

B.Sc. Part-I (Hons.), Paper-IB (Inorganic Chemistry)

Group-C, Unit-1 Nomenclature of Inorganic compounds

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A systematic nomenclature of inorganic compounds was proposed by International Union of pure & Applied Chemistry (IUPAC). Nomenclature is an important/essential part of study of inorganic compounds.

⇒ IUPAC nomenclature of simple inorganic compounds/salts:

A simple inorganic compound/salt has one cation and one anion, e.g. CuSO_4 .

* Steps of IUPAC nomenclature: 1. Cation (i.e., metal ion) named first in usual way.
2. Oxidation state of ^{the} metal ^{is} written just after name of the metal in Roman numerals (I, II, III, ...)

within a small bracket, ().

3. Anion named with ending (suffix) ide/ate/ite at last.

For example, (i) CuCl_2 : Copper(II) chloride (ii) $\text{Fe}_2(\text{SO}_4)_3$: Iron(III) sulphate

(iii) Hg_2I_2 : Mercury(I) iodide (iv) $\text{Co}(\text{NO}_2)_2$: Cobalt(II) nitrite

(v) Cr_2O_3 : Chromium(III) oxide (vi) $\text{Mn}(\text{OH})_2$: Manganese(II) hydroxide.

⇒ IUPAC nomenclature of isopolyanions/salts/acids:

Isopoly acids/anions/salts, where the anions which condense together are all of the same type. Isopoly acids/anions contain only one metal (Group-5 or 6) along with hydrogen and oxygen/oxygen only. Amphoteric metals of Group-5 (V, Nb & Ta) and Group-6 (Cr, Mo & W) in the oxidation states +5 & +6 form weak acids, which readily condense or polymerize to form anions containing several molecules of the acid anhydrides called isopolyanions. General isopolyanions have composition $[\text{M}_n\text{O}_{19}]^{n-}$, where $M = \text{Nb, Ta, Mo \& W}$; $n =$ valency or oxidation state of the metal. Cr forms polyanion of formula $\text{Cr}_2\text{O}_7^{2-}$.

* Steps of IUPAC nomenclature:

1. First prefix di, tri, tetra- for 2, 3, 4... respectively corresponding to number of ^{the} central metal is written.

2. Simple anion of the central metal, which condense/polymerize to give polyanion, is ^{then} written with ending (suffix) 'ate'.

For example, (i) $\text{Cr}_2\text{O}_7^{2-}$: Dichromate (ii) $\text{Mo}_7\text{O}_{24}^{6-}$: Heptamolybdate

(iii) $\text{Ta}_6\text{O}_{18}^{6-}$: Hexatantalate (iv) $\text{W}_{12}\text{O}_{41}^{8-}$: Dodecatungstate

(v) $(\text{NH}_4)_4[\text{M}_{12}\text{O}_{36}]$: Ammonium dodecamolybdate.

(vi) $\text{Na}_8[\text{W}_6\text{O}_{21}]$: Sodium hexatungstate

(2)

⇒ IUPAC nomenclature of Heteropoly anions/salts/acids:

Heteropoly anions/acids/salts, where two or more different types of anions condense together. For example, molybdate (MoO_4^{2-}) or tungstate (WO_4^{2-}) groups with phosphate (PO_4^{3-}), silicate (SiO_3^{2-}), borate (BO_3^{3-}) etc.

Heteropoly acids/anions/salts may be formed by coordination of the central atom with 4 to 6 oxoanions, which may be mononuclear (containing one metal ion each), as in $[\text{P}(\text{MoO}_4)_6]^{7-}$ or trinuclear (containing three metal ion each), as in $[\text{P}(\text{W}_3\text{O}_{10})_4]^{3-}$.

* Steps of IUPAC nomenclature:

1. First di, tri, tetra... prefix written ^{respectively} for 2, 3, 4... corresponding to number of the central metal (M_n or W)
2. Central metal (M_n or W) name is ^{then} written after replacing suffix (ending) by 'o'. e.g. for Mo : molybdo, W : tungsto.
3. Simple anion, containing another element (Si , B , P , Ce , Co etc.) named in last using ending (suffix) 'ate'.
4. If simple anion has ^{transition} element of variable oxidation state, then its oxidation state is shown by Roman numeral (I, II, III...) within small bracket after the name of simple anion.
5. If formula of ^{hetero} polyanion is duplicate/triplicate etc, then dimeric, trimeric word written in beginning of the name.

For example, (i) $[\text{Ce}^{\text{IV}}\text{Mo}_{12}\text{O}_{42}]^{8-}$: Dodecamolybdocerate(IV)

(ii) $\text{Na}_3[\text{PMo}_{12}\text{O}_{40}]$: Sodium dodecamolybdophosphate

(iii) $\text{K}_8[\text{Co}_2\text{W}_{12}\text{O}_{42}]$ or $\text{K}_8[(\text{CoW}_6\text{O}_{21})_2]$: Dimeric potassium hexatungsto cobaltate(III)

(iv) $[\text{SiW}_{12}\text{O}_{40}]^{4-}$: Dodecatungsto silicate or, 12-Tungsto silicate

(v) $\text{Na}_5[\text{PMo}_{10}\text{V}_2\text{O}_{40}]$: Sodium decamolybdodivanadophosphate.

Exercise: Write down IUPAC name of following:

1. $\text{Fe}(\text{NO}_3)_3$
2. Hg_2SO_4
3. Fe_3O_4
4. CrCl_3
5. CoI_2
6. $[\text{P}_2\text{M}_{12}\text{O}_{40}]^{3-}$
7. $[\text{Mo}_8\text{O}_{26}]^{4-}$
8. $[\text{HW}_6\text{O}_{21}]^{5-}$
9. $(\text{NH}_4)_3[\text{PMo}_{12}\text{O}_{40}]$
10. $[\text{FeMo}_6\text{O}_{24}]^{6-}$

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