WEIRD CHEMIST

P-Block Elements — Solutions

Oxyacids

DPP – 04

Topic: Oxyacids | **Questions:** 23 Questions | **Exam:** JEE / NEET

▶ TYPE 1 : Oxyacids of Boron

Key Concepts — Oxyacids of Boron

- **Orthoboric acid** $B(OH)_3$ (or H_3BO_3): B is sp^2, trigonal planar; Lewis acid (not Brønsted acid)
- **Metaboric acid** HBO_2: cyclic trimer $(HBO_2)_3$; B is sp^2; obtained by heating orthoboric acid at $\sim$160°C
- Orthoboric acid acts as a Lewis acid by **accepting** OH^- from water: $B(OH)_3 + H_2O \xrightarrow{B(OH)_4^-} + H^+$
- It does **not** donate a proton directly (not a Brønsted acid)

Q1. Structures of metaboric acid and orthoboric acid respectively are:

Explanation

The question asks for **metaboric first**, then **orthoboric**.

Metaboric acid (HBO_2): The B atom has one OH group and one double bond to O. Simplified structural formula: HO–B=O.

Orthoboric acid ($B(OH)_3$): The B atom has three OH groups. Structural formula: HO–B with two more OH groups = HO–$B(OH)_2$.

Option (1): Shows HO–$B(OH)_2$ first, then HO–B=O $\Rightarrow$ orthoboric first, metaboric second. **Wrong order**.
Option (2): Shows HO–B=O first, then HO–$B(OH)_2$ $\Rightarrow$ metaboric first, orthoboric second. **Correct order**.

Approach

Simple memory trick: Meta = "less water" (one OH), Ortho = "full" (three OH). HO–B=O is lean/meta; HO–$B(OH)_2$ is full/ortho. Question says "metaboric and orthoboric respectively" $\Rightarrow$ lean comes first.

Answer

(2) Metaboric: HO–B=O; Orthoboric: HO–$B(OH)_2$

Q2. Orthoboric acid —

Explanation

Orthoboric acid ($B(OH)_3$) is a **Lewis acid**, not a Brønsted acid. It does **not** donate a proton from its O–H bonds directly.

The B atom in $B(OH)_3$ is electron-deficient (sp^2, only 6 electrons). It accepts the lone pair of OH^- from a water molecule:

$$B(OH)_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$$

B's empty p orbital accepts $OH^- \Rightarrow$ B becomes sp^3, completing its coordination sphere $\Rightarrow$ $[B(OH)_4]^-$ formed and H^+ is released into solution.

Approach

B has an empty orbital = "open hand." Water has OH^- to give. B grabs the OH^- (Lewis acid) $\Rightarrow$ H^+ is left behind $\Rightarrow$ solution becomes acidic. Not donation, **acceptance**.

Answer

(4) Accepts OH^- to form $[B(OH)_4]^-$.

Q3. Boric acid is an acid because its molecule [NEET-II 2016]

Explanation

This is the same Lewis acid mechanism as Q2 but phrased as "why is it an acid?"

$B(OH)_3$ accepts OH^- from H_2O, releasing H^+:

$$B(OH)_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$$

Acidity $\Rightarrow$ H^+ ions in solution. This H^+ comes from **water**, not from boric acid itself. The driving force is B's electron deficiency (accepting OH^-).

Options (2), (3), (4) all suggest proton donation from boric acid itself — this is incorrect; boric acid does not donate protons.

Approach

The trick: boric acid is NOT acidic the way HCl is acidic (proton donation). It is acidic because it takes OH^- away from water, indirectly releasing H^+ into solution.

Answer

(1) Accepts OH^- from water releasing proton.

▶ TYPE 2 : Oxyacids of Phosphorus

Key Concepts — Oxyacids of Phosphorus

- **Basicity rule**: count P–OH groups only (P–H bonds do NOT ionize)
- H_3PO_4 (3 OH) = tribasic; H_3PO_3 (2 OH) = dibasic; H_3PO_2 (1 OH) = **monobasic**
- **P oxidation state**: use formula $n(\text{H}) + x \cdot n(\text{P}) + (-2) \cdot n(\text{O}) = 0$
- H_3PO_2: $x = +1$; H_3PO_3: $x = +3$; H_3PO_4: $x = +5$
- **Reducing power**: due to P–H bonds (not P–OH bonds) $\Rightarrow$ H_3PO_2 (2 P–H) is strongest reducer
- Pyrophosphoric acid $H_4P_2O_7$: obtained by heating **orthophosphoric** acid (H_3PO_4), **not** H_3PO_3
- All P oxyacids: tetrahedral P; at least one P=O and one P–OH
- $(HPO_3)_3$ cyclic trimer: 3 P atoms, each with 1 P=O $\Rightarrow$ 3 P=O bonds total

Q4. Pick out the incorrect statement:

Explanation

- **(1)** $P_4O_6 + {}_6H_2O \longrightarrow {}_4H_3PO_3$. **Correct**.
- **(2)** $P_4O_{10} + {}_6H_2O \longrightarrow {}_4H_3PO_4$. **Correct**.
- **(3)** "Pyrophosphoric acid by heating orthophosphorus acid." **Incorrect**.
  Heating orthophosphorus acid (H_3PO_3) gives **pyrophosphorous** acid ($H_4P_2O_5$), NOT pyrophosphoric acid.
  Pyrophosphoric acid ($H_4P_2O_7$) is obtained by heating **orthophosphoric** acid (H_3PO_4).
- **(4)** Dehydrating H_3PO_4 at 316°C gives metaphosphoric acid (HPO_3). **Correct**.

Approach

Memory shortcut: "Pyro-**phosphoric**" comes from ortho-**phosphoric**. "Pyro-**phosphorous**" comes from ortho-**phosphorous**. Mixing up the two names is the classic trap.

Answer

(3) Pyrophosphoric acid is obtained by heating orthophosphoric acid (H_3PO_4), not orthophosphorus acid (H_3PO_3).

Q5. Hypophosphorus acid H_3PO_2 is —

Explanation

From the structural diagram: H_3PO_2 has

- **1** P–OH group (the top OH in the structure)
- **2** direct P–H bonds (the two H on the sides)
- **1** P=O bond (the bottom O)

Basicity = number of **ionizable** (P–OH) H atoms = **1**.

P–H bonds do NOT ionize in solution. Therefore H_3PO_2 is **monobasic** (monoprotic).

It has 3 H atoms in its formula but only 1 can donate as H^+ — this is a very common trap in

exams.

Approach

Quick rule for all P oxyacids:
Basicity = number of OH groups only.
H_3PO_4: 3 OH $\rightarrow$ tribasic. H_3PO_3: 2 OH $\rightarrow$ dibasic. H_3PO_2: 1 OH $\rightarrow$ **monobasic**. Always count OH, never count P–H.

Answer

(3) Monobasic.

Q6. Correct order of decreasing acid strength of oxyacids of Group-15 elements:

Explanation

For oxyacids with the same number of O atoms (e.g. all having the form H_3XO_4), acid strength depends on the electronegativity of the central atom X. Higher electronegativity of X $\Rightarrow$ more electron withdrawal from O–H $\Rightarrow$ weaker O–H bond $\Rightarrow$ easier proton release $\Rightarrow$ **stronger acid**.

Group 15 electronegativity: N > P > As > Sb (decreases down group)

Therefore acid strength: $HNO_3 > H_3PO_4 > H_3AsO_4 > H_3SbO_4$

Approach

Going down Group 15, the central atom gets bigger and less electronegative $\Rightarrow$ it pulls the O–H electrons less $\Rightarrow$ harder to release H^+ $\Rightarrow$ weaker acid. Think: N (top, most EN) = strongest acid; Sb (bottom) = weakest.

Answer

(3) $HNO_3 > H_3PO_4 > H_3AsO_4 > H_3SbO_4$

Q7. $2P \xrightarrow{-H_2O} Q \xrightarrow{-[O]} R$ **If P is the parent phosphoric acid, the incorrect statement is:**

Explanation

Identifying P, Q, R:
- $P = H_3PO_4$ (orthophosphoric acid; P oxidation state $= +5$)
- $Q = 2H_3PO_4 - H_2O = H_4P_2O_7$ (pyrophosphoric; P $= +5$)
- $R = H_4P_2O_7 - [O] = H_4P_2O_6$ (P oxidation state $= +4$)

Checking statement (3): "oxidation state remains the same in P, Q, R."

P: $4+2x-14=0 \Rightarrow x=+5$; Q: $4+2x-14=0 \Rightarrow x=+5$; R: $4+2x-12=0 \Rightarrow x=+4$

The oxidation state **changes** from $+5$ (in Q) to $+4$ (in R) when [O] is removed. So statement (3) is **incorrect**.

Statements (1), (2), (4) are all valid for these acids.

Approach

The -[O] step removes an oxygen from the molecule. Fewer O atoms but same H atoms means P must reduce its oxidation state (it contributed those O atoms). So P's oxidation state can't stay constant across all three.

Answer

(3) Oxidation state of P is $+5$ in P and Q, but drops to $+4$ in R. It does **not** remain the same.

Q8. Oxidation states of P in $H_4P_2O_5$, $H_4P_2O_6$, $H_4P_2O_7$ are respectively:

Explanation

Using the formula: $n(\text{H}) \cdot (+1) + n(\text{P}) \cdot x + n(\text{O}) \cdot (-2) = 0$

Acid	Calculation	x per P	Oxidation state
$H_4P_2O_5$	$4 + 2x - 10 = 0$	$x = +3$	**+3**
$H_4P_2O_6$	$4 + 2x - 12 = 0$	$x = +4$	**+4**
$H_4P_2O_7$	$4 + 2x - 14 = 0$	$x = +5$	**+5**

Approach

Each time one O is added ($O_5 \to O_6 \to O_7$) while H stays fixed at 4, the oxidation state of P rises by 1 step ($+3 \to +4 \to +5$). Pattern: more O = higher oxidation state of central atom.

Answer

(1) $+3,\ +4,\ +5$

Q9. Which statement is not valid for oxyacids of phosphorus? [AIPMT Pre. 2012]

Explanation

- **(1)** All P oxyacids have 4-coordinated tetrahedral P. **Valid**.
- **(2)** All contain at least one P=O and one P–OH. **Valid**. (even H_3PO_2 has 1 P=O and 1 P–OH)
- **(3)** H_3PO_4 used to make triple superphosphate. **Valid**.
- **(4)** Hypophosphorous acid (H_3PO_2) is a diprotic acid. **Not valid**. H_3PO_2 has only **one** P–OH group $\Rightarrow$ it is **monoprotic**, not diprotic.

Approach

The formula H_3PO_2 has 3 H atoms, so students assume it is triprotic. But 2 of those H atoms are direct P–H bonds (non-ionizable). Only 1 H is in a P–OH bond $\Rightarrow$ monoprotic.

Answer

(4) Hypophosphorous acid is **monoprotic** (monobasic), not diprotic.

Q10. How many P=O bonds are present in $(HPO_3)_3$? [AIIMS 2012]

Explanation

$(HPO_3)_3$ is **trimetaphosphoric acid** (cyclic trimer of HPO_3).

Molecular formula: $H_3P_3O_9$. Structure: a 6-membered ring (P–O–P–O–P–O) with each P also having:

- 1 terminal P=O bond (pointing outward)
- 1 terminal P–OH bond
- 2 P–O–P ring bonds

Each of the **3 P atoms** contributes **1 P=O bond**.

Total P=O bonds $= 3 \times 1 =$ **3**.

Approach

In cyclic metaphosphate structures, every P has exactly one P=O. Number of P atoms in the formula = subscript in $(HPO_3)_n$. For the trimer ($n = 3$): 3 P atoms $\times$ 1 P=O each = 3 bonds.

Answer

(2) 3 P=O bonds.

Q11. Strong reducing behaviour of H_3PO_2 is due to:

Explanation

H_3PO_2 (hypophosphorous acid) is one of the strongest reducing agents among P oxyacids. Its structure has:

- **2 direct P–H bonds**
- 1 P–OH group
- 1 P=O bond

The **P–H bonds** are the source of reducing power. P (oxidation state $+1$) can be oxidised to higher states ($+3$, $+5$) by donating the H atoms from P–H bonds.

H_3PO_3 has 1 P–H bond $\Rightarrow$ moderate reducer.
H_3PO_2 has 2 P–H bonds $\Rightarrow$ **stronger** reducer.
H_3PO_4 has 0 P–H bonds $\Rightarrow$ no reducing power.

Approach

P–H bonds = "fuel for reduction." More P–H bonds = more reducing power. P–OH bonds are spectators in redox reactions.

Answer

(3) Presence of one –OH group and two P–H bonds.

Q12. Lowest oxidation state of phosphorus is in

Explanation

Calculating oxidation state of P in each compound:

Compound	Equation	Oxidation state
H_3PO_2	$3 + x - 4 = 0$	$x = +\mathbf{1}$ ← lowest
H_3PO_4	$3 + x - 8 = 0$	$x = +5$
$H_4P_2O_7$	$4 + 2x - 14 = 0$	$x = +5$
H_3PO_3	$3 + x - 6 = 0$	$x = +3$

Lowest oxidation state = $+1$, which occurs in H_3PO_2.

Approach

Quick oxidation state formula for P oxyacids: $x = 2n(\text{O}) - n(\text{H})$. H_3PO_2: $x = 2(2) - 3 = +1$.
Minimum oxygen count = lowest oxidation state.

Answer

(1) H_3PO_2 (oxidation state of P $= +1$).

Q13. Which is the correct statement for the given acids?

Explanation

Phosphinic acid = hypophosphorous acid = H_3PO_2:
Structure: 1 P–OH, 2 P–H, 1 P=O ⇒ basicity = **1** ⇒ **monoprotic**

Phosphonic acid = phosphorous acid = H_3PO_3:
Structure: 2 P–OH, 1 P–H, 1 P=O ⇒ basicity = **2** ⇒ **diprotic**

Only option (2) correctly states: phosphinic is monoprotic AND phosphonic is diprotic.

Approach

Phosphinic ↔ H_3PO_2: one "i" in name → one ionizable H.
Phosphonic ↔ H_3PO_3: more complex → two ionizable H.
Or just count OH groups in the structure.

Answer

(2) Phosphinic acid is monoprotic; phosphonic acid is diprotic.

▶ TYPE 3 : Oxyacids of Nitrogen & Sulphur

Key Concepts — S Oxyacids & S–S Bonds

- S–S bond present in: $H_2S_2O_3$ (thiosulphuric), $H_2S_2O_6$ (dithionic), H_2SnO_6 polythionic acids
- S–S bond **absent** in: $H_2S_2O_7$ (pyrosulphuric, connected via S–O–S bridge), H_2SO_4, $H_2S_2O_8$
- $H_2S_2O_8$ (peroxodisulphuric): has O–O peroxide bridge; formula HO–S(=O)$_2$–O–O–S(=O)$_2$–OH
- $S_2O_8^{2-}$: peroxodisulphate; contains O–O bridge, not S–S
- Polythionic acids H_2SnO_6: number of S–S bonds $= (n-1)$

Q14. Which oxyacid of sulphur contains a sulphur–sulphur single bond?

Explanation

- **$H_2S_2O_6$** (dithionic acid): structure is HO–S(=O)$_2$–S(=O)$_2$–OH. The two –SO_3H units are directly connected by an **S–S single bond**.
- **$H_2S_2O_7$** (pyrosulphuric / oleum): structure is HO–SO_2–O–SO_2–OH. Connected via **S–O–S bridge**, no S–S bond.
- **$H_2S_2O_8$** (peroxodisulphuric): has **O–O peroxide bridge**, no S–S bond.
- **$H_2S_2O_3$** (thiosulphuric acid): debated; the "extra" S is terminal, not a bridge between two different sulphur environments in a way that constitutes a classical S–S single bond. The question specifically tests $H_2S_2O_6$.

Approach

Key word: "di-thio-nic" = two S atoms joined directly (S–S bond). Any sulphur acid where you see "dithion-" in the name = S–S bond.

Answer

(1) $H_2S_2O_6$ (dithionic acid).

Q15. The structure of peroxodisulphuric acid is:

Explanation

Peroxodisulphuric acid ($H_2S_2O_8$) contains a **peroxide (O–O) bridge** between two sulphate units:

HO–S(=O)$_2$–O–O–S(=O)$_2$–OH

Key features:

- Each S: tetrahedral, sp^3, oxidation state $= +6$
- The central O–O bond = peroxide linkage (bond length $\sim$149 pm)
- 4 terminal S=O bonds (2 on each S)
- 2 S–OH bonds (one on each S)

Option (4) in the PDF shows HO–S(=O)$_2$–O–O–S(=O)$_2$–OH with the O–O bridge $\Rightarrow$ **correct structure**. Options (1)–(3) show S–S or S–S–S chains which are wrong for this compound.

Approach

"Peroxo" = peroxide = O–O bond. Whenever you see "peroxo" in a compound name, draw an O–O bridge and connect the rest of the formula on both sides. Same logic as H_2O_2 but here it's built into a larger sulphate framework.

Answer

(4) Structure with O–O peroxide bridge: HO–S(=O)$_2$–O–O–S(=O)$_2$–OH.

Q16. Number of S–S bonds in $H_2S_nO_6$ is

Explanation

H_2SnO_6 represents the **polythionic acids**: $H_2S_2O_6$ ($n = 2$), $H_2S_3O_6$ ($n = 3$), $H_2S_4O_6$ ($n = 4$), etc.

Structure: each polythionic acid has two terminal –SO_3H units (like dithionic acid) with a chain of $(n - 2)$ "extra" S atoms in between. The S atoms form a linear chain: **–S–S–S–** etc.

Counting S–S bonds in a chain of n S atoms:
$n = 2$: S–S (1 bond) $= n - 1 = 1$
$n = 3$: S–S–S (2 bonds) $= n - 1 = 2$
$n = 4$: S–S–S–S (3 bonds) $= n - 1 = 3$

General formula: number of S–S bonds $= n - 1$.

Approach

Same logic as counting bonds in a carbon chain: n atoms in a chain have $n - 1$ bonds between them. The S chain in polythionic acids follows the same pattern.

Answer

(2) $(n - 1)$

Q17. $S_2O_8^{2-}$ has:

Explanation

$S_2O_8^{2-}$ is the **peroxodisulphate** ion, derived from peroxodisulphuric acid ($H_2S_2O_8$).

Structure: $[O_3S–O–O–SO_3]^{2-}$

- **S–S bond?** No. The two S atoms are **not** directly bonded to each other.
- **S–O bridge?** No. The bridge between the two S atoms is O–O, not S–O–S.
- **O–O bridge? Yes!** The peroxide O–O linkage connects the two sulphate groups.

- **All S–O bond lengths same?** No. The S–O bonds to the peroxide O (longer, weaker) are different from the terminal S=O bonds (shorter, stronger).

Approach

"Peroxo" always means O–O bridge. In $S_2O_8^{2-}$, the two extra O atoms (compared to $SO_4^{2-} \times 2$ = 8 O total) form the peroxide bridge. That's the O–O in the middle.

Answer

(3) O–O bridge (peroxide linkage).

Q18. S–S linkage is absent in

Explanation

- **$H_2S_2O_7$** (pyrosulphuric acid / oleum): Structure = HO–SO_2–**O**–SO_2–OH. Two SO_3H units connected via a **S–O–S oxygen bridge**, no direct S–S bond. **S–S absent**.
- **$H_2S_2O_3$** (thiosulphuric): has S–S bond (one S is like a "thio" replacement of an O in sulphate). **S–S present**.
- **$H_2S_2O_5$** (pyrosulphurous acid): has a direct S–S bond in some representations. **S–S present**.
- **$H_2S_2O_6$** (dithionic): direct S–S bond. **S–S present**.

Approach

$H_2S_2O_7$: "pyro-sulphuric" is just two sulphate units sharing one oxygen (dehydration product of H_2SO_4): $H_2SO_4 + SO_3 \longrightarrow H_2S_2O_7$. This creates S–O–S bridge, not S–S.

Answer

(1) $H_2S_2O_7$ (pyrosulphuric acid).

▶ TYPE 4 : Oxyacids of Halogens

Key Concepts — Oxyacids of Halogens

- **F**: forms **only HOF** (hypofluorous acid). Cannot form higher oxyacids since F is most electronegative (cannot have positive oxidation state)
- **Cl**: HClO, $HClO_2$, $HClO_3$, $HClO_4$ (all four series)
- **Br**: HBrO, $HBrO_3$, $HBrO_4$ (three); **I**: HIO_3, HIO_4 etc.
- **Acidity order** in $HClO_n$ series ($n = 1 \to 4$): $HClO < HClO_2 < HClO_3 < HClO_4$ (more O = more electronegative environment = weaker O–H bond = stronger acid)
- **Oxidising power**: decreases as n increases (HClO is strongest oxidiser, $HClO_4$ is weakest)
- **Thermal stability**: **increases** with n ($HClO_4$ is most stable; HClO decomposes readily)

- **Cl–O bond order**: increases with n (more resonance structures with more O atoms)

Q19. Which oxy acid of fluorine exists?

Explanation

Fluorine is the **most electronegative** element; it cannot hold a positive oxidation state. In all higher oxyacids (HXO_2, HXO_3, HXO_4), the central halogen has a positive oxidation state (e.g. in $HClO_4$, Cl is $+7$).

F cannot achieve these positive states $\Rightarrow$ HFO_2, HFO_3, HFO_4 do not exist.

HOF (hypofluorous acid): Here the bonding is H–O–F. Oxygen (not F) is the central-like atom with negative oxidation state. F is in -1 state and O is -2? Actually in HOF: O is -1, F is -1, H is $+1$. This is the only oxy acid F can form, and it does exist (though unstable).

Approach

Simple rule: F is most electronegative element in the periodic table. It can **never** be positive. Only **HOF** has F in -1 state (acceptable). Any HFO_n with $n \geq 2$ would need F to be positive $\Rightarrow$ impossible.

Answer

(1) HOF (hypofluorous acid).

Q20. Which of the following statements is correct?

Explanation

- **(1)** All form $HOXO_3$ type (perhalate): F cannot form HOF_3. **Incorrect**.
- **(2)** Only Cl and Br form oxyacids: F (HOF) and I (HIO_3, HIO_4) also form oxyacids. **Incorrect**.
- **(3)** All halogens form oxyacids: F (HOF), Cl (HClO to $HClO_4$), Br (HBrO to $HBrO_4$), I (HIO_3, HIO_4). All four form at least one oxyacid. **Correct**.
- **(4)** Only iodine forms oxyacids: clearly wrong.

Approach

Even though F forms only one (HOF), that counts. All $\neq$ all form the same number. All $=$ each of F, Cl, Br, I forms at least one oxyacid.

Answer

(3) All halogens form oxyacids.

Q21. $HClO_n$ series ($n = 1$ to 4). The incorrect statement is:

Explanation

Checking each statement:

- **(1)** Acidic character increases with n: $HClO < HClO_2 < HClO_3 < HClO_4$. **Correct**.
- **(2)** Oxidising power increases with decreasing n: HClO (strongest oxidiser) $> HClO_2 > HClO_3 > HClO_4$. **Correct**.
- **(3)** Thermal stability **decreases** with increasing n: **Incorrect**.
  Thermal stability actually **increases** with n. $HClO_4$ is the most thermally stable; HClO decomposes easily even at room temperature.
- **(4)** Cl–O bond order decreases with decreasing n: Fewer O atoms $\Rightarrow$ fewer resonance structures $\Rightarrow$ lower average bond order per Cl–O. **Correct**.

Approach

Remember for the $HClO_n$ series: as n increases, **acidity** $\uparrow$, **stability** $\uparrow$, **Cl–O bond order** $\uparrow$, but **oxidising power** $\downarrow$. The "decreasing stability" option is always the trap.

Answer

(3) Thermal stability **increases** (not decreases) with increasing n. $HClO_4$ is most stable; HClO is least stable.

Q22. Which halogen forms only one oxyacid (HOX)?

Explanation

- **F**: forms **only HOF**. Cannot form higher oxyacids (needs positive oxidation state which F cannot have).
- **Cl**: HClO, $HClO_2$, $HClO_3$, $HClO_4$ — **four** oxyacids.
- **Br**: HBrO, $HBrO_3$, $HBrO_4$ — multiple oxyacids.
- **I**: HIO_3, HIO_4, H_5IO_6 — multiple.

Approach

F is the outlier. Its extreme electronegativity limits it to one and only one oxyacid (HOF) where F stays in -1 state. All other halogens can achieve positive oxidation states in multiple oxyacids.

Answer

(1) F (fluorine). Only HOF exists.

Q23. Correct order of acidity: [NEET-I 2016]

Explanation

Acidity of oxyacids of the same halogen increases with the number of oxygen atoms (n). Each additional O atom:

- withdraws more electron density from the Cl–O–H bond
- weakens the O–H bond
- makes proton release easier $\Rightarrow$ stronger acid

Therefore: $HClO < HClO_2 < HClO_3 < HClO_4$

$HClO_4$ (perchloric acid) is one of the strongest known acids.
HClO (hypochlorous acid) is a weak acid.

Approach

Easy pattern: more O atoms on the same central atom = stronger acid. Just count the O atoms in the formula: $1 < 2 < 3 < 4$. The acid with more O is always stronger. This applies across all oxyacid series (not just halogens).

Answer

(2) $HClO < HClO_2 < HClO_3 < HClO_4$

Quick Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	(2)	5	(3)	9	(4)	13	(2)	17	(3)	21	(3)
2	(4)	6	(3)	10	(2)	14	(1)	18	(1)	22	(1)
3	(1)	7	(3)	11	(3)	15	(4)	19	(1)	23	(2)
4	(3)	8	(1)	12	(1)	16	(2)	20	(3)		