Inorganic chemistry theory questions

Question 16: Nitrogen Family Trends

Identify the INCORRECT statement about Group 15 elements:

A. Nitrogen cannot form dπ-pπ bonds due to absence of d-orbitals, hence N≡N bond is very strong

B. BiH_3 is the strongest reducing agent among Group 15 hydrides

C. Nitrogen shows oxidation states from -3 to +5, but +5 state becomes less stable down the group

D. NCl_3 is less stable than PCl_3 because nitrogen cannot expand its octet

Choose the most appropriate answer:

A. C only

B. D only

C. A and D only

D. All are correct

Inorganic chemistry theory questions

Question 15: Transition Metal Catalysis

Consider the following reactions catalyzed by transition metals:

(i) Contact process: V_2O_5 catalyzes SO_2 oxidation

(ii) Haber process: Fe catalyzes $N_2 + H_2$ reaction

(iii) Hydrogenation: Ni catalyzes alkene + H_2 reaction

(iv) Ostwald process: Pt catalyzes NH_3 oxidation

The reason transition metals act as good catalysts is:

A. They can show variable oxidation states

B. They have partially filled d-orbitals that can accept and donate electrons

C. They can form interstitial compounds

D. They have high enthalpy of atomization

Choose the correct answer:

A. A and B only

B. A, B and C only

C. B and D only

D. A, B, C and D

Inorganic chemistry theory questions

Question 17: Dichromate Oxidation Products

$K_2Cr_2O_7$ in acidic medium can oxidize different substrates. Match the substrate with the product:

Substrate: H_2S → Product: ?

Substrate: SO_2 → Product: ?

Substrate: I^- → Product: ?

When $K_2Cr_2O_7$ oxidizes H_2S in acidic medium, the products are:

A. S and Cr^{3+}

B. SO_2 and Cr^{3+}

C. SO_3 and Cr^{2+}

D. H_2SO_4 and Cr^{3+}

S

$$K_2Cr_2O_7 + 3H_2S + 4H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3S + 7H_2O$$

Inorganic chemistry theory questions

Question 18: Ligand Field Theory

Consider the following complexes:

A. $[CoF_6]^{3-}$

B. $[Co(H_2O)_6]^{3+}$

C. $[Co(NH_3)_6]^{3+}$

D. $[Co(CN)_6]^{3-}$

$F^- < H_2O < NH_3 < CN^-$

Arrange these complexes in increasing order of crystal field splitting energy (Δ_o):

A. A < B < C < D

B. D < C < B < A

C. A < B < D < C

D. B < A < C < D

Inorganic chemistry theory questions

Question 19: Inert Pair Effect

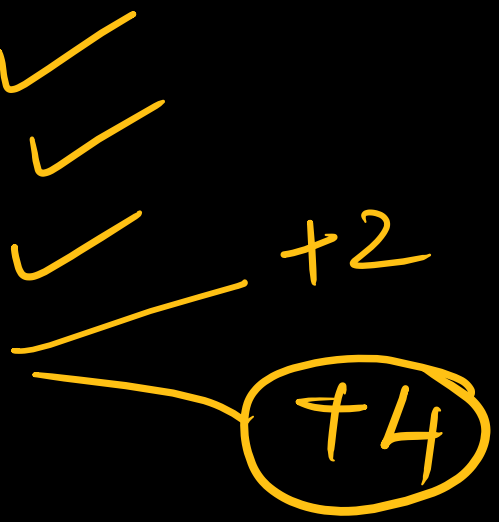
The inert pair effect is most pronounced in:

A. Tl in Group 13, showing stable +1 oxidation state

B. Pb in Group 14, showing stable +2 oxidation state

C. Bi in Group 15, showing stable +3 oxidation state

D. Po in Group 16, showing stable +4 oxidation state



Choose the correct statements:

A. A and B only

B. A, B and C only

C. B, C and D only

D. A, B, C and D

Inorganic chemistry theory questions

Question 20: Coordination Compound Nomenclature and Structure

The coordination compound $[Cr(H_2O)_4Cl_2]Cl.2H_2O$ exhibits:

(i) Ionization isomerism

(ii) Hydrate isomerism

(iii) Geometrical isomerism

(iv) Optical isomerism

$[Cr(H_2O)_5Cl]Cl_2$

$[Cr(H_2O)_4Cl_2]$

Which of the above types of isomerism are possible?

A. (i), (ii) and (iii) only

B. (i) and (iii) only

C. (ii) and (iii) only

D. (i), (ii), (iii) and (iv)

Inorganic chemistry theory questions

Which of the following statements about noble gas compounds are correct?

A. XeF_2, XeF_4, and XeF_6 are all stable compounds with linear, square planar, and distorted octahedral geometries respectively

B. XeF_6 reacts with SiO_2 to give $XeOF_4$

C. XeO_3 and XeO_4 are both powerful oxidizing agents, with XeO_4 being explosive

D. Xenon forms compounds because its ionization energy is comparable to that of oxygen

Choose the correct answer:

A. A and C only

B. B and C only

C. A, B and C only

D. B, C and D only

$$XeF_6 + SiO_2 \longrightarrow XeOF_4 + SiF_4$$

Inorganic chemistry theory questions

Question 1: Chromate-Dichromate Equilibrium

Given below are two statements:

Statement I: In aqueous solution, chromate ion (CrO_4^{2-}) converts to dichromate ion ($Cr_2O_7^{2-}$) in acidic medium, and the reverse occurs in basic medium.

Statement II: The conversion is due to the change in oxidation state of chromium from +6 in chromate to +7 in dichromate.

In the light of the above statements, choose the correct answer from the options given below:

A. Statement I is true but Statement II is false

B. Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I

C. Statement I is false but Statement II is true

D. Both Statement I and Statement II are false

Inorganic chemistry theory questions

Question 13: Permanganate Titration Calculation

In a titration, 20 mL of 0.1 M $FeSO_4$ solution required 'V' mL of 0.02 M $KMnO_4$ in acidic medium. The volume 'V' is:

(Given: $MnO_4^- \rightarrow Mn^{2+}$ and $Fe^{2+} \rightarrow Fe^{3+}$)

A. 8 mL

B. 10 mL

C. 20 mL

D. 40 mL

$$\overset{+7}{Mn}O_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

$N_1V_1 = N_2V_2$ n-factor - 5

$(M_1 \times n_1) \times V_1 = (M_2 \times n_2) V_2$ $= 0.1 \times 1 \times 20 = 0.02 \times 5 \times V$

$V = 20\ mL$

Inorganic chemistry theory questions

Question 12: Halogen Oxoacids

The correct order of acidic strength of halogen oxoacids is:

A. $HClO_4 > HClO_3 > HClO_2 > HClO$

B. $HClO > HClO_2 > HClO_3 > HClO_4$

C. $HIO_4 > HBrO_4 > HClO_4$

D. $HClO_4 > HBrO_4 > HIO_4$

Same halogen, more oxygen = Stronger

Choose the correct answer from the options given below:

A. A and D only

B. A and C only

C. B and D only

D. A, C and D only

Same O.S, Smaller halogen = Stronger

Inorganic chemistry theory questions

Question 11: Coordination Number and Geometry

Match the following complexes with their coordination numbers and geometries:

Complex: $[Fe(C_2O_4)_3]^{3-}$ — 6

Complex: $[Ni(CO)_4]$ — 4

Complex: $[Cu(NH_3)_4]^{2+}$ — 4

Complex: $[CoF_6]^{3-}$ — 6

The coordination number and geometry of $[Fe(C_2O_4)_3]^{3-}$ is:

A. 3, trigonal planar

B. 6, octahedral ✓

C. 4, square planar

D. 6, trigonal prismatic

Inorganic chemistry theory questions

Question 10: Actinoid Properties

Which of the following statements are INCORRECT about actinoids?

A. All actinoids are radioactive in nature

B. Actinoid contraction is greater than lanthanoid contraction due to poor shielding of 5f electrons

C. Actinoids show higher oxidation states than lanthanoids, with uranium showing up to +6

D. The most common oxidation state of all actinoids is +3, similar to lanthanoids

+3 to +7

Choose the correct answer:

A. D only

B. A and D only

C. C and D only

D. All are correct

Inorganic chemistry theory questions

Question 9: Oxygen Family Anomalies

Consider the following statements about Group 16 elements:

A. The boiling point order is $H_2O > H_2S > H_2Se > H_2Te$ due to hydrogen bonding in H_2O

B. The bond angle decreases in the order $H_2O > H_2S > H_2Se > H_2Te$ due to decreasing electronegativity

C. SF_6 is kinetically inert while SCl_6 does not exist due to larger size of chlorine

D. Oxygen shows oxidation states from -2 to +2, while sulfur shows -2 to +6

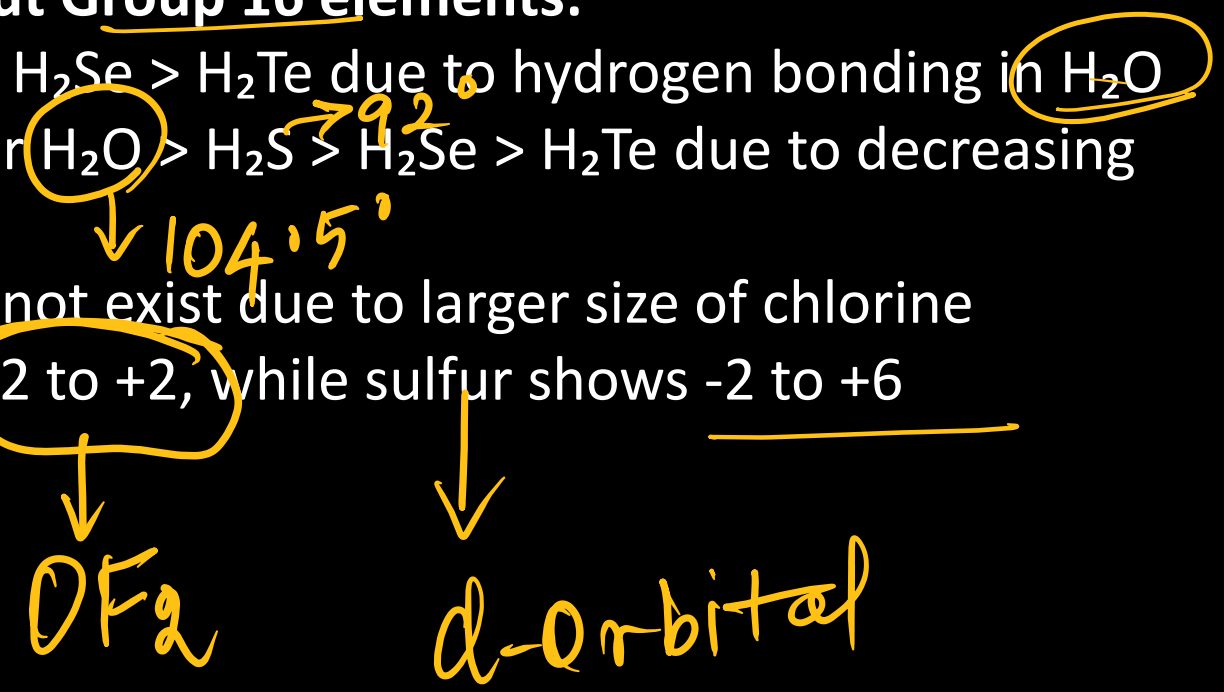
Choose the correct statements:

A. A, B and C only

B. A, C and D only

C. B, C and D only

D. A, B, C and D



Inorganic chemistry theory questions

Question 8: Crystal Field Splitting

Given below are two statements about coordination compounds:

Assertion A: The complex $[Ni(CN)_4]^{2-}$ is diamagnetic while $[NiCl_4]^{2-}$ is paramagnetic.

Reason R: CN^- is a strong field ligand causing electron pairing, while Cl^- is a weak field ligand.

In the light of the above statements, choose the correct answer:

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true but R is NOT the correct explanation of A

C. A is true but R is false

D. A is false but R is true

Inorganic chemistry theory questions

Question 7: d-Block Electronic Configuration

Which of the following pairs of elements have nearly identical atomic radii despite being in different periods?

A. Zr and Hf

B. Nb and Ta

C. Mo and W

D. Fe and Ru

Choose the correct answer:

A. A and B only

B. A, B and C only

C. B, C and D only

D. A, B, C and D

Inorganic chemistry theory questions

Question 6: $K_2Cr_2O_7$ Reactions

Identify the incorrect statement about the reactions of potassium dichromate:

A. $K_2Cr_2O_7$ reacts with $FeSO_4$ in acidic medium to produce $Fe_2(SO_4)_3$ and $Cr_2(SO_4)_3$

B. $K_2Cr_2O_7$ on heating with KCl and conc. H_2SO_4 liberates chlorine gas

C. $K_2Cr_2O_7$ reacts with H_2O_2 in acidic medium to form blue-colored peroxochromate CrO_5

D. $K_2Cr_2O_7$ reacts with NaOH to form Na_2CrO_4 without any change in oxidation state

Choose the most appropriate answer from the options given below:

A. B only

B. C only

C. B and C only

D. All statements are correct

$$K_2Cr_2O_7 + 4KCl + 6H_2SO_4 \rightarrow 3H_2O + 2Cl_2\uparrow + Cr_2(SO_4)_3 + K_2SO_4$$

Inorganic chemistry theory questions

Question 5: Ionization Energy Anomaly in Group 13

The first ionization energy of elements in group 13 follows the order:

B > Ga > Al > In > Tl

This trend is anomalous because:

Ga => [Ar] $3d^{10}4s^2$ $4p^1$

A. Ga has higher ionization energy than Al due to presence of completely filled $3d^{10}$ orbitals which provide poor shielding

B. The expected trend should be B > Al > Ga > In > Tl based on atomic size alone

C. The anomaly is due to inert pair effect becoming prominent from Al onwards

D. Al has lower ionization energy than Ga due to larger atomic radius

Choose the correct answer:

A. A and B only

B. B and D only

C. A, B and D only

D. A and D only

Inorganic chemistry theory questions

Question 4: Coordination Compounds - Isomerism

Consider the following coordination compounds:

(i) $[Co(NH_3)_5Cl]SO_4$

(ii) $[Pt(NH_3)_2Cl_2]$

(iii) $[Co(en)_2Cl_2]^+$

(iv) $[Cr(NH_3)_3Cl_3]$

Which of the above can exhibit geometrical isomerism?

A. (ii) and (iii) only

B. (i), (ii) and (iii) only

C. (ii), (iii) and (iv) only

D. (i), (ii), (iii) and (iv)

Inorganic chemistry theory questions

Question 3: $KMnO_4$ Oxidation in Different Media

Potassium permanganate oxidizes oxalic acid in different media.

Identify the product of Mn obtained in each medium:

In acidic medium: $KMnO_4 + H_2C_2O_4 + H_2SO_4 \rightarrow$

In neutral/alkaline medium: $KMnO_4 + H_2C_2O_4 \rightarrow$

In strongly alkaline medium: $KMnO_4 + H_2C_2O_4 + KOH \rightarrow$

A. Mn^{2+}, MnO_2, MnO_4^{2-}

B. MnO_2, MnO_4^{2-}, Mn^{2+}

C. Mn^{2+}, MnO_4^{2-}, MnO_2

D. MnO_4^{2-}, MnO_2, Mn^{2+}

Inorganic chemistry theory questions

Statement I: Potassium permanganate on heating at 573 K forms potassium manganate

Statement II: Both potassium permanganate and potassium manganate are tetrahedral and paramagnetic in nature

MnO_4^- ⇒ diamag $3d^0 4s^0$

$3d^1$

$$2\,KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$$

$\overset{+6}{Mn}O_4^{2-}$

Inorganic chemistry theory questions

Question 2: Lanthanoid Contraction

Which of the following statements are correct about lanthanoids?

A. The ionic radii of lanthanoids decrease steadily from La^{3+} to Lu^{3+} due to lanthanoid contraction

B. Lanthanoid contraction is due to imperfect shielding of 4f electrons

C. Ce^{4+} is a strong oxidizing agent while Eu^{2+} is a strong reducing agent

D. All lanthanoids exhibit +3 oxidation state and their compounds are generally colored

Choose the correct answer from the options given below:

A. A, B and C only

B. B, C and D only

C. A, C and D only

D. A, B, C and D

Eu^{3+} [Xe] $4f^6$

$Eu - [Xe]\ 4f^7\ 6s^2$

$Eu^{2+} - [Xe]\ 4f^7\ 6s^0$

Inorganic chemistry theory questions

Statement A: All group 16 elements form oxides of general formula EO_2 and EO_3 where E = S, Se, Te and Po. Both types are acidic in nature.

Statement B: TeO_2 is an oxidising agent while SO_2 is reducing in nature

Statement C: The reducing property ~~decreases~~ increases from H_2S to H_2Te down the group

Inorganic chemistry theory questions

Statement (A): Decreasing order of atomic radii: Tl > In > Ga > Al > B

Statement (B): Down group 13, electronegativity decreases from top to bottom

Statement (C): Al dissolves in dil. HCl and liberates H_2, but conc. HNO_3 renders Al passive by forming a protective oxide layer

Statement (D): All elements of group 13 exhibit highly stable +1 oxidation state

Statement (E): Hybridization of Al in $[Al(H_2O)_6]^{3+}$ ion is sp^3d^2

Inorganic chemistry theory questions

Statement A: Stability decreases in order $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

Statement B: Reducing ability increases in order $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Statement C: Among the hydrides, NH_3 is strong reducing agent while BiH_3 is mild reducing agent

Statement D: Basicity increases in order $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Inorganic chemistry theory questions

The group 14 elements A and B have the first ionisation enthalpy values of 708 and 715 $kJmol^{-1}$ respectively. The above values are lowest among their group members. The nature of their ions A^{2+} B^{4+} respectively is

a) both reducing
b) both oxidising
c) reducing and oxidising
d) oxidising and reducing

C
Si
Ge
Sn – 708 – Sn^{2+} → Sn^{4+}
Pb – 715 – Pb^{4+} → Pb^{2+}

Inorganic chemistry theory questions

Assertion A: $[CoCl(NH_3)_5]^{2+}$ absorbs at lower wavelength of light with respect to $[Co(NH_3)_5(H_2O)]^{3+}$

Reason R: The wavelength of light absorbed depends on the oxidation state of the metal ion.

$Cl^- < H_2O < NH_3$

↓

Smaller Δo → Absorbs lower energy

↓

Longer wl.

Inorganic chemistry theory questions

Iron (III) catalyses the reaction between iodide and persulphate ions, in which A. Fe^{3+} oxidises the iodide ion B. Fe^{3+} oxidises the persulphate ion C. Fe^{2+} reduces the iodide ion D. Fe^{2+} reduces the persulphate ion Choose the most appropriate answer from the options given below:

$$2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$$

$$2Fe^{2+} + S_2O_8^{2-} \longrightarrow 2Fe^{3+} + 2SO_4^{2-}$$

Inorganic chemistry theory questions

Which of the following statements are correct about Zn, Cd and Hg?

Statement A: They exhibit high enthalpy of atomization as the d-subshell is filled

Statement B: Zn and Cd do not show variable oxidation state while Hg shows

Statement C: Compounds of Zn, Cd and Hg are paramagnetic in nature

Statement D: Zn, Cd and Hg are called soft metals

$Zn - [Ar] 3d^{10} 4s^2$

$Cd - [Kr] 4d^{10} 5s^2$

$Hg - [Xe] 4f^{14} 5d^{10} 6s^2$ ($+1$, $+2$)

Inorganic chemistry theory questions

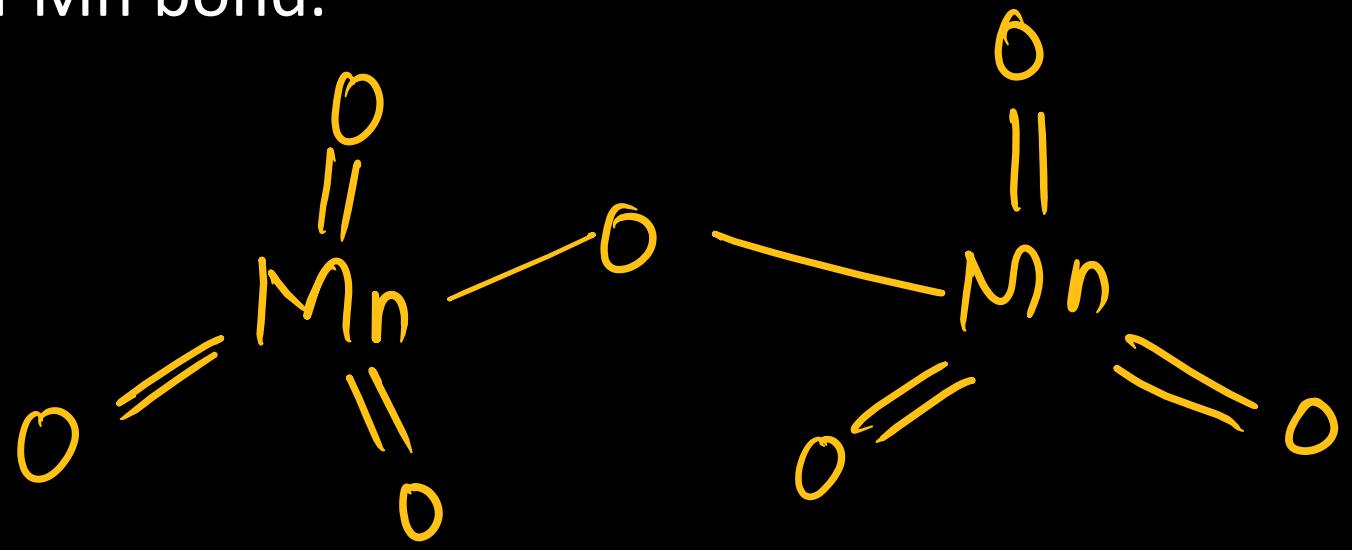
Highest oxidation state of Mn in exhibited in Mn_2O_7. The correct statements about Mn_2O_7 are

(A) Mn is tetrahedrally surrounded by oxygen atoms.

(B) Mn is octahedrally surrounded by oxygen atoms.

(C) Contains Mn-O-Mn bridge

(D) Contains Mn-Mn bond.



Inorganic chemistry theory questions

Identify the incorrect statement for PCl_5 from the following.

a)In this molecule, orbitals of phosphorus are assumed to undergo sp^3d hybridization.

b)The geometry of PCl_5 is trigonal bipyramidal.

c)PCl_5 has two axial bonds stronger than three equatorial bonds.

d)The three equatorial bonds of PCl_5 lie in a plane