent chain polymer. Sulfates decrease, hydroxides increase in solubility down the group.

COMMON MISTAKE

Confusing BeF2 (covalent polymer) with ionic compounds; Be does not react with cold water unlike Mg.

EXAM TIP

BeO is amphoteric: reacts with HCl and NaOH. BeF2 has linear Be with bridging F (chain polymer). Be does not react with cold water but Mg does slowly.

MEMORY TRICK

Sulphates – solubility goes South (decreases). Hydroxides – Happy going Down (increases).

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with alkaline earth metal periodic trends and anomalous Be behaviour; correct choice is (A). See worked explanation.

TOPIC REVISION

Alkaline Earth Metals (Group 2)

2 PYQs · Last-minute revision

TOPIC SUMMARY

Group 2 metals (Be–Ba): Be is anomalous (diagonal with Al), forms covalent compounds and amphoteric BeO. Sulfate solubility decreases down (BaSO4 insoluble); hydroxide solubility increases down.

IMPORTANT FORMULA SHEET

BeO + 2HCl → BeCl2 + H2O
BeO + 2NaOH → Na2BeO2 + H2O
Sulfate sol.: Be>Mg>Ca>Sr>Ba
- Hydroxide sol.: Be<Mg<Ca<Sr<Ba

FREQUENTLY ASKED CONCEPTS

Diagonal Be–Al relationship
Amphoteric BeO
Solubility trends
- Polymeric BeF2

COMMON MISTAKES & QUICK NOTES

Watch out:
Confusing BeF2 (covalent polymer) with ionic compounds; Be does not react with cold water unlike Mg.
Last-minute:
Be anomalous: covalent, amphoteric oxide, no reaction with cold water. BeF2 is a covalent chain polymer. Sulfates decrease, hydroxides increase in solubility down the group.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q14 Q73

Expect **1 question(s)** next session on **Diagonal Be–Al relationship, solubility trends, amphoteric BeO, BeF2 structure.**

TOPIC 3

Boron & Aluminium Group (Group 13)

20 questions · Easy 0 | Medium 1 | Hard 19 · PYQ frequency: High

Q5 *DEC 2011*

The correct statement regarding closo-\BnHn\ species is:

(a) it always has a 2^- charge

(b) it always has a 2^+ charge

(c) it is a neutral species

(d) it is more reactive than nido, arachno, and hypo-boranes

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A it always has^{-2} charge

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $B_nH_n^{2-}$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl_3 > BPh_3 > BMe_3$ (F/Cl pi-donation reduces Lewis acidity in BF_3).

↓

LOGIC / WORKING

- closo-Boranes need n + 1 skeletal pairs, which for B_nH_n requires two extra electrons: they exist only as $[B_nH_n]^{2-}$ dianions, and are the least reactive class.
- Therefore the answer is (A).

FINAL: (A) it always has^{-2} charge

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl_3 > BPh_3 > BMe_3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF_3 is the strongest Lewis acid — BCl_3 is stronger because F lone-pair donation weakens BF_3 more than Cl weakens BCl_3.

EXAM TIP

BCl_3 is stronger Lewis acid than BF_3 because F lone pairs back-donate into empty p orbital more than Cl. Al_2Me_6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl_3 > BPh_3 > BMe_3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B **it always has +2 charge.**

Why (A) is the key — closo-Boranes need n + 1 skeletal pairs, which for B_nH_n requires two extra electrons: they exist only as $[B_nH_n]^{2-}$ dianions, and are the least reactive class.

C **it is a neutral species**

Option (C) is ruled out by the same reasoning: closo-Boranes need n + 1 skeletal pairs, which for B_nH_n requires two extra electrons: they exist only as $[B_nH_n]^{2-}$ dianions, and are the least reactive

D **it is more reactive than nido , arachno, and hypo-boranes**

Option (D) is ruled out by the same reasoning: closo-Boranes need n + 1 skeletal pairs, which for B_nH_n requires two extra electrons: they exist only as $[B_nH_n]^{2-}$ dianions, and are the least reactive

Q6 *DEC 2011*

Lewis acidity of BCl_3, BPh_3 and BMe_3 with respect to pyridine follows the order

(a) $BCl_3 > BPh_3 > BMe_3$

(b) $BMe_3 > BPh_3 > BCl_3$

(c) $BPh_3 > BMe_3 > BCl_3$

(d) $BCl_3 > BMe_3 > BPh_3$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A $BCl_3 > BPh_3 > BMe_3$

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Toward pyridine: $BCl_3 > BPh_3 > BMe_3$ (a).
- Therefore the answer is (A).

FINAL: (A) $BCl_3 > BPh_3 > BMe_3$

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B $BMe_3 > BPh_3 > BCl_3$

Why (A) is the key — Toward pyridine: $BCl_3 > BPh_3 > BMe_3$ (a).

C $BPh_3 > BMe_3 > BCl_3$

Option (C) is ruled out by the same reasoning: Toward pyridine: $BCl_3 > BPh_3 > BMe_3$

D $BCl_3 > BMe_3 > BPh_3$

Option (D) is ruled out by the same reasoning: Toward pyridine: $BCl_3 > BPh_3 > BMe_3$

Q13 *DEC 2011*

Bayer's process involves.

(a) Synthesis of B_2H_6 from $NaBH_4$

(b) Synthesis of $NaBH_4$ from borax

(c) Synthesis of $NaBH_4$ from B_2H_6

(d) Synthesis of $B_3N_3H_6$ from B_2H_6

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B Synthesis of NaBH4 from borax

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- The Bayer process makes $NaBH_4$ from borax (b).
- Therefore the answer is (B).

FINAL: (B) Synthesis of NaBH4 from borax

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

A **Synthesis of B2H6 from NaBH4**

Why (B) is the key — The Bayer process makes $NaBH_4$ from borax (b).

C **Synthesis of NaBH4 from B2H6**

Option (C) is ruled out by the same reasoning: The Bayer process makes $NaBH_4$ from borax

D **Synthesis of B3N3H6 from B2H6**

Option (D) is ruled out by the same reasoning: The Bayer process makes $NaBH_4$ from borax

Q17 *JUNE 2012*

The most used acid catalyst in oil industry and the relevant process are respectively

(a) Alumino phosphate and reforming

(b) Alumino silicate and cracking

(c) Alumino silicate and reforming

(d) Alumino phosphate and cracking

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B Alumino silicate and cracking

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- Zeolitic aluminosilicates (e.g. Y zeolite) are the solid-acid catalysts of fluid catalytic cracking, the largest catalytic process in refining.
- Therefore the answer is (B).

FINAL: (B) Alumino silicate and cracking

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

A **Alumino phosphate and reforming**

Why (B) is the key — Zeolitic aluminosilicates (e.g. Y zeolite) are the solid-acid catalysts of fluid catalytic cracking, the largest catalytic process in refining.

C **Alumino silicate and reforming**

Option (C) is ruled out by the same reasoning: Zeolitic aluminosilicates (e.g. Y zeolite) are the solid-acid catalysts of fluid catalytic cracking, the largest catalytic process in

D **Alumino phosphate and cracking.**

Option (D) is ruled out by the same reasoning: Zeolitic aluminosilicates (e.g. Y zeolite) are the solid-acid catalysts of fluid catalytic cracking, the largest catalytic process in

Q22 *DEC 2012*

Structure of a carborane with formula, $C_2B_4H_8$, is formally derived from

(a) Closo-borane

(b) Nido-borane

(c) Arachno-borane

(d) Conjuncto-borane

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B Nido-borane

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- $C_2B_4H_8$ (≡ B_6H_{10}) is a nido cluster (b).
- Therefore the answer is (B).

FINAL: (B) Nido-borane

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

A **Closo-borane**

Why (B) is the key — $C_2B_4H_8$ (≡ B_6H_{10}) is a nido cluster (b).

C **Arachno-borane**

Option (C) is ruled out by the same reasoning: $C_2B_4H_8$ (≡ B_6H_{10}) is a nido cluster

D **Conjuncto-borane**

Option (D) is ruled out by the same reasoning: $C_2B_4H_8$ (≡ B_6H_{10}) is a nido cluster

Q23 *DEC 2012*

Boric acid is a weak acid in aqueous solution. But its acidity increases significantly in the presence of ethylene glycol, because

(a) ethylene glycol releases additional H^+

(b) $B(OH)_4^-$ is consumed in forming a compound with ethylene glycol

(c) ethylene glycol neutralizes H^+ released by boric acid

(d) Boric acid dissociates better in the mixed-solvent

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B B(OH)4- is consumed in forming a complex with ethylene glycol

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo BnHn2- (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (B).

FINAL: (B) B(OH)4- is consumed in forming a complex with ethylene glycol

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

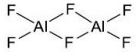
A **Ethylene glycol releases additional H+**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

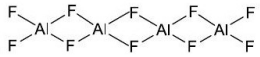
C **Ethylene glycol neutralizes H+ released by boric acid**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

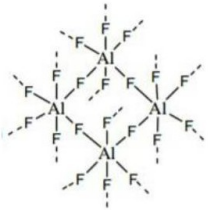
D **Boric acid dissociates better in the mixed-solvent**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

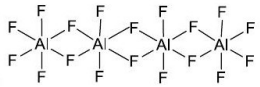
Q37 *DEC 2013*

37. The solid state structure of aluminum fluoride is

(a) 

(b) 

(c) 

(d) 

Correct answer is (c)

In solid state, aluminum fluorides have 3D network structure unlike Al_3Cl_3

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer C Option C (see PDF)

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of $BX3$, and borane structures. Correct answer is (C).

FINAL: (C) Option C (see PDF)

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **C**

A **Option A (see PDF)**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

B **Option B (see PDF)**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

D **Option D (see PDF)**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

Q38 *DEC 2013*

38. The orbital interactions shown below represent

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer C CH-Li interaction in Li4(CH3) 4

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo BnHn2- (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (C).

FINAL: (C) CH-Li interaction in Li4(CH3) 4

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **C**

A — **CH-Al interactions in Al2 (CH3) 6**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

B — **B-H interactions in B2H6**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

D — **CH3CH2-Mg interactions in EtMgBr.(OEt2) 2**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (C). See worked explanation.

Q41 *DEC 2013*

Number of isomeric derivatives possible for the neutral closo-carborane, $C_2B_{10}H_{12}$ is

(a) three

(b) two

(c) four

(d) six

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A three

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- ortho, meta and para $C_2B_{10}H_{12}$ — three (a).
- Therefore the answer is (A).

FINAL: (A) three

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B **two**

Why (A) is the key — ortho, meta and para $C_2B_{10}H_{12}$ — three (a).

C **four**

Option (C) is ruled out by the same reasoning: ortho, meta and para $C_2B_{10}H_{12}$ — three

D **six**

Option (D) is ruled out by the same reasoning: ortho, meta and para $C_2B_{10}H_{12}$ — three

Q42 *DEC 2013*

For higher boranes 3c-2e 'BBB' bond may be a part of their structures. In B_5H_9, the number of such electron deficient bond(s) present is/are

(a) four

(b) two

(c) zero

(d) one

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer D One

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- $B H_9$ (styx 4120): four B–H–B bridges, one closed 3c-2e BBB bond, two B–B bonds — one BBB bond.
- Therefore the answer is (D).

FINAL: (D) One

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **D**

A **Four**

Why (D) is the key — B H_9 (styx 4120): four B–H–B bridges, one closed 3c-2e BBB bond, two B–B bonds — one BBB bond.

B **Two**

Option (B) is ruled out by the same reasoning: B H_9 (styx 4120): four B–H–B bridges, one closed 3c-2e BBB bond, two B–B bonds — one BBB

C **Zero**

Option (C) is ruled out by the same reasoning: B H_9 (styx 4120): four B–H–B bridges, one closed 3c-2e BBB bond, two B–B bonds — one BBB

Q50 *DEC 2014*

50. A borane (X) is reacted with ammonia to give a salt of borohydride (Y). The ^{11}B NMR spectrum of Y consists of a triplet and a quintet. The borane X is

(a) B_2H_6
(b) B_3H_9
(c) B_4H_8
(d) B_5H_9

Correct answer is (a)

Diborane reacts with ammonia as



QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A B_2H_6

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (A).

FINAL: (A) B_2H_6

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B B_3H_9

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

C B_4H_8

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

D B_5H_9

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

Q57 *DEC 2015*

57. The order of increasing Bronsted acidity for boron hydrides is
(a) $B_5H_9 < B_6H_{10} < B_{10}H_{14}$
(b) $B_{10}H_{14} < B_5H_9 < B_6H_{10}$
(c) $B_6H_{10} < B_{10}H_{14} < B_5H_9$
(d) $B_{10}H_{14} < B_6H_{10} < B_5H_9$
Correct option is (a)
Acidic strength of Borane depends upon
(i) number of Boron atoms
(ii) decapping
Hence, the correct order of acidity is **$B_5H_9 < B_6H_{10} < B_{10}H_{14}$**

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A $B_5H_9 < B_6H_{10} < B_{10}H_{14}$

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $B_nH_{n+2}^{-}$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl_3 > BPh_3 > BMe_3$ (F/Cl pi-donation reduces Lewis acidity in BF_3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (A).

FINAL: (A) $B_5H_9 < B_6H_{10} < B_{10}H_{14}$

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl_3 > BPh_3 > BMe_3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF_3 is the strongest Lewis acid — BCl_3 is stronger because F lone-pair donation weakens BF_3 more than Cl weakens BCl_3.

EXAM TIP

BCl_3 is stronger Lewis acid than BF_3 because F lone pairs back-donate into empty p orbital more than Cl. Al_2Me_6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl_3 > BPh_3 > BMe_3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B $B_{10}H_{14} < B_5H_9 < B_6H_{10}$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

C $B_6H_{10} < B_{10}H_{14} < B_5H_9$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

D $B_{10}H_{14} < B_6H_{10} < B_5H_9$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

Q60 *DEC 2015*

The reaction of BCl_3, with NH_4Cl gives product A which upon reduction by $NaBH_4$ gives product B. Product B upon reacting with HCl affords compound C, which is

(a) $Cl_3\ B_3\ N_3\ H_9$

(b) $[ClBNH]_3$

(c) $[HBNH]_3$

(d) $(ClH)_3\ B_3\ N_3(ClH)_3$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A $Cl_3B_3N_3H_9$

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- A = B-trichloroborazine $[ClBNH]_3$; B = borazine $[HBNH]_3$; borazine adds three HCl across its B–N bonds (Cl to B, H to N) to give the cyclic adduct $B_3N_3H_9Cl_3$ ($Cl_3B_3N_3H_9$).
- Therefore the answer is (A).

FINAL: (A) $Cl_3B_3N_3H_9$

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B **[ClBNH] 3**

Why (A) is the key — A = B-trichloroborazine $[ClBNH]_3$; B = borazine $[HBNH]_3$; borazine adds three HCl across its B–N bonds (Cl to B, H to N) to give the cyclic adduct $B_3N_3H_9Cl_3$ ($Cl_3B_3N_3H_9$).

C **[HBNH] 3**

Option (C) is ruled out by the same reasoning: A = B-trichloroborazine $[ClBNH]_3$; B = borazine $[HBNH]_3$; borazine adds three HCl across its B–N bonds (Cl to B, H to N) to give the cyclic adduct $B_3N_3H_9Cl_3$…

D **$(ClH)_3B_3N_3(ClH)_3$**

Option (D) is ruled out by the same reasoning: A = B-trichloroborazine $[ClBNH]_3$; B = borazine $[HBNH]_3$; borazine adds three HCl across its B–N bonds (Cl to B, H to N) to give the cyclic adduct $B_3N_3H_9Cl_3$…

Q67 *Dec 2016*

67. The final product(s) of the reaction of arachno borane, B_4H_{10} with NMe_3 is/are
(a) $[BH_3.NMe_,]$ and $[B_3H_7 . NMe_3]$
(b) $[BH_2(NMe_3)_2]^+ [B_3H_8]^-$
(c) $[B_4H_{10}.NMe_3]$
(d) $[B_4H_{10}.NMe_3]$ and $[BH_2(NMe_3)_2]^+ [B_3H_8]^-$
Correct option (a)

$$B_4H_{10} + NMe_3 \rightarrow Me_3NB_3H_7 + Me_3NBH_3$$

[CSIR JUNE 2017]

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A $[BH_3.NMe,]$ and $[B_3H_7 . NMe_3]$

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo BnHn2- (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (A).

FINAL: (A) **$[BH_3.NMe,]$ and $[B_3H_7 . NMe_3]$**

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B $[BH_2(NMe_3)_2]+ [B_3H_8]-$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

C $[B_4H_{10}.NMe_3]$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

D $[B_4H_{10}.NMe_3]$ and $[BH_2(NMe_3)_2]+ [B_3H_8]-$

Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

Q69 *JUNE 2017*

Addition of two electrons to the bismuth cluster Bi_5^{3+} results in a change of structure type from

(a) closo to nido

(b) nido to arachno

(c) closo to arachno

(d) arachno to hypho

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A closo to nido

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn^{2-}$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl_3 > BPh_3 > BMe_3$ (F/Cl pi-donation reduces Lewis acidity in BF_3).

↓

LOGIC / WORKING

- Bi^{+} has $5\times3 - 3 = 12 = 2n + 2$ skeletal electrons (closo trigonal bipyramid); adding two gives $2n + 4$, a nido square pyramid.
- Therefore the answer is (A).

FINAL: (A) closo to nido

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl_3 > BPh_3 > BMe_3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF_3 is the strongest Lewis acid — BCl_3 is stronger because F lone-pair donation weakens BF_3 more than Cl weakens BCl_3.

EXAM TIP

BCl_3 is stronger Lewis acid than BF_3 because F lone pairs back-donate into empty p orbital more than Cl. Al_2Me_6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl_3 > BPh_3 > BMe_3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B — **nido to arachno**

Why (A) is the key — Bi^{+} has $5\times3 - 3 = 12 = 2n + 2$ skeletal electrons (closo trigonal bipyramid); adding two gives $2n + 4$, a nido square pyramid.

C — **closo to arachno**

Option (C) is ruled out by the same reasoning: Bi^{+} has $5\times3 - 3 = 12 = 2n + 2$ skeletal electrons (closo trigonal bipyramid); adding two gives $2n + 4$, a nido square

D — **arachno to hypho**

Option (D) is ruled out by the same reasoning: Bi^{+} has $5\times3 - 3 = 12 = 2n + 2$ skeletal electrons (closo trigonal bipyramid); adding two gives $2n + 4$, a nido square

Q78 *DEC 2018*

78. The reaction of decaborane $B_{10}H_{14}$, with acetylene in the presence of Et_2S gives
(a) $C_2B_{10}H_{12}$
(b) $C_2B_8H_{10}$
(c) $C_2B_{10}H_{14}$
(d) $C_2B_9H_{11}$
Correct option is (a)

$$B_{10}H_{14} + 2Et_2S \longrightarrow B_{10}H_{12}(Et_2S)_2 \xrightarrow[-H_2]{HC\equiv CH,\ -2Et_2S} C_2B_{10}H_{12}$$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A $C_2B_{10}H_{12}$

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of $BX3$, and borane structures. Correct answer is (A).

FINAL: (A) $C_2B_{10}H_{12}$

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B $C_2B_8H_{10}$
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

C $C_2B_{10}H_{14}$
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

D $C_2B_9H_{11}$
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

Q81 *DEC 2018*

81. B_2H_6 reacts with
(A) water to give boric acid and H_2
(B) oxygen to give B_2O_3 and H_2
(C) water to give boric acid and H_2O
(D) oxygen to give B_2O_3 and H_2O
Correct statements from the above are
(a) A and B
(b) A and D
(c) B and C
(d) B and D
Correct option is (b)
The correct reaction of B_2H_6 with O_2 and water are

$$B_2O_3+H_2O \xleftarrow{O_2} B_2H_6 \xrightarrow{6H_2O} 2B(OH)_3+H_2$$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B oxygen to give B2O3 and H2

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo BnHn2- (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of BX3, and borane structures. Correct answer is (B).

FINAL: (B) oxygen to give B2O3 and H2

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

A **water to give boric acid and H2**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

C **water to give boric acid and H2O**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

D **oxygen to give B2O3 and H2O**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (B). See worked explanation.

Q83 *JUNE 2019*

83. The species that results by replacing one quarter of Si(IV) in pyrophyllite $[Al_2(OH)_2\ Si_4O_{10}]$ with Al(III) [charge balance by K(1)] is

(a) muscovile
(b) phlogopite
(c) montmorillonite
(d) tale
Correct option is (a)

$$[Al_2(OH)_2\ Si_4O_{10}] \xrightarrow[\text{by Al(III)and charge balance by K(I)}]{\text{replaced by 1/4 of Si(IV)}} KAl_2(OH)_2(Si_3AlO_{10})$$

Pyrophyllite Muscovite

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A muscovile

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- Key principle: Wade's rules, Lewis acidity of $BX3$, and borane structures. Correct answer is (A).

FINAL: (A) muscovile

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo $BnHn$ always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B **phlogopite**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

C **montmorillonite**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

D **tale**
Inconsistent with Wade's rules, Lewis acidity of BX3, and borane structures; correct choice is (A). See worked explanation.

Q86 *JUNE 2019*

The correct statements regarding Boron among the following (1) Nuclear spin of ^{11} B is greater than that of ^{10} B (II) The polarities of B-H bond and C-H bonds are opposite (III) Cross-section of neutron absorption for ^{10} B is much more than that of ^{11} B (IV) B reacts with boiling aq. NaOH solution to form $NaB(OH)_4$

(a) II and III

(b) I and II

(c) III and IV

(d) II and IV

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer A II and III

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl3>BPh3>BMe3$ (F/Cl pi-donation reduces Lewis acidity in $BF3$).

↓

LOGIC / WORKING

- B–H (B^δ+–H^δ−) is polarised opposite to C–H. ^{10}B has a huge neutron cross-section. ^{11}B (I = 3/2) has a smaller spin than ^{10}B (I = 3). Crystalline boron is not attacked by boiling aqueous NaOH. II and III (a).
- Therefore the answer is (A).

FINAL: (A) II and III

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: $BCl3>BPh3>BMe3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking $BF3$ is the strongest Lewis acid — $BCl3$ is stronger because F lone-pair donation weakens $BF3$ more than Cl weakens $BCl3$.

EXAM TIP

$BCl3$ is stronger Lewis acid than $BF3$ because F lone pairs back-donate into empty p orbital more than Cl. $Al2Me6$ has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. $BCl3>BPh3>BMe3$: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **A**

B — **I and II**

Why (A) is the key — B–H (B^δ+–H^δ−) is polarised opposite to C–H. ^{10}B has a huge neutron cross-section. ^{11}B (I = 3/2) has a smaller spin than ^{10}B (I = 3). Crystalline boron is not attacked by boiling aqueous NaOH. II and III (a).

C — **III and IV**

Option (C) is ruled out by the same reasoning: B–H (B^δ+–H^δ−) is polarised opposite to C–H. ^{10}B has a huge neutron cross-section. ^{11}B (I = 3/2) has a smaller spin than ^{10}B (I = 3). Crystalline boron is not…

D — **II and IV**

Option (D) is ruled out by the same reasoning: B–H (B^δ+–H^δ−) is polarised opposite to C–H. ^{10}B has a huge neutron cross-section. ^{11}B (I = 3/2) has a smaller spin than ^{10}B (I = 3). Crystalline boron is not…

Q93 *DEC 2019*

Correct statement/s among the following with respect to ionization energy (IE) is/are (i) ($IE_1+IE_2+IE_3$) for indium is more than that of aluminium (ii) IE_1 of scandium is higher than that of cobalt (iii) IE_1 of gallium is lower than that of selenium (iv) IE_1 of nitrogen is greater than that of oxygen

(a) (ii) and (iv)

(b) (iii) and (iv)

(c) (i) and (iv)

(d) (ii) and (iii)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Wade's rules, Lewis acidity of BX3, closo/nido/arachno boranes

PYQ FREQUENCY
High · 11 paper

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Correct Answer B (iii) and (iv)

CONCEPT

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn2-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: BCl3>BPh3>BMe3 (F/Cl pi-donation reduces Lewis acidity in BF3).

↓

LOGIC / WORKING

- (i) false — the sum for In (≈5083 kJ) is less than Al (≈5139). (ii) false — IE_1(Sc) 633 < IE_1(Co) 760. (iii) true — Ga 579 < Se 941. (iv) true — half-filled $2p^3$ makes N (1402) > O (1314).
- Therefore the answer is (B).

FINAL: (B) (iii) and (iv)

SHORTCUT / EXAM TRICK

Lewis acidity towards pyridine: BCl3>BPh3>BMe3. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

COMMON MISTAKE

Thinking BF3 is the strongest Lewis acid — BCl3 is stronger because F lone-pair donation weakens BF3 more than Cl weakens BCl3.

EXAM TIP

BCl3 is stronger Lewis acid than BF3 because F lone pairs back-donate into empty p orbital more than Cl. Al2Me6 has 3c-2e Al-C-Al bridges.

MEMORY TRICK

F donates most pi electrons → reduces Lewis acidity most. BCl3>BPh3>BMe3: steric and electronic factors together.

Why the Other Options Are Wrong

Correct answer: **B**

A — **(ii) and (iv)**

Why (B) is the key — (i) false — the sum for In (≈5083 kJ) is less than Al (≈5139). (ii) false — IE_1(Sc) 633 < IE_1(Co) 760. (iii) true — Ga 579 < Se 941. (iv) true — half-filled $2p^3$ makes N (1402) > O (1314).

C — **(i) and (iv)**

Option (C) is ruled out by the same reasoning: (i) false — the sum for In (≈5083 kJ) is less than Al (≈5139). (ii) false — IE_1(Sc) 633 < IE_1(Co) 760. (iii) true — Ga 579 < Se 941. (iv) true — half-filled…

D — **(ii) and (iii) Main Group Elements**

Option (D) is ruled out by the same reasoning: (i) false — the sum for In (≈5083 kJ) is less than Al (≈5139). (ii) false — IE_1(Sc) 633 < IE_1(Co) 760. (iii) true — Ga 579 < Se 941. (iv) true — half-filled…

TOPIC REVISION

Boron & Aluminium Group (Group 13)

20 PYQs · Last-minute revision

TOPIC SUMMARY

Group 13 (B–Tl): B is a metalloid; Al is metallic. Both are Lewis acids. Boranes follow Wade's rules: closo $BnHn_2^-$ (n+1 SEP, charge always -2), nido (n+2 SEP), arachno (n+3 SEP). Lewis acidity: $BCl_3 > BPh_3 > BMe_3$ (F/Cl pi-donation reduces Lewis acidity in BF_3).

IMPORTANT FORMULA SHEET

Closo $BnHn_2^-$: n+1 SEP, charge -2
Nido $BnHn_{+4}$: n+2 SEP
Arachno $BnHn_{+6}$: n+3 SEP

- Lewis acidity: $BCl_3 > BPh_3 > BMe_3$

FREQUENTLY ASKED CONCEPTS

Closo/nido/arachno boranes
Wade's rules for SEP
Lewis acidity of BX_3

- 3c-2e bonds in boranes

COMMON MISTAKES & QUICK NOTES

Watch out:
Thinking BF_3 is the strongest Lewis acid — BCl_3 is stronger because F lone-pair donation weakens BF_3 more than Cl weakens BCl_3.
Last-minute:
Lewis acidity towards pyridine: $BCl_3 > BPh_3 > BMe_3$. Wade's SEP: closo n+1, nido n+2, arachno n+3. Closo BnHn always has -2 charge.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q5 Q6 Q13 Q17 Q22 Q23 Q37 Q38 Q41 Q42 Q50 Q57 Q60 Q67 Q69 Q78 Q81 Q83 Q86 Q93

Expect **3 question(s)** next session on **Wade's rules, Lewis acidity of BX_3, closo/nido/arachno boranes.**

TOPIC 4

Carbon & Silicon Group (Group 14)

29 questions · Easy 0 | Medium 0 | Hard 29 · PYQ frequency: Very High

Q1 *JUNE 2011*

1. The correct order of stability of difluorides is:

(a) $GeF_2 > SiF_2 > CF_2$

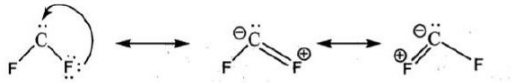
(b) $CF_2 > SiF_2 > GeF_2$

(c) $SiF_2 > GeF_2 > CF_2$

(d) $CF_2 > GeF_2 > SiF_2$

Correct answer: (b)

Stabilisation via back-bonding. Due to innert pair effect stability of +2 oxidation state increases down the group.



QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer B CF2 > SiF2 > GeF2

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (B).

FINAL: (B) CF2 > SiF2 > GeF2

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A **GeF2 > SiF2 > CF2**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (B). See worked explanation.

C **SiF2 > GeF2 > CF2**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (B). See worked explanation.

D **CF2 > GeF2 > SiF2**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (B). See worked explanation.

Q2 *JUNE 2011*

Alkali metal superoxides are obtained by the reaction of

(a) Oxygen with alkali metals in liquid ammonia

(b) Water with alkali metals in liquid ammonia

(c) H_2 O_2 with alkali metals

(d) H_2 O_2 with alkali metals in liquid ammonia

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer A Oxygen with alkali metals in liquid ammonia.

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Passing oxygen through the metal–ammonia solution gives the superoxide MO_2 (e.g. KO_2); H_2O_2 or water give peroxides/hydroxides.
- Therefore the answer is (A).

FINAL: (A) Oxygen with alkali metals in liquid ammonia.

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **Water with alkali metals in liquid ammonia**

Why (A) is the key — Passing oxygen through the metal–ammonia solution gives the superoxide MO_2 (e.g. KO_2); H_2O_2 or water give peroxides/hydroxides.

C **H_2O_2 with alkali metals.**

Option (C) is ruled out by the same reasoning: Passing oxygen through the metal–ammonia solution gives the superoxide MO_2 (e.g. KO_2); H_2O_2 or water give

D **H_2O_2 with alkali metals in liquid ammonia.**

Option (D) is ruled out by the same reasoning: Passing oxygen through the metal–ammonia solution gives the superoxide MO_2 (e.g. KO_2); H_2O_2 or water give

Q3 *JUNE 2011*

3. Match List-I (compounds) with List-II (application) and select the correct answer using the codes given below the lists.

List 1 **List 2**

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer A Tri sodium phosphate (i) Plasticizer

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) Tri sodium phosphate (i) Plasticizer

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **Tri aryl phosphates (ii) Water softener**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Tri ethyl phosphate (iii) Toothpaste**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D **Calcium hydrogen phosphate (iv) Insecticides**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q7 *DEC 2011*

Among the following pairs (1) oxygen-sulfur & (2) nitrogen-phosphorus (3) phosphorus arsenic & (4) chlorine-iodine Those in which the first ionization energies differ by more than 300 kJ mole are:

(a) (1) and (3) only

(b) (1) and (2) only

(c) (2) and (3) only

(d) (3) and (4) only

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer B (1) and (2) only

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- First IEs (kJ mol^{-1}): O 1314/S 1000 (Δ = 314), N 1402/P 1012 (390), P 1012/As 947 (65), Cl 1251/I 1008 (243). Only pairs (1) and (2) differ by more than 300.
- Therefore the answer is (B).

FINAL: (B) (1) and (2) only

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A **(1) and (3) only**

Why (B) is the key — First IEs (kJ mol⁻¹): O 1314/S 1000 (Δ = 314), N 1402/P 1012 (390), P 1012/As 947 (65), Cl 1251/I 1008 (243). Only pairs (1) and (2) differ by more than 300.

C **(2) and (3) only**

Option (C) is ruled out by the same reasoning: First IEs (kJ mol⁻¹): O 1314/S 1000 (Δ = 314), N 1402/P 1012 (390), P 1012/As 947 (65), Cl 1251/I 1008 (243). Only pairs (1) and (2) differ by more than

D **(3) and (4) only**

Option (D) is ruled out by the same reasoning: First IEs (kJ mol⁻¹): O 1314/S 1000 (Δ = 314), N 1402/P 1012 (390), P 1012/As 947 (65), Cl 1251/I 1008 (243). Only pairs (1) and (2) differ by more than

Q9 *DEC 2011*

9. The material that exhibits the highest electrical conductivity among the following sulfur - nitrogen compounds is
(a) S_4N_4
(b) S_7NH

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer D (SN) x

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (D).

FINAL: (D) (SN) x

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A S_4N_4

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

B S_7NH Main Group Elements

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

C S_2N_2

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

Q11 *DEC 2011*

A Sodalite cage in zeolites is

(a) a truncated tetrahedron

(b) an icosahedron

(c) a truncated octahedron

(d) a dodecahedron

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C a truncated octahedron

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- The sodalite (Î²) cage is a truncated octahedron with 24 T-atom vertices, 8 hexagonal and 6 square faces.
- Therefore the answer is (C).

FINAL: (C) a truncated octahedron

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A **a truncated tetrahedron**

Why (C) is the key — The sodalite (Î²) cage is a truncated octahedron with 24 T-atom vertices, 8 hexagonal and 6 square faces.

B **an icosahedron**

Option (B) is ruled out by the same reasoning: The sodalite (Î²) cage is a truncated octahedron with 24 T-atom vertices, 8 hexagonal and 6 square

D **a dodecahedron**

Option (D) is ruled out by the same reasoning: The sodalite (Î²) cage is a truncated octahedron with 24 T-atom vertices, 8 hexagonal and 6 square

Q20 *DEC 2012*

For the deposition of Pb by electroplating, the best suited compound among the following is

(a) $PbCl_2$

(b) $PbSO_4$

(c) $Pb(Et)_4$

(d) $Pb(BF_4)_2$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer D $Pb(BF_4)_2$

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Lead fluoroborate is highly soluble and gives smooth lead deposits; $PbCl_2$ and $PbSO_4$ are insoluble and $PbEt_4$ is a covalent, non-conducting liquid.
- Therefore the answer is (D).

FINAL: (D) $Pb(BF_4)_2$

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A — **$PbCl_2$**

Why (D) is the key — Lead fluoroborate is highly soluble and gives smooth lead deposits; $PbCl_2$ and $PbSO_4$ are insoluble and $PbEt_4$ is a covalent, non-conducting liquid.

B — **$PbSO_4$**

Option (B) is ruled out by the same reasoning: Lead fluoroborate is highly soluble and gives smooth lead deposits; $PbCl_2$ and $PbSO_4$ are insoluble and $PbEt_4$ is a covalent, non-conducting

C — **$Pb(Et)_4$**

Option (C) is ruled out by the same reasoning: Lead fluoroborate is highly soluble and gives smooth lead deposits; $PbCl_2$ and $PbSO_4$ are insoluble and $PbEt_4$ is a covalent, non-conducting

Q24 *DEC 2012*

Silicates with continuous 3D frame work are

(a) Neso-silicates

(b) Soro-silicates

(c) Phyllo-silicates

(d) Tecto-silicates

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer D Tecto-silicates

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Tectosilicates (framework silicates: quartz, feldspars, zeolites) share all four oxygens of every tetrahedron in three dimensions.
- Therefore the answer is (D).

FINAL: (D) Tecto-silicates

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A — **Neso-silicates**

Why (D) is the key — Tectosilicates (framework silicates: quartz, feldspars, zeolites) share all four oxygens of every tetrahedron in three dimensions.

B — **Soro-silicates**

Option (B) is ruled out by the same reasoning: Tectosilicates (framework silicates: quartz, feldspars, zeolites) share all four oxygens of every tetrahedron in three

C — **Phyllo-silicates**

Option (C) is ruled out by the same reasoning: Tectosilicates (framework silicates: quartz, feldspars, zeolites) share all four oxygens of every tetrahedron in three

Q28 *JUNE 2013*

Among the oxides of nitrogen, N_2O_3, N_2O_4, and N_2O_5 the compound(s) having N-N bond is/are

(a) N_2O_4 and N_2O_5

(b) N_2O_3 and N_2O_5

(c) N_2O_3 and N_2O_4

(d) N_2O_5 only

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer C N_2O_3 and N_2O_4

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- N_2O_3 (ON–NO_2) and N_2O_4 (O_2N–NO_2) have N–N bonds; N_2O is O_2N–O–NO_2.
- Therefore the answer is (C).

FINAL: (C) N_2O_3 and N_2O_4

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A **N_2O_4 and N_2O_5**

Why (C) is the key — N_2O_3 (ON–NO_2) and N_2O_4 (O_2N–NO_2) have N–N bonds; N_2O is O_2N–O–NO_2.

B **N_2O_3 and N_2O_5**

Option (B) is ruled out by the same reasoning: N_2O_3 (ON–NO_2) and N_2O_4 (O_2N–NO_2) have N–N bonds; N_2O is

D **N_2O_5 only**

Option (D) is ruled out by the same reasoning: N_2O_3 (ON–NO_2) and N_2O_4 (O_2N–NO_2) have N–N bonds; N_2O is

Q30 *JUNE 2013*

The correct equilibrium order for the interconversion of different forms of SiO_2 is

(a) Tridymite ⇌ quartz ⇌ cristobalite ⇌ liquid SiO_2

(b) quartz ⇌ Tridymite ⇌ cristobalite ⇌ liquid SiO_2

(c) quartz ⇌ cristobalite ⇌ tridymite ⇌ liquid SiO_2

(d) cristobalite ⇌ tridymite ⇌ quartz ⇌ liquid SiO_2

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer B quartz ⇌Tridymite ⇌cristobalite ⇌liquid SiO_2

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- With rising temperature: α-quartz → β-quartz (573 °C) → tridymite (870 °C) → cristobalite (1470 °C) → liquid (1710 °C).
- Therefore the answer is (B).

FINAL: (B) quartz ⇌Tridymite ⇌cristobalite ⇌liquid SiO_2

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A **Tridymite ⇌ quartz ⇌cristobalite ⇌ liquid SiO_2**

Why (B) is the key — With rising temperature: α-quartz → β-quartz (573 °C) → tridymite (870 °C) → cristobalite (1470 °C) → liquid (1710 °C).

C **quartz⇌cristobalite ⇌ tridymite⇌liquid SiO_2**

Option (C) is ruled out by the same reasoning: With rising temperature: α-quartz → β-quartz (573 °C) → tridymite (870 °C) → cristobalite (1470 °C) → liquid (1710

D **cristobalite ⇌ tridymite ⇌ quartz ⇌liquid SiO_2**

Option (D) is ruled out by the same reasoning: With rising temperature: α-quartz → β-quartz (573 °C) → tridymite (870 °C) → cristobalite (1470 °C) → liquid (1710

Q33 *DEC 2013*

Treatment of ClF_3 with SbF_5 leads to the formation of a/an

(a) polymeric material
(b) covalent cluster
(c) ionic compound
(d) lewis acid-base adduct

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C ionic compound

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- SbF abstracts F^- from ClF_3 to give the ionic salt $[ClF_2]^+[SbF_6]^-$.
- Therefore the answer is (C).

FINAL: (C) ionic compound

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A **polymeric material**

Why (C) is the key — SbF abstracts F^- from ClF_3 to give the ionic salt $[ClF_2]^+[SbF_6]^-$.

B **covalent cluster**

Option (B) is ruled out by the same reasoning: SbF abstracts F^- from ClF_3 to give the ionic salt

D **lewis acid-base adduct**

Option (D) is ruled out by the same reasoning: SbF abstracts F^- from ClF_3 to give the ionic salt

Q34 *DEC 2013*

The reason for the chemical inertness of gaseous nitrogen at room temperature is best given

(a) high bonding energy only

(b) electronic configuration

(c) HOMO-LUMO gap only

(d) high bond energy and HOMO-LUMO gap

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer D high bond energy and HOMO-LUMO gap.

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- N_2 is inert because of its very strong triple bond (945 kJ mol^{-1}) and the large HOMO–LUMO gap that makes it neither a good donor nor a good acceptor.
- Therefore the answer is (D).

FINAL: (D) high bond energy and HOMO-LUMO gap.

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A — **high bonding energy only**

Why (D) is the key — N_2 is inert because of its very strong triple bond (945 kJ mol^{-1}) and the large HOMO–LUMO gap that makes it neither a good donor nor a good acceptor.

B — **electronic configuration**

Option (B) is ruled out by the same reasoning: N_2 is inert because of its very strong triple bond (945 kJ mol^{-1}) and the large HOMO–LUMO gap that makes it neither a good donor nor a good

C — **HOMO-LUMO gap only**

Option (C) is ruled out by the same reasoning: N_2 is inert because of its very strong triple bond (945 kJ mol^{-1}) and the large HOMO–LUMO gap that makes it neither a good donor nor a good

Q39 *DEC 2013*

39. In a specific reaction, hexachlorocyclotriphosphazene, $N_3P_3Cl_6$ was reacted with a metal fluoride to obtain mixed halo derivatives namely $N_3P_3Cl_3F$ (A), $N_3P_3Cl_4F$ (B), $N_3P_3Cl_3F_3$(C), $N_3P_3Cl_2F_4$ (D),$N_3P_3ClF_5$ (E). Compositions among these which can give isomeric products are
(a) A, B and C (b) B, C and D (c) C, D and E (d) E, A and B
Correct answer is (c)
$N_3P_3Cl_3F$ (A) = only 1 isomer

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C Option C (see PDF)

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (C).

FINAL: (C) Option C (see PDF)

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A **Option A (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

B **Option B (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

D **Option D (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

Q47 *DEC 2014*

47. The reaction between SbF_5 and two equivalents of HF leads to the formation of
(a) $H_2SbF_3+2F_2$ (b) $HSbF_2 + 3F_2$ (c) $SbF_3+H_2 +2F_2$ (d) $[SbF_6]^-[H_2F]^+$
Correct answer is (d)
HF exist as H_2F_2 , and it act as fluoride donar if strong fluoride acceptor is present like SbF_5, AsF_5, Therefore, the reaction will be HF 2 moles = H_2F_2
H_2F_2 (lewis base) + SbF_5 (lewis base) $\rightarrow [H_2F]^+ + [SbF_6]^-$
SbF_5 act as Lewis acids as it has vacant 'd' orbital of suitable energy

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer D Option D (see PDF)

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (D).

FINAL: (D) Option D (see PDF)

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A **Option A (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

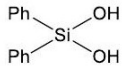
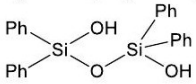
B **Option B (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

C **Option C (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

Q49 *JUNE 2014*

Therefore, size decreases.

49.The reaction between diphenyldichlorosilane and water in 1:2 molar ratio gives product A which on heating above 100°C yields a cyclic or polymeric product B. The products A and B respectively, are

(a)  and 

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C Ph2Si(OH)2 (diphenylsilanediol) and cyclic/polymeric silicone

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (C).

FINAL: (C) Ph2Si(OH)2 (diphenylsilanediol) and cyclic/polymeric silicone

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: C

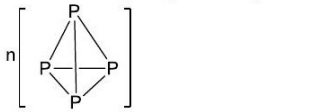
A — **Ph2Si(OH)Cl and cyclic trimer**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

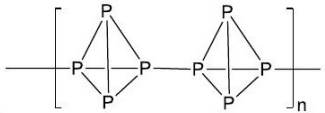
B — **Ph2SiCl(OH) and linear polymer**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

D — **Ph2SiO and HCl adduct**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

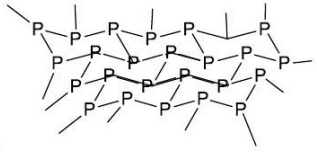
Q53 *DEC 2014*

53. All forms of phosphorus upon melting, exist as

(a) 

(b) 

(c) 

(d) 

Correct option is (a)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer A Option A (see PDF)

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

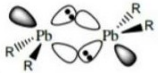
B **Option B (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

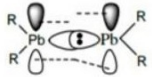
D **Option D (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q56 *DEC 2014*

56. Considering the inert pair effect on lead, the most probable structure of PbR_2 [R =2.6-C_6H_3 (2. 6 – $Pr_2C_6H_3)_2$ is



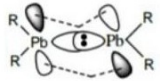
(a)



(b)



(c)



(d)

Correct option is (a)

Due to IPE ns^2 electron-pair become inactive. In Pb

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer A Option A (see PDF)

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q65 *Dec 2016*

65. Consider the following statements for KC_8:
(A) It is paramagnetic
(B) It has eclipsed layer structure
(C) Its electrical conductivity is greater than that of graphite.
The correct answer is
(a) A and B
(b) A and C
(c) B and C
(d) A, B and C
Correct option is (d)
$8C\ (graphite) + K^+\ (am) + e^-\ (am) \rightarrow [K\ (am)]^+\ [C8]^-\ (s)$
Due to the presence of unpaired electrons in π^* band of graphite it is paramagnetic and its electrical conductance increases. It has eclipsed layer structure

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer A It is paramagnetic

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) It is paramagnetic

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **It has eclipsed layer structure**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Its electrical conductivity is greater than that of graphite. The**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D **A and B**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q66 *Dec 2016*

66. Among the following, choose the correct products that are formed in the reaction of S_2Cl_2 with ammonia in CCl_4
NH_4Cl(A) , S_4N_4 (B) , S_8 (C) , and $S_3N_3Cl_3$ (D).
(a) A, B and C
(b) A, B and D
(c) B, C and D
(d) A, C and D
Correct option is (a)

$$6S_2Cl_2 + 16NH_3 \xrightarrow{CCl4,\ or\ C6H6} S_4N_4 + S_8 + 12NH_4Cl$$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer A , S_4N_4

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) , S_4N_4

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B , S_8

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C , and $S_3N_3Cl_3$

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D .

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q68 *JUNE 2017*

Both potassium and sulfuric acid form intercalation compounds with graphite. The graphite layers are

(a) reduced in both the cases
(b) oxidized in both the cases
(c) oxidized in the case of potassium and reduced in the case of sulphuric acid
(d) reduced in the case of potassium and oxidized in the case of sulphuric acid

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer D reduced in the case of potassium and oxidized in the case of sulphuric acid

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Potassium donates electrons to the layers (KC_8, graphite reduced); H_2SO_4 intercalation forms $C_{24}^{+}HSO_4^{-}$ (graphite oxidised).
- Therefore the answer is (D).

FINAL: (D) reduced in the case of potassium and oxidized in the case of sulphuric acid

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A **reduced in both the cases Main Group Elements**

Why (D) is the key — Potassium donates electrons to the layers (KC_8, graphite reduced); H_2SO_4 intercalation forms $C_{24}^{+}HSO_4^{-}$ (graphite oxidised).

B **oxidized in both the cases**

Option (B) is ruled out by the same reasoning: Potassium donates electrons to the layers (KC_8, graphite reduced); H_2SO_4 intercalation forms $C_{24}^{+}HSO_4^{-}$ (graphite

C **oxidized in the case of potassium and reduced in the case of sulphuric acid**

Option (C) is ruled out by the same reasoning: Potassium donates electrons to the layers (KC_8, graphite reduced); H_2SO_4 intercalation forms $C_{24}^{+}HSO_4^{-}$ (graphite

Q74 *JUNE 2018*

74. Among the elements Zn, Ga, Ge as As, the one with the lowest first ionization energy is -
1. As
2. Zn
3. Ga
4. Ge
Correct option is (c)
$Zn \rightarrow 3d^{10}\ 4s^2$
$Ga \rightarrow 4s^2\ 4p^1$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C Ga

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (C).

FINAL: (C) Ga

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A — **As**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

B — **Zn**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

D — **Ge**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

Q75 *JUNE 2018*

75. A binary fluoride (Z) of xenon combines with two moles of NaF to give a product which on hearting to 100°C affords compounds A. the alkaline hydrolysis of A gives perxenate salt. Z and A are, respectively,

1. XeF_2 and XeF_4
2. XeF_4 and XeF_6
3. XeF_6 and XeF_4
4. XeF_6 and XeF_6

Correct option is (d)

The above reaction undergoes as follows

$$\underset{(Z)}{XeF_6} + 2NF \rightarrow Na_2[XeF_8] \xrightarrow{100^{\circ}C} \underset{(A)}{[XeF_6]} \xrightarrow{alkaline\ hydrolysis} Perxenate + 2NaF$$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer D XeF6 and XeF6

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (D).

FINAL: (D) XeF6 and XeF6

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **D**

A — **XeF2 and XeF4**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

B — **XeF4 and XeF6**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

C — **XeF6 and XeF4**

Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (D). See worked explanation.

Q77 *JUNE 2018*

77. Consider the following statements for Be_2Cl_4 (I), B_2Cl_4 (II) and Ga_2Cl_4 (III):
(A) There is an M-M (M= Be, B, Ga) bond in all.
(B) The oxidation state of Be, B and Ga is +2.
(C) The geometry around the central atom is planar for all.
(D) The geometry around the central atom is planar in I and II only.
The correct statement(s) is/are
1. A, B and C
2. A and B
3. D only

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer C The geometry around the central atom is planar for all.

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (C).

FINAL: (C) The geometry around the central atom is planar for all.

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: C

A **There is an M-M (M= Be, B, Ga) bond in all.**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

B **The oxidation state of Be, B and Ga is +2.**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

D **The geometry around the central atom is planar in I and II only. The**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (C). See worked explanation.

Q79 *DEC 2018*

In compound $N_3P_3F_6$, the geometry around nitrogen and phosphorus, respectively, are

(a) pyramidal and tetrahedral

(b) planar and tetrahedral

(c) pyramidal and planar

(d) planar and trigonal bipyramidal

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer B planar and tetrahedral

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- In the cyclophosphazene ring the nitrogen atoms are planar (spÂ²-like, part of the delocalised ring) and each phosphorus is tetrahedral (two F, two N).
- Therefore the answer is (B).

FINAL: (B) planar and tetrahedral

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A — **pyramidal and tetrahedral**

Why (B) is the key — In the cyclophosphazene ring the nitrogen atoms are planar (spÂ²-like, part of the delocalised ring) and each phosphorus is tetrahedral (two F, two N).

C — **pyramidal and planar**

Option (C) is ruled out by the same reasoning: In the cyclophosphazene ring the nitrogen atoms are planar (spÂ²-like, part of the delocalised ring) and each phosphorus is tetrahedral (two F, two

D — **planar and trigonal bipyramidal**

Option (D) is ruled out by the same reasoning: In the cyclophosphazene ring the nitrogen atoms are planar (spÂ²-like, part of the delocalised ring) and each phosphorus is tetrahedral (two F, two

Q82 *DEC 2018*

82. Match the items given in Column-I with those given in Column-II

Column-I	Column-II
(A) Magic number	(I) Nuclear fission
(B) Liquid drop model of nucleus	(II) Q-value
(C) Actinides	(III) Radioactivity
(D) Threshold energy	(IV) Shell model of nucleus

The correct match is

(a) A-IV, B-1, C-III, D-II

(c) A-III, B-IV, C-I, D-II

(b) A-II, B-L, C-III, D-IV

(d) A-IV, B-III, C-I, D-II

Correct option is (a)

Magic number →shell model of nucleus

Liquid drop model of nucleus → nuclear fission

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO_2, small, makes pi bonds), Silicon is polymeric (SiO_2, big, uses d-orbitals for 3D network).

Correct Answer A Magic number (I) Nuclear fission

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) Magic number (I) Nuclear fission

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **Liquid drop model of nucleus (II) Q-value**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Actinides (III) Radioactivity**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D **Threshold energy (IV) Shell model of nucleus**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q85 *JUNE 2019*

In the synthesis of polydimethylsiloxane, the chain forming, branching and terminating agents respectively, are

(a) Me_2SiCl_2, Me_3SiCl and $MeSiCl_3$

(b) Me_2SiCl_2, $MeSiCl_3$ and Me_3SiCl

(c) $MeSiCl_3$, Me_2SiCl_2 and Me_3SiCl

(d) Me_2SiCl_2, $MeSiCl_3$ and Me_4Si

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer B Me_2SiCl_2, $MeSiCl_3$ and Me_3SiCl

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Me_2SiCl_2 builds the linear –O–$SiMe_2$–O– chain, $MeSiCl_3$ introduces branch points (three Si–O bonds) and Me_3SiCl caps the chain ends.
- Therefore the answer is (B).

FINAL: (B) Me_2SiCl_2, $MeSiCl_3$ and Me_3SiCl

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A **Me_2SiCl_2 , Me_3SiCl and $MeSiCl_3$**

Why (B) is the key — Me_2SiCl_2 builds the linear –O–$SiMe_2$–O– chain, $MeSiCl_3$ introduces branch points (three Si–O bonds) and Me_3SiCl caps the chain ends.

C **$MeSiCl_3$, Me_2SiCl_2 and Me_3SiCl**

Option (C) is ruled out by the same reasoning: Me_2SiCl_2 builds the linear –O–$SiMe_2$–O– chain, $MeSiCl_3$ introduces branch points (three Si–O bonds) and Me_3SiCl caps the chain

D **Me_2SiCl_2 , $MeSiCl_3$ and Me_4Si**

Option (D) is ruled out by the same reasoning: Me_2SiCl_2 builds the linear –O–$SiMe_2$–O– chain, $MeSiCl_3$ introduces branch points (three Si–O bonds) and Me_3SiCl caps the chain

Q88 *JUNE 2019*

Choose the correct statement(s) among the following (1) The dihedral angle in O_2F_2 is 0^°. (II) OF_2 is generally prepared by reacting fluorine gas with dilute (2\%) aq. NaOH solution (III) O_2F_2 can be readily reduced by H_2S.

(a) I and II only

(b) I, II and III

(c) II and III only

(d) II only

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer C II and III only

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- OF_2 is made from F_2 and 2 % aqueous NaOH. O_2F_2 is a strong fluorinating oxidant that H_2S readily reduces. The F–O–O–F dihedral is about 87°, not 0°. II and III (c).
- Therefore the answer is (C).

FINAL: (C) II and III only

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **C**

A — **I and II only**

Why (C) is the key — OF_2 is made from F_2 and 2 % aqueous NaOH. O_2F_2 is a strong fluorinating oxidant that H_2S readily reduces. The F–O–O–F dihedral is about 87°, not 0°. II and III (c).

B — **I, II and III**

Option (B) is ruled out by the same reasoning: OF_2 is made from F_2 and 2 % aqueous NaOH. O_2F_2 is a strong fluorinating oxidant that H_2S readily reduces. The F–O–O–F dihedral is about 87°, not 0°. II and III…

D — **II only**

Option (D) is ruled out by the same reasoning: OF_2 is made from F_2 and 2 % aqueous NaOH. O_2F_2 is a strong fluorinating oxidant that H_2S readily reduces. The F–O–O–F dihedral is about 87°, not 0°. II and III…

Q95 *DEC 2019*

95. Choose the correct statements for the Group 15 halides:
(i)$AsCl_3$ can form complexes of type $[AsCl_4]^-$ in the presence of a chloride source
(ii) PF_3 acts as a strong a-donor ligand towards d-metals
(iii) In the solid state, SbF_5 has a trigonal bipyramidal structure
(iv) The reaction of SbF_5 with anhydrous HF generates $[H_2F]^+$ ions
a. (i) and (iv)
b. (ii) , (iii) and (iv)
c. (i) , (iii) and (iv)
d. (ii) and (iii)

Correct option is (a)
a.$SbF_5 + 2HF \rightarrow [H_2F]^+ [SbF_6]^-$
b.In the solid state, SbF_5 is tetrameric thus, it has octahedral structure.

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer A Option A (see PDF)

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- Key principle: inert pair effect, difluoride stability, and silicate structures. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with inert pair effect, difluoride stability, and silicate structures; correct choice is (A). See worked explanation.

Q96 *DEC 2019*

The reaction of XeF_6 with a limited amount of quartz gives compound A . Then on reaction with an equivalent amount of XeO_3. A gives B. The products A and B are, respectively

(a) $XeOF_2$ and XeO_2F_2

(b) $XeOF_4$ and XeO_2F_2

(c) $XeOF_2$ and $XeOF_4$

(d) XeO_2F_2 and $XeOF_4$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Inert pair effect, difluoride stability, silicate structures, graphite vs diamond

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Correct Answer B $XeOF_4$ and XeO_2F_2

CONCEPT

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

↓

LOGIC / WORKING

- $XeOF_4$ (A), XeO_2F_2 (B) (b).
- Therefore the answer is (B).

FINAL: (B) $XeOF_4$ and XeO_2F_2

SHORTCUT / EXAM TRICK

CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

COMMON MISTAKE

Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.

EXAM TIP

CF2 stability due to ppi-ppi back-bond from F to empty p on C. This is opposite to inert pair trend. Graphite conducts electricity along planes (sp2 C, delocalised pi electrons).

MEMORY TRICK

Carbon is molecular (CO2, small, makes pi bonds), Silicon is polymeric (SiO2, big, uses d-orbitals for 3D network).

Why the Other Options Are Wrong

Correct answer: **B**

A **$XeOF_2$ and XeO_2F_2**

Why (B) is the key — $XeOF_4$ (A), XeO_2F_2 (B) (b).

C **$XeOF_2$ and $XeOF_4$**

Option (C) is ruled out by the same reasoning: $XeOF_4$ (A), XeO_2F_2 (B)

D **XeO_2F_2 and $XeOF_4$**

Option (D) is ruled out by the same reasoning: $XeOF_4$ (A), XeO_2F_2 (B)

TOPIC REVISION

Carbon & Silicon Group (Group 14)

29 PYQs · Last-minute revision

TOPIC SUMMARY

Group 14 (C–Pb): inert pair effect stabilises +2 state down the group (Pb2+ most stable). C forms ppi-ppi bonds (CO2 molecular); Si prefers sigma bonding (SiO2 polymeric network). Difluoride stability: CF2>SiF2>GeF2 (F→C pi back-bonding stabilises CF2).

IMPORTANT FORMULA SHEET

MF2 stability: CF2>SiF2>GeF2
Inert pair: +2 stability Pb>Sn>Ge
SiO4(4-) tetrahedra share corners
- Graphite sp2 C; Diamond sp3 C

FREQUENTLY ASKED CONCEPTS

Inert pair effect
Difluoride stability (back-bonding)
Silicate structures
- Allotropes of carbon

COMMON MISTAKES & QUICK NOTES

Watch out:
Confusing difluoride stability (CF2 most stable, back-bonding) with inert pair (Pb2+ most stable). These are DIFFERENT trends pointing OPPOSITE directions.
Last-minute:
CF2 most stable difluoride (back-bonding). Inert pair: Pb2+>>Sn2+>Ge2+ stability. CO2 is linear molecular; SiO2 is 3D network. Silicones: -Si(R2)-O- chains.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q1 Q2 Q3 Q7 Q9 Q11 Q20 Q24 Q28 Q30 Q33 Q34 Q39 Q47 Q49 Q53 Q56 Q65 Q66 Q68 Q74 Q75 Q77 Q79 Q82 Q85 Q88 Q95 Q96

Expect **3 question(s)** next session on **Inert pair effect, difluoride stability, silicate structures, graphite vs diamond.**

TOPIC 5

Nitrogen & Phosphorus Group (Group 15)

21 questions · Easy 0 | Medium 1 | Hard 20 · PYQ frequency: Very High

Q8 *DEC 2011*

The reaction between NH_4Br and Na metal in liquid ammonia (solvent) results in the products

(a) NaBr, HBr

(b) NaBr, H_2

(c) H_2, HBr

(d) HBr, H_2

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer B NaBr, H_2

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- NH_4^+ is the acid of liquid ammonia; sodium reduces it: $2NH_4Br + 2Na \rightarrow 2NaBr + H_2 + 2NH_3$.
- Therefore the answer is (B).

FINAL: (B) NaBr, H_2

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **B**

A **NaBr, HBr**

Why (B) is the key — NH_4^+ is the acid of liquid ammonia; sodium reduces it: $2NH_4Br + 2Na \rightarrow 2NaBr + H_2 + 2NH_3$.

C **H_2, HBr**

Option (C) is ruled out by the same reasoning: NH_4^+ is the acid of liquid ammonia; sodium reduces it: $2NH_4Br + 2Na \rightarrow 2NaBr + H_2$ +

D **HBr, H_2**

Option (D) is ruled out by the same reasoning: NH_4^+ is the acid of liquid ammonia; sodium reduces it: $2NH_4Br + 2Na \rightarrow 2NaBr + H_2$ +

Q10 *DEC 2011*

The final product (s) of the reaction $P(OR)_3$+R^´ X is/are

(a) R^´ $PO(OR)_2$ and RX

(b) [R^´ $PO(OR)_2$] X

(c) [R^´ $RPO_2(OR)$] X

(d) ROR'and $P(OR)_2$ X

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A R'PO(OR)2 and RX

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Michaelis–Arbuzov: the phosphite is alkylated at P, and the halide then dealkylates the phosphonium ion, giving the phosphonate $R'P(O)(OR)_2$ and the alkyl halide RX.
- Therefore the answer is (A).

FINAL: (A) R'PO(OR)2 and RX

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **[R'PO(OR)2]X**

Why (A) is the key — Michaelis–Arbuzov: the phosphite is alkylated at P, and the halide then dealkylates the phosphonium ion, giving the phosphonate R′P(O)(OR)$_2$ and the alkyl halide RX.

C **[R'RPO2(OR)]X**

Option (C) is ruled out by the same reasoning: Michaelis–Arbuzov: the phosphite is alkylated at P, and the halide then dealkylates the phosphonium ion, giving the phosphonate R′P(O)(OR)$_2$ and the alkyl…

D **ROR' and P(OR)2X**

Option (D) is ruled out by the same reasoning: Michaelis–Arbuzov: the phosphite is alkylated at P, and the halide then dealkylates the phosphonium ion, giving the phosphonate R′P(O)(OR)$_2$ and the alkyl…

Q16 *JUNE 2012*

16. Among the halides, NCl_3 (A), PCl_3 (B) and $AsCl_3$ (C), those which produce two different acids.
(a) A and B
(b) A and C
(c) B and C
(d) A, B and C
Correct answer is (c).

$NCl_3 + 4\,H_2O \rightarrow NH_4OH + 3HOCl$

$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$ (two different Acids),

$AsCl_3 + 3H_2O \rightarrow H_3AsO_3 + 3H_2$ (two different acids)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C , those which produce two different acids.

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (C).

FINAL: (C) , those which produce two different acids.

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: C

A , PCl_3

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

B and $AsCl_3$

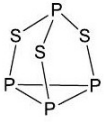
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

D A and B

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

Q18 *JUNE 2012*

18. The correct structure of P_4S_3 is:



(a)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A Option A (see PDF)

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

Q19 *JUNE 2012*

Low oxidation state complexes are often air-sensitive, but are rarely water sensitive because

(a) Air is reducing in nature while water is inert

(b) Both air and water are oxidizing in nature

(c) Both air and water are not acceptors

(d) Complexes with low oxidation states will easily lose electrons to O_2 but will not bind to a π-donor molecule like H_2O

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer D Complexes with low oxidation states will easily lose electrons to O_2 but will not bind to a π–donor molecule like H_2O.

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- O_2 is an oxidant and a π-acceptor that readily takes electrons from electron-rich low-valent metals; water is neither oxidising under normal conditions nor a π-acceptor, so it usually leaves such complexes alone.
- Therefore the answer is (D).

FINAL: (D) Complexes with low oxidation states will easily lose electrons to O_2 but will not bind to a π–donor molecule like H_2O.

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **D**

A **Air is reducing in nature while water is inert**

Why (D) is the key — O_2 is an oxidant and a π-acceptor that readily takes electrons from electron-rich low-valent metals; water is neither oxidising under normal conditions nor a π-acceptor, so it usually leaves such complexes alone.

B **Both air and water are oxidizing in nature**

Option (B) is ruled out by the same reasoning: O_2 is an oxidant and a π-acceptor that readily takes electrons from electron-rich low-valent metals; water is neither oxidising under normal conditions nor a…

C **Both air and water are not acceptors**

Option (C) is ruled out by the same reasoning: O_2 is an oxidant and a π-acceptor that readily takes electrons from electron-rich low-valent metals; water is neither oxidising under normal conditions nor a…

Q26 *JUNE 2013*

Which of the following is used as propellant for whipping creams?

(a) N_2O

(b) NO

(c) N_2O_3

(d) N_2O_5

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A N_2O

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Nitrous oxide dissolves in the fat and expands on release, so N_2O is the propellant in whipped-cream cans.
- Therefore the answer is (A).

FINAL: (A) N_2O

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **NO**

Why (A) is the key — Nitrous oxide dissolves in the fat and expands on release, so N_2O is the propellant in whipped-cream cans.

C **N_2O_3**

Option (C) is ruled out by the same reasoning: Nitrous oxide dissolves in the fat and expands on release, so N_2O is the propellant in whipped-cream

D **N_2O_5**

Option (D) is ruled out by the same reasoning: Nitrous oxide dissolves in the fat and expands on release, so N_2O is the propellant in whipped-cream

Q27 *JUNE 2013*

Flame proof fabrices contain

(a) $H_2NC(O)NH_2 \cdot Na_2SO_4$

(b) $H_2NC(S)NH_2 \cdot Na_2SO_4$

(c) $H_2NC(O)NH_2 \cdot H_3PO_4$

(d) $H_2NC(S)NH_2 \cdot H_3PO_4$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C H2NC(O)NH2 . H3PO4

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Urea phosphate is used in flame-proof fabrics (c).
- Therefore the answer is (C).

FINAL: (C) H2NC(O)NH2 . H3PO4

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **C**

A **H2NC(O)NH2 . Na2SO4**

Why (C) is the key — Urea phosphate is used in flame-proof fabrics (c).

B **H2NC(S)NH2 . Na2SO4**

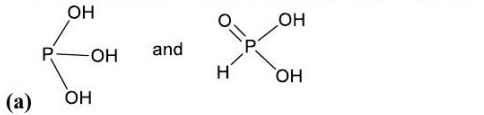
Option (B) is ruled out by the same reasoning: Urea phosphate is used in flame-proof fabrics

D **H2NC(S)NH2 . H3PO4**

Option (D) is ruled out by the same reasoning: Urea phosphate is used in flame-proof fabrics

Q36 *DEC 2013*

36. Two tautomeric forms of phosphorus acid are



(a)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A Option A (see PDF)

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

Q40 *DEC 2013*

40. Xenon forms several fluorides and oxofluorides which exihibit acidic behaviour. The correct sequence of descending Lewis acidity among the given species is represented by

(a) $XeF_6 > XeOF_4 > XeF_4 > XeO_2F_2$

(b) $XeOF_4 > XeO_2F_2 > XeOF_4 > XeF_6$

(c) $XeF_4 > XeO_2F_2 > XeOF_4 > XeF_6$

(d) $XeF_4 > XeF_6 > XeOF_4 > XeO_2F_2$

Correct answer is (a)

Relative acidic strength of xenon fluorides follows order $XeF_6 > XeO_3 > F > XeOF_4 > XeF_4$, $XeO_2F_2 > XeF_2$.
This order depends upon (i) number of lone pair (ii) number of 'F' atoms

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A $XeF_6 > XeOF_4 > XeF_4 > XeO_2F_2$

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (A).

FINAL: (A) $XeF_6 > XeOF_4 > XeF_4 > XeO_2F_2$

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B $XeOF_4 > XeO_2F_2 > XeOF_4 > XeF_6$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

C $XeF_4 > XeO_2F_2 > XeOF_4 > XeF_6$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

D $XeF_4 > XeF_6 > XeOF_4 > XeO_2F_2$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

Q43 *JUNE 2014*

Reactions of elemental as with hot and conc. HNO_3, and H_2SO_4 respectively, give

(a) As_4O_6 and $As_2(SO_4)_3$

(b) $As(NO_3)_5$ and $As_2(SO)_3$

(c) As_4O_6 and H_3AsO_4

(d) H_3AsO_4 and As_4O_6

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer D H_3AsO_4 and As_4O_6

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Hot HNO_3 gives H_3AsO_4; hot H_2SO_4 gives As_4O_6 (d).
- Therefore the answer is (D).

FINAL: (D) H_3AsO_4 and As_4O_6

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **D**

A As_4O_6 and $As_2(SO_4)_3$

Why (D) is the key — Hot HNO_3 gives H_3AsO_4; hot H_2SO_4 gives As_4O_6 (d).

B $As(NO_3)_5$ and $As_2(SO)_3$

Option (B) is ruled out by the same reasoning: Hot HNO_3 gives H_3AsO_4; hot H_2SO_4 gives As_4O_6

C As_4O_6 and H_3AsO_4

Option (C) is ruled out by the same reasoning: Hot HNO_3 gives H_3AsO_4; hot H_2SO_4 gives As_4O_6

Q52 *DEC 2014*

The main products of the reaction of equimolar quantities of XeF_6 with $NaNO_3$ are

(a) $XeOF_4$, NaF and NO_2F

(b) XeO_2F_2, NaF, NOF and F_2

(c) $XeOF_4$, $NaNO_2$ and F_2

(d) XeF_4, $NaNO_2$, and F_2 O

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A $XeOF_4$, NaF and NO_2F

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- $XeF_6 + NaNO_3 \rightarrow XeOF_4 + NaF + NO_2F$ (partial oxygen transfer to xenon, fluorination of the nitryl group).
- Therefore the answer is (A).

FINAL: (A) $XeOF_4$, NaF and NO_2F

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **XeO_2F_2, NaF, NOF and F_2**

Why (A) is the key — $XeF_6 + NaNO_3 \rightarrow XeOF_4 + NaF + NO_2F$ (partial oxygen transfer to xenon, fluorination of the nitryl group).

C **$XeOF_4$, $NaNO_2$ and F_2**

Option (C) is ruled out by the same reasoning: $XeF_6 + NaNO_3 \rightarrow XeOF_4 + NaF + NO_2F$ (partial oxygen transfer to xenon, fluorination of the nitryl

D **XeF_4, $NaNO_2$, and F_2O**

Option (D) is ruled out by the same reasoning: $XeF_6 + NaNO_3 \rightarrow XeOF_4 + NaF + NO_2F$ (partial oxygen transfer to xenon, fluorination of the nitryl

Q54 *DEC 2014*

54. The correct set of pseudo halide anions is

(a) CN^-, ClO_4^-, BF_4^-, PF_6^-

(c) SCN^-, PO^{-3}_4, $H_2PO^-_4$,N^-_3

(b) N^-_3, NO^-_3, HSO_4 AsF^-_6

(d) CN^-, N^-_3, SCN^-, NCN^{2-}

Correct option is (d)

Pseudo halogen are polyatomic analogous of Halogen whose chemistry resemble with true Halogen common example. CN^-, N^-_3 , SCN^-, NCN^{2-}.These anions contain nitrogen atoms.

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer D CN-, N^{-3} , SCN-, NCN_{2-}

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (D).

FINAL: (D) CN-, N^{-3} , SCN-, NCN_{2-}

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **D**

A CN^- , ClO_{4}^-, BF_{4}^-, PF_{6}^-

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (D). See worked explanation.

B SCN^-, PO^{-34}, H_2PO^{-4} ,N^{-3}

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (D). See worked explanation.

C N^{-3}, NO^{-3}, HSO_4 AsF^{-6}

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (D). See worked explanation.

Q55 *DEC 2014*

example: CN^-, N_3^-, SCN^-, NCN^-. These anions contain nitrogen atoms.

55. The oxoacid of phosphorus having P atoms in +4, +3, and +4 oxidation states respectively, is

(a) $H_5P_3O_{10}$

(b) $H_5P_3O_7$

(c) $H_5P_3O_8$

(d) $H_5P_3O_9$

Correct option is (c)

The average of oxidation states is $\frac{4+3+4}{3} = \frac{11}{3}$

$H_5P_3O_{10}$ = +5+3x-20 =0 , 3x =+15 , x=+5

$H_5P_3O_7$ = +5+3x-14 = 0 ,x=+3

$H_5P_3O_8$ = +5+ 3x-16=0 , x=+ 11/3

$H_5P_3O_9$ = +5+3x-18=0 . x= +13/3

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C $H_5P_3O_8$

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (C).

FINAL: (C) $H_5P_3O_8$

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: C

A $H_5P_3O_{10}$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

B $H_5P_3O_7$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

D $H_5P_3O_9$

Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

Q59 *DEC 2014*

59. Consider the following reaction :

$$N_3P_3Cl_6 + 6HNMe_2 \rightarrow N_3P_3Cl_3(NMe_2)_3 + 3\ Me_2NH.HCl$$

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer B 3

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (B).

FINAL: (B) 3

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **B**

A — **4**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

C — **2**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

D — **5**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

Q62 *June 2016*

[CSIR June 2016]

62. The numbers of P-S and P-P bonds in the compound P_4S_3 are, respectively

(a) 6 and 3

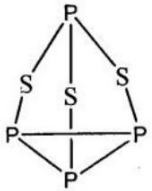
(b) 4 and 3

(c) 3 and 6

(d) 6 and 2

Correct option is (a)

Structure of P_4S_3 is



Number of P-S bond=6

Number of P-P bond = 3

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer A 6 and 3

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (A).

FINAL: (A) 6 and 3

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **A**

B **4 and 3**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

C **3 and 6**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

D **6 and 2**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (A). See worked explanation.

Q70 *JUNE 2017*

The compound N_2F_2 has two isomers. Choose the correct option from the following:

(a) both isomers possess a σ_v plane

(b) both isomers possess σ_h plane

(c) one isomer has a σ_h plane while the other has a σ_v plane

(d) none of them have a σ_h plane

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C one isomer has a σh plane while the other has a σv plane

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- cis-N_2F_2 is C_2v (σ_v planes, no σ_h); trans-N_2F_2 is C_2h (the molecular plane is σ_h).
- Therefore the answer is (C).

FINAL: (C) one isomer has a σh plane while the other has a σv plane

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **C**

A **both isomers possess a σv plane**

Why (C) is the key — cis-N_2F_2 is C_2v (σ_v planes, no σ_h); trans-N_2F_2 is C_2h (the molecular plane is σ_h).

B **both isomers possess σh plane**

Option (B) is ruled out by the same reasoning: cis-N_2F_2 is C_2v (σ_v planes, no σ_h); trans-N_2F_2 is C_2h (the molecular plane is

D **none of them have a σh plane**

Option (D) is ruled out by the same reasoning: cis-N_2F_2 is C_2v (σ_v planes, no σ_h); trans-N_2F_2 is C_2h (the molecular plane is

Q72 *DEC 2017*

Choose the incorrect statement for the phosphomolybdate anion $[PMo_{12}O_{40}]^{3-}$

(a) It has a Keggin structure
(b) Phosphorus is in +5 oxidation state
(c) It is extremely basic
(d) It forms crystalline precipitates with $[R_4\ N]^+$(R= bulky alkyl or aryl group)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C It is extremely basic. Main Group Elements

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Keggin-type phosphomolybdate is a very weak base / strong acid ($H_3PMo_{12}O_{40}$ is a heteropolyacid); the other statements are true.
- Therefore the answer is (C).

FINAL: (C) It is extremely basic. Main Group Elements

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **C**

A **It has a Keggin structure.**

Why (C) is the key — Keggin-type phosphomolybdate is a very weak base / strong acid ($H_3PMo_{12}O_{40}$ is a heteropolyacid); the other statements are true.

B **Phosphorus is in +5 oxidation state.**

Option (B) is ruled out by the same reasoning: Keggin-type phosphomolybdate is a very weak base / strong acid ($H_3PMo_{12}O_{40}$ is a heteropolyacid); the other statements are

D **It forms crystalline precipitates with $[R_4N]+$ (R = bulky alkyl or aryl group)**

Option (D) is ruled out by the same reasoning: Keggin-type phosphomolybdate is a very weak base / strong acid ($H_3PMo_{12}O_{40}$ is a heteropolyacid); the other statements are

Q76 *JUNE 2018*

76. Consider following statements:
I: $AsCl_5$ is thermally less stable than PCl_5.
II: Size of As is more than that of P.
choose correct answer from the following
1. Statements I and II are true and II is the correct explanation of I.
2. Statements I and II are true but II is not the correct explanation of I.
3. Statement I is true and statement II is false.
4. Both the statements I and II are false.
Correct option is (b)

On descending the group, the stability of +3 oxidation state increases and that of +5 oxidation state decreases. Size usually increases on descending the group (P = 1.10 A^0 and As = 1.21 A^0). Thus, $AsCl_5$ is thermally less stable than PCl_5 and As is larger than P but less stability of $AsCl_5$, is not due to larger size of As, instead it is due inert pair effect.

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer B Statements I and II are true but II is not the correct explanation of I.

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (B).

FINAL: (B) Statements I and II are true but II is not the correct explanation of I.

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **B**

A **Statements I and II are true and II is the correct explanation of I.**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

C **Statement I is true and statement II is false.**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

D **Both the statements I and II are false.**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (B). See worked explanation.

Q80 *DEC 2018*

80. The number of 2c-2e bonds ('x') of a molecule is related to 'N' (valence electrons) and 'n' (skeletal atoms) by x=(8n-N)/2. For P_4S_3, the values of x, N and n, respectively, are
(a) 7, 38 ,9
(b) 7 , 24 , 9
(c) 9, 38, 7
(d) 9, 24, 7
Correct option is (c)

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C 9, 38, 7

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Key principle: basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry. Correct answer is (C).

FINAL: (C) 9, 38, 7

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **C**

A **7, 38 ,9**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

B **7 , 24 , 9**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

D **9, 24, 7**
Inconsistent with basicity of P oxoacids (P-OH count) and NOx/P4Sn chemistry; correct choice is (C). See worked explanation.

Q84 *JUNE 2019*

The oxidation state of sulphur in the dithionous and dithionic acids, respectively, are

(a) +4, +6

(b) - 4,+5

(c) +3, +5

(d) +3,+6

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer C +3, +5

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Dithionous acid $H_2S_2O_4$: S is +3; dithionic acid $H_2S_2O_6$: S is +5.
- Therefore the answer is (C).

FINAL: (C) +3, +5

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **C**

A **+4, +6**

Why (C) is the key — Dithionous acid $H_2S_2O_4$: S is +3; dithionic acid $H_2S_2O_6$: S is +5.

B **-4, +5**

Option (B) is ruled out by the same reasoning: Dithionous acid $H_2S_2O_4$: S is +3; dithionic acid $H_2S_2O_6$: S is

D **+3, +6**

Option (D) is ruled out by the same reasoning: Dithionous acid $H_2S_2O_4$: S is +3; dithionic acid $H_2S_2O_6$: S is

Q94 *DEC 2019*

The reason for significantly high solubility of $AgClO_4$ in benzene than in alkane solvents is

(a) Alkane solvents are non- polar

(b) Benzene is an aprotic solvent

(c) PhAg is formed

(d) Benzene acts as a soft base

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides

PYQ FREQUENCY
Very High · 13 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Correct Answer D Benzene acts as a soft base

CONCEPT

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

↓

LOGIC / WORKING

- Ag^+ is a soft acid and the benzene π-system is a soft base; the Ag^+–arene π-complex dissolves $AgClO_4$ in benzene, which saturated alkanes cannot provide.
- Therefore the answer is (D).

FINAL: (D) Benzene acts as a soft base

SHORTCUT / EXAM TRICK

Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: N2O5→HNO3, P4O10→H3PO4 (not CO, not NO).

COMMON MISTAKE

Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.

EXAM TIP

P4S3 has a cage with 3 S bridges on alternate P-P edges. H3PO3 is a strong reducing agent because P-H bond can be oxidised. Bismuth shows inert pair effect (+3 stable).

MEMORY TRICK

P-H is invisible to acid-base chemistry (non-acidic). Only count the OH groups on P for basicity.

Why the Other Options Are Wrong

Correct answer: **D**

A **Alkane solvents are non- polar.**

Why (D) is the key — Ag^+ is a soft acid and the benzene π-system is a soft base; the Ag^+–arene π-complex dissolves $AgClO_4$ in benzene, which saturated alkanes cannot provide.

B **Benzene is an aprotic solvent.**

Option (B) is ruled out by the same reasoning: Ag^+ is a soft acid and the benzene π-system is a soft base; the Ag^+–arene π-complex dissolves $AgClO_4$ in benzene, which saturated alkanes cannot

C **PhAg is formed.**

Option (C) is ruled out by the same reasoning: Ag^+ is a soft acid and the benzene π-system is a soft base; the Ag^+–arene π-complex dissolves $AgClO_4$ in benzene, which saturated alkanes cannot

TOPIC REVISION

Nitrogen & Phosphorus Group (Group 15)

21 PYQs · Last-minute revision

TOPIC SUMMARY

Group 15 (N–Bi): N forms ppi-ppi multiple bonds; P prefers sigma/dpi bonding. Oxoacids of P: H3PO4 (tribasic, 3 P-OH), H3PO3 (dibasic, 2 P-OH + 1 P-H), H3PO2 (monobasic, 1 P-OH + 2 P-H). P-H bonds are NON-acidic.

IMPORTANT FORMULA SHEET

H3PO2: 1 P-OH → monobasic
H3PO3: 2 P-OH → dibasic
H3PO4: 3 P-OH → tribasic

- $N_2O_5 + H_2O \rightarrow 2HNO_3$

FREQUENTLY ASKED CONCEPTS

Basicity of P oxoacids (P-OH count)
P-H bond (non-acidic)
P4Sn cage structures

- Acid anhydrides vs non-anhydrides

COMMON MISTAKES & QUICK NOTES

Watch out:
Counting P=O as acidic, or including P-H in basicity count. H3PO3 is dibasic NOT tribasic.
Last-minute:
Count only P-OH for basicity. H3PO2 (1 OH) = monobasic. H3PO3 (2 OH) = dibasic. H3PO4 (3 OH) = tribasic. Acid anhydrides: $N_2O_5 \rightarrow HNO_3$, $P_4O_{10} \rightarrow H_3PO_4$ (not CO, not NO).

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q8 Q10 Q16 Q18 Q19 Q26 Q27 Q36 Q40 Q43 Q52 Q54 Q55 Q59 Q62 Q70 Q72 Q76 Q80 Q84 Q94

Expect **3 question(s)** next session on **Oxoacids of P (basicity), P4Sn structures, NOx chemistry, acid anhydrides.**

TOPIC 6

Oxygen & Sulfur Group (Group 16)

3 questions · Easy 0 | Medium 2 | Hard 1 · PYQ frequency: Rare

Q31 *DEC 2013*

The reaction of $FeCl_3 \cdot 6\ H_2O$ with $SOCl_2$ yields.

(a) $FeCl_2(s)$, $SO_2(g)$ and $HCl(g)$

(b) $FeCl_3(s)$, $SO_2(g)$ and $HCl(l)$

(c) $FeCl_2(S)$, $SO_2(s)$ and $HCl(g)$

(d) $FeCl_3(s)$, $SO_2(g)$ and $HCl(g)$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Superoxide vs peroxide, sulfur allotropes, oxoacids of sulfur, thiosulfate

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Correct Answer D $FeCl_3(s)$, $SO_2(g)$ and $HCl(g)$ $FeCl_3.6H_2O + SOCl_2 \rightarrow FeCl_3(s) + SO_2(g) + HCl(g)$

CONCEPT

Group 16 (O–Po): O2- (oxide), O22- (peroxide, diamagnetic), O2- (superoxide, paramagnetic). Sulfur forms S8 crown, polysulfides. SO3 is anhydride of H2SO4; SO2 of H2SO3. Ozone is bent with C2v symmetry.

↓

LOGIC / WORKING

- $SOCl_2$ is the standard dehydrating agent for hydrated chlorides: $FeCl_3 \cdot 6H_2O + 6SOCl_2 \rightarrow FeCl_3 + 6SO_2(g) + 12HCl(g)$, giving anhydrous $FeCl_3$ without hydrolysis.
- Therefore the answer is (D).

FINAL: (D) $FeCl_3(s)$, $SO_2(g)$ and $HCl(g)$ $FeCl_3.6H_2O + SOCl_2 \rightarrow FeCl_3(s) + SO_2(g) + HCl(g)$

SHORTCUT / EXAM TRICK

O2- = superoxide (1 unpaired e-, paramagnetic). O22- = peroxide (diamagnetic). SO3 + H2O → H2SO4. S8 is the stable allotrope at room temperature.

COMMON MISTAKE

Confusing sulfite (SO3(2-)) with sulfate (SO4(2-)). Superoxide is paramagnetic; peroxide is diamagnetic.

EXAM TIP

Thiosulfate S2O3(2-): two non-equivalent S atoms (one at center +5 oxidation state, one at periphery -1, average +2 for whole ion). Concentrated H2SO4: dehydrating + sulfonating agent.

MEMORY TRICK

SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Why the Other Options Are Wrong

Correct answer: **D**

A **$FeCl_2$ (s), SO_2 (g) and HCl (g)**

Why (D) is the key — $SOCl_2$ is the standard dehydrating agent for hydrated chlorides: $FeCl_3 \cdot 6H_2O + 6SOCl_2 \rightarrow FeCl_3 + 6SO_2(g) + 12HCl(g)$, giving anhydrous $FeCl_3$ without hydrolysis.

B **$FeCl_3$(s), SO_2(g) and HCl(l)**

Option (B) is ruled out by the same reasoning: $SOCl_2$ is the standard dehydrating agent for hydrated chlorides: $FeCl_3 \cdot 6H_2O + 6SOCl_2 \rightarrow FeCl_3 + 6SO_2(g) + 12HCl(g)$, giving anhydrous $FeCl_3$ without

C **$FeCl_2$ (S), SO_2(s) and HCl (g)**

Option (C) is ruled out by the same reasoning: $SOCl_2$ is the standard dehydrating agent for hydrated chlorides: $FeCl_3 \cdot 6H_2O + 6SOCl_2 \rightarrow FeCl_3 + 6SO_2(g) + 12HCl(g)$, giving anhydrous $FeCl_3$ without

Q91 *DEC 2019*

91. Consider the following statements:
(A) The highest oxidation state of Group 3 elements is more readily shown in their oxides than in fluorides
(B)Fe can exist in-2 formal oxidation state also
(C) Mn , Tc and Re easily form M(II) compounds
The correct statement(s) is/are
(a) A and B
(b) A and C
(c) Band C
(d) C only

Correct option is (a)
(A) The highest oxidation state +8 of group 8 elements is shown readily in oxides like OsO_4 and RuO_4 than in fluorides like RuF_8 and OsF_8 because these fluorides are unstable due to increased steric hinderance.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Superoxide vs peroxide, sulfur allotropes, oxoacids of sulfur, thiosulfate

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Correct Answer A The highest oxidation state of Group 3 elements is more readily shown in their oxides than in fluorides

CONCEPT

Group 16 (O–Po): O2- (oxide), O22- (peroxide, diamagnetic), O2- (superoxide, paramagnetic). Sulfur forms S8 crown, polysulfides. SO3 is anhydride of H2SO4; SO2 of H2SO3. Ozone is bent with C2v symmetry.

↓

LOGIC / WORKING

- Key principle: superoxide vs peroxide and oxoacids of sulfur. Correct answer is (A).

FINAL: (A) The highest oxidation state of Group 3 elements is more readily shown in their oxides than in fluorides

SHORTCUT / EXAM TRICK

O2- = superoxide (1 unpaired e-, paramagnetic). O22- = peroxide (diamagnetic). SO3 + H2O → H2SO4. S8 is the stable allotrope at room temperature.

COMMON MISTAKE

Confusing sulfite (SO3(2-)) with sulfate (SO4(2-)). Superoxide is paramagnetic; peroxide is diamagnetic.

EXAM TIP

Thiosulfate S2O3(2-): two non-equivalent S atoms (one at center +5 oxidation state, one at periphery -1, average +2 for whole ion). Concentrated H2SO4: dehydrating + sulfonating agent.

MEMORY TRICK

SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Why the Other Options Are Wrong

Correct answer: **A**

B

Fe can exist in^{-2} formal oxidation state also

Inconsistent with superoxide vs peroxide and oxoacids of sulfur; correct choice is (A). See worked explanation.

C

Mn , Tc and Re easily form M(II) compounds The

Inconsistent with superoxide vs peroxide and oxoacids of sulfur; correct choice is (A). See worked explanation.

D

A and B

Inconsistent with superoxide vs peroxide and oxoacids of sulfur; correct choice is (A). See worked explanation.

Q92 *DEC 2019*

The correct statements for dithionite and dithionate anions from the following are (A) both have S-S bond (B) both are dianionic (C) oxidation state of sulphur is +3 and +5, respectively (D) sulphur in dithionate has lone pair of electrons

(a) A, B and C

(b) A, B and D

(c) B, C and D

(d) A and B only

QUESTION INSIGHTS

ESTIMATED TIME
3–5 min

DIFFICULTY
Hard

CONCEPT TESTED
Superoxide vs peroxide, sulfur allotropes, oxoacids of sulfur, thiosulfate

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★★★

EXPECTED LEVEL
Part C (high merit)

MEMORY HOOK
SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Correct Answer A A, B and C

CONCEPT

Group 16 (O–Po): O2- (oxide), O22- (peroxide, diamagnetic), O2- (superoxide, paramagnetic). Sulfur forms S8 crown, polysulfides. SO3 is anhydride of H2SO4; SO2 of H2SO3. Ozone is bent with C2v symmetry.

↓

LOGIC / WORKING

- Dithionite $[O_2S–SO_2]^{2-}$ (S +3) and dithionate $[O_3S–SO_3]^{2-}$ (S +5) both have an S–S bond and a 2− charge. S in dithionate carries no lone pair. A, B and C (a).
- Therefore the answer is (A).

FINAL: (A) A, B and C

SHORTCUT / EXAM TRICK

O2- = superoxide (1 unpaired e-, paramagnetic). O22- = peroxide (diamagnetic). SO3 + H2O → H2SO4. S8 is the stable allotrope at room temperature.

COMMON MISTAKE

Confusing sulfite (SO3(2-)) with sulfate (SO4(2-)). Superoxide is paramagnetic; peroxide is diamagnetic.

EXAM TIP

Thiosulfate S2O3(2-): two non-equivalent S atoms (one at center +5 oxidation state, one at periphery -1, average +2 for whole ion). Concentrated H2SO4: dehydrating + sulfonating agent.

MEMORY TRICK

SO3 → H2SO4 (3 oxygens → sulfuric). SO2 → H2SO3 (2 oxygens → sulfurous). Count the oxygens!

Why the Other Options Are Wrong

Correct answer: **A**

B — **A, B and D**

Why (A) is the key — Dithionite $[O_2S–SO_2]^{2-}$ (S +3) and dithionate $[O_3S–SO_3]^{2-}$ (S +5) both have an S–S bond and a 2− charge. S in dithionate carries no lone pair. A, B and C (a).

C — **B, C and D**

Option (C) is ruled out by the same reasoning: Dithionite $[O_2S–SO_2]^{2-}$ (S +3) and dithionate $[O_3S–SO_3]^{2-}$ (S +5) both have an S–S bond and a 2− charge. S in dithionate carries no lone pair. A, B and C

D — **A and B only**

Option (D) is ruled out by the same reasoning: Dithionite $[O_2S–SO_2]^{2-}$ (S +3) and dithionate $[O_3S–SO_3]^{2-}$ (S +5) both have an S–S bond and a 2− charge. S in dithionate carries no lone pair. A, B and C

TOPIC REVISION

Oxygen & Sulfur Group (Group 16)

3 PYQs · Last-minute revision

TOPIC SUMMARY

Group 16 (O–Po): O2- (oxide), O22- (peroxide, diamagnetic), O2- (superoxide, paramagnetic). Sulfur forms S8 crown, polysulfides. SO3 is anhydride of H2SO4; SO2 of H2SO3. Ozone is bent with C2v symmetry.

IMPORTANT FORMULA SHEET

O2- = superoxide (paramagnetic)
O22- = peroxide (diamagnetic)
SO3 + H2O → H2SO4
- S8: 8-membered crown ring

FREQUENTLY ASKED CONCEPTS

Superoxide vs peroxide (magnetism)
Sulfur allotropes (S8)
Oxoacids of sulfur
- Thiosulfate structure

COMMON MISTAKES & QUICK NOTES

Watch out:
Confusing sulfite (SO3(2-)) with sulfate (SO4(2-)). Superoxide is paramagnetic; peroxide is diamagnetic.
Last-minute:
O2- = superoxide (1 unpaired e-, paramagnetic). O22- = peroxide (diamagnetic). SO3 + H2O → H2SO4. S8 is the stable allotrope at room temperature.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q31 Q91 Q92

Expect **1 question(s)** next session on **Superoxide vs peroxide, sulfur allotropes, oxoacids of sulfur, thiosulfate.**

TOPIC 7

Halogens (Group 17)

9 questions · Easy 0 | Medium 9 | Hard 0 · PYQ frequency: High

Q21 *DEC 2012*

The electronegativity differences is the highest for the pair

(a) Li, Cl

(b) K, F

(c) Na, Cl

(d) Li, F

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer B K, F

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- K (0.82) and F (3.98) give the largest electronegativity difference, 3.16.
- Therefore the answer is (B).

FINAL: (B) K, F

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **B**

A **Li, Cl**

Why (B) is the key — K (0.82) and F (3.98) give the largest electronegativity difference, 3.16.

C **Na, Cl**

Option (C) is ruled out by the same reasoning: K (0.82) and F (3.98) give the largest electronegativity difference,

D **Li, F**

Option (D) is ruled out by the same reasoning: K (0.82) and F (3.98) give the largest electronegativity difference,

Q25 *JUNE 2013*

25. Which of the following pairs has the highest difference in their first ionization energy?
(a) Xe, Cs
(b) Kr, Rb
(c) Ar, K
d) Ne, Na
Correct answer is (d)

As we go down the group in periodic table for sodium family, the number of electrons increases and their attraction towards nucleus increases and simultaneously with addition of new energy shells but increase in distance is more pronounced as that of increase in e^-, So Na loses e^-s very easily therefore lowest ionization energy .

In the case of inert gas family, Ne has its complete octet, strongly connected with nucleus e attraction and do not give e^- s to lose easily therefore highest ionization energy.

Thus Na, Ne pair have highest difference in their first ionization energy in given option.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer: D

As we go down the group in periodic table for sodium family, the number of electrons increases and their attraction towards nucleus increases and simultaneously with addition of new energy shells but increase in distance is more pronounced as that of increase in e- , So Na loses e-s very easily therefore lowest ionization energy . In the case of inert gas family, Ne has its complete octet, strongly connected with nucleus e attraction and do not give e- s to lose easily therefore highest ionization energy. Thus Na, Ne pair have highest difference in their first ionization energy in given option.

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (D).

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

FINAL: (D) **As we go down the group in periodic table for sodium family, the number of electrons increases and their attraction towards nucleus increases and simultaneously with addition of new energy shells but increase in distance is more pronounced as that of increase in e- , So Na loses e-s very easily therefore lowest ionization energy . In the case of inert gas family, Ne has its complete octet, strongly connected with nucleus e attraction and do not give e- s to lose easily therefore highest ionization energy. Thus Na, Ne pair have highest difference in their first ionization energy in given option.**

Why the Other Options Are Wrong

Correct answer: D

A **Xe, Cs**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (D). See worked explanation.

B **Kr, Rb**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (D). See worked explanation.

C **Ar, K d) Ne, Na**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (D). See worked explanation.

Q29 *JUNE 2013*

29. Identify the pairs in which the covalent radii of elements are almost similar
(A) Nb, Ta
(B) Mo, W
(C) La, Lu
(D) Sc, Y
(a) A and B only
(b) A and C only
(c) B and C only
(d) A, B and C only
Correct answer is (a)
As we move from Nb-Ta and Mo-W there is introduction of electron into f-orbital. As the shielding power of f-orbital is very less. Therefore, as we move from La-Lu in 4f series the size decreases, this is termed as Lanthanide contraction. This leads to slight increase in size of 5d metal than 4d. Due to this size of d and 5d metals are nearly similar. Hence Nb-Ta and Mo-W have similar covalent radii.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer A Nb, Ta

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (A).

FINAL: (A) Nb, Ta

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **A**

B **Mo, W**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (A). See worked explanation.

C **La, Lu**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (A). See worked explanation.

D **Sc, Y**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (A). See worked explanation.

Q48 *DEC 2014*

48. Among F^-, Na^+, O^{2-} and Mg^{2+} ions, those having the highest and the lowest ionic radii respectively are
(a) O^{2-} and Na^+ (b) F^- and Mg^{2+} (c) O^{2-} and Mg^{2+} (d) Mg^{2+} and O^{2-}
Correct answer is (c)
All the ions are isoelectronic. Therefore, the size depends upon effective muclear charge.
Size of isoelectronic ions $\propto \frac{1}{Z}$

	F^-	O^{2-}	Na^+	Mg^{2+}
Atomic number	9	8	11	12
Number of electrons	10	10	10	10

Hence, the order of size will be $O^{2-} > F^- > Na^+ > Mg^{2+}$
Since, atomic number increases.
Therefore, z, increases .
Therefore. size decreases.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer C (c)

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (C).

FINAL: (C) (c)

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **C**

A

O2- and Na+ (b) F- and Mg2+ (c) O2- and Mg2+ (d) Mg2+ and O2-

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

B

Main Group Elements

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

D

Correct answer is (c)

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

Q61 *DEC 2015*

Protonated form of ZSM-5 catalyzes the reaction of ethene with benzene to produce ethylbenzene. The correct statement for this catalytic process is

(a) alkyl carbocation is formed

(b) carbanion is formed

(c) benzene converted to $(C_6H_5)^+$group

(d) vinyl radical is formed

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer A alkyl carbocation is formed

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- The Brønsted acid sites of H-ZSM-5 protonate ethene to an ethyl carbocation, which alkylates benzene (Friedel–Crafts type).
- Therefore the answer is (A).

FINAL: (A) alkyl carbocation is formed

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **A**

B **carbanion is formed**

Why (A) is the key — The Brønsted acid sites of H-ZSM-5 protonate ethene to an ethyl carbocation, which alkylates benzene (Friedel–Crafts type).

C **benzene converted to (C_6H_5) + group**

Option (C) is ruled out by the same reasoning: The Brønsted acid sites of H-ZSM-5 protonate ethene to an ethyl carbocation, which alkylates benzene (Friedel–Crafts

D **vinyl radical is formed**

Option (D) is ruled out by the same reasoning: The Brønsted acid sites of H-ZSM-5 protonate ethene to an ethyl carbocation, which alkylates benzene (Friedel–Crafts

Q63 *June 2016*

63. The compound which dissolves in $POCl_3$ to give a solution with highest chloride ion concentration ,is -

(a) Et_3N

(b) KCl

(c) $FeCl_3$

(d) $SbCl_5$

Correct option is (b)

$POCl_3 \rightarrow POCl_2^+ + Cl^-$

$POCl_6 + Cl \rightarrow POCl_4^-$

(1) $Et_3N \xrightarrow{liq\ \ POCl3} (OPCl_2 .NEt_3)^+ + Cl^-$

$POCl_6 + Cl^- \rightarrow POCl_4^-$ (Cl^- concentration is not enhanced)

(ii) $KCl \xrightarrow{liq\ \ POCl3} K^+ + Cl^-$

The Cl^- ion produced in this reaction increases the concentration of Cl^- and it is not consumed by $POCl_3$

(iii) $FeCl_3 + OPCl_3 \rightarrow POCl_2^+ + CeCl_4^-$

(iv) $SbCl_6 + OPCl_3 \rightarrow POCl_2^+ + SbCl_6^-$

[CSIR Dec 2016]

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer B KCl

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (B).

FINAL: (B) KCl

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **B**

A Et_3N

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (B). See worked explanation.

C $FeCl_3$

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (B). See worked explanation.

D $SbCl_5$

Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (B). See worked explanation.

Q64 *Dec 2016*

64. The metal iodide with metallic lustre and high electrical conductivity is

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer C LaI_2

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (C).

FINAL: (C) LaI_2

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **C**

A **NaI**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

B **CdI_2**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

D **BiI_3**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

Q87 *JUNE 2019*

Choose the correct statement(s) among the following (I) LiF is more soluble than $LiClO_4$ in water. (II) The standard reduction potential [E^o] of Li is more negative than that of Na (III) The heat of hydration of $Li^+(g)$ is greater than that of $Na^+(g)$

(a) I and II

(b) I and III

(c) II and III

(d) III Only

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer C II and III

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- II and III are true; LiF is sparingly soluble (c).
- Therefore the answer is (C).

FINAL: (C) II and III

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **C**

A **I and II**
Why (C) is the key — II and III are true; LiF is sparingly soluble (c).

B **I and III**
Option (B) is ruled out by the same reasoning: II and III are true; LiF is sparingly soluble

D **III Only**
Option (D) is ruled out by the same reasoning: II and III are true; LiF is sparingly soluble

Q90 *DEC 2019*

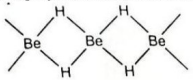
In fulvalene the junctural bond (C–C) is the donor pi-bond. Hence, its common hapticity will be two

90. Match the items in Column I with those of Column II

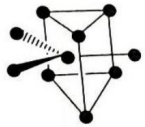
Column I (species)	Column I (structure/properties)
(a) NaH	**(i)** Polymeric chain
(b) BeH_2	**(ii)** Interstitial hydride
(c) $HfH_{2.10}$	**(iii)** Tricapped trigonal prismatic
(d) $[TcH_9]$	**(iv)** Saline hydride

The correct match is.
(1)a-iv, b-ii c-iii, d-i
(2)a-i, b-iv, c-ii, d-iii
(3)a-iv, b-i, c-ii, d-iii
(4)a-iv, b-i, c-iii, d-ii
Correct option is (c)

- Alkali metal hydrides are saline hydride.
- BeH_2 has polymeric structure with 3c-2e bonding.



- Bigger metal hydrides are usually interstitial hydrides as H^- can be trapped in their bigger voids.
- $[TcH_9]^{-2}$ is trigonal tricapped prismatic.



QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides

PYQ FREQUENCY
High · 8 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Correct Answer C HfH_2.10 (iii) Tricapped trigonal prismatic

CONCEPT

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

↓

LOGIC / WORKING

- Key principle: HX acid strength, EA anomaly of F, and interhalogen geometry. Correct answer is (C).

FINAL: (C) HfH_2.10 (iii) Tricapped trigonal prismatic

SHORTCUT / EXAM TRICK

HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

COMMON MISTAKE

Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).

EXAM TIP

ClF3: T-shaped (2 LP). IF5: square pyramidal (1 LP). IF7: pentagonal bipyramidal (0 LP). Pseudo-halides: CN-, SCN-, N3- (react like halides). Ionization energy difference: Ne-Na and Xe-Cs are largest.

MEMORY TRICK

HF stays as dimers/clusters in water (H-bonded) → weak acid. The stronger the H-bonding, the weaker the acid behaviour.

Why the Other Options Are Wrong

Correct answer: **C**

A **NaH (i) Polymeric chain**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

B **BeH_2 (ii) Interstitial hydride**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

D **[TcH_9] (iv) Saline hydride The**
Inconsistent with HX acid strength, EA anomaly of F, and interhalogen geometry; correct choice is (C). See worked explanation.

TOPIC REVISION

Halogens (Group 17)

9 PYQs · Last-minute revision

TOPIC SUMMARY

Group 17 (F–I): F has the highest electronegativity; HF is a weak acid (strong H-bonding, pKa~3.2). Acid strength in water: HI>HBr>HCl>>HF. Bond dissociation energy: Cl2>Br2>F2>I2. Electron affinity: Cl>F>Br>I (F anomalously low due to 2p electron repulsion).

IMPORTANT FORMULA SHEET

Acid strength: HI>HBr>HCl>>HF
EA: Cl>F>Br>I
ClF3: T-shaped (2 LP)
- IF7: pentagonal bipyramidal

FREQUENTLY ASKED CONCEPTS

HF weak acid (H-bonding)
EA anomaly of F
Interhalogen geometries (VSEPR)
- Pseudo-halides (CN-, N3-)

COMMON MISTAKES & QUICK NOTES

Watch out:
Thinking HF is the strongest hydrohalic acid (it is the weakest in water) OR that F has the highest EA (Cl does due to F2p repulsion).
Last-minute:
HF is WEAK acid despite most electronegative F. EA: Cl is highest, not F. Interhalogen XYn: n=1(linear), 3(T-shaped), 5(square pyramidal), 7(pentagonal bipyramidal).

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q21 Q25 Q29 Q48 Q61 Q63 Q64 Q87 Q90

Expect **2 question(s)** next session on **HX acid strength, EA anomaly of F, interhalogen geometry, pseudo-halides.**

TOPIC 8

Periodic Trends & General Properties

2 questions · Easy 2 | Medium 0 | Hard 0 · PYQ frequency: Rare

Q45 *JUNE 2014*

The correct order of decreasing electronegativity of the following atoms is,

(a) As>Al>Ca>S
(b) S>As>Al>Ca
(c) Al>Ca>S>As
(d) S>Ca>As>Al

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
IE1 trends and exceptions, EA anomaly of F, periodic anomalies

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
BOON anomalies: B and O Are Odd (lower IE than neighbours Be and N). Zn-Ga: Zn has extra stability from filled 3d10.

Correct Answer B S> As > Al> Ca

CONCEPT

IE1 increases L→R across period with key exceptions: B<Be (2p vs 2s stability) and O<N (half-filled 2p3 in N extra stable). EA: Cl>F>Br>I (F anomalous). Among Zn, Ga, Ge, As: Ga has lowest IE1 (loses lone 4p electron easily).

↓

LOGIC / WORKING

- Pauling values: S 2.58 > As 2.18 > Al 1.61 > Ca 1.00.
- Therefore the answer is (B).

FINAL: (B) S> As > Al> Ca

SHORTCUT / EXAM TRICK

IE1 dips at Group 13 (B<Be) and Group 16 (O<N). Biggest IE difference: Xe-Cs and Ne-Na pairs. Ga has lowest IE1 among Zn,Ga,Ge,As (Zn has filled 3d10 stability, As has half-filled 4p3).

COMMON MISTAKE

Forgetting O<N in IE1 (half-filled 2p3 in N extra stable). Thinking Zn has lowest IE1 among Zn-Ga-Ge-As (it is Ga).

EXAM TIP

Zn (3d10 4s2), Ga (4s2 4p1), Ge (4s2 4p2), As (4s2 4p3). IE1 order: As>Ge>Zn>Ga. The Ga 4p1 electron is easiest to remove. Biggest IE difference pairs are between noble gas and alkali metal.

MEMORY TRICK

BOON anomalies: B and O Are Odd (lower IE than neighbours Be and N). Zn-Ga: Zn has extra stability from filled 3d10.

Why the Other Options Are Wrong

Correct answer: **B**

A **As > Al> Ca >S**

Why (B) is the key — Pauling values: S 2.58 > As 2.18 > Al 1.61 > Ca 1.00.

C **Al> Ca >S>As**

Option (C) is ruled out by the same reasoning: Pauling values: S 2.58 > As 2.18 > Al 1.61 > Ca

D **S> Ca >As > Al Main Group Elements**

Option (D) is ruled out by the same reasoning: Pauling values: S 2.58 > As 2.18 > Al 1.61 > Ca

Q71 *JUNE 2015*

71. The first ionization energy is the lowest for
(a) Br
(b) Se
(c) P
(d) As
Correct option is (b)
Generally, ionisation energy increases on moving from left to right in a period in periodic table.
•Ionisation energy decreases as we move down in given group
• Ionisation energy will be more for full filled and half filled orbital.

QUESTION INSIGHTS

ESTIMATED TIME
1–1.5 min

DIFFICULTY
Easy

CONCEPT TESTED
IE1 trends and exceptions, EA anomaly of F, periodic anomalies

PYQ FREQUENCY
Rare · 2 papers

REVISION PRIORITY
★★★☆☆

EXPECTED LEVEL
Part B

MEMORY HOOK
BOON anomalies: B and O Are Odd (lower IE than neighbours Be and N). Zn-Ga: Zn has extra stability from filled 3d10.

Correct Answer B Se

CONCEPT

IE1 increases L→R across period with key exceptions: B<Be (2p vs 2s stability) and O<N (half-filled 2p3 in N extra stable). EA: Cl>F>Br>I (F anomalous). Among Zn, Ga, Ge, As: Ga has lowest IE1 (loses lone 4p electron easily).

↓

LOGIC / WORKING

- Key principle: IE1 exceptions (B<Be, O<N) and EA anomaly of F. Correct answer is (B).

FINAL: (B) Se

SHORTCUT / EXAM TRICK

IE1 dips at Group 13 (B<Be) and Group 16 (O<N). Biggest IE difference: Xe-Cs and Ne-Na pairs. Ga has lowest IE1 among Zn,Ga,Ge,As (Zn has filled 3d10 stability, As has half-filled 4p3).

COMMON MISTAKE

Forgetting O<N in IE1 (half-filled 2p3 in N extra stable). Thinking Zn has lowest IE1 among Zn-Ga-Ge-As (it is Ga).

EXAM TIP

Zn (3d10 4s2), Ga (4s2 4p1), Ge (4s2 4p2), As (4s2 4p3). IE1 order: As>Ge>Zn>Ga. The Ga 4p1 electron is easiest to remove. Biggest IE difference pairs are between noble gas and alkali metal.

MEMORY TRICK

BOON anomalies: B and O Are Odd (lower IE than neighbours Be and N). Zn-Ga: Zn has extra stability from filled 3d10.

Why the Other Options Are Wrong

Correct answer: **B**

A — **Br**
Inconsistent with IE1 exceptions (B<Be, O<N) and EA anomaly of F; correct choice is (B). See worked explanation.

C — **P**
Inconsistent with IE1 exceptions (B<Be, O<N) and EA anomaly of F; correct choice is (B). See worked explanation.

D — **As**
Inconsistent with IE1 exceptions (B<Be, O<N) and EA anomaly of F; correct choice is (B). See worked explanation.

TOPIC REVISION

Periodic Trends & General Properties

2 PYQs · Last-minute revision

TOPIC SUMMARY

IE1 increases L→R across period with key exceptions: B<Be (2p vs 2s stability) and O<N (half-filled 2p3 in N extra stable). EA: Cl>F>Br>I (F anomalous). Among Zn, Ga, Ge, As: Ga has lowest IE1 (loses lone 4p electron easily).

IMPORTANT FORMULA SHEET

IE1 exceptions: Be>B and N>O
EA: Cl>F>Br>I
IE1(Zn-As): As>Ge>Zn>Ga
- Diagonal: Li like Mg, Be like Al, B like Si

FREQUENTLY ASKED CONCEPTS

IE1 exceptions (B, O)
EA anomaly of F
IE1 among Zn-Ga-Ge-As
- Diagonal relationships

COMMON MISTAKES & QUICK NOTES

Watch out:
Forgetting O<N in IE1 (half-filled 2p3 in N extra stable). Thinking Zn has lowest IE1 among Zn-Ga-Ge-As (it is Ga).
Last-minute:
IE1 dips at Group 13 (B<Be) and Group 16 (O<N). Biggest IE difference: Xe-Cs and Ne-Na pairs. Ga has lowest IE1 among Zn,Ga,Ge,As (Zn has filled 3d10 stability, As has half-filled 4p3).

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q45 Q71

Expect **1 question(s)** next session on **IE1 trends and exceptions, EA anomaly of F, periodic anomalies.**

TOPIC 9

Main Group Chemistry – General

5 questions · Easy 0 | Medium 5 | Hard 0 · PYQ frequency: Moderate

Q4 *JUNE 2018*

5. Statement I is true and statement II is false.

4. Both the statements I and II are false.

Correct option is (b)

On descending the group, the stability of +3 oxidation state increases and that of +5 oxidation state decreases. Size usually increases on descending the group (P = 1.10 A^0 and As = 1.21 A^0). Thus, $AsCl_5$ is thermally less stable than PCl_5 and As is larger than P but less stability of $AsCl_5$, is not due to larger size of As, instead it is due inert pair effect.

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Acid anhydrides, isoelectronic species, catenation, diagonal relationships

PYQ FREQUENCY
Moderate · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Correct Answer A Option A (see PDF)

CONCEPT

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N_2O_3, B_2O_3, N_2O_5, SO_3, P_4O_{10}: exactly 5 are acid anhydrides (not CO, not NO).

↓

LOGIC / WORKING

- Key principle: acid anhydrides, diagonal relationships, and isoelectronic species. Correct answer is (A).

FINAL: (A) Option A (see PDF)

SHORTCUT / EXAM TRICK

CO and NO are NOT acid anhydrides. Isoelectronic: N_2=CO=NO+ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

COMMON MISTAKE

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

EXAM TIP

Acid anhydrides: $B_2O_3 \rightarrow H_3BO_3$, $N_2O_3 \rightarrow HNO_2$, $N_2O_5 \rightarrow HNO_3$, $SO_3 \rightarrow H_2SO_4$, $P_4O_{10} \rightarrow H_3PO_4$ (5 from the list). CO and NO stay as gases in water under normal conditions.

MEMORY TRICK

CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Why the Other Options Are Wrong

Correct answer: **A**

B **Option B (see PDF)**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

C **Option C (see PDF)**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

D **Option D (see PDF)**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

Q12 *DEC 2011*

The styx code of B_4H_{10} is:

(a) 4120
(b) 4220
(c) 4012
(d) 3203

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Acid anhydrides, isoelectronic species, catenation, diagonal relationships

PYQ FREQUENCY
Moderate · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Correct Answer C 4012

CONCEPT

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N_2O_3, B_2O_3, N_2O_5, SO_3, P_4O_{10}: exactly 5 are acid anhydrides (not CO, not NO).

↓

LOGIC / WORKING

- B_4H_{10} (arachno): 4 B–H–B bridges, 0 BBB bonds, 1 B–B bond, 2 extra BH_2 units — styx 4012.
- Therefore the answer is (C).

FINAL: (C) 4012

SHORTCUT / EXAM TRICK

CO and NO are NOT acid anhydrides. Isoelectronic: N2=CO=NO+ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

COMMON MISTAKE

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

EXAM TIP

Acid anhydrides: $B_2O_3 \rightarrow H_3BO_3$, $N_2O_3 \rightarrow HNO_2$, $N_2O_5 \rightarrow HNO_3$, $SO_3 \rightarrow H_2SO_4$, $P_4O_{10} \rightarrow H_3PO_4$ (5 from the list). CO and NO stay as gases in water under normal conditions.

MEMORY TRICK

CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Why the Other Options Are Wrong

Correct answer: **C**

A — **4120**

Why (C) is the key — B_4H_{10} (arachno): 4 B–H–B bridges, 0 BBB bonds, 1 B–B bond, 2 extra BH_2 units — styx 4012.

B — **4220**

Option (B) is ruled out by the same reasoning: B_4H_{10} (arachno): 4 B–H–B bridges, 0 BBB bonds, 1 B–B bond, 2 extra BH_2 units — styx

D — **3203**

Option (D) is ruled out by the same reasoning: B_4H_{10} (arachno): 4 B–H–B bridges, 0 BBB bonds, 1 B–B bond, 2 extra BH_2 units — styx

Q15 *JUNE 2012*

The strength of P π-d π bonding in E-O(E=Si, P, S and Cl) follows the order

(a) Si-O > P-O > S-O > Cl-O

(b) P-O>Si-O>S-O>Cl-O

(c) S-O > Cl-O > P-O > Si-O

(d) Cl-O>S-O>P-O>Si-O

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Acid anhydrides, isoelectronic species, catenation, diagonal relationships

PYQ FREQUENCY
Moderate · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Correct Answer D Cl-O>S-O>P-O>Si-O

CONCEPT

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N_2O_3, B_2O_3, N_2O_5, SO_3, P_4O_{10}: exactly 5 are acid anhydrides (not CO, not NO).

↓

LOGIC / WORKING

- pπ–dπ bonding to oxygen strengthens as the d orbitals contract and match oxygen 2p better: Cl–O > S–O > P–O > Si–O.
- Therefore the answer is (D).

FINAL: (D) Cl-O>S-O>P-O>Si-O

SHORTCUT / EXAM TRICK

CO and NO are NOT acid anhydrides. Isoelectronic: N_2=CO=NO+ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

COMMON MISTAKE

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

EXAM TIP

Acid anhydrides: $B_2O_3 \rightarrow H_3BO_3$, $N_2O_3 \rightarrow HNO_2$, $N_2O_5 \rightarrow HNO_3$, $SO_3 \rightarrow H_2SO_4$, $P_4O_{10} \rightarrow H_3PO_4$ (5 from the list). CO and NO stay as gases in water under normal conditions.

MEMORY TRICK

CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Why the Other Options Are Wrong

Correct answer: **D**

A **Si-O>P-O>S-O>Cl-O**

Why (D) is the key — pπ–dπ bonding to oxygen strengthens as the d orbitals contract and match oxygen 2p better: Cl–O > S–O > P–O > Si–O.

B **P-O>Si-O>S-O>Cl-O**

Option (B) is ruled out by the same reasoning: pπ–dπ bonding to oxygen strengthens as the d orbitals contract and match oxygen 2p better: Cl–O > S–O > P–O >

C **S-O>Cl-O>P-O>Si-O**

Option (C) is ruled out by the same reasoning: pπ–dπ bonding to oxygen strengthens as the d orbitals contract and match oxygen 2p better: Cl–O > S–O > P–O >

Q44 *DEC 2013*

44.Chromite ore on fusion with sodium carbonate gives
(a) Na_2CrO_4 and Fe_2O_3
(b) $Na_2Cr_2O_7$ and Fe_2O_3
(c) $Cr_2(CO_3)_3$ and $Fe(OH)_3$
(d) Na_2CrO_4 and $Fe_2(CO_3)_3$
Correct answer is (a)
Chromium is extracted from chromite ore:
(I) $4FeCr_2O_4, +8Na_2CO_3 +7O_2 \rightarrow 8Na_2CrO_4 +2Fe_2O_2 +8CO_2$
(II) $2Na_2CrO_4+H_2SO_4 \rightarrow Na_2SO_4 + Na_2Cr_2O_7 + H_2O$
(III) $Na_2C_2O_7+2C \rightarrow Cr_2O_7 +Na_2CO_3 +CO$
(IV) $Cr_2O_3 +2A1 \rightarrow Al_2O_3 + 2Cr$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Acid anhydrides, isoelectronic species, catenation, diagonal relationships

PYQ FREQUENCY
Moderate · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Correct Answer A Na2CrO4 and Fe2O3

CONCEPT

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N2O3, B2O3, N2O5, SO3, P4O10: exactly 5 are acid anhydrides (not CO, not NO).

↓

LOGIC / WORKING

- Key principle: acid anhydrides, diagonal relationships, and isoelectronic species. Correct answer is (A).

FINAL: (A) Na2CrO4 and Fe2O3

SHORTCUT / EXAM TRICK

CO and NO are NOT acid anhydrides. Isoelectronic: N2=CO=NO+ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

COMMON MISTAKE

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

EXAM TIP

Acid anhydrides: B2O3→H3BO3, N2O3→HNO2, N2O5→HNO3, SO3→H2SO4, P4O10→H3PO4 (5 from the list). CO and NO stay as gases in water under normal conditions.

MEMORY TRICK

CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Why the Other Options Are Wrong

Correct answer: **A**

B **Na2Cr2O7 and Fe2O3**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

C **Cr2(CO3)3 and Fe(OH)3**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

D **Na2CrO4 and Fe2(CO3)3**
Inconsistent with acid anhydrides, diagonal relationships, and isoelectronic species; correct choice is (A). See worked explanation.

Q46 *JUNE 2014*

The correct order of the size of S, S^{2-}, S^{2+} and S^{4+} species is,

(a) $S > S^{2+} > S^{4+} > S^{2-}$

(b) $S^{2+} > S^{4+} > S^{2-} > S$

(c) $S^{2-} > S > S^{2+} > S^{4+}$

(d) $S^{4+} > S^{2-} > S > S^{2+}$

QUESTION INSIGHTS

ESTIMATED TIME
2–3 min

DIFFICULTY
Medium

CONCEPT TESTED
Acid anhydrides, isoelectronic species, catenation, diagonal relationships

PYQ FREQUENCY
Moderate · 5 papers

REVISION PRIORITY
★★★★☆

EXPECTED LEVEL
Part B / Part C

MEMORY HOOK
CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Correct Answer C S2-> S > S2+ > S4+

CONCEPT

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N_2O_3, B_2O_3, N_2O_5, SO_3, P_4O_{10}: exactly 5 are acid anhydrides (not CO, not NO).

↓

LOGIC / WORKING

- Anions are larger and cations smaller than the atom, shrinking with charge: $S^{2-} > S > S^{2+} > S^{4+}$.
- Therefore the answer is (C).

FINAL: (C) S2-> S > S2+ > S4+

SHORTCUT / EXAM TRICK

CO and NO are NOT acid anhydrides. Isoelectronic: N2=CO=NO+ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

COMMON MISTAKE

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

EXAM TIP

Acid anhydrides: $B_2O_3 \rightarrow H_3BO_3$, $N_2O_3 \rightarrow HNO_2$, $N_2O_5 \rightarrow HNO_3$, $SO_3 \rightarrow H_2SO_4$, $P_4O_{10} \rightarrow H_3PO_4$ (5 from the list). CO and NO stay as gases in water under normal conditions.

MEMORY TRICK

CO and NO stay as CO and NO in water – they are NOT anhydrides. The 5 real anhydrides all form common named acids.

Why the Other Options Are Wrong

Correct answer: **C**

A

S > S2+> S4+ > S2-

Why (C) is the key — Anions are larger and cations smaller than the atom, shrinking with charge: $S^{2-} > S > S^{2+} > S^{4+}$.

B

S2+ >S4+ > S2- > S

Option (B) is ruled out by the same reasoning: Anions are larger and cations smaller than the atom, shrinking with charge: $S^{2-} > S > S^{2+} >$

D

S4+ > S2- > S > S2+

Option (D) is ruled out by the same reasoning: Anions are larger and cations smaller than the atom, shrinking with charge: $S^{2-} > S > S^{2+} >$

TOPIC REVISION

Main Group Chemistry – General

5 PYQs · Last-minute revision

TOPIC SUMMARY

Cross-cutting main-group concepts: diagonal relationships (Li-Mg, Be-Al, B-Si), isoelectronic species, catenation (C>>S>P>Si), acid anhydrides. Among CO, NO, N_2O_3, B_2O_3, N_2O_5, SO_3, P_4O_{10}: exactly 5 are acid anhydrides (not CO, not NO).

IMPORTANT FORMULA SHEET

$B_2O_3 + 3H_2O \rightarrow 2H_3BO_3$

$N_2O_5 + H_2O \rightarrow 2HNO_3$

$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

- $SO_3 + H_2O \rightarrow H_2SO_4$

FREQUENTLY ASKED CONCEPTS

Acid anhydrides (5 of 7)

Isoelectronic species

Catenation trend C>>S>P>Si

- Diagonal relationships

COMMON MISTAKES & QUICK NOTES

Watch out:

Counting CO or NO as acid anhydrides – they do not react with water to give stable oxoacids under normal conditions.

Last-minute:

CO and NO are NOT acid anhydrides. Isoelectronic: $N_2 = CO = NO^+$ (10 electrons each). Catenation: C>>S>P>Si. Diagonal: Li like Mg, Be like Al, B like Si.

MOST-REPEATED PYQs & EXPECTED IN EXAM

PYQs in this topic: Q4 Q12 Q15 Q44 Q46

Expect **1 question(s)** next session on **Acid anhydrides, isoelectronic species, catenation, diagonal relationships.**

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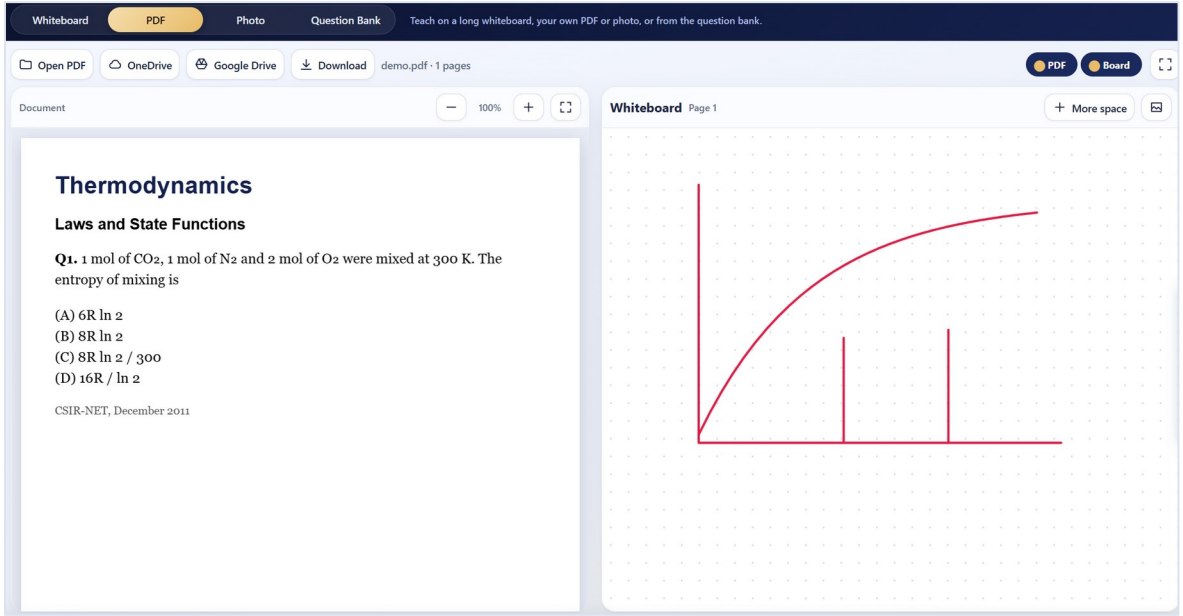
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