D And F Block Elements

Question1

Baeyer's reagent is :

[NEET 2024 Re]

Options:

A.

Acidic potassium permanganate solution

B.

Acidic potassium dichromate solution

C.

Cold, dilute, aqueous solution of potassium permanganate

D.

Hot, concentrated solution of potassium permanganate

Answer: C

Solution:

Baeyer’s reagent is cold, dilute, aqueous solution of potassium permanganate

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Question2

Which of the following pairs of ions will have same spin only magnetic moment values within the pair?

A. Zn^{2+}, Ti^{2+}

B. Cr^{2+}, Fe^{2*}

C. Ti^{3+}, Cu^{2+}

D. V^{2*}, Cu^{+}

Choose the correct answer from the options given below :

[NEET 2024 Re]

Options:

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A.

C and D only

B.

A and D only

C.

A and B only

D.

B and C only

Answer: D

Solution:

Magnetic moment $\mu = \sqrt{n(n+2)}BM$

$n \Rightarrow$ Number of unpaired electrons

Ion	n	μ(BM)
Zn^{2+}	0	0
Ti^{2+}	2	$\sqrt{8}$
Cr^{2+}	4	$\sqrt{24}$
Fe^{2+}	4	$\sqrt{24}$
Ti^{2+}	1	$\sqrt{3}$
Cu^{2+}	1	$\sqrt{3}$
V^{2+}	3	$\sqrt{15}$
Cu^{2+}	0	0

Hence (Cr^{2+}, Fe^{2+}) and (Ti^{3+}, Cu^{2+}) are the pair of same magnetic moment.

Question3

Which of the following set of ions act as oxidising agents?

[NEET 2024 Re]

Options:

A.

Ce^{4+} and Tb^{4+}

B.

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La^{3+} and Lu^{3+}

C.

Eu^{2+} and Yb^{2+}

D.

Eu^{2+} and Tb^{4+}

Answer: A

Solution:

Most stable oxidation state of lanthanoids is +3

Ce^{4+} and Tb^{4+} will get reduced easily and will be good oxidising agents.

Question4

The UV-visible absorption bands in the spectra of lanthanoid ions are ' X ', probably because of the excitation of electrons involving ' Y '. The ' X ' and ' Y ', respectively, are :

[NEET 2024 Re]

Options:

A.

Broad and f orbitals

B.

Narrow and f orbitals

C.

Broad and d and f orbitals

D.

Narrow and d and f orbitals

Answer: B

Solution:

In lanthanoids, absorption bands are narrow because of excitation within f-level.

Question5

Choose the correct answer from the options given below:

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	List-I (Block/group in periodic table)		List-II (Element)
A.	Lanthanoid	I.	Ce
B.	d-block element	II.	As
C.	p-block element	III.	Cs
D.	s-block element	IV.	Mn

[NEET 2024 Re]

Options:

A.

A-I, B-II, C-IV, D-III

B.

A-I, B-IV, C-III, D-II

C.

A-I, B-IV, C-II, D-III

D.

A-IV, B-I, C-II, D-III

Answer: C

Solution:

Element	Block/group in periodic table
Ce (Z = 58)	Lanthanoid
As (Z = 33)	p-block element
Cs (Z = 55)	s-block element
Mn (Z = 25)	d-block element

Question6

Identify the incorrect statement.

[NEET 2024 Re]

Options:

A.

PEt_3 and $AsPh_3$ as ligands can form dπ - dπ bond with transition metals

B.

The N − N single bond is as strong as the P − P single bond

C.

Nitrogen has unique ability to form pπ − pπ multiple bonds with nitrogen, carbon and oxygen

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D.

Nitrogen cannot form dπ - pπ bond as other heavier elements of its group

Answer: B

Solution:

● PEts and $AsPh_3$ as ligands can form dπ − dπ bond with transition metals.

● The N − N single bond is weaker than the single P − P bond because of high inter-electronic repulsion of the non-bonding electrons.

● Nitrogen has unique ability to form pπ − pπ multiple bonds with itself, carbon and oxygen.

● Nitrogen cannot form dπ − pπ bond as other heavier elements of its group.

Question7

'Spin only' magnetic moment is same for which of the following ions?

A. Ti^{3+}

B. Cr^{2+}

C. Mn^{2+}

D. Fe^{2+}

E. Sc^{3+}

Choose the most appropriate answer from the options given below.

[NEET 2024]

Options:

A.

B and D only

B.

A and E only

C.

B and C only

D.

A and D only

Answer: A

Solution:

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Ions	No. of unpaired electrons	Configuration
Ti^{3+}	1	$3d^1$
Cr^{2+}	4	$3d^4$
Mn^{2+}	5	$3d^5$
Fe^{2+}	4	$3d^6$
Sc^{3+}	0	$3d^0$

Spin only magnetic moment is given by $\sqrt{n(n+2)}$ BM

$\therefore Cr^{2+}$ and Fe^{2+} will have same spin only magnetic moment.

Question8

The E° value for the Mn^{3+}/Mn^{2+} couple is more positive than that of Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} due to change of

[NEET 2024]

Options:

A.

d^5 to d^4 configuration

B.

d^5 to d^2 configuration

C.

d^4 to d^5 configuration

D.

d^3 to d^5 configuration

Answer: C

Solution:

$E^\circ_{Mn^{3+}/Mn^{2+}} > E^\circ_{Cr^{3+}/Cr^{2+}}$ or $E^\circ_{Fe^{3+}/Fe^{2+}}$

Electronic configuration of $Mn^{3+} = [Ar]3d^4$

Electronic configuration of $Mn^{2+} = [Ar]3d^5$

Electronic configuration of $Cr^{3+} = [Ar]3d^3$

Electronic configuration of $Cr^{2+} = [Ar]3d^4$

As Mn^{3+} from d4 configuration goes to more stable d^5 configuration (Half filled), due to more exchange energy in d^5 configuration.

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Question9

The pair of lanthanoid ions which are diamagnetic is

[NEET 2024]

Options:

A.

Ce^{4+} and Yb^{2+}

B.

Ce^{3+} and Eu^{2+}

C.

Gd^{3*} and Eu^{3+}

D.

Pm^{3+} and Sm^{3+}

Answer: A

Solution:

Magnetic moment $\mu = \sqrt{n(n+2)}$

n⟶ number of unpaired electron

$Ce^{4+} \Rightarrow (Xe)\ 4f^0$

$\mu = 0$ Diamagnetic

$Yb^{2+} \Rightarrow (Xe)\ 4f^{14}$ ⇅ ⇅ ⇅ ⇅ ⇅ ⇅ ⇅

$\mu = 0$ Diamagnetic

$Ce^{3+} \Rightarrow (Xe)\ 4f^1$ 1 | | | | | |

$\mu = \sqrt{3}$ Paramagnetic

$Eu^{2+} \Rightarrow (Xe)\ 4f^7$ 1 1 1 1 1 1 1

$\mu = \sqrt{63}$ Paramagnetic

$Gd^{3+} \Rightarrow (Xe)\ 4f^7$ 1 1 1 1 1 1 1

$\mu = \sqrt{63}$ Paramagnetic

$Eu^{3+} \Rightarrow (Xe)\ 4f^6$ 1 1 1 1 1 1 |

$\mu = \sqrt{48}$ Paramagnetic

$Pm^{3+} \Rightarrow (Xe)\ 4f^4$ 1 1 1 1 | | |

$\mu = \sqrt{24}$ Paramagnetic

$Sm^{3+} \Rightarrow (Xe)\ 4f^5$ 1 1 1 1 1 | |

$\mu = \sqrt{35}$ Paramagnetic

Hence Ce^{4+} and Yb^{2+} are only diamagnetic.

Question10

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The stability of Cu^{2+} is more than Cu+salts in aqueous solution due to

[NEET 2023]

Options:

A.

Enthalpy of atomization

B.

Hydration energy

C.

Second ionisation enthalpy

D.

First ionisation enthalpy

Answer: B

Solution:

The stability of $Cu^{2+}(aq)$ is more than $Cu^{+}(aq)$ is due to the much more negative $\Delta hyd^{\circ}$of $Cu^{2+(aq)}$ than $Cu^{+}(aq)$, which more than compensates for second ionisation enthalpy of Cu.

$\Delta_{hyd}\ H^{\circ}$ of $Cu^{2+}(aq) = -2121\ kJ\,mol^{-1}$

$\Delta_i H_1^{\ 0}$ of $Cu = +745\ kJ\,mol^{-1}$

$\Delta_i H_2^{\ 0}$ of $Cu = +1960\ kJ\,mol^{-1}$

Question11

Which of the following statements are INCORRECT?

A. All the transition metals except scandium form MO oxides which are ionic.
B. The highest oxidation number corresponding to the group number in transition metal oxides is attained in Sc_2O_3 to Mn_2O_7.
C. Basic character increases from V_2O_3 to V_2O_4 to V_2O_5.
D. V_2O_4 dissolves in acids to give VO_4^{3-} salts.
E. CrO is basic but Cr_2O_3 is amphoteric.

Choose the correct answer from the options given below:

[NEET 2023]

Options:

A.

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B and D only

B.

C and D only

C.

B and C only

D.

A and E only

Answer: B

Solution:

All transitions metals except Sc from MO oxides which are ionic.
- The highest oxidation number corresponding to the group number in transition metal oxides in attained in Sc_2O_3 to Mn_2O_7.
- Acidic character increases from V_2O_3 to V_2O_4 to V_2O_5.
- V_2O_4 dissolves in acids to give VO^{2+}.
- CrO is basic but Cr_2O_3 is amphoteric.

Question12

Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :
Ionisation enthalpy increases along each series of the transition elements from left to right. However, small variations occur.

Reason (R) :
There is corresponding increase in nuclear charge which accompanies the filling of electrons in the inner d-orbitals.
In the light of the above statements, choose the most appropriate answer from the options given below :

[NEET 2023 mpr]

Options:

A.

(A) is correct but (R) is not correct.

B.

(A) is not correct but (R) is correct.

C.

Both (A) and (R) are correct and (R) is the correct explanation of (A).

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D.

Both (A) and (R) are correct but (R) is not the correct explanation of (A).

Answer: C

Solution:

Reason is the correct explanation of Assertion.

Question13

Given below are two statements : one is labelled as

Assertion (A) and the other is labelled as Reason (R).

Assertion (A) :- Ionisation enthalpies of early actinoids are lower than for early lanthanoids.

Reason (R) : Electrons are entering 5f orbitals in actinoids which experience greater shielding from nuclear charge.

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

[NEET 2023 mpr]

Options:

A.

(A) is true but (R) is false.

B.

(A) is false but (R) is true

C.

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

D.

Both (A) and (R) are true but (R) is not the correct explanation of (A).

Answer: C

Solution:

Reason in correct explanation the above Assertion.

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Question14

Gadolinium has a low value of third ionisation enthalpy because of [NEET-2022]

Options:

A. small size

B. high exchange enthalpy

C. high electronegativity

D. high basic character

Answer: B

Solution:

Electronic configuration of Gadolinium

Gd :- [Xe] $4f^7 5d^1 6s^2$

In case of 3^{rd} ionisation enthalpy electron will be removed from $5d$ and resultant configuration will be [Xe]4f $f^{\top}$ that is stable electronic configuration as it will have high exchange energy, hence less energy will be required to remove 3^{rd} electron.

Question15

Given below are half cell reactions:

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$

$$E^\circ_{Mn^{2+}/MnO_4^-} = -1.510V$$

$$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$$

$$E^\circ_{O_2/H_2O} = +1.223V$$

Will the permanganate ion, MnO_4^- liberate O_2 from water in the presence of an acid? [NEET-2022]

Options:

A. Yes, because $E^\circ_{cell} = +0.287V$

B. No, because $E^\circ_{cell} = -0.287V$

C. Yes, because $E^\circ_{cell} = +2.733V$

D. No, because $E^\circ_{cell} = -2.733V$

Answer: A

Solution:

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- $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2-} + 4H_2O$ . . . (i)

$E_{MnO_4^-/Mn^{2+}}^\circ = -E_{Mn^{2-}/MnO_4^-}^\circ = 1.51V$

$-H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$ . . . (ii)

$E_{O_2/H_2O}^\circ = 1.223V$

Using $2\times$ (i) $+5\times$ (ii), net cell reactions is

$2MnO_4^- + 6H^+ \longrightarrow 2Mn^{2+} + \frac{5}{2}O_2 + 3H_2O$

$E_{\text{cell}}^\circ = E_C^\circ - E_A^\circ = E_{MnO_4^-/Mn^{2+}}^\circ - E_{O_2/H_2O}^\circ = 1.51 - 1.223 = 0.287V$

Since $E_{\text{cell}}^0 > 0$, therefore net cell reaction is spontaneous and so MnO_4^- liberate O_2 from H_2O in presence of an acid.

Question16

If radius of second Bohr orbit of the He^+ ion is 105.8pm, what is the radius of third Bohr orbit of Li^{2+} ion? [NEET-2022]

Options:

A. 158.7pm

B. 15.87pm

C. 1.587pm

D. 158.7Å

Answer: A

Solution:

$r_n \propto \frac{n^2}{Z}$

$\frac{r_3(Li^{2-})}{r_2(He^-)} = \frac{(n_3)^2}{Z(Li^{2-})} \times \frac{Z(He^+)}{(n_2)^2}$

$\frac{r_3(Li^{2+})}{105.8} = \frac{(3)^2}{3} \times \frac{2}{(2)^2}$

$= 105.8 \times \frac{3}{2}$

$r_3(Li^{2+}) = 158.7pm$

Question17

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Decrease in size from left to right in actinoid series is greater and gradual than that in lanthanoid series due to :
[NEET Re-2022]

Options:

A. 5 f orbitals have greater shielding effect

B. 4 f orbitals are penultimate

C. 4 f orbitals have greater shielding effect

D. 5 f orbitals have poor shielding effect

Answer: D

Solution:

Due to large size of 5f orbitals their shielding effect is poor.

Question18

Given below are two statements:
Statement I: Cr^{2+} is oxidising and Mn^{3+} is reducing in nature.
Statement II: Sc^{3+} compounds are repelled by the applied magnetic field.
In the light of the above statements, choose the most appropriate answer from the options given below:
[NEET Re-2022]

Options:

A. Statement I is incorrect but Statement II is correct

B. Both Statement I and Statement II are correct

C. Both Statement I and Statement II are incorrect

D. Statement I is correct but Statement II is incorrect

Answer: A

Solution:

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Cr^{-2} : $[Ar]3d^4$

Cr^{-2} is reducing as its configuration changes from d^4 to $d^3(t_{2g}^3)$

Mn^{-3} is oxidising in nature.

Mn^{-2}: [Ar] $3d^5$ (extra stability)

Statement I is incorrect

Sc^{-3} : [Ar]

diamagnetic - repelled by magnetic field.

Statement (II) is correct.

Question19

The incorrect statement among the following is : [NEET 2021]

Options:

A. Actinoid contraction is greater for element to element than lanthanoid contraction

B. Most of the trivalent Lanthanoid ions are colorless in the solid state

C. Lanthanoids are good conductors of heat and electricity

D. Actinoids are highly reactive metals, especially when finely divided.

Answer: B

Solution:

● Actinoids are highly reactive metals, especially when finely divided
● Actinoid contraction is greater from element to element than lanthanoid contraction resulting from poor shielding by 5f electrons
● Many trivalent lanthanoids ions are coloured both in the solid state and in aqueous solutions.
● Lanthanoids have typical metallic structure and are good conductors of heat and electricity

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Question20

Which of the following reactions is the metal displacement reaction? Choose the right option. [NEET 2021]

Options:

A. $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

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B. $Cr_2O_3 + 2Al \xrightarrow{\Delta} Al_2O_3 + 2Cr$

C. $Fe + 2HCl \rightarrow FeCl_2 + H_2\uparrow$

D. $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2\uparrow$

Answer: B

Solution:

● Both reactions (1) and (4) are examples of decomposition reactions.
● Reactions (2) and (3), both are examples of displacement reactions, while reaction (2) is an example of metal displacement reaction.

Question21

Zr (Z = 40) and Hf (Z = 72) have similar atomic and ionic radii because of :
[NEET 2021]

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Options:

A. Belonging to same group

B. Diagonal relationship

C. Lanthanoid contraction

D. Having similar chemical properties

Answer: C

Solution:

● The cumulative effect of the contraction of the lanthanoid series, known as lanthanoid contraction, causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series.
● The almost identical radii of Zr (160 pm) and Hf (159 pm) is a consequence of the lanthanoid contraction.

Question22

Identify the incorrect statement.
(2019)

Options:

A. The transition metals and their compounds are known for their catalytic activity due to their ability to adopt multiple oxidation states and to form complexes.

B. Interstitial compounds are those that are formed when small atoms like H , C or N are

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trapped inside the crystal lattices of metals

C. The oxidation states of chromium in CrO_4^{2-} and $Cr_2O_7^{2-}$ are not the same.

D. $Cr^{2+}(d^4)$ is a stronger reducing agent than $Fe^{2+}(d^6)$ in water.

Answer: C

Solution:

Oxidation state of Cr in CrO_4^{2-} and $Cr_2O_7^{2-}$ is +6 i.e. oxidation states are same.

Question23

The manganate and permanganate ions are tetrahedral, due to (NEET 2019)

Options:

A. the π -bonding involves overlap of d -orbitals of oxygen with d -orbitals of manganese

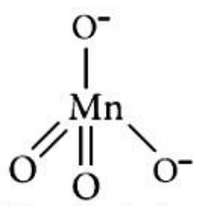
B. the π -bonding involves overlap of p -orbitals of oxygen with d -orbitals of manganese

C. there is no π -bonding

D. the π -bonding involves overlap of p -orbitals of oxygen with p -orbitals of manganese.

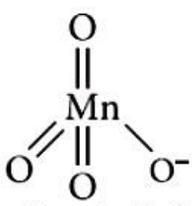
Answer: B

Solution:



Tetrahedral

Manganate ion (green)



Tetrahedral

Permanganate ion (purple)

In manganate and permanganate ions, π -bonding takes place by overlap of p -orbitals of oxygen with d -orbitals of manganese.

Question24

Match the catalyst with the process:

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Catalyst	Process
(i) V_2O_5	(p) The oxidation of ethyne to ethanal
(ii) $TiCl_4 + Al(CH_3)_3$	(q) Polymerisation of alkynes
(iii) $PdCl_2$	(r) Oxidation of SO_2 in the manufacture of H_2SO_4
(iv) Nickel complexes	(s) Polymerisation of ethylene

Which of the following is the correct option?
(Odisha NEET 2019)

Options:

A. (i)-(r), (ii)-(s), (iii)-(p), (iv)-(q)

B. (i)-(p), (ii)-(q), (iii)-(r), (iv)-(s)

C. (i)-(p), (ii)-(r), (iii)-(q), (iv)-(s)

D. (i)-(r), (ii)-(p), (iii)-(s), (iv)-(q)

Answer: A

Question25

When neutral or faintly alkaline $KMnO_4$ is treated with potassium iodide, iodide ion is converted into ′X′ . ′X′ is
(Odisha NEET 2019)

Options:

A. I_2

B. IO_4^-

C. IO_3^-

D. IO

Answer: C

Solution:

In neutral or faintly alkaline solutions:
$2MnO_4^- + H_2O + I^- \rightarrow 2MnO_2 + 2OH^- + IO_3^-$

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Question26

Which one of the following ions exhibits d − d transition and paramagnetism as well?
(NEET 2018)

Options:

A. CrO_4^{2-}

B. $Cr_2O_7^{2-}$

C. MnO_4^-

D. MnO_4^{2-}

Answer: D

Solution:

In CrO_4^{2-}	$Cr^{+6}(n = 0)$	diamagnetic
In CrO_7^{2-}	$Cr^{+6}(n = 0)$	diamagnetic
In MnO_4^-	$Mn^{+7}(n = 0)$	diamagnetic
In MnO_4^{2-}	$Mn^{+6}(n = 0)$	paramagnetic

In MnO_4^{2-}, one unpaired electron (n) is present in d -orbital so, d − d transition is possible.

Question27

Match the metal ions given in Column-I with the spin magnetic moments of the ions given in Column-II and assign the correct code:

Column-I	Column-II
A. Co^{3+}	(i) $\sqrt{8}$ B.M.
B. Cr^{3+}	(ii) $\sqrt{35}$ B.M.
C. Fe^{3+}	(iii) $\sqrt{3}$ B.M.
D. Ni^{2+}	(iv) $\sqrt{24}$ B.M.
	(v) $\sqrt{15}$ B.M.

(NEET 2018)

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Options:

A. A-(iv), B-(v), C-(ii), D-(i)

B. A-(i), B-(ii), C-(iii), D-(iv)

C. A-(iv), B-(i), C-(ii), D-(iii)

D. A-(iii), B-(v), C-(i), D-(ii)

Answer: A

Question28

Name the gas that can readily decolourise acidified $KMnO_4$ solution. (NEET 2017)

Options:

A. SO_2

B. NO_2

C. P_2O_5

D. CO_2

Answer: A

Solution:

SO_2 readily decolourises pink violet colour of acidified $KMnO_4$ solution.

$$\underset{\text{(Pink violet)}}{2KMnO_4} + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + \underset{\text{(Colourless)}}{2MnSO_4} + 2H_2SO_4$$

Question29

$HgCl_2$ and I_2 both when dissolved in water containing I^- ions, the pair of species formed is (NEET 2017)

Options:

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A. HgI_2, I^-

B. HgI_4^{2-}, I_3^-

C. Hg_2I_2, I^-

D. HgI_2, I_3^-

Answer: B

Solution:

$$HgCl_{2(aq)} + 4I^-_{(aq)} \rightarrow HgI_4^{2-}{}_{(aq)} + 2Cl^-_{(aq)}$$
$$I_{2(s)} + I^-(aq) \rightarrow I^-_{3(aq)}$$

Question30

The reason for greater range of oxidation states in actinoids is attributed to (NEET 2017)

Options:

A. actinoid contraction

B. 5f , 6d and 7s levels having comparable energies

C. 4f and 5d levels being close in energies

D. the radioactive nature of actinoids.

Answer: B

Solution:

Actinoids have a greater range of oxidation states due to comparable energies of 5f , 6d and 7s orbitals. Hence, all their electrons can take part in bond formation.

Question31

Which one of the following statements related to lanthanons is incorrect? (NEET-II 2016)

Options:

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A. Europium shows + 2 oxidation state.

B. The basicity decreases as the ionic radius decreases from Pr to Lu.

C. All the lanthanons are much more reactive than aluminium.

D. Ce(+4) solutions are widely used as oxidizing agent in volumetric analysis.

Answer: C

Solution:

The first few members of lanthanoid series are quite reactive, almost like calcium. However, with increasing atomic number, their behaviour becomes similar to that of aluminium.

Question32

Which one of the following statements is correct when SO_2 is passed through acidified $K_2Cr_2O_7$ solution?
(NEET-I 2016)

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Options:

A. SO_2 is reduced.

B. Green $Cr_2(SO_4)_3$ is formed.

C. The solution turns blue.

D. The solution is decolourised.

Answer: B

Solution:

$$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow \underset{\text{(Green)}}{K_2SO_4 + Cr_2(SO_4)_3} + H_2O$$

Question33

The electronic configurations of Eu (Atomic No. 63), Gd (Atomic No. 64) and Tb (Atomic No. 65) are
(NEET-I 2016)

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Options:

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A. $[Xe]4f^{6}5d^{1}6s^{2}$, $[Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f^{8}5d^{1}6s^{2}$

B. $[Xe]4f^{7}6s^{2}$, $[Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f^{9}6s^{2}$

C. $[Xe]4f^{7}6s^{2}$, $[Xe]4f^{8}6s^{2}$ and$[Xe]4f^{8}5d^{1}6s^{2}$

D. $[Xe]4f^{6}5d^{1}6s^{2}$, $[Xe]4f^{7}5d^{1}6s^{2}$ and $[Xe]4f^{9}6s^{2}$

Answer: B

Question34

Gadolinium belongs to 4f series. Its atomic number is 64. Which of the following is the correct electronic configuration of gadolinium?
(2015)

Options:

A. $[Xe]4f^{9}5s^{1}$

B. $[Xe]4f^{7}5d^{1}6s^{2}$

C. $[Xe]4f^{6}5d^{2}6s^{2}$

D. $[Xe]4f^{8}6d^{2}$

Answer: B

Question35

Assuming complete ionisation, same moles of which of the following compounds will require the least amount of acidified $KMnO_4$ for completer oxidation ?
(2015)

Options:

A. $FeSO_3$

B. FeC_2O_4

C. $Fe(NO_2)_2$

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D. $FeSO_4$

Answer: D

Solution:

$KMnO_4(Mn^{2+})$ changes to Mn^{2+} i.e., number of electron involved per mole of $KMnO_4$ is 5
(a) For $FeSO_3$
$Fe^{2+} \rightarrow Fe^{3+}$ (No. of e^-s involved = 1)
$SO_3^{2-} \rightarrow SO_4^{2-}$ (No. of e^-s involved = 2)
Total number of e^- s involved = 1 + 2 = 3
(b) For FeC_2O_4,
$Fe^{2+} \rightarrow Fe^{3+}$ (No of e^-s involved = 1)
$C_2O_4^{2-} \rightarrow 2CO_2$ (No. of e^-s involved = 2)
Total number of e^- s involved = 1 + 2 = 3
(c) For $Fe(NO_2)_2$
$Fe^{2+} \rightarrow Fe^{3+}$ (No. of e^-s involved = 1)
$2NO_2^- \rightarrow 2NO_3^-$ (No. of e^-s involved = 4)
Total number of e^-s involved = 1 + 4 = 5
(d) For $FeSO_4$
$Fe^{2+} \rightarrow Fe^{3+}$ (No.of e^-s involved = 1)
Total number of e^-s involved = 1
As $FeSO_4$ requires least number of electrons thus,it wil require least amount of $KMnO_4$

Question36

Magnetic moment 2.84 B.M. is given by (At. nos. Ni = 28, Ti = 22, Cr = 24, Co = 27) (2015) Cancelled

Options:

A. Cr^{2+}

B. Co^{2+}

C. Ni^{2+}

D. Ti^{2+}

Answer: C

Solution:

Magnetic moment (μ) = $\sqrt{n(n+2)}$
2.84 B.M.corresponds to 2 unpaired electrons.
$Cr^{2+} - 3d^4$, 4unpaired electrons
$CO^{2+} - 3d^7$, 3unpaired electrons

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$Ni^{2+} - 3d^8$, 2unpaired electrons
$Ti^{3+} - 3d^1$, 1unpaired electrons

Question37

Which of the following processes does not involve oxidation of iron? (2015 Cancelled)

©

Options:

A. Formation of $Fe(CO)_5$ from Fe

B. Liberation of H_2 from steam by iron at high temperature.

C. Rusting of iron sheets.

D. Decolourisation of blue $CuSO_4$ solutiion by iron

Answer: A

Solution:

Solution:
Oxidation number of Fe in $Fe(CO)_5$ is zero

Question38

Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii? (Numbers in the parenthesis are atomic numbers) (2015 Cancelled)

©

Options:

A. Zr(40) and Hf(72)

B. Zr(40) and Ta(73)

C. Ti(22) and Zr(40)

D. Zr(40) and Nb(41)

Answer: A

Solution:

Zr and Hf have nearly same radii due to lanthanoid contraction.

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Question39

The reaction of aqueous $KMnO_4$ with H_2O_2 in acidic conditions gives (2014)

Options:

A. Mn^{4+} and O_2

B. Mn^{2+} and O_2

C. Mn^{2+} and O_3

D. Mn^{4+} and MnO_2

Answer: B

Solution:

Hydrogen peroxide is oxidised to H_2O and O_2
$2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$
or,$2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$

Question40

Magnetic moment 2.83 BM is given by which of the following ions? (At. nos. Ti = 22, Cr = 24, Mn = 25, Ni = 28) (2014)

Options:

A. Ti^{3+}

B. Ni^{2+}

C. Cr^{3+}

D. Mn^{2+}

Answer: B

Solution:

Magnetic moment is given by
$\mu = \sqrt{n(n+2)}$ B.M [where n=no .of unpaired electrons]

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when n = 2,then μ = 2.83 B.M
For Ti^{3+}, n = 1 : $Cr^{3+}(3d^3)$, n = 3
$Ni^{3+}(3d^8)$, n = 2; Mn^{2+}, n = 5
Hence,Ni^{2+} has two unpaired electrons, with magnetic moment 2.83 B.M.

Question41

Reason of lanthanoid contraction is (2014)

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Options:

A. negligible screening effect of ‘f ’-orbitals

B. increasing nuclear charge

C. decreasing nuclear charge

D. decreasing screening effect.

Answer: A

Solution:

Solution:
Due to poor shielding effect of 4f-orbitals, nucleus will exert a strong attraction and size of atom or ion goes on decreasing as move in the series with increase in atomic number.

Question42

Which of the following statements about the interstitial compounds is incorrect? (NEET 2013)

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Options:

A. They are much harder than the pure metal.

B. They have higher melting points than the pure metal.

C. They retain metallic conductivity.

D. They are chemically reactive.

Answer: D

Solution:

Interstitial compounds are generally chemically inert.

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Question43

Which of the following lanthanoid ions is diamagnetic? (At. nos. Ce = 58, Sm = 62, Eu = 63, Yb = 70)
(2013 NEET)

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Options:

A. Eu^{2+}

B. Yb^{2+}

C. Ce^{2+}

D. Sm^{2+}

Answer: B

Solution:

$Sm^{2+}(Z = 62) : [Xe]4f^{6}$
$Eu^{2+}(Z = 63) : [Xe]4f^{7}$
$Yb^{2+}(Z = 70) : [Xe]4f^{14}$
$Ce^{2+}(Z = 58) : [Xe]4f^{1}5d^{1}$
only Yb^{2+} is diamagnetic

Question44

Identify the correct order of solubility in aqueous medium,
(2013 NEET)

©

Options:

A. $Na_2S > CuS > ZnS$

B. $Na_2S > ZnS > CuS$

C. $CuS > ZnS > Na_2S$

D. $ZnS > Na_2S > CuS$

Answer: B

Solution:

Sodium sulphide is soluble in water. The solubility product (and hence solubility) of ZnS is larger than that of CuS.

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Question45

Sc(Z = 21) is a transition element but Zn (Z = 30) is not because (Karnataka NEET 2013)

Options:

A. both Sc^{3+} and Zn^{2+} ions are colourless and form white compounds.

B. in case of Sc, 3d orbitals are partially filled but in Zn these are filled.

C. last electron is assumed to be added to 4s level in case of Zn.

D. both Sc and Zn do not exhibit variable oxidation states.

Answer: B

Solution:

Solution:
Sc(Z = 21) has incompletely filled 3d -orbitals in its ground state ($3d^1$), it is considered as a transition element but Zn(Z = 30) has completely filled d -orbitals ($3d^{10}$) in its ground state and its common oxidation state of (+2), it is not considered as a transition element.

Question46

Identify the alloy containing a non-metal as a constituent in it. (2012)

Options:

A. Invar

B. Steel

C. Bell metal

D. Bronze

Answer: B

Solution:

Invar ⇒ Ni(metal)+ Fe(metal)
Steel ⇒ C(non-metal) + Fe(metal)
Bell ⇒ Cu(metal) + Sn(metal) + Fe(metal)
Bronze ⇒ Cu(metal) + Sn(metal)

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Question47

Which of the statements is not true?
(2012)

Options:

A. On passing H_2S trough acidified $K_2Cr_3O_7$ solution a milky colour is observed

B. $Na_2Cr_2O_7$ is preferred over $K_2Cr_2O_7$ in volumetric analysis

C. $K_2Cr_2O_7$ solution in acidic medium is orange

D. $K_2Cr_2O_7$ solution becomes yellow on increasing th pH beyond 7.

Answer: B

Question48

The catalytic activity of transition metals and their compounds is ascribed mainly to
(2012 Mains)

Options:

A. their magnetic behaviour

B. their unfilled d-orbitals

C. their ability to adopt variable oxidation states

D. their chemical reactivity

Answer: C

Question49

Which of the following exhibits only +3 oxidation state?
(2012 Mains)

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Options:

A. U

B. Th

C. Ac

D. Pa

Answer: C

Solution:

U exhibits + 3, + 4, + 5, + 6
Th exhibits + 3, + 4 ; Ac exhibits + 3 only
Pa exhibits + 3, + 4, + 5

Question50

Which one of the following does not correctly represent the correct order of the property indicated against it? (2012 Mains)

Options:

A. $Ti < V < Cr < Mn$; increasing number of oxidation states

B. $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$: increasing magnetic moment

C. $Ti < V < Cr < Mn$: increasing melting points

D. $Ti < V < Mn < Cr$: increasing 2nd ionization enthalpy

Answer: C

Solution:

Element
$Ti < V < Cr < Mn$

No. of oxidation states 3 4 5 6
Given order is correct
Magnetic moment (μ) = $\sqrt{n(n+2)}$ B.M
For Ti^{3+} $n = 1$, $\mu = \sqrt{1(1+2)} = \sqrt{3}$ B.M.
For V^{3+} $n = 2$, $\mu = \sqrt{2(2+2)} = \sqrt{8}$ B.M
For Cr^{3+} $n = 3$, $\mu = \sqrt{3(3+2)} = \sqrt{15}$ B.M
For Mn^{3+} $n = 4$, $\mu = \sqrt{4(4+2)} = \sqrt{24}$ B.M
Thus magnetic moment : $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$
Melting point order : Mn < Ti < Cr < V
1245°C 1668°C 875°C 1900°C

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2nd ionisation enthalpy order

	Ti	<	V	<	Mn	<	Cr
kJ/mol	1320		1376		1513		1635

Question51

Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^{\circ}_{M^{2+}/M}\right)$ value has a positive sign ?
(2012 Mains)

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Options:

A. Co (Z=27)

B. Ni (Z=28)

C. Cu (Z=29)

D. Fe (Z=26)

Answer: C

Solution:

Element	Co	Ni	Cu	Fe
$E^{\circ}_{\frac{M^{2+}}{M}}(V)$	-0.28	-0.25	+.034	-0.44

Question52

For the four successive transition elements (Cr, Mn, Fe and Co), the stability of +2 oxidation state will be there in which of the following order?
(At. nos. Cr = 24, Mn = 25, Fe = 26, Co = 27)
(2011)

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Options:

A. Mn > Fe > Cr > Co

B. Fe > Mn > Co > Cr

C. Co > Mn > Fe > Cr

D. Cr > Mn > Co > Fe

Answer: A

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Solution:

The order can be explained using the idea of spin correlation. Spin correlation refers to lowering of energy for like (parallel) spins. Spin correlation leading to decrease in repulsion for electrons of like spins than for electrons of different spins is called exchange energy.
Spin correlation and its exchange energy gives an electronic configuration a special stability which is greatest for half-filled electronic configurations.
$Mn^{2+}(d^5)$ gets stabilisation due to half-filled configuration.In $Fe^{2+}(d^6)$ the placing of one extra electron in a subshell destabilises. Placing of 2 electrons in $Co^{2+}(d^7)$ destabilisesit more.$Cr^{2+}(d^4)$ has one vacant subshell. Fe^{2+} gets more Stabilisation compared to Cr^{2+} through exchange energy. So the order is as follows:
Mn > Fe > Cr > Co

Question53

Acidified $K_2Cr_2O_7$ solution turns green when Na_2SO_3 is added to it.This is due to the formation of (2011)

©

Options:

A. $Cr_2(SO_4)_3$

B. CrO_4^{2-}

C. $Cr_2(SO_3)_3$

D. $CrSO_4$

Answer: A

Solution:

$K_2Cr_2O_7 + 4H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$
$[Na_2SO_3 + [O] \rightarrow Na_2SO_4] \times 3$

$K_2Cr_2O_7 + 3Na_2SO_3 + 4H_2SO_4 \rightarrow 3Na_2SO_4 + K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O$
or $Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \rightarrow 3SO_4^{2-} + 2Cr^{3+} + 4H_2O$

Question54

Which of the following ions will exhibit colour in aqueous solutions? (2010)

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Options:

A. $La^{3+}(Z = 57)$

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B. $Ti^{3+}(Z = 22)$

C. $Lu^{3+}(Z = 71)$

D. $Sc^{3+}(Z + 21)$

Answer: B

Solution:

Solution:
$Ti^{3+}(Z = 22)$
Ions which have unpaired electrons exhibit colour in solution.
Ti^{3+} has an outer electronic configuration of $4s^0 3d^1$, i.e.,
1 unpaired electron
Thus its solution will be coloured
$Sc^{3+} \rightarrow d^0$.
In case of La^{3+}, $4f^0$ configuration is present and in Lu^{3+}, $4f^{14}$ is present,So,there is no possibility of f - f transition, hence these ions do not appear coloured.

Question55

Which of the following ions has electronic configuration [Ar]$3d^6$? (At. nos. Mn = 25, Fe = 26, Co = 27, Ni = 28) (2010)

Options:

A. Ni^{3+}

B. Mn^{3+}

C. Fe^{3+}

D. Co^{3+}

Answer: D

Solution:

The electronic configuration of the given ions is :
Ni^{3+} : [Ar]$3d^7 4s^0$, Mn^{3+} : [Ar]$3d^4 4s^0$
Fe^{3+} : [Ar]$3d^5 4s^0$, Co^{3+}; [Ar]$3d^6 4s^0$.
Thus Co^{3+} is the ion with the desired configuration.

Question56

Which of the following pairs has the same size? (2010)

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Options:

A. Fe^{2+}, Ni^{2+}

B. Zr^{4+}, Ti^{4+}

C. Zr^{4+}, Hf^{4+}

D. Zn^{2+}, Hf^{4+}

Answer: C

Solution:

Solution:
Hf^{4+} and Zr^{4+} belong to group IVB.But,Hf^{4+} has same size as Zr^{4+} due to the addition of 14 lanthanide elements before it in which electrons are added into the f-subshell which poorly shield the outer electrons and contraction in size occurs.

Question57

Which of the following oxidation states is the most common among the lanthanoids?
(2010 Mains)

Options:

A. 4

B. 2

C. 5

D. 3

Answer: D

Solution:

Solution:
The common stable oxidation state of all the lanthanoids is +3. The oxidation state of +2 and +4 are also exhibited by some of the elements. These oxidation states are only stablein those cases where stable $4f^0$, $4f^7$ or $4f^{14}$ configurations are achieved.

Question58

Match List I (substances) with List II (processes) employed in the manufacture of the substances and select the correct option.

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List -I (Substances)	List - II (Processes)
(a) Sulphuric acid	(i) Haber's process
(b) Steel	(ii) Bessemer's Process
(c) Sodium hydroxide	(iii) Leblane process
(d) Ammonia	(iv) Contact process

(2010 Mains)

Options:

A. a - (i), b - (iv), c - (ii), d - (iii)

B. a - (i), b - (ii), c - (iii), d - (iv)

C. a - (iv), b - (iii), c - (ii), d - (i)

D. a - (iv), b - (ii), c - (iii), d - (i)

Answer: D

Question59

Which one of the elements with the following outer orbital configurations may exhibit the largest number of oxidation states? (2009)

Options:

A. $3d^5 4s^1$

B. $3d^5 4s^2$

C. $3d^2 4s^2$

D. $3d^3 4s^2$

Answer: B

Solution:

Greater the number of valence electrons, more will be the number of oxidation states exhibited by the element. Option (a) : $3d^5 4s^1$, can show a maximum of 6 oxidation states
Option (b) : $3d^5 4s^2$, can show a maximum of 7 oxidation states.
Option (c) : $3d^2 4s^2$ can show a maximum of 4 oxidation states.

Option (d) : $3d^3 4s^2$ can show a maximum of 5 oxidation states.

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Question60

The correct order of decreasing second ionisation enthalpy of Ti(22), V(23), Cr(24) and Mn(25) is
(2008)

Options:

A. Mn > Cr > Ti > V

B. Ti > V > Cr > Mn

C. Cr > Mn > V > Ti

D. V > Mn > Cr > Ti

Answer: C

Solution:

Electronic configuration of the given elements arc
$Mn \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^2$
$Cr \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$
$Ti \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^2$
$V \rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
In general, ionization potential (both 1st and 2nd) increases from left to right across the period due to increase in effective nuclear charge. On this basis, the second IP values should exhibit the trend:
Mn > Cr > V > Ti
But the actual observed order is: Cr > Mn > V > Ti Practically, only chromium is exceptional and rest others show the normal trend. This exceptional behavior of chromium is ($3d^5$) that it achieves after the loss of first electron.due to the stable configuration

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Question61

Which one of the following ions is the most stable in aqueous solution? (At. No. Ti = 22, V = 23, Cr = 24, Mn = 25)
(2007)

Options:

A. V^{3+}

B. Ti^{3+}

C. Mn^{3+}

D. Cr^{3+}

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Answer: D

Solution:

Solution:
+4 is the most stable oxidation state of vanadium and titanium. Mn^{3+} is not stable.Mn^{2+}, rather than Mn^{3+} is much more stable in aqueous solution. For chromium, +3 oxidation state is most stable in aqueous solution

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Question62

Identify the incorrect statement among the following:
(2007)

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Options:

A. Lanthanoid contraction is the accumulation of successive shrinkages.

B. As a result of lanthanoid contraction, the properties of 4d series of the transition elements have no similarities with the 5d series of elements.

C. Shielding power of 4f electrons is quite weak.

D. There is a decrease in the radii of the atoms or ions as one proceeds from La to Lu.

Answer: B

Solution:

In each vertical column of transition elements, the elements of second and third transition series resemble each other more closely than the elements of first and secondtransition series on account of lanthanide contraction. Hence the properties of elements of 4d series of the transition elements resemble with the properties of the elements of 5d series of the transition elements.

Question63

In which of the following pairs are both the ions coloured in aqueous solution?
(At. no. : Sc = 21, Ti = 22, Ni = 28, Cu = 29, Co = 27)
(2006)

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Options:

A. Ni^{2+}, Cu^{2+}

B. Ni^{2+}, Ti^{3+}

C. Sc^{3+}, Ti^{3+}

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D. Sc^{3+}, Co^{2+}

Answer: B

Solution:

Sc → [Ar]3d ^{1}4s^{2}, Sc^{3+} → [Ar]
T i → [Ar]3d ^{2}4s^{2}, T i^{3+} → [Ar]3d ^{1}
N i → [Ar]3d ^{8}4s^{2}, N i^{2+} → [Ar]3d ^{8}
Cu → [Ar]3d ^{10}4s^{1}, Cu^{+} → [Ar]3d ^{10}
Co → [Ar]3d ^{7}4s^{2}, Co^{2+} → [Ar]3d ^{7}
T i^{3+}, N i^{2+} and Co^{2+} are coloured due to presence of unpaired electrons.

Question64

Copper sulphate dissolves in excess of KCN to give (2006)

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Options:

A. $Cu(CN)_2$

B. CuCN

C. $[Cu(CN)_4]^{3-}$

D. $[Cu(CN)_4]^{2-}$

Answer: C

Solution:

First cupric cyanide is formed which decomposes to give cuprous cyanide and cyanogen gas. Cuprous cyanide dissolves in excess of potassium cyanide to form a complex, potassium cyanide $[K_3Cu(CN)_4]$

$[CuSO_4 + 2KCN \rightarrow Cu(CN)_2 + K_2SO_4] \times 2$

$2Cu(CN)_2 \rightarrow Cu_2(CN)_2 + (CN)_2$

$Cu_2(CN)_2 + 6KCN \rightarrow 2K_3Cu(CN)_4$

$2CuSO_4 + 10KCN \rightarrow 2K_3Cu(CN)_4 + 2K_2SO_4 + (CN)_2$

Question65

More number of oxidation states are exhibited by the actinoids than by the lanthanoids. The main reason for this is (2006, 2005)

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Options:

A. more active nature of the actinoids

B. more energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals

C. lesser energy difference between 5f and 6d orbitals than that between 4f and 5d orbitals

D. greater metallic character of the lanthanoids than that of the corresponding actinoids

Answer: C

Solution:

The 5f-orbitals extend into space beyond the 6s and 6p-orbitals and participate in bonding. This is in direct contrast to the lanthanides where the 4f orbitals are buried deep inside in the atom, totally shielded by outer orbitals and thus unable to take part in bonding.

Question66

The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is
(2005)

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Options:

A. one

B. two

C. five

D. one fifth

Answer: B

Solution:

In alkaline medium :

$2KMnO_4 + H_2O \rightarrow 2\,KOH + 2MnO_2 + 3[O]$

$KI + 3[O] \rightarrow KIO_3$

$2KMnO_4 + KI + H_2O \rightarrow 2\,KOH + 2MnO_2 + KIO_3$

Question67

Four successive members of the first row transition elements are listed below with their atomic numbers. Which one of them is expected to have the highest third ionisation enthalpy?

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(2005)

Options:

A. Vanadium (Z = 23)

B. Chromium (Z = 24)

C. Manganese (Z = 25)

D. Iron (Z = 26)

Answer: C

Solution:

$V^{2+}(21)$ $[Ar]3d^{3}4s^{0}$

$Cr^{2+}(22)$ $[Ar]3d^{4}4s^{0}$

$Mn^{2+}(23)$ $[Ar]3d^{5}4s^{0}$

$Fe^{2+}(24)$ $[Ar]3d^{5}4s^{1}$

$\Rightarrow I.E_3(Mn) > I.E_3(Fe) > I.E_3(Cr) > I.E_3(V)$

Question68

The aqueous solution containing which one of the following ions will be colourless? (Atomic number : Sc = 21, Fe = 26 Ti = 22, Mn = 25) (2005)

Options:

A. Sc^{3+}

B. Fe^{2+}

C. Ti^{3+}

D. Mn^{2+}

Answer: A

Solution:

If the transition metal ion has unpaired electron then it shows colour.
Sc^{3+} : $[Ar]3d^{0}4s^{0}$
Fe^{2+} : $[Ar]3d^{5}4s^{1}$
Ti^{3+} : $[Ar]3d^{1}4s^{0}$
Mn^{2+} : $[Ar]3d^{5}4s^{0}$
Sc^{3+} do not contain unpaired electron, hence it will not undergo $d-d$ transition and do not show colour.

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Question69

Among the following series of transition metal ions, the one where all metal ions have $3d^2$ electronic configuration is
[At. nos. Ti = 22, V = 23, Cr = 24, Mn = 25]
(2004)

Options:

A. Ti^{3+}, V^{2+}, Cr^{3+}, Mn^{4+}

B. Ti^{+}, V^{4+}, Cr^{6+}, Mn^{7+}

C. Ti^{4+}, V^{3+}, Cr^{2+}, Mn^{3+}

D. Ti^{2+}, V^{3+}, Cr^{4+}, Mn^{5+}

Answer: D

Solution:

$_{22}Ti = 3d^2 4s^2$; $Ti^{2+} = 3d^2$
$_{23}V = 3d^3 4s^2$; $V^{3+} = 3d^2$
$_{24}Cr = 3d^4 4s^2$; $Cr^{4+} = 3d^2$
$_{25}Mn = 3d^5 4s^2$; $Mn^{5+} = 3d^2$

Question70

Lanthanoids are
(2004)

Options:

A. 14 elements in the sixth period (atomic no. 90 to 103) that are filling 4f sublevel

B. 14 elements in the seventh period (atomic number = 90 to 103) that are filling 5f sublevel

C. 14 elements in the sixth period (atomic number = 58 to 71) that are filling the 4f sublevel

D. 14 elements in the seventh period (atomic number = 50 to 71) that are filling 4f sublevel.

Answer: C

Solution:

As sixth period can accommodate only 18 elements in the table, 14 members of 4f series (atomic number 58 to 71) are

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separately accommodated in a horizontal row below the periodic table. These are called as lanthanides.

Question71

Which one of the following characteristics of the transition metals is associated with their catalytic activity?
(2003)

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Options:

A. High enthalpy of atomization

B. Paramagnetic behaviour

C. Colour of hydrated ions

D. Variable oxidation states

Answer: D

Solution:

The transition elements, on account of their variable valency, are able to form unstable intermediate compounds very readily.

Question72

The basic character of the transition metal monoxides follows the order (Atomic no's. Ti = 22, V = 23, Cr = 24, Fe = 26)
(2003)

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Options:

A. VO > CrO > TiO > FeO

B. CrO > VO > FeO > TiO

C. TiO > FeO > VO > CrO

D. TiO > VO > CrO > FeO

Answer: D

Solution:

The order of basicity of transition metal oxide is, TiO > VO > CrO > FeO

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Question73

The correct order of ionic radii of Y^{3+} La^{3+}, Eu^{3+} and Lu^{3+} is(At. nos. Y = 39, La = 57, Eu = 63, Lu = 71) (2002)

Options:

A. $Y^{3+} < La^{3+} < Eu^{3+} < Lu^{3+}$

B. $Y^{3+} < Lu^{3+} < Eu^{3+} < La^{3+}$

C. $Lu^{3+} < Eu^{3+} < La^{3+} < Y^{3+}$

D. $La^{3+} < Eu^{3+} < Lu^{3+} < Y^{3+}$

Answer: B

Solution:

On going from La^{3+} to Lu^{3+}, the ionic radius shrinks from 1.15Å to 0.93Å (lanthanide contraction). The radius of La^{3+} is also larger than that of Y^{3+} ion which lies immediately above it in periodic table.

Question74

General electronic configuration of lanthanides is (2002)

Options:

A. $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

B. $(n-2)f^{10-14}(n-1)d^{0-1}ns^2$

C. $(n-2)f^{0-14}(n-1)d^{10}ns^2$

D. $(n-2)d^{0-1}(n-1)f^{1-14}ns^2$

Answer: A

Solution:

The general electronic structure of lanthanides is, $(n-2)f^{1-14}(n-1)s^2p^6d^{0-1}ns^2$

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Question75

An atom has electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$, you will place it in
(2002)

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Options:

A. fifth group

B. fifteenth group

C. second group

D. third group.

Answer: A

Solution:

The electronic configuration of an atom: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$
In the configuration, the last electron of the atom is filled in d sub-shell as $3d^3$. Thus, this element belongs to d -block of the periodic table with group no. V.

Question76

Which of the following shows maximum number of oxidation states?
(2002, 2000, 1994)

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Options:

A. Cr

B. Fe

C. Mn

D. V

Answer: C

Solution:

Each of the element in group III B to VII B can show the maximum oxidation state equal to its group number. Mn is in group seven shows a maximum oxidation state of +7 in $KMnO_4$.

Question77

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Zn gives H_2 gas with H_2SO_4 and HCl but not with HNO_3 because (2002)

Options:

A. Zn act as oxidising agent when react with HNO_3

B. HNO_3 is weaker acid than H_2SO_4 and HCl

C. In electrochemical series Zn is above hydrogen

D. NO_3^- is reduced in preference to hydronium ion.

Answer: D

Solution:

Zinc is on the top position of hydrogen in electrochemical series. So, Zn displaces H_2 from dilute H_2SO_4 and HCl with liberation of H_2.
$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
On the other hand HNO_3 is an oxidising agent. Hydrogen obtained in this reaction is converted into H_2O.
$Zn + 4HNO_3 \rightarrow Zn(NO_3)_2 + 2NO_2 + 2H_2O$

Question78

Which of the following statement is not correct? (2001)

Options:

A. $La(OH)_3$ is less basic than $Lu(OH)_3$.

B. In lanthanide series ionic radius of Ln^{+3} ion decreases.

C. La is actually an element of transition series rather lanthanides.

D. Atomic radius of Zn and Hf are same because of lanthanide contraction.

Answer: A

Solution:

$La(OH)_3$ is more basic than $Lu(OH)_3$. In lanthanides the basic character of hydroxides decreases as the ionic radius decreases.

Question79

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The most convenient method to protect the bottom of ship made of iron is
(2001)

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Options:

A. coating it with red lead oxide

B. white tin plating

C. connecting it with Mg block

D. connecting it with Pb block.

Answer: B

Solution:

The most convenient method to protect the bottom of the ship made of iron is white tin plating preventing the build up of barnacles.

Question80

Which ion is colourless?
(2000)

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Options:

A. Cr^{4+}

B. Sc^{3+}

C. Ti^{3+}

D. V^{3+}

Answer: B

Solution:

$21\ Sc \rightarrow [Ar]3d^{1}4s^{2}$
In Sc^{3+} there is no unpaired 'd electrons, therefore it is colourless ion in its solution.

Question81

Which of the following configuration is correct for iron?

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(1999)

Options:

A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^7$

B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5$

D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

Answer: D

Question82

Which of the following has more unpaird d -electrons?
(1999)

Options:

A. N^{3+}

B. Fe^{2+}

C. Zn^{+}

D. Cu^{+}

Answer: B

Question83

Bell metal is an alloy of
(1999)

Options:

A. Cu + Zn

B. Cu + Sn

C. Cu + Pb

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D. Cu + Ni

Answer: B

Solution:

Solution:
Bell metal ⇒Cu = 80%, Sn = 20% It is used for making bells, utensils, etc.

Question84

In which of the following compounds transition metal has zero oxidation state?
(1999)

Options:

A. $NOClO_4$

B. NH_2NH_2

C. CrO_5

D. $[Fe(CO)_5]$

Answer: D

Solution:

In Iron carbonyl the oxidation number of 'Fe' is zero.
$[Fe(CO)_5] \rightarrow x + 5 \times 0 = 0 \Rightarrow x = 0$

Question85

Which one of the following elements constitutes a major impurity in pig iron?
(1998)

Options:

A. Sulphur

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B. Oxygen

C. Silicon

D. Carbon

Answer: D

Solution:

Solution:
Pig iron is the impure form of iron, which contains carbon as the major impurity, i.e. 2.5 to 5%.

Question86

Which one of the following ionic species will impart colour to an aqueous solution?
(1998)

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Options:

A. Zn^{2+}

B. Cu^{+}

C. Ti^{4+}

D. Cr^{3+}

Answer: D

Solution:

Solution:
$Cr^{3+}(21) \rightarrow 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^3$
As Cr^{3+} ion has three unpaired electrons in its valence shell, so it imparts green colour to an aqueous solution.

Question87

Which one of the following elements shows maximum number of different oxidation states in its compounds?
(1998)

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Options:

A. Gd

B. La

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C. Eu

D. Am

Answer: D

Solution:

'La forms compounds in which its oxidation no. is +3.
'Eu' and 'Gd' exhibit +2 as well as +3 oxidation state and not higher than that, due to stable (f^7) configuration. whereas 'Am' exhibits the oxidation states $+2$, $+3$, $+4$, $+5$, $+6$, etc. due to extremely large size and low ionisation energy.

Question88

Without losing its concentration, $ZnCl_2$ solution cannot be kept in contact with
(1998)

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Options:

A. Pb

B. Al

C. Au

D. Ag

Answer: B

Solution:

Only 'Al' lies above 'Zn' in electrochemical series, which can displace the later from $ZnCl_2$ solution. Therefore conc. of $ZnCl_2$ will decrease when kept in 'Al' container.
$2\,Al + 3ZnCl_2 \rightarrow 2AlCl_3 + 3\,Zn$

Question89

The lanthanide contraction is responsible for the fact that
(1997)

Options:

A. Zr and Hf have about the same radius

B. Zr and Zn have the same oxidation state

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C. Zr and Y have about the same radius

D. Zr and Nb have similar oxidation state.

Answer: A

Solution:

Due to lanthanide contration the size for Zr and Hf is same. Lanthanide contraction can be explained on the basis of shielding effect.In multi-electron atoms the electrons are added in outer shells. The electrons already present in inner shells, shield the outer electrons from nuclear charge, making them experience a lower effective charge of the nucleus. The shielding effect exerted by the inner electrons decreases in the order s > p > d > f . This f subshell poorly shields the outer electron from nuclear attraction which results in more attractive pull of nucleus on outer electron and smaller size.In case of post lanthenide elements like Hf, 4f subshell is filled and it is not very effective at shielding the outer shell (n=5 and n=6) electrons. it is similar to Zr.

Question90

Which of the following element is responsible for oxidation of water to O_2 in biological processes?
(1997)

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Options:

A. Cu

B. Mo

C. Fe

D. Mn

Answer: C

Question91

The electronic configuration of gadolinium (Atomic No. = 64) is
(1997)

Options:

A. $[Xe]4f^{3}5d^{5}6s^{2}$

B. $[Xe]4f^{6}5d^{2}6s^{2}$

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C. $[Xe]4f^{8}5d^{9}6s^{2}$

D. $[Xe]4f^{7}5d^{1}6s^{2}$

Answer: D

Solution:

Half-filled and fully filled orbitals are more stable.

Question92

$K_2Cr_2O_7$ on heating with aqueous NaOH gives (1997)

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Options:

A. $Cr_2O_7^{2-}$

B. $Cr(OH)_2$

C. CrO_4^{2-}

D. $Cr(OH)_3$

Answer: C

Solution:

$K_2Cr_2O_7 + 2\,NaOH \rightarrow K_2CrO_4 + Na_2CrO_4 + H_2O$
or $Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

Question93

A transition element X has a configuration $[Ar]3d^4$ in its +3 oxidation state. Its atomic number is (1996)

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Options:

A. 22

B. 19

C. 25

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D. 26

Answer: C

Solution:

The metal atom will have three more electrons. Therefore, the atomic number of the metal = (18) + 4 + 3 = 25

Question94

When calomel reacts with NH_4OH, we get (1996)

Options:

A. Hg_2O

B. HgO

C. $HgNH_2Cl$

D. $NH_2 - Hg - Hg - Cl$

Answer: C

Solution:

When calomel reacts with NH_4OH, it turns black due to the formation of a mixture of mercury and ammonium basic mercury (II) chloride.

$Hg_2Cl_2 + 2NH_4OH \rightarrow NH_4Cl + 2H_2O + Hg + HgNH_2Cl$

(Calomel)

Question95

The electronic configuration of transition elements is exhibited by (1996)

Options:

A. ns^1

B. ns^2np^5

C. $ns^2(n-1)d^{1-10}$

D. $ns^2(n-1)d^{10}$

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Answer: C

Solution:

General electronic configuration of transition elements is $ns^2(n-1)d^{1-10}$.

Question96

$KMnO_4$ reacts with oxalic acid according to the equation
$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
Here 20 mL of 0.1M $KMnO_4$ is equivalent to
(1996)

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Options:

A. 50 mL of 0.5M $C_2H_2O_4$

B. 20 mL of 0.1M $C_2H_2O_4$

C. 20 mL of 0.5M $C_2H_2O_4$

D. 50 mL of 0.1M $C_2H_2O_4$

Answer: D

Solution:

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$
$\therefore$ 2 moles of $MnO_4^- \equiv$ 5 moles of $C_2O_4^{2-}$
20 mL of 0.1M $KMnO_4$ = 2 mmol of $KMnO_4$
Also, 50 mL of 0.1M $C_2H_2O_4 \equiv$ 5 mmol of $C_2O_4^{2-}$
Therefore, these are equivalent.

Question97

Amongst TiF_6^{2-}, CoF_6^{3-}, Cu_2Cl_2 and $NiCl_4^{2-}$ which are the colourless species? (Atomic number of Ti = 22, Co = 27, Cu = 29, Ni = 28)
(1995)

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Options:

A. CoF_6^{3-} and $NiCl_4^{2-}$

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B. TiF_6^{2-} and Cu_2Cl_2

C. Cu_2Cl_2 and $NiCl_4^{2-}$

D. TiF_6^{2-} and CoF_6^{3-}

Answer: B

Solution:

In TiF_6^{2-} titanium is in +4 state. In Cu_2Cl_2, the copper is in +1 state. Thus, in both cases, transition from one d -orbital to other is not possible.
Ti : $[Ar]3d^2 4s^2 \rightarrow Ti^{4+}$: $[Ar]3d^0 4s^0$
Cu : $[Ar]3d^{10} 4s^1 \rightarrow Cu^+$: $[Ar]3d^{10} 4s^0$

Question98

The mercury is the only metal which is liquid at 0°C. This is due to its (1995)

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Options:

A. high vapour pressure

B. weak metallic bond

C. high ionization energy

D. both (b) and (c).

Answer: D

Solution:

Very high ionisation energy of Hg makes it difficult for electrons to participate in metallic bonding.

Question99

Which of the following statement concerning lanthanide elements is false?
(1994)

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Options:

A. All lanthanides are highly dense metals.

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B. More characteristic oxidation state of lanthanide elements is +3 .

C. Lanthanides are separated from one another by ion exchange method.

D. Ionic radii of trivalent lanthanides steadily increases with increase in the atomic number.

Answer: D

Solution:

Ionic radii of trivalent lanthanides decreases with increase in atomic number.

Question100

To protect iron against corrosion, the most durable metal plating on it, is
(1994)

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Options:

A. copper plating

B. zinc plating

C. nickel plating

D. tin plating.

Answer: B

Question101

When $CuSO_4$ is electrolysed using platinum electrodes,
(1993)

Options:

A. copper is liberated at cathode, sulphur at anode

B. copper is liberated at cathode, oxygen at anode

C. sulphur is liberated at cathode, oxygen at anode

D. oxygen is liberated at cathode, copper at anode.

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Answer: B

Solution:

$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-}$
$H_2O \rightleftharpoons H^+ + OH^-$
At cathode : $Cu^{2+} + 2e^- \rightarrow Cu$
At anode : $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

Question102

The transition elements have a general electronic configuration (1991)

©

Options:

A. $ns^2np^6nd^{1-10}$

B. $(n-1)d^{1-10}$, ns^{0-2}, np^{0-6}

C. $(n-1)d^{1-10}$, ns^{1-2}

D. $nd^{1-10}ns^{-2}$

Answer: C

Solution:

Solution:
The general electronic configuration of transition elements is $(n-1)d^{1-10}ns^{1-2}$

Question103

Photographic films and plates have an essential ingredient of (1989)

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Options:

A. silver nitrate

B. silver bromide

C. sodium chloride

D. oleic acid.

Answer: B

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Solution:

AgBr is highly photosensitive and is used as an ingredient for photographic films and plates.

Question104

Nitriding is the process of surface hardening of steel by treating it is an atmosphere of
(1989)

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Options:

A. NH_3

B. O_3

C. N_2

D. H_2S

Answer: A

Solution:

When steel is heated in presence of NH_3, iron nitride on the surface of steel is formed which imparts a hard coating. This process is called nitriding.

Question105

A blue colouration is not obtained when
(1989)

©

Options:

A. ammonium hydroxide dissolves in copper sulphate

B. copper sulphate solution reacts with $K_4[Fe(CN)_6]$

C. ferric chloride reacts with sod. ferrocyanide

D. anhydrous $CuSO_4$ is dissolved in water.

Answer: B

Solution:

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$2CuSO_4 + K_4[Fe(CN)_6] \rightarrow \underset{\text{chocolate ppt.}}{Cu_2[Fe(CN)_6]} + 2K_2SO_4$

Question106

The electronic configurations of four elements are given below. Which element does not belong to the same family as others? (1989)

Options:

A. $[Xe]4f^{4}5d^{10}6s^{2}$

B. $[Kr]4d^{10}5s^{2}$

C. $[Ne]3s^{2}3p^{5}$

D. $[Ar]3d^{10}4s^{2}$

Answer: C

Solution:

$[Ne]3s^{2}3p^{5}$ is the electronic configuration of a p -block element whereas other configurations are those of d -block elements.

Question107

The oxidation state of Cr in $K_2Cr_2O_7$ is (1988)

Options:

A. +5

B. +3

C. +6

D. +7

Answer: C

Solution:

Oxidation state of Cr in $K_2Cr_2O_7$ is $2 + 2x - 14 = 0$

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⇒2x = 12 ⇒ x = 6

Question108

Hypo is used in photography to (1988)

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Options:

A. reduce AgBr grains to metallic silver

B. convert metallic silver to silver salt

C. remove undecomposed silver bromide as a soluble complex

D. remove reduced silver.

Answer: C

Solution:

Undecomposed AgBr forms a soluble complex with hypo and the reaction is given as :

$$AgBr + 2Na_2S_2O_3 \rightarrow \underset{\text{Soluble complex}}{Na_3[Ag(S_2O_3)_2]} + NaBr$$

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