

d and f Block Elements

Question1

Which from following elements belongs to inner transition elements?

MHT CET 2025 5th May Evening Shift

Options:

A.

Cm

B.

W

C.

Mo

D.

Ru

Answer: A

Solution:

- Inner transition elements = **Lanthanides (atomic numbers 57–71) and Actinides (atomic numbers 89–103).**

Now check each option:

- **Cm (Curium)** → Actinide, atomic number 96 → **Yes, inner transition element ✓**
- **W (Tungsten)** → Transition metal, group 6 (not inner transition).
- **Mo (Molybdenum)** → Transition metal, group 6 (not inner transition).
- **Ru (Ruthenium)** → Transition metal, group 8 (not inner transition).



✓ Correct Answer: Option A (Cm)

Question2

Which actinoid from following in its +3 state has largest size?

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Options:

A.

U

B.

Bk

C.

Es

D.

Md

Answer: A

Solution:

With increasing atomic number of actinoids, nuclear charge and effective nuclear charge experienced by each 5 f electrons increases. As a result, the whole of 5 f electron shell contracts at each successive element, resulting in actinoid contraction.

Element	Ground state Electronic configuration	Ionic radii (Ac^{3+}), pm
Uranium (Z = 92)	$[Rn]5f^3 6d^1 7s^2$	118
Berkelium (Z = 97)	$[Rn]5f^9 6d^0 7s^2$	110
Einsteinium (Z = 99)	$[Rn]5f^{11} 6d^0 7s^2$	98
Mendelevium (Z = 101)	$[Rn]5f^{13} 6d^0 7s^2$	90



Question3

What is the number of unpaired electrons in f orbitals of lutetium in its +3 oxidation state?

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Options:

A.

7

B.

5

C.

4

D.

0 (zero)

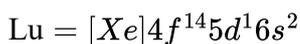
Answer: D

Solution:

1. Element involved: Lutetium (Lu)

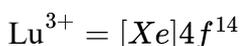
- Atomic number of Lutetium (Lu) = 71

2. Electronic configuration of neutral Lu:



3. Oxidation state mentioned: +3

In the +3 oxidation state, Lu loses 2 electrons from 6s and 1 electron from 5d:



4. Distribution of electrons in f-orbitals:

- The 4f orbitals are **completely filled** with 14 electrons.

- A fully filled orbital means **all electrons are paired**.

5. Therefore, number of unpaired electrons = 0.

✔ Answer: Option D (0, zero)

Question4

What is the value of spin only magnetic moment for Cu^{2+} in BM?

MHT CET 2025 26th April Evening Shift

Options:

A.

2.84

B.

3.87

C.

1.73

D.

0.0

Answer: C

Solution:

Step 1: Write electronic configuration

- Atomic number of Cu: 29
- Ground state (Cu neutral): $[\text{Ar}] 3d^{10} 4s^1$

For Cu^{2+} : remove 2 electrons (first from 4s, then 3d).

So configuration: $[\text{Ar}] 3d^9$.

Step 2: Count unpaired electrons

- $3d^9$ means 9 electrons in d -orbitals.
- d^{10} is fully filled (0 unpaired).
- d^9 will have **1 unpaired electron**.

Thus, number of unpaired electrons $n = 1$.

Step 3: Use spin-only formula

Magnetic moment (BM):

$$\mu = \sqrt{n(n+2)} \text{ B.M.}$$

Substitute $n = 1$:

$$\mu = \sqrt{1(1+2)} = \sqrt{3} \approx 1.73 \text{ B.M.}$$

 **Final Answer:**

Option C: 1.73

Question5

Which lanthanoid from following may exhibit +4 oxidation state with f^0 configuration?

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Options:

- A. Eu
- B. Tb
- C. Ce
- D. Lu

Answer: C

Solution:

Step 1: Recall electronic configurations of neutral atoms

- Ce ($Z = 58$): $[\text{Xe}]4f^15d^16s^2$

- **Eu (Z = 63):** $[\text{Xe}]4f^76s^2$
- **Tb (Z = 65):** $[\text{Xe}]4f^96s^2$
- **Lu (Z = 71):** $[\text{Xe}]4f^{14}5d^16s^2$

Step 2: Consider +4 oxidation state

Remove 4 electrons, preferentially from 6s, then 5d, then 4f.

- **Ce⁴⁺:** Neutral = $[\text{Xe}]4f^15d^16s^2$.
Remove 2 from 6s → $[\text{Xe}]4f^15d^1$.
Remove 1 from 5d → $[\text{Xe}]4f^1$.
Remove last from 4f → $[\text{Xe}]$.
→ *So Ce⁴⁺ has f⁰.*
- **Eu⁴⁺:** Neutral = $[\text{Xe}]4f^76s^2$.
Remove 2 from 6s → $[\text{Xe}]4f^7$.
Remove 2 from 4f → $[\text{Xe}]4f^5$.
→ Not f⁰.
- **Tb⁴⁺:** Neutral = $[\text{Xe}]4f^96s^2$.
Remove 2 from 6s → $[\text{Xe}]4f^9$.
Remove 2 more from 4f → $[\text{Xe}]4f^7$.
→ Not f⁰.
- **Lu⁴⁺:** Neutral = $[\text{Xe}]4f^{14}5d^16s^2$.
Remove 2 from 6s → $[\text{Xe}]4f^{14}5d^1$.
Remove 1 from 5d → $[\text{Xe}]4f^{14}$.
Remove 1 from 4f → $[\text{Xe}]4f^{13}$.
→ Not f⁰.

Step 3: Conclusion

Only Ce⁴⁺ achieves the f⁰ configuration.

Answer: Option C (Ce)

Question 6

Which cation from following exhibits no magnetic moment?

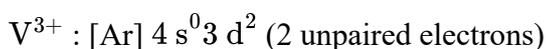
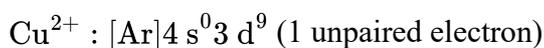
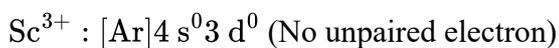
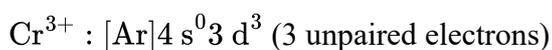
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Options:



Answer: B

Solution:



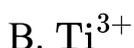
In in +3 oxidation state Sc^{3+} has no unpaired electrons, hence it does not show any magnetic moment.

Question7

Which from following elements in respective oxidation state develops highest spin only magnetic moment?

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Options:



D. Ni^{2+}

Answer: A

Solution:

Outer Electronic configuration	No. of unpaired electrons
$\text{Mn}^{2+} - 3d^5$	5
$\text{Ti}^{3+} - 3d^1$	1
$\text{Cu}^{2+} - 3d^9$	1
$\text{Ni}^{2+} - 3d^8$	2

Greater the number of unpaired electrons, greater will be the magnetic moment.

$$\text{As } \mu = \sqrt{n(n+2)} \text{ BM}$$

\therefore Mn in +2 oxidation state develops highest spin only magnetic moment.

Question8

Which element from following has smallest ionic size in +3 state?

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Options:

A. Lu

B. La

C. Dy

D. Nd

Answer: A

Solution:

In lanthanoid series, the ionic radii decreases from La^{3+} to Lu^{3+} , The phenomenon of lanthanide contraction is observed in case of 4 f elements due to an increase in the effective nuclear charge in lanthanides.

Hence, Lu^{3+} is having smallest ionic radius

Question9

Which lanthanoid from following has highest ionisation (IE_1) enthalpy?

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Options:

- A. Tm
- B. Dy
- C. Nd
- D. Yb

Answer: D

Solution:

Ytterbium (Yb) has 70 electrons.

Its outermost electronic configuration is $[\text{Xe}]4f^{14}6s^2$.

Yb has the highest first ionization energy (IE_1) among the lanthanoids listed because the 4f subshell is completely filled, which makes it more stable and harder to remove an electron.

Question10

What is the value of spin only magnetic moment for Mn^{2+} in BM?

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Options:



A. 3.87

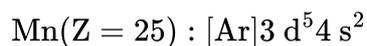
B. 4.9

C. 1.73

D. 5.92

Answer: D

Solution:



Therefore, it has 5 unpaired elect

∴ Spin-only magnetic moment,

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

$$\therefore \mu = \sqrt{5(5+2)} = \sqrt{35} = 5.92\text{BM}$$

Question11

Identify the lanthanoid that exhibits zero effective magnetic moment in +3 state.

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Options:

A. Ho

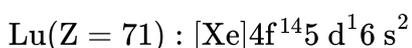
B. Lu

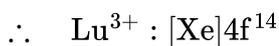
C. Pr

D. Er

Answer: B

Solution:





Since there are zero unpaired electrons, the effective magnetic moment will be zero.

Question12

Find the value of spin only magnetic moment for Zn^{2+} in BM.

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Options:

A. 1.73

B. 2.84

C. 0.0

D. 3.87

Answer: C

Solution:

We are asked to find the spin-only magnetic moment of Zn^{2+} .

Step 1: Write electron configuration of Zn^{2+}

- Atomic number of Zn = 30.

Ground state: $[\text{Ar}]3d^{10}4s^2$.

For Zn^{2+} , remove two 4s electrons $\rightarrow [\text{Ar}]3d^{10}$.

Step 2: Count unpaired electrons

Configuration: $3d^{10}$.

All orbitals completely filled \rightarrow **0 unpaired electrons.**

Step 3: Spin-only magnetic moment

Formula:

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

where n = number of unpaired electrons.

For $n = 0$:

$$\mu = \sqrt{0(0 + 2)} = 0 \text{ BM.}$$

Final Answer:

$$\mu = 0.0 \text{ BM}$$

Correct Option: C (0.0)

Question13

Which element from following has largest ionic size in +3 state?

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Options:

A. Pr

B. Sm

C. La

D. Yb

Answer: C

Solution:

In lanthanoid series, the ionic radii decreases from La^{3+} to Lu^{3+} .

Hence, La^{3+} has the largest ionic size.

Question14

Identify the element having highest ionisation enthalpy (IE_1) from following.



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Options:

A. Ce

B. La

C. Gd

D. Yb

Answer: D

Solution:

Ionisation enthalpy decreases down the group and increases from left to right with some irregularities due to electronic configurations and poor shielding effect of the f-orbital in lanthanoid series. Therefore, Yb has highest ionisation enthalpy (IE_1).

Question15

Which from following is used as catalyst in Fisher Tropsch process for the synthesis of gasoline?

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Options:

A. Fe – Cr

B. Co – Th

C. Mo

D. Ni

Answer: B

Solution:



The **Fischer–Tropsch (FT) process** is used to convert **syngas** ($\text{CO} + \text{H}_2$) into hydrocarbons (liquid fuels like gasoline, diesel, waxes, etc.).

Typical catalysts:

- **Iron (Fe-based catalysts, often Fe–Cr)**
- **Cobalt (Co-based catalysts, often Co–Th, Co–Mg, etc.)**
- **Nickel (Ni)** is also a hydrogenation catalyst, but not widely used in FT due to excess methane formation.
- **Molybdenum (Mo)** is not a common FT catalyst.

👉 For **gasoline synthesis**, **Cobalt–Thoria (Co–Th)** catalysts are more effective because cobalt-based systems give higher molecular weight hydrocarbons and better selectivity.

Iron–chromium (Fe–Cr) is also used, especially when the H_2/CO ratio is low (like from coal gasification), but Co–Th is the more classic choice.

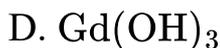
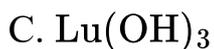
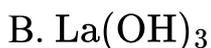
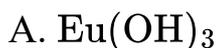
✅ **Correct Answer: Option B – Co–Th**

Question16

Identify a weakest base from following

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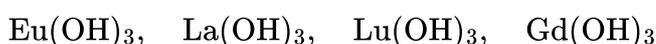
Options:



Answer: C

Solution:

We need to identify the **weakest base** among these lanthanide hydroxides:



Step 1: Trend of basicity in lanthanide hydroxides

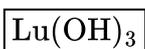
- Hydroxides of lanthanides are ionic but weakly basic.
- Basic strength **decreases across the lanthanide series** from La \rightarrow Lu.
- This is because of **lanthanide contraction**: as atomic number increases, ionic radius decreases, leading to higher charge density on Ln^{3+} .
- Greater polarization of the O–H bond in OH^- makes $\text{Ln}(\text{OH})_3$ less ionic and therefore less basic.

Step 2: Comparing the given elements

- Lanthanum (La): atomic number 57 \rightarrow **largest ionic size** \rightarrow hydroxide is **most basic**.
- Lutetium (Lu): atomic number 71 \rightarrow **smallest ionic size** \rightarrow hydroxide is **least basic**.
- Gd (64) and Eu (63) lie in the middle \rightarrow intermediate basicity.

Final Answer:

The weakest base is:



(Correct Option C)

Question17

Which from following elements forms coloured compound in its respective oxidation state?

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Options:



Answer: D

Solution:



Ion	Outer electronic configuration	No. of unpaired electrons
Sc ³⁺	3 d ⁰	0
Ti ⁴⁺	3 d ⁰	0
Zn ²⁺	3 d ¹⁰	0
Cr ³⁺	3 d ³	3

Due to absence of unpaired electrons $d - d$ transition is not possible in case of Sc³⁺, Ti⁴⁺ and Zn²⁺ ions and hence will be colourless.

Question18

Which from following is the general formula of compound obtained when lanthanoid (Ln) reacts with carbon at elevated temperature?

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Options:

- A. LnC
- B. LnC₂
- C. Ln₃C
- D. LnC₃

Answer: B

Solution:

Step 1: Recall lanthanide–carbon compounds

When lanthanides react with carbon at high temperature, they typically form carbides.

Carbides are categorized as:

1. **Salt-like carbides** – containing C⁴⁻, e.g., CaC₂.
2. **Covalent carbides** – like SiC.



3. **Interstitial carbides** – transition/inner transition metals with carbon atoms in interstitial sites.

For lanthanides (electropositive, large atoms), the typical products are **ionic carbides**:

- **Dicarbides** (LnC_2): containing the acetylide ion C_2^{2-} .
- **Sesquicarbides** (Ln_2C_3): containing C_3^{4-} ion.

Step 2: Match with options

Options given are:

- A: LnC
- B: LnC_2
- C: Ln_3C
- D: LnC_3

Known correct general formula is LnC_2 (dicarbides).

These are the common carbides of lanthanides formed at elevated temperatures.

Final Answer:

Option B: LnC_2

Question19

Which from following is a soft metal?

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Options:

- A. Cr
- B. V
- C. Co
- D. Cd

Answer: D

Solution:

Among the given options:

- Chromium (Cr)
- Vanadium (V)
- Cobalt (Co)
- Cadmium (Cd)

Cadmium (Cd) is a soft metal. It is easily cut with a knife and has low hardness compared to the others listed, which are hard transition metals.

Correct answer: Option D (Cd)

Question20

If Ln represents lanthanoid element find the general formula of lanthanoid hydroxide.

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Options:

- A. $\text{Ln}(\text{OH})$
- B. $\text{Ln}(\text{OH})_2$
- C. $\text{Ln}(\text{OH})_3$
- D. $\text{Ln}(\text{OH})_4$

Answer: C

Solution:

The most common oxidation state of lanthanoids is +3.

Hydroxide ion has the formula OH^- .

Let the lanthanoid ion be Ln^{3+} .

To balance the charges in the compound:

- 1 lanthanoid ion: +3
- 3 hydroxide ions: $3 \times (-1) = -3$



So, the formula becomes $\text{Ln}(\text{OH})_3$.

Correct option:

Option C

$\text{Ln}(\text{OH})_3$

Question21

Which from following lanthanoids exhibits +4 oxidation state in F^7 configuration?

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Options:

A. Ce

B. Yb

C. Eu

D. Tb

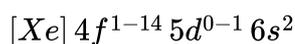
Answer: D

Solution:

Let's analyze the question step-by-step using the NCERT approach:

Step 1: Write the general configuration of Lanthanoids

The general electronic configuration for Lanthanoids (atomic numbers 58 to 71) in their ground state is:



Step 2: Understand the meaning of F^7 configuration

F^7 means $4f^7$ configuration.

A $4f^7$ configuration is especially stable because it is half-filled.

Step 3: Analyze the oxidation states

Normally, lanthanoids show only +3 oxidation state. Some show +2 or +4 when half-filled or empty/full f -subshells can be attained.

Step 4: Consider each option

Let's check which element can show +4 state **and** reach $4f^7$ configuration:

- **Ce (Cerium), atomic number 58**
- Ground state: $[Xe]4f^15d^16s^2$
- +4 state: loses 4 electrons $\Rightarrow [Xe]$ (as all electrons are removed including 4f-electron, not $4f^7$)
- **Yb (Ytterbium), atomic number 70**
- Ground state: $[Xe]4f^{14}6s^2$
- +4 state: would be $[Xe]4f^{12}$
- No $4f^7$ here.
- **Eu (Europium), atomic number 63**
- Ground state: $[Xe]4f^76s^2$
- +4 state: $[Xe]4f^5$
- No $4f^7$ here.
- **Tb (Terbium), atomic number 65**
- Ground state: $[Xe]4f^96s^2$
- +4 state: removes 4 electrons:
 - 2 from 6s, 2 from 4f
 - $[Xe]4f^7$
 - **This is $4f^7$, which is half-filled and especially stable.**

Answer:

Option D — **Tb (Terbium)** exhibits the +4 oxidation state in which it attains the $4f^7$ configuration.

Question22

Which cation from following develops least magnetic moment?

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Options:

A. Cu^{2+}

B. Cr^{3+}

C. Co^{2+}

D. Fe^{2+}

Answer: A

Solution:

Ion	Outer electronic configuration	No. of unpaired electrons	Magnetic moment $\mu = \sqrt{n(n+2)}BM$
Cu^{2+}	$[\text{Ar}]3d^9$	1	1.73
Cr^{3+}	$[\text{Ar}]3d^3$	3	3.87
Co^{2+}	$[\text{Ar}]3d^7$	3	3.87
Fe^{2+}	$[\text{Ar}]4d^6$	4	4.89

Question23

Which from following is a lanthanoid element?

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Options:

A. Er

B. Am

C. Np

D. Lr

Answer: A

Solution:

Let us check each option:

- **Option A: Er**

Er stands for **Erbium**.

Atomic number: 68

It is found in the 6th period, among the elements with atomic numbers 58 to 71, which are called lanthanoids.

- **Option B: Am**

Am stands for **Americium**.

Atomic number: 95

It belongs to the actinoid series (atomic numbers 89 to 103).

- **Option C: Np**

Np stands for **Neptunium**.

Atomic number: 93

It is also an actinoid element.

- **Option D: Lr**

Lr stands for **Lawrencium**.

Atomic number: 103

It is also an actinoid.

Conclusion:

The correct answer is **Option A: Er** (Erbium), which is a lanthanoid element.

Question24

What is the number of unpaired electrons in Ti in +3 state?

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Options:

A. 4

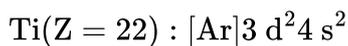
B. 3

C. 1

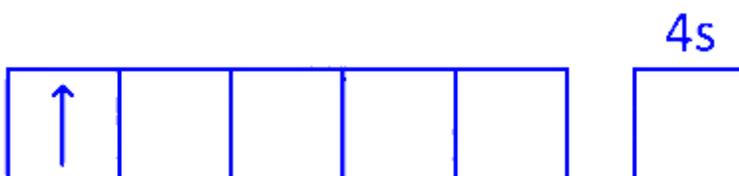
D. Zero

Answer: C

Solution:



Orbital notation of Ti^{3+} :



Hence, the number of unpaired electrons is 1.

Question25

Identify the element from following such that the last electron is placed in $(n - 1)d$ orbital.

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Options:

A. Dy

B. Ag

C. Pu

D. Pa

Answer: B

Solution:

The last electron will be placed in $(n - 1)d$ orbital for **transition elements** (d-block elements) because their general valence shell electronic configuration is:

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

Let's go through the given options one by one:

Option A: Dy (Dysprosium)

- Atomic number: 66
- Electronic configuration: $[\text{Xe}] 4f^{10}6s^2$
- Last electron enters $4f$ orbital (f-block element).

Option B: Ag (Silver)

- Atomic number: 47
- Electronic configuration: $[\text{Kr}] 4d^{10}5s^1$
- Last electron enters $4d$ orbital, which is $(n - 1)d$, since $n = 5$ (so $(5 - 1) = 4$).
- **Correct choice** (d-block element).

Option C: Pu (Plutonium)

- Atomic number: 94
- Electronic configuration: $[\text{Rn}] 5f^67s^2$
- Last electron enters $5f$ orbital (f-block element).

Option D: Pa (Protactinium)

- Atomic number: 91
- Electronic configuration: $[\text{Rn}] 5f^26d^17s^2$
- Last electron enters $5f$ or $6d$ orbital, but for Pa, it's considered $5f^2$ (also f-block).

Answer:

Option B (Ag) is correct because its last electron enters a $(n - 1)d$ orbital.

Question26

Which transition series includes elements Co and Mo respectively?

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Options:

A. 4d and 5d

B. 5d and 6d

C. 3d and 4d

D. 3d and 6d

Answer: C

Solution:

Let us check step by step:

1. Cobalt (Co):

- Atomic number of Co = 27
- Its electronic configuration: $[Ar] 3d^7 4s^2$
- The differentiating electron enters the **3d orbital**.
- Hence, **Co belongs to the 3d transition series.**

1. Molybdenum (Mo):

- Atomic number of Mo = 42
- Its electronic configuration: $[Kr] 4d^5 5s^1$
- The differentiating electron enters the **4d orbital**.
- Hence, **Mo belongs to the 4d transition series.**

1. Conclusion:

- Co \rightarrow 3d series
- Mo \rightarrow 4d series

Therefore, the correct option is:

Option C: 3d and 4d

Question27

Which from following elements is NOT regarded as transition element?

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Options:

A. Ni

B. Fe

C. Ag

D. Hg

Answer: D

Solution:

According to the NCERT textbook, a **transition element** is defined as an element whose atom or ion has an **incomplete d-subshell**. This means at least one of their common oxidation states must have an incomplete d-orbital.

Let us check each option:

1. Nickel (Ni):

- Atomic number: 28
- Electronic configuration: $[Ar]3d^84s^2$
- It has an incomplete 3d subshell.

1. Iron (Fe):

- Atomic number: 26
- Electronic configuration: $[Ar]3d^64s^2$
- It has an incomplete 3d subshell.

1. Silver (Ag):

- Atomic number: 47
- Electronic configuration: $[Kr]4d^{10}5s^1$
- Common ion: Ag^+ has configuration $[Kr]4d^{10}$ (**completely filled d-subshell**).

1. Mercury (Hg):

- Atomic number: 80
- Electronic configuration: $[Xe]4f^{14}5d^{10}6s^2$
- Common ion: Hg^{2+} has configuration $[Xe]4f^{14}5d^{10}$ (**completely filled d-subshell**).

According to NCERT:

- Transition elements are those having incomplete d-subshell **in either elemental or any common oxidation state**.
- **Zn, Cd, and Hg** are NOT considered as transition elements because their atoms and common ions have fully filled d-subshell.



Answer:

Option D: Hg is NOT regarded as a transition element.

Question28

Which from following cations develops lowest value of spin only magnetic moment?

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Options:

- A. V^{3+}
- B. Cr^{3+}
- C. Mn^{2+}
- D. Fe^{2+}

Answer: A

Solution:

To solve this, we use the **spin-only magnetic moment formula**:

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

where n = number of unpaired electrons.

Step 1: Find electronic configuration for each cation

- (A) V^{3+}

Atomic number of V = 23 \rightarrow configuration = $[Ar] 3d^3 4s^2$

Removing 3 electrons (2 from 4s, 1 from 3d) $\rightarrow [Ar] 3d^2$

\rightarrow Unpaired electrons = 2

- (B) Cr^{3+}

Atomic number of Cr = 24 \rightarrow configuration = $[Ar] 3d^5 4s^1$

Removing 3 electrons (first 4s and then 2 from 3d) $\rightarrow [Ar] 3d^3$

\rightarrow Unpaired electrons = 3

- (C) Mn^{2+}

Atomic number of Mn = 25 → configuration = [Ar] $3d^5 4s^2$

Removing 2 electrons (from 4s) → [Ar] $3d^5$

→ Unpaired electrons = 5

• **(D) Fe²⁺**

Atomic number of Fe = 26 → configuration = [Ar] $3d^6 4s^2$

Removing 2 electrons (from 4s) → [Ar] $3d^6$

→ Unpaired electrons = 4

Step 2: Calculate spin-only magnetic moment

- For V³⁺ ($n = 2$):

$$\mu = \sqrt{2(2 + 2)} = \sqrt{8} \approx 2.83 \text{ BM}$$

- For Cr³⁺ ($n = 3$):

$$\mu = \sqrt{3(3 + 2)} = \sqrt{15} \approx 3.87 \text{ BM}$$

- For Mn²⁺ ($n = 5$):

$$\mu = \sqrt{5(5 + 2)} = \sqrt{35} \approx 5.92 \text{ BM}$$

- For Fe²⁺ ($n = 4$):

$$\mu = \sqrt{4(4 + 2)} = \sqrt{24} \approx 4.90 \text{ BM}$$

Step 3: Compare values

- V³⁺: ~2.83 BM (lowest)
- Cr³⁺: ~3.87 BM
- Fe²⁺: ~4.90 BM
- Mn²⁺: ~5.92 BM

Final Answer:

V³⁺ develops the lowest value of spin-only magnetic moment.

Question29

Which pair of metal ions from following have same number of unpaired electrons?

MHT CET 2024 16th May Evening Shift

Options:

A. Co^{2+} and Mn^{3+}

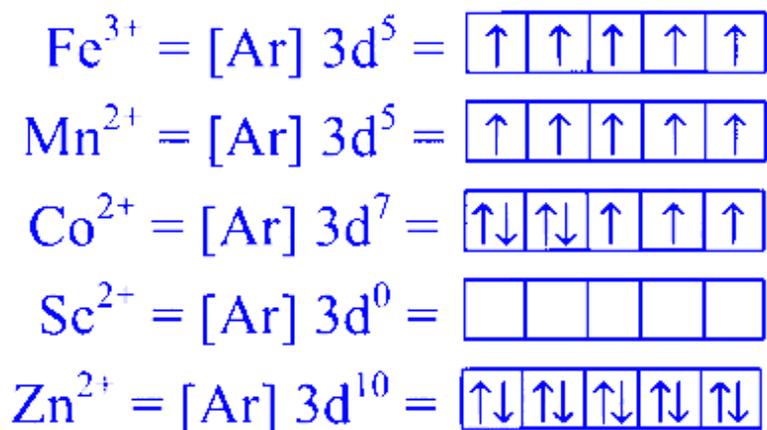
B. Mn^{2+} and Zn^{2+}

C. Fe^{3+} and Mn^{2+}

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

Answer: C

Solution:



Question30

Identify an actinoid element from following.

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Options:

A. No

B. Mo

C. Co

D. Ce



Answer: A

Solution:

Option A, No (Nobelium), is an actinoid element. Actinoids, also known as actinides, are a series of elements that include atomic numbers 89 to 103 on the periodic table. Nobelium, with the atomic number 102, is part of this series. Actinoid elements are typically characterized by their radioactive properties and their position in the f-block of the periodic table.

Question31

Which from following elements has completely filled 4 f orbital at expected ground state configuration?

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Options:

A. W

B. Yb

C. Eu

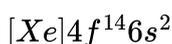
D. Cd

Answer: B

Solution:

In the context of electron configurations, the element that has a completely filled 4f orbital at its expected ground state is Ytterbium (Yb).

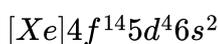
Ytterbium (Yb) has the atomic number 70. Its electron configuration can be written as:



This configuration indicates that all seven 4f orbitals are completely filled with 14 electrons, which is characteristic of Ytterbium's place in the lanthanide series.

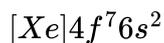
In contrast:

Tungsten (W), with atomic number 74, has the electron configuration:



The 4f orbitals are still completely filled as in Yb, but it is not the element that completes filling them.

Europium (Eu), with atomic number 63, has the electron configuration:



Here, the 4f orbitals are only half-filled.

Cadmium (Cd), with atomic number 48, has the electron configuration:



Cadmium does not involve the 4f orbitals at all.

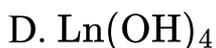
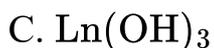
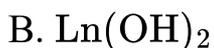
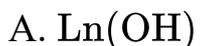
Therefore, the correct choice is **Option B: Yb (Ytterbium)**, which has a completely filled 4f orbital in its ground state electron configuration.

Question32

What is the general formula of lanthanoid hydroxide? (Consider Ln as any lanthanoid element)

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Options:



Answer: C

Solution:

Stable oxidation state of Ln is +3.

∴ General formula for lanthanoid hydroxide is $\text{Ln}(\text{OH})_3$.

Question33

Which among the following properties is NOT exhibited by transition elements?

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Options:

- A. These are generally hard.
- B. These form alloys with other metals.
- C. These do not conduct heat.
- D. These are malleable and ductile.

Answer: C

Solution:

Answer: Option C (These do not conduct heat.)

Explanation:

Transition elements are metals known for their characteristic metallic properties:

Hardness: Transition metals are generally hard and have high melting and boiling points.

Formation of Alloys: They readily form alloys with other metals, due to their similar atomic sizes and the ability of their d-electrons to partake in metallic bonding.

Thermal and Electrical Conductivity: Like most metals, transition elements are good conductors of heat and electricity. Thus, the statement "These do not conduct heat" is incorrect.

Malleability and Ductility: Transition metals are typically malleable and ductile, allowing them to be shaped and drawn into wires.

Therefore, the property not exhibited by transition elements is that they do not conduct heat.

Question34

Which among the following is ferromagnetic substance?

MHT CET 2024 15th May Morning Shift



Options:

A. NaCl

B. H₂O

C. O₂

D. CrO₂

Answer: D

Solution:

	Substance	Magnetic property
(A)	NaCl	Diamagnetic
(B)	H ₂ O	Diamagnetic
(C)	O ₂	Paramagnetic
(D)	CrO ₂	Ferromagnetic

Question35

Which element from following is the last element of 5d-transition series?

MHT CET 2024 11th May Evening Shift

Options:

A. Hg

B. Cd

C. In

D. Ag

Answer: A

Solution:

The last element of the 5d-transition series is **Option A: Hg (Mercury)**.

Explanation

The 5d transition series consists of the elements from Lanthanum (La, atomic number 57) to Mercury (Hg, atomic number 80). This series comprises a portion of the d-block elements, specifically those wherein the d-electron shell is being filled progressively.

Hg (Mercury) is the last element of this series, with an atomic number of 80. Its electron configuration is $[Xe]4f^{14}5d^{10}6s^2$.

Elements in the 5d series span across the periodic table and are found prominently in groups commonly referred to as the transition metals. Mercury is well-known for being the only metal that is liquid at room temperature.

Understanding the periodic table's structure and where the d-block elements are located helps clarify configurations and series order and facilitates identification of such elements without much confusion.

Question36

Which element from following is NOT considered as transition element on the basis of electronic configuration?

MHT CET 2024 11th May Evening Shift

Options:

- A. Ti
- B. V
- C. Hg
- D. Ag

Answer: C

Solution:

Transition elements have partially filled d-orbitals.



Among the given elements, Hg has completely filled d-orbital in its ground state. Hence, it is not considered as transition element.

Question37

Which element from following has lowest ionization enthalpy (IE_1) ?

MHT CET 2024 11th May Morning Shift

Options:

A. Cu

B. Sc

C. Mn

D. Zn

Answer: B

Solution:

The ionization enthalpy (IE_1) of the elements of the 3d transition series increases gradually from left to right with some irregularities. Therefore, among the given elements, Sc has the lowest ionization enthalpy (IE_1).

Question38

Which element from following exhibits highest number of various different possible oxidation states?

MHT CET 2024 11th May Morning Shift

Options:

A. Fe

B. Cr



C. Mn

D. Ni

Answer: C

Solution:

Element	Outer E.C.	Oxidation states
Fe	$3d^6 4s^2$	+2, +3, +4, +5, +6
Cr	$3d^5 4s^1$	+2, +3, +4, +5, +6
Mn	$3d^5 4s^2$	+2, +3, +4, +5, +6, +7
Ni	$3d^{10} 4s^2$	+2, +3, +4

Question39

Which element from following does **NOT** exhibit magnetic moment in +2 state?

MHT CET 2024 10th May Evening Shift

Options:

A. Mn

B. Co

C. Fe

D. Zn

Answer: D

Solution:

Ion	E.C.	No. of unpaired electrons
Zn^{2+}	$[\text{Ar}]3d^{10}$	0
Co^{2+}	$[\text{Ar}]3d^7$	3
Fe^{2+}	$[\text{Ar}]3d^6$	4
Mn^{2+}	$[\text{Ar}]3d^5$	5

$\therefore \text{Zn}^{2+}$ has no unpaired electron, so it will not exhibit magnetic moment.

Question40

Identify false statement about transition elements.

MHT CET 2024 10th May Evening Shift

Options:

- A. These exhibit properties between those of s and p block elements.
- B. All these elements are grouped as 3 d to 6 d series.
- C. 5 d series is comprised of all elements from La ($Z = 57$) to Hg ($Z = 80$).
- D. Elements of 6 d series belongs to 7th period of periodic table.

Answer: C

Solution:

Option C is false.

The 5d series of transition metals does not comprise all elements from La ($Z = 57$) to Hg ($Z = 80$). Instead, the 5d series begins with the element Hafnium (Hf, $Z = 72$) and ends with Mercury (Hg, $Z = 80$), excluding Lanthanum (La) and continuing through the actinides after Lanthanum. The inclusion of Lanthanum marks the beginning of the lanthanides, which are not considered part of the 5d transition series.

Question41

Identify rare earth element from following.

MHT CET 2024 10th May Morning Shift

Options:

A. Sm

B. Hg

C. Zn

D. W

Answer: A

Solution:

The rare earth element from the provided options is Samarium (Sm).

Rare earth elements are a group of 17 elements in the periodic table, specifically the 15 lanthanides (from Lanthanum to Lutetium), along with Scandium and Yttrium. They are known for their similar properties and are often found together in mineral deposits.

Samarium (Sm) is a part of the lanthanide series and is considered a rare earth element. Its applications include use in samarium-cobalt magnets, which are known for their high permanent magnetization, and in the production of certain types of lasers.

The other elements listed are not considered rare earth elements:

Hg (Mercury) is a transition metal.

Zn (Zinc) is a transition metal.

W (Tungsten) is a transition metal.

For reference:

Samarium (Sm) is atomic number 62.

It falls under the category of rare earth elements, specifically the lanthanides.

Question42

Which element from following has completely filled f-orbital in observed and expected electronic configuration?



MHT CET 2024 10th May Morning Shift

Options:

A. Sm

B. Pr

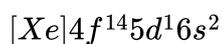
C. Lu

D. Dy

Answer: C

Solution:

The element lutetium (Lu) has a completely filled f-orbital in both its observed and expected electronic configuration. The electronic configuration for lutetium is:



In this configuration, the 4f orbital is fully filled with 14 electrons. Thus, option C, Lu, is the correct answer.

Question43

Which element from following in +2 state exhibits highest magnetic moment?

MHT CET 2024 9th May Evening Shift

Options:

A. Fe

B. Cr

C. Mn

D. Ni

Answer: C



Solution:

Species	Outer E.C.	Number of unpaired electrons (n)	Magnetic moment $\mu = \sqrt{n(n+2)}BM$
Fe^{2+}	$[Ar]3d^6$	4	$\mu = \sqrt{4(4+2)} = 4.89BM$
Cr^{2+}	$[Ar]3d^4$	4	$\mu = \sqrt{4(4+2)} = 4.89BM$
Mn^{2+}	$[Ar]3d^5$	5	$\mu = \sqrt{5(5+2)} = 5.91BM$
Ni^{2+}	$[Ar]3d^8$	2	$\mu = \sqrt{2(2+2)} = 2.83BM$

Question44

What is the highest oxidation state of third row transition elements?

MHT CET 2024 9th May Evening Shift

Options:

- A. +5
- B. +6
- C. +7
- D. +8

Answer: D

Solution:

The highest oxidation state observed in third row transition elements is +8.

In the third row of the transition series, osmium (Os) and ruthenium (Ru) are known to achieve the +8 oxidation state. Osmium forms compounds such as osmium tetroxide (OsO_4), where it exhibits this maximum oxidation state. Likewise, ruthenium can also reach this state under particular circumstances, although it is less common than for osmium. Therefore, the correct option is:

Option D: +8

Question45

Which from following elements belongs to the actinoids?

MHT CET 2024 9th May Morning Shift

Options:

A. Cm

B. Pm

C. Tm

D. Sm

Answer: A

Solution:

Option A, Cm (Curium), belongs to the actinoids.

The actinoids, also known as actinides, are a series of elements with atomic numbers from 89 to 103. They are located in the f-block of the periodic table and are characterized by their radioactive properties and the filling of the 5f electron orbital. Some well-known actinoids include Uranium (U), Thorium (Th), and Plutonium (Pu).

Curium (Cm), with atomic number 96, is one of the elements in this series. It is named after Marie and Pierre Curie and is typically synthesized in nuclear reactors due to its radioactive nature.

In contrast:

Pm (Promethium), Option B, belongs to the lanthanoids.

Tm (Thulium), Option C, also belongs to the lanthanoids.

Sm (Samarium), Option D, is another member of the lanthanoids.

The lanthanoids are elements with atomic numbers from 57 to 71, characterized by the filling of the 4f electron orbital.

Question46

What is the number of electrons present in d-subshell if its atomic number is 27 and oxidation state is +2 ?

MHT CET 2024 9th May Morning Shift

Options:

- A. 8
- B. 7
- C. 6
- D. 5

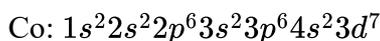
Answer: B

Solution:

To determine the number of electrons present in the d-subshell for an atom with atomic number 27 in a +2 oxidation state, start by identifying the element. An atomic number of 27 corresponds to cobalt (Co).

Ground State Electron Configuration of Cobalt (Co):

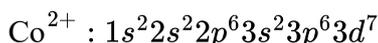
The neutral cobalt atom has 27 electrons. The electron configuration is:



In this configuration, the 3d subshell contains 7 electrons.

Effect of a +2 Oxidation State:

A +2 oxidation state indicates the loss of 2 electrons from the neutral configuration. Electrons are typically removed from the highest energy level, which is the 4s orbital for cobalt. Thus, removing 2 electrons from the 4s orbital results in:



The 3d subshell still contains 7 electrons because the electrons were removed from the 4s orbital instead.

Therefore, the number of electrons in the d-subshell for a Co in a +2 oxidation state is option **B, 7**.

Question47

Which from following properties of lanthanoids is NOT true?

MHT CET 2024 4th May Evening Shift



Options:

- A. These are bad conductors of heat and electricity.
- B. These are soft metals.
- C. Coordination number is usually greater than six.
- D. These are strongly paramagnetic.

Answer: A

Solution:

Option A is NOT a true property of lanthanoids.

Most lanthanoids are actually good conductors of heat and electricity due to their metallic nature. Below are explanations for each property mentioned:

Option A: Lanthanoids generally have metallic properties, including good conductivity of heat and electricity. They have free electrons that facilitate this conduction.

Option B: Soft metals. Lanthanoids have relatively low hardness compared to other metals and can be easily cut with a knife. This is true because their metallic bonding is not very strong.

Option C: Coordination number is usually greater than six. Lanthanoids have large ionic radii, supporting high coordination numbers, often greater than six.

Option D: Strongly paramagnetic. Lanthanoids exhibit strong paramagnetism due to the presence of unpaired f electrons. Their magnetic moment can be quite high, corresponding to the number of unpaired electrons.

Question48

Which element from following has half filled f orbital at observed ground state?

MHT CET 2024 4th May Evening Shift

Options:

- A. Gd
- B. Sm
- C. Nd

D. Ho

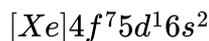
Answer: A

Solution:

The element with a half-filled 4f orbital in its observed ground state is gadolinium (Gd).

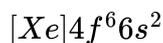
Explanation:

Gadolinium (Gd) has the electron configuration:



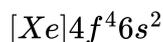
This configuration shows that Gd has seven electrons in the 4f orbital, which corresponds to a half-filled 4f subshell. A half-filled subshell is particularly stable due to its symmetrical electron distribution.

Samarium (Sm):



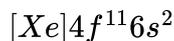
Here, the 4f subshell is not half-filled.

Neodymium (Nd):



The 4f subshell is also not half-filled.

Holmium (Ho):



The 4f subshell exceeds half-fill and moves towards being fully filled.

Thus, gadolinium (Gd) is the element that exhibits a half-filled 4f orbital in its observed ground state, making option A the correct choice.

Question49

Identify ferromagnetic substance from following.

MHT CET 2024 4th May Morning Shift

Options:

A. NaCl

B. C₆H₆



C. CrO_2

D. H_2O

Answer: C

Solution:

	Substance	Magnetic property
(A)	NaCl	Diamagnetic
(B)	C_6H_6	Diamagnetic
(C)	CrO_2	Ferromagnetic
(D)	H_2O	Diamagnetic

Question50

Which pair of elements from following has half filled d-orbital in observed electronic configuration?

MHT CET 2024 4th May Morning Shift

Options:

A. Cu and Mn

B. Mn and Cr

C. Zn and Co

D. Cu and Zn

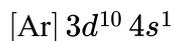
Answer: B

Solution:

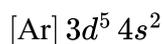
In the periodic table, the transition metals are elements that have partially filled d orbitals. For an element to have a half-filled d orbital, it should have five electrons in the d subshell (d^5 configuration).

The relevant electron configurations for the elements in the options provided are:

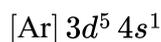
Copper (Cu):



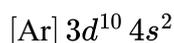
Manganese (Mn):



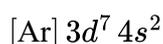
Chromium (Cr):



Zinc (Zn):



Cobalt (Co):



Both manganese (Mn) and chromium (Cr) have a half-filled d orbital in their electronic configurations. Manganese has the configuration $3d^5$, and chromium also has $3d^5$. Thus, the correct pair with half-filled d orbitals is:

Option B: Mn and Cr

Question51

Identify the element having smallest ionic size in +3 state from following.

MHT CET 2024 3rd May Evening Shift

Options:

A. Nd

B. Sm

C. Ho

D. Lu

Answer: D

Solution:



The ionic size of an element in a given oxidation state generally decreases with increasing atomic number across the lanthanide series (from left to right). This is due to what is known as the lanthanide contraction, where the effective nuclear charge increases, pulling the electron cloud closer to the nucleus and resulting in a smaller ionic radius.

Given the options:

Option A: Nd (Neodymium)

Option B: Sm (Samarium)

Option C: Ho (Holmium)

Option D: Lu (Lutetium)

Lutetium (Lu) is at the end of the lanthanide series. Due to the cumulative effect of the lanthanide contraction, Lu in the +3 oxidation state has the smallest ionic size among the given options. Therefore, the element with the smallest ionic size in the +3 state is Lu (Lutetium).

Question52

Which from following lanthanoids exhibits no effective magnetic moment in +3 state?

MHT CET 2024 3rd May Evening Shift

Options:

A. Ce

B. La

C. Gd

D. Eu

Answer: B

Solution:

Option B: La

The element Lanthanum (La) exhibits no effective magnetic moment in the +3 oxidation state.

In the +3 state, La has an electronic configuration of $[\text{Xe}] 5d^0 4f^0$, meaning that it has no unpaired electrons in the f-orbitals. The absence of unpaired electrons results in zero magnetic moment.

The effective magnetic moment (μ_{eff}) is calculated using the following formula for lanthanoids:

$$\mu_{eff} = \sqrt{n(n+2)}\mu_B$$

where n is the number of unpaired electrons and μ_B is the Bohr magneton. Since $n = 0$ for La^{3+} , the effective magnetic moment becomes zero.

Other lanthanoids typically have unpaired f-electrons contributing to a non-zero magnetic moment.

Question53

Which from following metal ions in their respective oxidation states forms coloured compound?

MHT CET 2024 3rd May Morning Shift

Options:

A. Zn^{2+}

B. Fe^{2+}

C. Cu^+

D. Sc^{3+}

Answer: B

Solution:

Colour of transition metal ion depends on the presence of unpaired electrons.

Metal	Configuration	Unpaired electrons
Zn^{2+}	$4s^0 3d^{10}$	0
Cu^+	$4s^0 3d^{10}$	0
Fe^{2+}	$4s^0 3d^6$	4
Sc^{3+}	$4s^0 3d^0$	0

Question54

What is the number of electrons present in 3d orbital of Ti in +2 state?

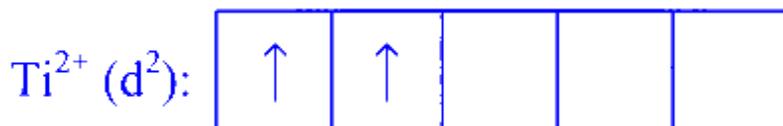
MHT CET 2024 3rd May Morning Shift

Options:

- A. Zero
- B. One
- C. Two
- D. Three

Answer: C

Solution:



There are 2 unpaired electrons in Ti^{2+} .

Question55

Which from following is NOT a lanthanoid element?

MHT CET 2024 2nd May Evening Shift

Options:

- A. Pm
- B. Er
- C. Yb

D. Hf

Answer: D

Solution:

Option D: **Hf (Hafnium)** is not a lanthanoid element.

The lanthanoid series consists of 15 metallic elements with atomic numbers from 57 to 71, from Lanthanum (La) to Lutetium (Lu). Here is a brief overview of the elements in this series along with their symbols and atomic numbers:

Lanthanum (La) - 57

Cerium (Ce) - 58

Praseodymium (Pr) - 59

Neodymium (Nd) - 60

Promethium (Pm) - 61

Samarium (Sm) - 62

Europium (Eu) - 63

Gadolinium (Gd) - 64

Terbium (Tb) - 65

Dysprosium (Dy) - 66

Holmium (Ho) - 67

Erbium (Er) - 68

Thulium (Tm) - 69

Ytterbium (Yb) - 70

Lutetium (Lu) - 71

Hafnium (Hf) is instead located in the transition metals section of the periodic table and has an atomic number of 72. It does not belong to the lanthanoid series.

Question56

Which from following catalysts is used in the Haber's process for manufacture of ammonia?

MHT CET 2024 2nd May Evening Shift

Options:

- A. MnO_2
- B. Mo/Fe
- C. Co – Th
- D. Fe – Cr

Answer: B

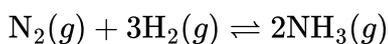
Solution:

In the Haber process, which is employed for the industrial production of ammonia, the most commonly used catalyst is a form of iron with a promoter. Over the years, the preferred composition for this catalytic system has been iron with the addition of small amounts of other elements to enhance its activity and longevity. The correct option for the catalyst used in the Haber's process is:

Option B

Mo/Fe

In this setup, iron (Fe) acts as the main catalyst, while molybdenum (Mo) is used as a promoter to improve the efficiency and activity of the iron catalyst. This catalytic system operates under high temperatures and pressures to facilitate the reaction between nitrogen (N_2) and hydrogen (H_2) to form ammonia (NH_3):



The role of the catalyst, particularly the Mo/Fe system, is critical in lowering the activation energy for the reaction, thereby increasing the rate at which ammonia is produced, without affecting the position of the chemical equilibrium.

Question57

Which element from following exhibits lowest number of different oxidation states?

MHT CET 2024 2nd May Morning Shift

Options:

- A. Sc



B. Cu

C. Ti

D. Zn

Answer: D

Solution:

To determine which element exhibits the lowest number of different oxidation states among Scandium (Sc), Copper (Cu), Titanium (Ti), and Zinc (Zn), let's analyze the common oxidation states of each element.

1. Scandium (Sc):

Electron Configuration: $[\text{Ar}] 3d^1 4s^2$

Common Oxidation States:

+3: This is the most common and stable oxidation state for Scandium.

Possible Oxidation States: Scandium primarily exhibits the +3 oxidation state, but in rare and unstable compounds, other oxidation states may be observed.

2. Copper (Cu):

Electron Configuration: $[\text{Ar}] 3d^{10} 4s^1$

Common Oxidation States:

+1: Found in compounds like Cu_2O .

+2: Found in compounds like CuO .

Possible Oxidation States:

+3: Less common but exists in some complexes.

0: In elemental form.

Total Different Oxidation States: At least **three** (+1, +2, +3).

3. Titanium (Ti):

Electron Configuration: $[\text{Ar}] 3d^2 4s^2$

Common Oxidation States:

+2

+3

+4: Most stable oxidation state.

Possible Oxidation States: Titanium can exhibit oxidation states ranging from +2 to +4, and in some complex compounds, even higher states.



Total Different Oxidation States: At least **three** (+2, +3, +4).

4. Zinc (Zn):

Electron Configuration: [Ar] 3d¹⁰ 4s²

Common Oxidation States:

+2: The only stable oxidation state.

Possible Oxidation States: Zinc **almost exclusively** exhibits the +2 oxidation state in its compounds.

Total Different Oxidation States: **One** (+2).

Conclusion:

Scandium (Sc): Primarily exhibits **one** common oxidation state (+3), but other states are theoretically possible.

Copper (Cu): Exhibits **multiple** oxidation states (+1, +2, +3).

Titanium (Ti): Exhibits **multiple** oxidation states (+2, +3, +4).

Zinc (Zn): Exhibits **only one** oxidation state (+2) in all its compounds.

Therefore, Zinc (Zn) exhibits the lowest number of different oxidation states among the given elements.

Answer: Option D

Question58

What is the total number of unpaired electrons in an element placed at period-4 and group-12 either in excited or at ground state?

MHT CET 2024 2nd May Morning Shift

Options:

A. Zero

B. One

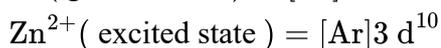
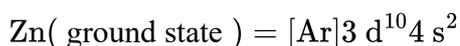
C. Two

D. Three

Answer: A

Solution:

Zn belongs to period 4 and group 12 of the periodic table.



Question 59

Which among the following elements does NOT exhibit ferromagnetic properties?

MHT CET 2023 14th May Evening Shift

Options:

A. Cr

B. Fe

C. Co

D. Ni

Answer: A

Solution:

Ferromagnetic materials are those that exhibit strong magnetic properties, where the magnetic moments of the atoms tend to align in the same direction upon an external magnetic field, even remaining magnetized after the external field is removed. Among the elements listed, chromium (Cr) does not exhibit ferromagnetic properties.

Let's consider each element:

- **Option A: Chromium (Cr)** - Chromium is actually antiferromagnetic. In antiferromagnetic materials, adjacent electrons pair up with opposite spins, which cancels out their magnetism at a macroscopic scale. This is why Cr does not exhibit ferromagnetic properties.
- **Option B: Iron (Fe)** - Iron is well-known as a ferromagnetic material, widely used in various applications for its magnetic properties. It is one of the most common ferromagnetic materials.
- **Option C: Cobalt (Co)** - Cobalt is ferromagnetic. It is part of the rare-earth metals and, like iron, is used for making magnets.



- **Option D: Nickel (Ni)** - Nickel is another well-known ferromagnet, although it has weaker magnetic properties than iron.

Therefore, the correct answer is **Option A: Chromium (Cr)**, as it does not exhibit ferromagnetic properties like the other elements listed.

Question60

Which from following elements is in liquid state at room temperature?

MHT CET 2023 14th May Evening Shift

Options:

- A. Se
- B. Br
- C. I
- D. S

Answer: B

Solution:

Among the options given, the element that is in a liquid state at room temperature is:

Option B: Br (Bromine)

Bromine is a chemical element with the symbol Br and atomic number 35. At room temperature (approximately 25 degrees Celsius or 77 degrees Fahrenheit), bromine is one of the only two elements on the periodic table that are in a liquid state, the other being mercury (Hg). Bromine is a halogen, and it appears as a reddish-brown liquid. It has a distinctive, strong smell and is known for its reactive properties.

The other elements listed are:

- **Option A: Se (Selenium)** which is a nonmetal that exists in several allotropes, but the most stable and dense form is a gray metallic-looking solid.
 - **Option C: I (Iodine)** which is also a halogen like bromine, but iodine is a solid at room temperature. It sublimates into a purple vapor when heated.
 - **Option D: S (Sulfur)** which is a yellow solid under normal conditions.
-



Question61

Find the number of unpaired electrons for copper in ground state configuration.

MHT CET 2023 14th May Evening Shift

Options:

- A. 1
- B. 2
- C. 3
- D. 4

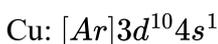
Answer: A

Solution:

To find the number of unpaired electrons in copper (Cu), we need to write down its electron configuration. The atomic number of copper is 29, indicating it has 29 electrons.

Copper, a transition metal, can sometimes have an electron configuration that is an exception to the typical filling order due to the relative energies of the atomic orbitals. The generally expected electron configuration would follow Hund's rule and the Aufbau principle, filling orbitals from lowest to highest energy level.

However, copper exhibits a unique electron arrangement where one electron in the 4s orbital is used to complete the 3d subshell, resulting in a more stable configuration. Its electron configuration in the ground state is:



When we look at this configuration:

- The 3d subshell is completely filled with 10 electrons, which means all five 3d orbitals have paired electrons. There are no unpaired electrons in the 3d subshell.
- The 4s subshell has 1 electron. This means there is just one unpaired electron in the 4s orbital.

Therefore, in its ground state, copper has a total of 1 unpaired electron.

The answer to the question is:

Option A : 1



Question62

Identify the element having highest ionization enthalpy.

MHT CET 2023 14th May Evening Shift

Options:

- A. Ti
- B. Sc
- C. Zn
- D. Ni

Answer: C

Solution:

The ionization enthalpy, also known as ionization energy, is the energy required to remove the most loosely bound electron from an isolated gaseous atom to form a cation. Generally speaking, ionization enthalpy increases across a period from left to right in the periodic table and decreases down a group. This is because the effective nuclear charge (which refers to the net positive charge experienced by an electron in a multi-electron atom) increases across a period, pulling the electrons in closer and thus requiring more energy to remove an electron. Conversely, ionization enthalpy decreases down a group as the outermost electrons are farther from the nucleus and more shielded by inner electrons, which makes them easier to remove.

Let's examine the given options in the context of their positions in the periodic table:

- **Titanium (Ti)** - Atomic number 22, located in period 4 and Group 4 of the periodic table (the first of the transition metals in this period).
- **Scandium (Sc)** - Atomic number 21, located in period 4 and is the first element in the transition series, Group 3 of the periodic table.
- **Zinc (Zn)** - Atomic number 30, located at the end of period 4 in the transition metals, specifically Group 12 of the periodic table. It has a completely filled d-subshell in its ground state.
- **Nickel (Ni)** - Atomic number 28, located in period 4, and is in Group 10 of the periodic table.

Now, considering the trends in ionization energy across the periodic table:

- Going from Sc to Zn (left to right) in the same period, generally, the ionization energy should increase because of the increased nuclear charge.
- Scandium has a $3d^1 4s^2$ configuration, so it would have lower ionization energy compared to Zinc, which has a $3d^{10} 4s^2$ configuration, since Zinc's d-subshell is completely filled, adding to the stability and requiring more energy to remove an electron.



- Nickel has the electron configuration $3d^84s^2$, so it has higher ionization energy compared to Scandium as well, but less than Zinc since Zinc has a completely filled d-subshell configuration that contributes to stability.
- Titanium with the electron configuration $3d^24s^2$ would have higher ionization energy than Scandium as it is to the right of Scandium but lower than that of Zinc for the same reasons discussed above.

Hence, Zinc (Zn) has the highest ionization enthalpy among the given elements due to its filled d-subshell which makes it highly stable relative to the other elements listed.

The correct answer is **Option C: Zn**.

Question63

Which among the following cations produces colourless aqueous solution in their respective oxidation state?

MHT CET 2023 14th May Morning Shift

Options:

- A. Ti^{3+}
- B. V^{3+}
- C. Sc^{3+}
- D. Cu^{2+}

Answer: C

Solution:

The color of the aqueous solutions of transition metal cations is generally due to electronic transitions among the d-orbitals as a consequence of ligand field splitting. Cations can absorb light of certain energies resulting in electronic transitions, which is what imparts color to their solutions.

Let's consider each of the given options:

Option A: Ti^{3+} (Titanium in +3 oxidation state) has one d electron ($3d^1$ configuration). This cation can undergo d-d transitions and is not colorless; it usually appears violet in aqueous solutions.

Option B: V^{3+} (Vanadium in +3 oxidation state) has two d electrons ($3d^2$ configuration). Like titanium, vanadium can also undergo d-d transitions and is typically green or blue in solutions, so it is not colorless either.



Option C: Sc^{3+} (Scandium in +3 oxidation state) has an electronic configuration of $3d^0$ after it has lost its three valence electrons. Since it has no d electrons, it cannot have d-d transitions and thus generally forms colorless solutions in water. Scandium is the correct answer to the question.

Option D: Cu^{2+} (Copper in +2 oxidation state) has one d electron ($3d^9$ configuration). It absorbs light in the red region, which makes its aqueous solution appear blue, so it is definitely not colorless.

Therefore, the cation that produces a colorless aqueous solution in its respective oxidation state is:

Option C: Sc^{3+} .

Question64

What is the number of elements present in each series of transition element?

MHT CET 2023 13th May Evening Shift

Options:

- A. 8
- B. 10
- C. 14
- D. 24

Answer: B

Solution:

Each series of transition elements contains 10 elements.

Question65

Which from following elements exhibits ferromagnetic properties?

MHT CET 2023 13th May Morning Shift

Options:

A. Mn

B. Co

C. Zn

D. Sc

Answer: B

Solution:

Among transition metals, Fe, Co and Ni are ferromagnetic.

Question66

Which element from the following possesses half-filled d-orbitals either in expected or in observed electronic configuration?

MHT CET 2023 12th May Evening Shift

Options:

A. Fe

B. Mn

C. Ni

D. Co

Answer: B

Solution:

Mn (Observed and expected electronic configurations): $[\text{Ar}]3d^5 4s^2$

Question67

What is the numerical value of spin only magnetic moment of copper in +2 state?

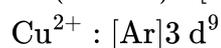
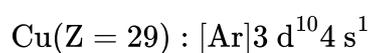
MHT CET 2023 12th May Morning Shift

Options:

- A. 0.0
- B. 1.73
- C. 2.78
- D. 4.4

Answer: B

Solution:



No. of unpaired $e^- = 1$

$$\mu = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3} = 1.73 \text{ BM}$$

Since the number of unpaired electrons (n) = 1, $\mu \approx 2$. Hence, option (B) is the correct answer.

Question68

Which element from following does NOT exhibit spin only magnetic moment in +3 state?

MHT CET 2023 11th May Evening Shift

Options:

- A. Cr
- B. V



C. Ti

D. Sc

Answer: D

Solution:

	Ions	Outer shell electronic configuration	No. of unpaired electrons
(A)	Cr^{3+}	$3d^3$	3
(B)	V^{3+}	$3d^2$	2
(C)	Ti^{3+}	$3d^1$	1
(D)	Sc^{3+}	$3d^0$	0

Sc^{3+} does not exhibit spin-only magnetic moment because of the absence of unpaired electrons.

Question69

Which from following cations in their respective oxidation states develops colourless aqueous solution?

MHT CET 2023 11th May Evening Shift

Options:

A. Fe^{3+}

B. Fe^{2+}

C. Cu^{2+}

D. Cu^{+}

Answer: D

Solution:



Ion	Outer electronic configuration	No. of unpaired electrons
Fe^{3+}	$3d^5$	5
Fe^{2+}	$3d^6$	4
Cu^{2+}	$3d^9$	1
Cu^+	$3d^{10}$	0

Cu^+ is colourless because of the absence of unpaired electrons.

Question 70

Oxidation state of manganese in potassium permanganate is:

MHT CET 2023 11th May Morning Shift

Options:

- A. +3
- B. +7
- C. +5
- D. +1

Answer: B

Solution:

Oxidation number of K = +1

Oxidation number of O = -2

KMnO_4 is a neutral molecule.

\therefore Sum of the oxidation number of all atoms = 0

Oxidation number of K + Oxidation number of Mn + $4 \times$ (Oxidation number of O) = 0

$(+1) + (\text{Oxidation number of Mn}) + 4 \times (-2) = 0$

$1 + (\text{Oxidation number of Mn}) = +8$

∴ Oxidation number of Mn = +7

Question71

Which of the following elements is doped with to obtain fibre amplifiers for optical fibre communication system?

MHT CET 2023 10th May Morning Shift

Options:

A. Zn

B. Cu

C. Er

D. La

Answer: C

Solution:

Erbium-doped fibre amplifiers are used in optical fibre communication systems.

Question72

Identify lanthanoid element from following.

MHT CET 2023 10th May Morning Shift

Options:

A. Eu

B. Cm



C. Am

D. Np

Answer: A

Solution:

The lanthanoids, or lanthanides, are a set of 15 chemical elements in the periodic table with atomic numbers from 57 (lanthanum) to 71 (lutetium). They are named after the first element in the series, lanthanum, and they are known for their similarity to each other and for their wide range of applications in various technologies, including electronics, optics, and as catalysts.

Here's a check on each of the given options:

Option A: Eu represents Europium, which is a lanthanoid element with the atomic number 63. It falls within the range of the lanthanoids in the periodic table.

Option B: Cm stands for Curium, which is not a lanthanoid. Curium is an actinoid (or actinide) element with the atomic number 96.

Option C: Am is the symbol for Americium, another actinoid element with the atomic number 95, sitting just before Curium in the periodic table.

Option D: Np stands for Neptunium, which is also an actinoid element, bearing the atomic number 93.

Therefore, the correct answer that identifies a lanthanoid element from the provided options is:

Option A: Eu (Europium)

Question 73

What is the stock notation of Manganese dioxide?

MHT CET 2023 9th May Evening Shift

Options:

A. Mn(I)O₂

B. Mn(II)O₂

C. Mn(III)O₂

D. Mn(IV)O₂

Answer: D

Solution:

The oxidation state of Mn in manganese dioxide (MnO_2) is +4 . Hence, the stock notation is Mn(IV)O_2

Question74

Which from following statements regarding transition elements is NOT CORRECT?

MHT CET 2023 9th May Evening Shift

Options:

- A. These exhibit properties between 's' and 'p' block elements.
- B. These form cations with incomplete d-subshell.
- C. 5d series consists of all elements from lanthanum to mercury of periodic table.
- D. These are arranged in four different 'd' series.

Answer: C

Solution:

The statement that is NOT CORRECT regarding transition elements is :

Option C : "5d series consists of all elements from lanthanum to mercury of periodic table."

This statement is incorrect because the 5d series of the transition elements does not start with lanthanum. The first element of the 5d series is hafnium (Hf), not lanthanum (La). Lanthanum is actually the first element in the lanthanide series.

Question75

Identify the element from following having six unpaired electrons in observed electronic configuration?

MHT CET 2023 9th May Evening Shift

Options:

- A. Cu
- B. Zn
- C. Cr
- D. Ti

Answer: C

Solution:

Chromium (Cr):

Expected electronic configuration: $[\text{Ar}]3d^4 4s^2$

Observed electronic configuration: $[\text{Ar}]3d^5 4s^1$

Hence, number of unpaired electrons in observed electronic configuration is 6.

Question 76

What are different possible oxidation states exhibited by scandium?

MHT CET 2023 9th May Morning Shift

Options:

- A. +4
- B. +5
- C. +4, +5
- D. +2, +3

Answer: D

Solution:



Scandium typically exhibits a +3 oxidation state. This is because it has an electronic configuration of $[\text{Ar}] 3d^1 4s^2$, and it typically loses the three outer electrons to achieve a noble gas configuration. While a +2 oxidation state is theoretically possible, it is not commonly observed. Scandium does not commonly exhibit +4 or +5 oxidation states.

Thus, the correct answer to the question is :

Option D : +2, +3

Question77

Find the value of spin only magnetic moment for chromium cation in +2 state.

MHT CET 2023 9th May Morning Shift

Options:

A. 3.87 BM

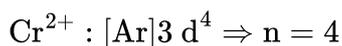
B. 4.90 BM

C. 2.84 BM

D. 1.73 BM

Answer: B

Solution:



\therefore Spin-only magnetic moment,

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

$$= \sqrt{4(4+2)} = \sqrt{24} \text{ BM}$$

$$= 4.90 \text{ BM}$$

Since the number of unpaired electrons (n) = 4, $\mu \approx 5$. Hence, option (B) is the correct answer.

Question78

Which among the following properties of lanthanoids is NOT true?



MHT CET 2022 11th August Evening Shift

Options:

- A. Good conductors of heat and electricity
- B. All are non-radioactive elements
- C. Have greater co-ordination number than six
- D. Strongly paramagnetic

Answer: B

Solution:

The incorrect property among the listed options for lanthanoids is:

Option B: All are non-radioactive elements

This statement is not true because not all lanthanoids are non-radioactive. Most lanthanoids are indeed non-radioactive under normal conditions. However, among the lanthanides, promethium (Pm) is an exception as it does not have any stable isotopes and is radioactive. The most common isotope of promethium, promethium-145, has a half-life of 17.7 years and thus, it decays over time emitting radiation.

The other options given are typically true for the lanthanides (also known as lanthanoids):

Option A: Good conductors of heat and electricity – True. Lanthanoids are metals and like most metals, they are generally good conductors of heat and electricity.

Option C: Have greater coordination number than six – True. Lanthanoids have the ability to adopt coordination numbers greater than 6 because of their relatively large ionic radii and the availability of empty 4f, 5d, and 6s orbitals that can participate in bonding.

Option D: Strongly paramagnetic – True. Many lanthanides are strongly paramagnetic due to the presence of unpaired electrons in their 4f orbitals. Their magnetic properties are significant and are utilized in various applications such as in magnets, phosphors, and in magnetic resonance imaging (MRI) contrast agents.

Question 79

Identify the element with smallest ionic radius in +3 oxidation state from following.

MHT CET 2022 11th August Evening Shift



Options:

- A. Er
- B. Lu
- C. Eu
- D. Yb

Answer: B

Solution:

For elements in the same group of the periodic table, the ionic radii decrease with an increase in atomic number due to increasing effective nuclear charge, which pulls the electrons closer to the nucleus. However, when looking across the lanthanide series (or rare earth metals), there is an additional factor called the lanthanide contraction to consider.

Within lanthanides, as the atomic number increases, the filling up of the 4f sublevel takes place. Due to the poor shielding effect of 4f electrons, the effective nuclear charge experienced by the outer electrons increases. Thus, despite a constant charge state (+3 in this case), elements later in the series will have smaller radii due to the stronger attraction by the nucleus.

Between erbium (Er), lutetium (Lu), europium (Eu), and ytterbium (Yb), Er and Lu are actual lanthanides, while Eu and Yb have different electronic configurations that make them exceptions within the series. Europium tends to have a larger radius due to having it typically in a +2 state, and ytterbium has an anomalous configuration with a filled 4f level, imparting it a smaller radius than expected for its position.

Among the given options, lutetium (Lu) has the highest atomic number (71) and is the last element in the lanthanide series. Because of the continued lanthanide contraction, Lu^{+3} is expected to have the smallest ionic radius of the given options:

- Er (Erbium) +3 is before Lu in the lanthanide series.
- Eu (Europium) +3 would generally have a larger ionic radius due to being earlier in the series and also due to its typical +2 state.
- Yb (Ytterbium) +3, although having a filled 4f level resulting in a smaller radius than expected, it is still not as small as that of Lu^{+3} because Yb has a lower atomic number.

Therefore, the correct answer is:

Option B: Lu (Lutetium)

Question 80

Which among the following cations will not form coloured compounds? (Atomic number Cu = 29, Ti = 22, V = 23, Mn = 25)



MHT CET 2021 24th September Evening Shift

Options:

A. V^{3+}

B. Ti^{3+}

C. Cu^{+}

D. Mn^{2+}

Answer: C

Solution:

$V^{3+} : 3 d^2 \rightarrow 2$ unpaired electrons

$Ti^{3+} : 3 d^1 \rightarrow 1$ unpaired electron

$Cu^{+} : 3 d^{10} \rightarrow$ No unpaired electron

$Mn^{2+} : 3 d^5 \rightarrow 5$ unpaired electrons

Due to absence of unpaired electron, Cu^{+} will not form coloured compounds.

Question81

Which element from following in +3 oxidation state forms colourless compounds?

MHT CET 2021 24th September Evening Shift

Options:

A. Sc ($Z = 21$)

B. Ti ($Z = 22$)

C. V ($Z = 23$)

D. Fe ($Z = 26$)

Answer: A

Solution:

$\text{Sc}^{3+} : 3d^0 \rightarrow$ No unpaired electron

$\text{Ti}^{3+} : 3d^1 \rightarrow$ 1 unpaired electron

$\text{V}^{3+} : 3d^2 \rightarrow$ 2 unpaired electrons

$\text{Fe}^{3+} : 3d^5 \rightarrow$ 5 unpaired electrons

Due to absence of unpaired electron, Sc in +3 oxidation state forms colourless compounds.

Question82

What is value of spin only magnetic moment of Ni($Z = 28$) in +2 oxidation state?

MHT CET 2021 23rd September Evening Shift

Options:

A. 3.1 BM

B. 0.0 BM

C. 2.8 BM

D. 1.7 BM

Answer: C

Solution:

The electronic configuration of Ni ($Z = 28$) is $[\text{Ar}] 3d^8 4s^2$.

In +2 oxidation state, the electronic configuration of Ni^{2+} is $[\text{Ar}] 3d^8$.

The number of unpaired electrons in Ni^{2+} is 2.

The spin-only magnetic moment is given by the formula:



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

where n is the number of unpaired electrons.

Therefore, the spin-only magnetic moment of Ni^{2+} is:

$$\mu = \sqrt{2(2+2)} = \sqrt{8} = 2.83\text{BM}$$

The closest option is **Option C: 2.8 BM**.

Question83

Which of the following elements in their respective oxidation states does not develop spin only magnetic moment? [

Ti(Z = 22), Zn(Z = 30), V(Z = 23), Cu(Z = 29)]

MHT CET 2021 23rd September Evening Shift

Options:

A. Cu^{2+}

B. Zn^{2+}

C. Ti^{3+}

D. V^{3+}

Answer: B

Solution:

To determine which element in its respective oxidation state does not develop a spin-only magnetic moment, we need to analyze the electronic configurations of the given ions as well as their unpaired electrons. The spin-only magnetic moment arises from unpaired electrons. If an ion has no unpaired electrons, it does not develop a spin-only magnetic moment.

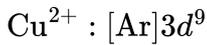
Let's consider each ion one by one:

1. Cu^{2+} : The atomic number of copper (Cu) is 29. Its ground-state configuration is:



For Cu^{2+} , we remove two electrons, preferably from the outermost shell first (4s) and then from the 3d orbitals:





The Cu^{2+} ion has 9 electrons in the 3d orbital, with one unpaired electron, thus it exhibits a spin-only magnetic moment.

2. Zn^{2+} : The atomic number of zinc (Zn) is 30. Its ground-state configuration is:



For Zn^{2+} , we remove two electrons from the outermost shell (4s):



The Zn^{2+} ion has a completely filled 3d orbital with no unpaired electrons, meaning it does not exhibit a spin-only magnetic moment.

3. Ti^{3+} : The atomic number of titanium (Ti) is 22. Its ground-state configuration is:

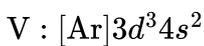


For Ti^{3+} , we remove three electrons (two from 4s and one from 3d):

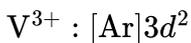


The Ti^{3+} ion has one unpaired electron in the 3d orbital, thus it exhibits a spin-only magnetic moment.

4. V^{3+} : The atomic number of vanadium (V) is 23. Its ground-state configuration is:



For V^{3+} , we remove three electrons (two from 4s and one from 3d):



The V^{3+} ion has two unpaired electrons in the 3d orbital, so it exhibits a spin-only magnetic moment.

From the analysis above, the element with an ion that does not develop a spin-only magnetic moment is:

Option B: Zn^{2+}

Question84

Identify ferromagnetic element from following.

MHT CET 2021 23th September Morning Shift

Options:

A. Iron

- B. Vanadium
- C. Chromium
- D. Manganese

Answer: A

Solution:

Ferromagnetism is a physical phenomenon in which certain materials, like iron, exhibit strong magnetic properties. These materials can retain their magnetic properties even in the absence of an external magnetic field. This phenomenon occurs because the magnetic moments of the atoms in ferromagnetic materials align in parallel, resulting in a strong net magnetic field.

Among the given options, iron is well-known for being a ferromagnetic material. While vanadium, chromium, and manganese can exhibit other types of magnetic behavior (paramagnetism or antiferromagnetism), they are not typically ferromagnetic at room temperature.

Therefore, the correct answer is:

Option A: Iron

Question85

Which element from following lanthanoids has half-filled f- orbital in observed and expected electronic configuration?

MHT CET 2021 22th September Evening Shift

Options:

- A. Eu
- B. Sm
- C. Ce
- D. Pm

Answer: A

Solution:



The lanthanoids are a series of chemical elements comprising atomic numbers 58 to 71, from cerium (Ce) to lutetium (Lu), all of which fill the 4f orbitals. The electronic configuration of the lanthanoids is generally represented as $[\text{Xe}]4f^n6s^2$, where n varies from 0 to 14 across the series. A half-filled f-orbital means that there are precisely 7 electrons in the 4f subshell since a full f-orbital can accommodate 14 electrons. Therefore, to identify which element has a half-filled f-orbital, we look for an element with 7 electrons in its 4f subshell.

To determine the correct option:

- **Eu (Europium)** has an atomic number of 63. Its expected electronic configuration is $[\text{Xe}]4f^76s^2$, indicating a half-filled 4f subshell with 7 electrons. Hence, Eu fits the condition of having a half-filled f-orbital.
- **Sm (Samarium)** has an atomic number of 62. Its electronic configuration would be $[\text{Xe}]4f^66s^2$, which is not half-filled.
- **Ce (Cerium)** has an atomic number of 58. Its electronic configuration is $[\text{Xe}]4f^16s^2$ after accounting for the actual electronic configuration, which shows that Ce does not have a half-filled 4f-orbital either.
- **Pm (Promethium)** has an atomic number of 61. Its expected electronic configuration would be $[\text{Xe}]4f^56s^2$, which also does not result in a half-filled 4f orbital.

Therefore, the correct answer is **Option A - Eu (Europium)**, which has a half-filled f-orbital as per the expected and observed electronic configuration.

Question86

Which element from following exhibits various different oxidation states from +2 to +7?

MHT CET 2021 22th September Morning Shift

Options:

- A. Mn
- B. Cr
- C. V
- D. Ni

Answer: A

Solution:

The element that exhibits various different oxidation states from +2 to +7 is Manganese (Mn).

Manganese is known for its ability to exhibit a wide range of oxidation states due to its multiple accessible electron configurations. The most common oxidation states of manganese are +2, +3, +4, +6, and +7, with the +2 and +7 states being particularly notable.



This variability in oxidation states can be attributed to the electron configuration of manganese, which is $[Ar]3d^54s^2$, allowing it to lose different numbers of electrons from its 3d and 4s orbitals.

Here are the oxidation states and some of the compounds in which they are found:

- +2: Mn^{2+} (in manganese(II) salts, such as manganese(II) sulfate $MnSO_4$)
- +3: Mn^{3+} (in manganese(III) oxide Mn_2O_3)
- +4: MnO_2 (in manganese dioxide)
- +6: MnO_4^{2-} (in manganate ion)
- +7: MnO_4^- (in permanganate ion)

The ability to exist in so many different oxidation states makes manganese unique and versatile in its chemical reactivity, which has significant implications in both biological systems and industrial applications.

Therefore, the correct option is:

Option A: Mn

Question87

Which block elements from following are known as transition elements?

MHT CET 2021 22th September Morning Shift

Options:

- A. f-block
- B. s-block
- C. p-block
- D. d-block

Answer: D

Solution:

The correct answer is **Option D, d-block**. Here's why:

The periodic table is organized into blocks based on the electron configuration of the elements within them. These blocks are:

- **s-block:** Elements in this block have their outermost electron in an *s* orbital. These are the alkali metals (Group 1) and alkaline earth metals (Group 2).



- **p-block:** Elements in this block have their outermost electron in a p orbital. This block includes a variety of elements, including the halogens (Group 17) and noble gases (Group 18).
- **d-block:** Elements in this block have their outermost electron in a d orbital. These are the **transition metals**. They are located in the central block of the periodic table, from Group 3 to Group 12.
- **f-block:** Elements in this block have their outermost electron in an f orbital. These are the inner transition metals, also known as the lanthanides and actinides.

Transition elements (d-block) exhibit a unique set of characteristics due to their partially filled d orbitals. Some of these characteristics include:

- **Variable Oxidation States:** Transition metals can form compounds with multiple oxidation states, giving rise to a wide range of chemical behaviors.
- **Colored Compounds:** Many transition metal compounds are colored due to the ability of d electrons to absorb and emit specific wavelengths of light.
- **Catalytic Activity:** Transition metals are often used as catalysts in chemical reactions, facilitating the breaking and formation of bonds.
- **Paramagnetism:** Many transition metals exhibit paramagnetism, meaning they are attracted to magnetic fields, due to the presence of unpaired d electrons.

In summary, the elements that are known as transition elements are located in the **d-block** of the periodic table. Their unique electronic configuration leads to a variety of interesting properties, including variable oxidation states, colored compounds, catalytic activity, and paramagnetism.

Question88

Which element among the following is ferromagnetic?

MHT CET 2021 21th September Evening Shift

Options:

- A. Ni
- B. Cu
- C. Sc
- D. Zn

Answer: A

Solution:

Among the options provided, the element that is ferromagnetic is :

- **Option A - Ni (Nickel)**



Nickel is a ferromagnetic material, along with iron and cobalt. These elements are characterized by their ability to be magnetized and to maintain a magnetic field.

The other options are not ferromagnetic :

- **Option B - Cu (Copper)** : Copper is not ferromagnetic. It is, in fact, diamagnetic, meaning it is weakly repelled by magnetic fields.
- **Option C - Sc (Scandium)** : Scandium is not ferromagnetic. Like copper, it is also classified as diamagnetic.
- **Option D - Zn (Zinc)** : Zinc is not ferromagnetic. It is another example of a diamagnetic material.

Ferromagnetic materials are unique in their ability to retain a magnetic field after an external magnetic field is removed, a property not found in the other elements listed here.

Question89

Which property from following is NOT exhibited by interstitial compounds?

MHT CET 2021 21th September Evening Shift

Options:

- A. Their melting points are higher than pure metal.
- B. Their densities are less than parent metal.
- C. Their chemical properties are different than parent metal.
- D. These are hard and good conductors of heat and electricity.

Answer: C

Solution:

Chemical properties of interstitial compounds are similar to the parent metal.

Question90



What are the formulae of the compounds formed when lanthanoids (Ln) react with nitrogen and halogen respectively?

MHT CET 2021 20th September Evening Shift

Options:

- A. LnN and LnX_3
- B. LnN_3 and LnX
- C. $(\text{Ln})_2\text{N}_3$ and LnX_2
- D. LnN and LnX

Answer: A

Solution:

Lanthanoids react with nitrogen and halogens to give nitrides and halides of the formulae LnN and LnX_3 respectively.

Question91

Which among following properties of lanthanoids is NOT true?

MHT CET 2021 20th September Evening Shift

Options:

- A. These are good conductors of heat and electricity.
- B. These are strongly paramagnetic.
- C. These all are non-radioactive.
- D. These have coordination number greater than 6 .

Answer: C



Solution:

Except promethium (Pm), all are non-radioactive in nature.

Question92

Which among the following elements has completely filled 4d-orbital?

MHT CET 2021 20th September Morning Shift

Options:

- A. Ag
- B. Cd
- C. Sc
- D. Zr

Answer: B

Solution:

Cd ($Z = 48$) \Rightarrow [Kr] $4d^{10} 5s^2$

Cd has completely filled 4d - orbital.

Question93

Identify the correct statement about properties of interstitial compounds.

MHT CET 2021 20th September Morning Shift

Options:



- A. Melting point of these compounds is lower than parent metal.
- B. Densities of these compounds are higher than parent metal.
- C. Chemical properties of interstitial compounds are different than parent metal.
- D. Metallic carbides are chemically inert.

Answer: D

Solution:

The correct answer is:

D. Metallic carbides are chemically inert

Explanation:

Interstitial compounds (like carbides, nitrides, and hydrides of transition metals) have the following properties:

- They generally have **higher melting points** than the parent metal → so **A is incorrect**
- Their **densities are usually higher** than the parent metal → **B is correct** , but not the best defining statement here
- Their **chemical properties are similar** to the parent metal → so **C is incorrect**
- **Metallic carbides** (e.g., TiC, WC) are **very hard, stable, and chemically inert** → **D is correct**

✓ **Correct option: D**

Question94

Identify the correct decreasing order of densities of *d*-block elements.

MHT CET 2020 19th October Evening Shift

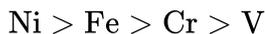
Options:

- A. $V > Cr > Fe > Ni$
- B. $Ni > Fe > Cr > V$
- C. $Fe > Ni > V > Cr$
- D. $Cr > Fe > V > Ni$

Answer: B

Solution:

The correct order of densities of *d*-block elements are as follows :



On moving across a period electrons have the same principal quantum number and so they are not making the atom bigger, but at the same time there is more protons and neutrons resulting increase in number of nucleons and due to effectively increase in charge of nucleus there is decrease in radius of the atom.

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Mass is increasing and volume is decreasing, overall we conclude that on moving left to right density increases.

Question95

Which of the following actinoids exhibits only +3 oxidation state?

MHT CET 2020 16th October Evening Shift

Options:

A. Lr ($Z = 103$)

B. U ($Z = 92$)

C. Th ($Z = 90$)

D. Pa ($Z = 91$)

Answer: A

Solution:

Lawrencium (Lr) shows only +3 oxidation state, that has electronic configuration $[Rn]5f^{14}7s^27p^1$. This element may easily give up three valence electron from the $7s$ and $7p$ subshell to form a stable +3 oxidation state. The state is especially stable in case of Lr because it contains full filled ($5f^{14}$) f-subshell.

Question96

Which of the following elements belongs to first inner transition series?

MHT CET 2020 16th October Evening Shift

Options:

A. Pu

B. Pr

C. Bk

D. Fm

Answer: B

Solution:

Praseodymium (Pr) element belongs to first inner transition series. This series includes the elements from cerium (Ce, atomic number 58) to lutetium (Lu, atomic number 71). These elements are called the lanthanoids because the chemistry of each element closely resembles, to the chemistry lanthanum.

Question97

Identify the element having highest enthalpy of atomisation from following.

MHT CET 2020 16th October Morning Shift

Options:

A. Sc($Z = 21$)

B. Fe($Z = 26$)

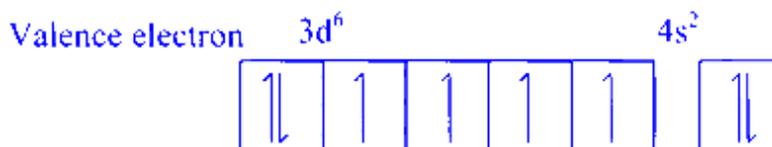
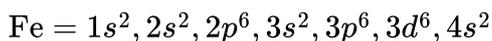
C. Zn($Z = 30$)

D. Cu($Z = 29$)

Answer: B

Solution:

Iron (Fe) has highest enthalpy of atomisation. depends upon strength of metallic bond, which further depends on number of unpaired electrons. Greater the number of unpaired electron stronger will be the metallic bond. In case of Fe($Z = 26$), electronic configuration of Fe, 4 unpaired electron are present.



Number of unpaired electrons = 4

Question98

Which among the following lanthanoids, shows only +3 oxidation state?

MHT CET 2020 16th October Morning Shift

Options:

- A. Cerium
- B. Gadolinium
- C. Terbium
- D. Neodymium

Answer: B

Solution:

The lanthanoids primarily exhibit a +3 oxidation state in their compounds, which is due to the removal of three electrons from their valence shells. However, some lanthanoids show variable oxidation states, including +2 and +4, in addition to the common +3 oxidation state. Among the options given:

- **Cerium (Option A)** has a common oxidation state of +3 but also notably exhibits a +4 oxidation state in some compounds, such as cerium(IV) oxide (CeO_2).
- **Gadolinium (Option B)** primarily shows a +3 oxidation state in its compounds.
- **Terbium (Option C)** has a +3 oxidation state but can also show a +4 oxidation state in some of its compounds.
- **Neodymium (Option D)** like cerium, predominantly exists in the +3 oxidation state but can also demonstrate a +4 oxidation state in some compounds.

Among these, **Gadolinium** (Option B) is most commonly associated with exhibiting only a +3 oxidation state in its compounds, with no common occurrences of other oxidation states. Therefore, the correct answer is **Option B: Gadolinium**. This adherence to a +3 oxidation state is due to the electronic configuration and the stability provided by the half-filled 4f orbital in gadolinium (Gd^{3+}).

Question99

What is the shape and magnetic nature of permanganate ion?

MHT CET 2019 3rd May Morning Shift

Options:

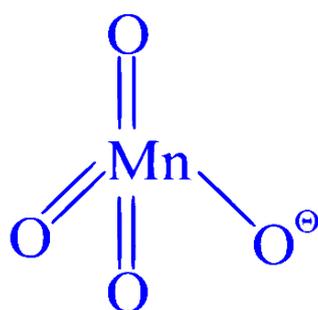
- A. Pyramidal diamagnetic
- B. Tetrahedral, diamagnetic
- C. Tetrahedral, paramagnetic
- D. Planar, paramagnetic

Answer: B

Solution:

The permanganate ions are tetrahedral. The π -bonding takes place by overlap of p -orbitals of oxygen with d -orbitals of manganese. It is also diamagnetic due to the absence of unpaired electron. The structure of permanganate ion is given below:





Tetrahedral
permanganate
ion (purple)

Question100

The highest oxidation state in plutonium (At. no. = 94) is

MHT CET 2019 3rd May Morning Shift

Options:

- A. +6
- B. +4
- C. +5
- D. +7

Answer: D

Solution:

The highest oxidation state in plutonium (Atomic number = 94) is +7. It can show a greater range of oxidation states which (in part) is attributed to the fact that $5f$, $6d$ and $7s$ levels are of comparable energies. Plutonium (Pu) can show oxidation state of +3, +4, +5, +6 and +7 in its compound.



Question101

When a mixture of manganese dioxide, potassium hydroxide and potassium chlorate is fused, the product obtained is

MHT CET 2019 2nd May Evening Shift

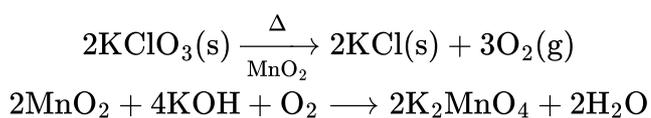
Options:

- A. K_2SO_4
- B. K_2MnO_3
- C. K_2MnO_4
- D. $KMnO_4$

Answer: C

Solution:

When a mixture of manganese dioxide, potassium hydroxide and potassium chlorate is fused then potassium chlorate first decomposes to give potassium chloride and oxygen gas. The formed O_2 gas then reacts with MnO_2 and KOH to give K_2MnO_4 . The equations for the above reaction can be written as :



Question102

The ionic charges on chromate ion and dichromate ion respectively is

MHT CET 2019 2nd May Morning Shift



Options:

A. -2, -2

B. -3, -2

C. -2, -4

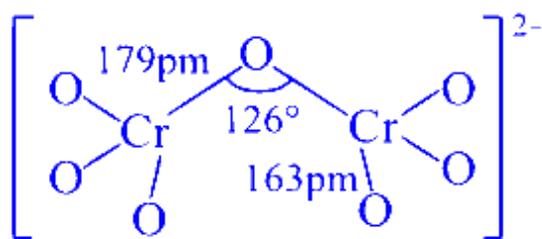
D. -4, -2

Answer: A

Solution:

The ionic charges on chromate and dichromate ion respectively is -2 and -2. This can be predicted on the basis of the following structures :

Dichromate ion ($\text{Cr}_2\text{O}_7^{2-}$)



Chromate ion (CrO_4^{2-})

