Inert Gas | Noble Gas | Aerogen | Group 18

└ small amount in air.

He, Ne, Ar, Kr, Xe, Rn

General configuration:- $ns^2\ np^6$ except He:- $1s^2$.

→ Except Rn, all inert gas present in air.

$$_{88}Ra^{228} \longrightarrow {}_{86}Rn^{222}$$ by α-particle disintegration.

→ Inert gas are less reactive due to:—

(i) closed shell ($ns^2\ np^6$)

(ii) High I.E

(iii) large +ve ΔH_{eg}: └ E- gain enthalpy

$$Ne_{(g)} + e^- \longrightarrow Ne^-_{(g)} \quad , \boxed{\Delta H_{eg} = +ve}$$

└ large energy absorb

Note:- Kr, Xe form compound with high E.N (F & O)

He, Ne, Ar] X

Abhishek

Kr → KrF_2, KrF_4

Xe → XeF_2, XeF_4, XeF_6, XeO_3, $XeOF_2$, $XeOF_4$

Rn → Radiactive (no compound)

Q. Which compound does not exist?

(a) KrF_2 (b) XeF_2 ~~(c)~~ NeF_2 (d) XeO_2F_2

→ 1st compound of inert gas isolated was $Xe^+[PtF_6]^-$ by Neil Bartlett.

→ $O_2 + PtF_6 \longrightarrow O_2^+[PtF_6]^-$

$O_2 \xrightarrow[1170\ KJ/mol]{} e^* + O_2^+$

→ $e^- + Xe^+ \xleftarrow[KJ/mol]{1165} Xe + PtF_6 \longrightarrow Xe^+[PtF_6]^-$

- 1st compound isolated
- paramagnetic
- colored.

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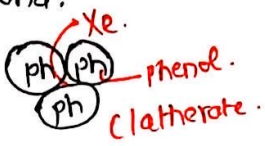
→ Formation of $Xe^+[PtF_6]^-$ indicate that ionization energy of xenon & molecular oxygen (O_2) is almost same.

Clatherate:- cage compound.

→ large size inert gas (Ar, Kr, Xe) occupy in vacant space of polar compound.



→ Dipole induced dipole is responsible for clatherate formation.

→ Except He & Ne, all other noble gas including Rn form clatherat
↳ due to small size, they easily escaple from void ↳ खाली जगह

→ Top to bottom, radius ↑es, I.E ↓es, [Electron gain enthalphy is +ve for noble gases.]

[Electron affinity is -ve for noble gases].

→ Top to bottom, B.pt ↑es due to vanderwaals attraction.

Hydrolysis:-

1) XeF_6:- Hydrolysis of XeF_6 is not redox rxn because O.S. of element remain same.

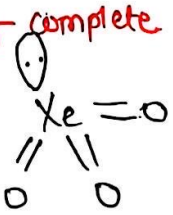
$$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$$
$$XeF_6 + 2H_2O \longrightarrow XeO_2F_2 + 4HF$$

} partial hydrolysis

$$XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF$$

} complete hydrolysis

- explosive
- pyramidal shape
- sp^3 hybridized
- Tetrahedral geometry.



Q. Which product not form when XeF_6 undergoes hydrolysis.

(a) $XeOF_4$ (b) XeO_2F_2 (c) XeO_3 (d) $XeOF_2$

~~XeF~~

② XeF_2

$$\overset{+2}{Xe}F_2 + H_2O \longrightarrow \overset{0}{Xe} + HF + O_2$$

→ Redox rxn.

~~XeF6~~

③ XeF_4

$$XeF_4 + H_2O \longrightarrow XeO_3 + Xe + HF + O_2$$

→ Redox rxn. (disproportation rxn)

→ Xenon fluoride form by direct combination.

$$Xe + F_2 \longrightarrow \begin{matrix} XeF_2 \\ XeF_4 \\ XeF_6 \end{matrix}$$

but $Xe + O_2 \longrightarrow XeO_3$ (not direct)

But, xenon oxide & xenon oxyfluoride form by hydrolysis of Xef

$$XeF_6 \xrightarrow{H_2O} XeOF_4 + XeO_2F_2 + XeO_3$$

→ Xenon fluoride are F^- donor and F^- acceptor.

$$XeF_4 + PF_5 \longrightarrow \overset{\oplus}{XeF_3} + \overset{\ominus}{PF_6}$$

(PF_5: P covalent, vacant d-orbital)

$$XeF_6 + AsF_5 \longrightarrow \overset{\oplus}{XeF_5} + \overset{\ominus}{AsF_6}$$

(AsF_5: vacant d.)

In these 2 rxn, Xenon fluoride is e^- donor.

$$XeF_4 + \overset{+}{M}\overset{-}{F} \longrightarrow M^+ + [XeF_5]^-$$

(XeF_4: vacant d-orb; MF: ionic)

→ XeF_4 is e^- acceptor.

$$XeF_4 + KF \longrightarrow K^+ + [XeF_5]^-$$

(KF: ionic)

$$XeF_4 + SbF_5 \longrightarrow SbF_6^- + [XeF_5]^+$$

(SbF_5: vacant d-orb)

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$XeF_6 + PF_5 \longrightarrow [XeF_5]^+ + PF_6^-$

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Q. XeF_2 reacts with PF_5 to give:-

(a) XeF_6 (b) $[XeF]^+[PF_6]^-$ (c) XeF_4 (d) $[PF_4]^+[XeF_3]^-$

Melting point & Boiling point

→ very low.

→ m.pt & B.pt ∝ vanderwaal's force ∝ mass.

vanderwaal's force of attraction → Instantenous dipole-induced dipole interaction.
└ london force / Dispersion force

→ V. F ∝ size ∝ polarisibility.

→ Inert gas has very low m.pt & b.pt because they have very weak vanderwaal's force of attraction.

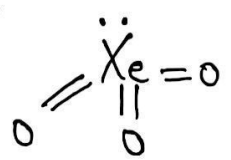
→ He, Ne, Ar, Kr, Xe ↓ size ↑es, polarizability ↑es, Dispersion force ↑es, B.pt ↑es, tendency of liquification ↑es, solubility in water ↑es. └ due to dipole-induced dipole.

Q. Inert gas soluble in water due to:-

(a) ion-dipole (b) Dispersion (c) Dipole - Dipole

(d) dipole- induced dipole / Debye.

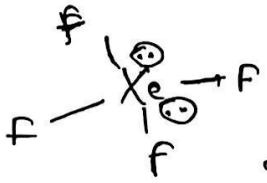
XeO_3 →



$H = 3 + 1 = 4\ (sp^3)$
σ, l.p.

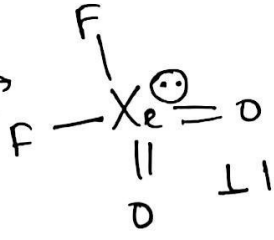
pyramidal shape.

XeF_4 →



2 lone pair.

XeO_2F_2 →



1 lone pair

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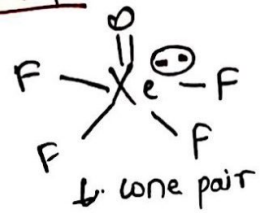
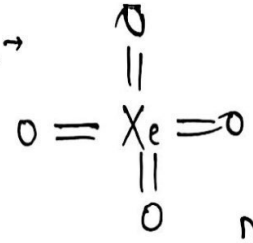
$XeOF_4$



XeO_4 →



no lone pair

Uses

He is lightest gas, so used in balloon (due to non-inflammable).

→ Liq. He used as cryogenics agent.

— Mixture of He & O_2 used by sea drivers because He has low solubility in blood.

→ Ne used in advertisement display.

→ Ar is used to provide inert atmosphere (bulb, welding metals).

questions

Q. The noble gas forming maximum number of compounds is :—

(a) Ne (b) Xe (c) Kr (d) Rn

Q. First compound of Xe synthesized was :—

(a) $[XeF^+][XePtF_5]^-$ (b) XeO_2

(c) $Xe[PtF_6]$ (d) $O_2[XeF_6]$

Q. The oxd. no. of xenon in $XeOF_2$ is :—

(a) zero (b) 2 (c) 4 (d) 3

$x + (-2 + 2) = 4$.

Q. Why noble gas compound are more common in Xenon?

(a) Due to its lower ionization potential (more reactive)

(b) Due to its higher I.E

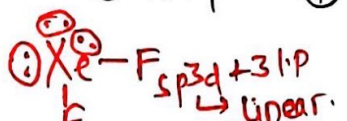
(c) Due to its str.

(d) None

Q. Which of the following Fluoride of Xe is impossible?

(a) XeF_2 (b) XeF_3 (c) XeF_4 (d) XeF_6

Q. XeF_2 molecule is :—



(a) Linear (b) Trigonal planar (c) Pyramidal (d) square planar

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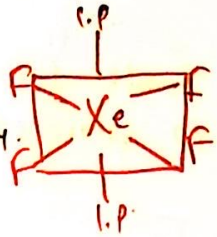
Q. In XeF_2, the hybridization of Xe is:-

(a) sp^3d^2 (b) sp^3 (c) sp^3d (d) sp^2

Q. Which of the following is planar?

(a) XeF_2 (b) $XeOF_4$ (c) XeO_2F_2 (d) XeF_4



Q. Hybridization & Structure of XeF_4 is:-

(a) sp^3d^2, square planar (b) sp^3, tetrahedral

(c) sp^3d, trigonal bipyramidal (d) sp^3d^2, hexagonal

$4+2 = sp^3d^2$.

Q. The structure of XeF_6 is:-

(a) Distorted octahedral (b) Pyramidal

(c) Tetrahedral (d) None

Q. XeF_2 on hydrolysis gives:-

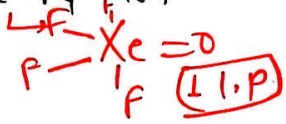
(a) XeO_3 (b) XeO (c) XeO_2 (d) Xe

Q. XeX_6 on hydrolysis gives:-

(a) XeO_3 (b) XeO (c) XeO_2 (d) Xe

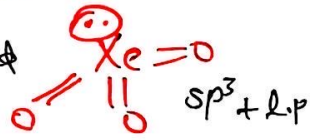
Q. Total no. of lone pair of e^- in $XeOF_4$ is:-

(a) 0 (b) 1 (c) 2 (d) 3



Q. Structure of XeO_3 is:-

(a) Linear (b) Planar (c) Pyramidal (d) T-shaped



sp^3 + L.P

Q. The formation of $O_2^+[PtF_6]^-$ is the basis for the formation of Xenon fluorides. because:-

(a) O_2 & Xe have comparable size.

(b) both O_2 & Xe are gases

(c) O_2 & Xe have comparable I.E (d) None

Q. Which of the following noble gases is not present in atmosphere?

(a) He (b) Ne (c) Ar (d) Rn

Q. Argon was discovered by:-

(a) Ramsay (b) Rayleigh (c) Rutherford (d) None

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Q. An inert gas atom :-
(a) has one e^- in outermost shell.
(b) has 3 e^- in " "
(c) has half-filled outermost shell
(d) has a saturated "

Q. Which radioactive element is inert gas?
(a) Ra (b) Rn (c) Pu (d) Po

Q. Which one of the following gases exist in monoatomic state?
(a) Chlorine (b) Helium (c) Oxygen (d) Nitrogen

Q. Which of the Following is most reactive?
(a) He (b) Ne (c) Ar (d) Xe

Q. Which noble gas is most soluble in water?
(a) He (b) Ne (c) Ar (d) Xe

Q. The force acting between noble gases atoms are:-
(a) London dispersion (b) Vanderwaals force
(c) ion-dipole force (d) Magnetic force

Q. B.pt & M.pt of inert gases are:-
(a) High (b) low (c) very high (d) very low.

Q. The m.pt & b.pt of which of these is lowest?
(a) He. (b) Ne (c) Kr (d) Ar.

Q. Which is most volatile in of all liquids :-
(a) ether (b) Liq. He (c) Liq. N_2 (d) Liq. Ne.

Q. Which one of has highest B.pt?
(a) He (b) Ne (c) Kr (d) Xe

Q. Which of the Following noble gases is not polarizable?
(a) He (b) Ar (c) Kr (d) Xe.

Q. Which of the noble gas has its ionization energy close to that of molecular O_2?
(a) Ar (b) Kr (c) Xe (d) Rn.

Q. Which of the Following are gases is the most abundant in
(a) He (b) Ne (c) Ar (d) Kr.

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). Percentage of argon in air is about :—
(a) 10%. (b) 0.1%. (c) <0.1%. (d) 1%.

Q. The separation of inert gases from air is possible due to diff in their
(a) density (b) Boiling point (c) sp. heat (d) Solubility
└ by fractional distillation

Q. A stable compound of noble gas was 1st prepared by:—
(a) Rayleigh (b) Rutherford (c) Ramsay (d) Neil Bertlett.

Q. A clathrate may be defined as:—
(a) cage compound (b) Liquid crystal (c) Mixture (d) Solid solution.

Q. In the clathrate of xenon with water, the nature bonding between Xenon & water molecules is:—
(a) covalent (b) co-ordinate (c) hydrogen (d) nor bonding (interactio

Q. Which one of the following soluble gases has the least tendency to form compounds?
(a) He (b) Ne (c) Kr (d) Xe.

Q. Nuclear Fusion produces:—
(a) Argon (b) Deuterium (c) Helium (d) Krypton.

Q. Monazite is a source of:—
(a) He (b) Kr (c) Ar (d) Ne.

Q. Which one of the following noble gases is obtained by radioactive disintegration?
(a) Ar (b) Kr (c) Xe (d) Rn.

Q. The gas that surrounds a radioactive element is:—
(a) He (b) Ne (c) N_2 (d) O_2

Q. Which one of the noble gases was observed in solar spectrum?
(a) He (b) Ne (c) Ar (d) Rn

Q. The colored discharge tube for advertisement mainly contains:—
(a) Xe (b) He (c) Ne (d) Ar.

Q. Helium is used in ballons instead of hydrogen because is:—
(a) Lighter than H_2 (b) More abundant than H_2.
(c) Incombustile (d) Radioactive & easily detected

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Q. Which one of the following is used in radiotherapy?
(a) Ar (b) Kr (c) Xe (d) Rn.

Q. The most useful noble gas is:-
(a) He (b) Ar (c) Ne (d) Xe

Q. Deep sea divers used to respire in a mixture of:-
(a) Oxygen & Ar (b) O_2 & He (c) O_2 & N_2 (d) O_2 & H_2

Q. The divers in deep sea in helium-oxygen mixture in preference to nitrogen-oxygen mixture. This is because:-
(a) Helium is less soluble in blood than nitrogen at high pressure
(b) Helium is lighter than nitrogen
(c) Helium is readily miscible with O_2.
(d) He is less poisonous than N_2.

Q. He is used with Oxygen in the apparatus of divers because:-
(a) is lighter than N_2.
(b) is not soluble in blood at high pressure
(c) is easily available
(d) is less reactive than N_2.

Q. The no. of lone pairs of electrons on Xe-atoms in XeF_2, XeF_4 & XeF_6 molecules are respectively:-
(a) 3, 2 & 1 (b) 4, 3 & 2 (c) 2, 3 & 1 (d) 3, 2 & 0

Q. The pair of species having identical shapes for molecules of both species is:-
(a) XeF_2, CO_2 (b) BF_3, PCl_3 (c) PF_5, IF_5 (d) CF_4, SF_4

Q. In the treatment of asthma, the gases used are:-
(a) mixture of He & O_2 (b)

Q. In clatherates of xenon with H_2O, the nature of bonding
(a) Covalent (b) H-bonding
(c) Co-ordinate (d) dipole induced dipole interaction

Q. XeF_2 react with PF_5 to give:-
(a) XeF_6 (b) $[XeF]^+[PF_6]^-$ (c) XeF_4 (d) none

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