1. Among following compound how many are paramagnetic in nature \(K_2O, Li_2O, MnO, ZnO, Na_2O\)

(A) 0
(B) 1
(C) 2
(D) 2

Ans. (B)

Sol. Unpaired electrons must be present for a compound to be paramagnetic. Oxide ion has fully filled orbitals and cation of alkali metal contain fully filled orbitals. MnO contains \(Mn^{+2}\) cation which has 5 unpaired electrons. Due to which MnO is paramagnetic.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>(K_2O)</td>
<td>diamagnetic</td>
</tr>
<tr>
<td>(Li_2O)</td>
<td>diamagnetic</td>
</tr>
<tr>
<td>(MnO)</td>
<td>paramagnetic</td>
</tr>
<tr>
<td>(ZnO)</td>
<td>diamagnetic</td>
</tr>
<tr>
<td>(Na_2O)</td>
<td>diamagnetic</td>
</tr>
</tbody>
</table>

2. A metal ion \(M^{+3}\) have \([Ar]3d^5\) configuration than possible metal is :

(A) Fe
(B) Co
(C) Cr
(D) Mn

Ans. (A)

Sol. \(Fe^{3+} = 3d^54s^0\)
\(Co^{3+} = 3d^64s^0\)
\(Cr^{3+} = 3d^34s^0\)
\(Mn^{3+} = 3d^44s^0\)
\(M^{+3} = [Ar]3d^54s^0\)
$M = [Ar]3d^64s^2$

so $Z$ for $M = 26$ and $M$ is $Fe$.

3. Which one of the following oxides of nitrogen does not have N-N bond

(A) $N_2O_4$

(B) $N_2O$

(C) $N_2O_3$

(D) $N_2O_5$

Ans. (D)

Sol. $N_2O_5$ contains an N-O-N bond.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Resonance structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N_2O_4$</td>
<td><img src="image" alt="Resonance structure of $N_2O_4$" /></td>
</tr>
<tr>
<td>$N_2O$</td>
<td><img src="image" alt="Resonance structure of $N_2O$" /></td>
</tr>
<tr>
<td>$N_2O_3$</td>
<td><img src="image" alt="Resonance structure of $N_2O_3$" /></td>
</tr>
<tr>
<td>$N_2O_5$</td>
<td><img src="image" alt="Resonance structure of $N_2O_5$" /></td>
</tr>
</tbody>
</table>

4. Malachite and calamine are ore of

(A) Zn and Cu

(B) Cu and Zn

(C) Fe and Cu
(D) Ag and Cu

Ans. (B)

Sol. Malachite \( \Rightarrow \text{CuCO}_3 \cdot \text{Cu(OH)}_2 \)

Calamine \( \Rightarrow \text{ZnCO}_3 \)

5. Which of the following metal ion have magnetic moment (spin only) 3.78 B.M.

(A) Co\(^{3+}\)

(B) Mn\(^{2+}\)

(C) V\(^{3+}\)

(D) Cr\(^{3+}\)

Ans. (D)

Sol. \( \mu = \sqrt{n(n + 2)} = 3.78 \Rightarrow n = 3 \)

<table>
<thead>
<tr>
<th>Metal ion</th>
<th>Electronic configuration</th>
<th>Unpaired electrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Co(^{3+})</td>
<td>[Ar]3d(^6)4s(^0)</td>
<td>4</td>
</tr>
<tr>
<td>(2) Mn(^{2+})</td>
<td>[Ar]3d(^4)4s(^0)</td>
<td>4</td>
</tr>
<tr>
<td>(3) V(^{3+})</td>
<td>[Ar]3d(^1)4s(^0)</td>
<td>1</td>
</tr>
<tr>
<td>(4) Cr(^{3+})</td>
<td>[Ar]3d(^3)4s(^0)</td>
<td>3</td>
</tr>
</tbody>
</table>

6. Magnetic moment (spin only) of \( B_2^+ \) ion is \( \ldots \times 10^{-2} \) B.M [Given \( \sqrt{3} = 1.73 \) B.M.]

Ans. 173

Sol. In \( B_2^+ \) ion number of electrons = 9

\[ B_2^+ = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2(\pi 2p_x^1 = \pi 2p_y^0) \]

so, number unpaired electron = 1

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

\[ \mu = \sqrt{3} \text{ B.M.} = 1.73 = 173 \times 10^{-2} \text{ B.M.} \]

7. A bulb of 120 watt emits of light of wavelength 920 nm then number of photons emitted by bulb per second are \( [X] \times 10^{20} \), then value of \( X \) is

[Report your answer to the nearest integer].
Ans. 6

Sol. Power = 120J/sec

\[ E = n \left( \frac{hc}{\lambda} \right) \]

\[ n = \left[ \frac{120 \times 920 \times 10^{-9}}{6.62 \times 10^{-34} \times 3 \times 10^8} \right] = 5558.9 \times 10^{17} = 5.5589 \times 10^{20} \]

8. In reaction

\( H_2O_2 + I_2 \rightarrow X \) (in basic medium)

then 'X' is

(A) \( IO_3^- \)

(B) \( IO_4^- \)

(C) \( I^- \)

(D) \( IO^- \)

Ans. (C)

Sol. \( H_2O_2 + I_2 + 2OH^- \rightarrow O_2 + 2I^- + 2H_2O \)

9. For endothermic reaction which is correct graph

(A)

(B)
Ans. (A)

Sol. \( \Delta G = \Delta H - T\Delta S \)
\[-RT\ln K_{eq} = \Delta H - T\Delta S \]
\[\ln K_{eq} = \left[\frac{-\Delta H}{R}\right]\frac{1}{T} + \left[\frac{\Delta S}{R}\frac{1}{T} \right] \]
Slope = \( \frac{-\Delta H}{R} \)

10. For a reaction \( \Delta H = -158.73 \text{kJ/mol}, \Delta S = -58.1 \text{J/K} \) \( T = 298 \text{K} \), then value of \( \Delta G \) (in kJ) is:
[Report your answer to nearest integer]

Ans. 141

Sol. \( \Delta G = \Delta H - T\Delta S \)
\[= -158.73 - \frac{298(-58.1)}{1000} = -158.73 + 17.31 = 141.4 \text{kJ} \]

11. What is the sum of oxidation number of Ag in \([Ag(NH_3)_2]^+\) and \([Ag(CN)_2]^-\) is ........

Ans. 2

Sol. \([Ag(NH_3)_2]^+\); \([Ag(CN)_2]^-\)

The sum of the oxidation states of all atoms in a species is equal to charge present on that species. In both the molecules silver oxidation state is +1.

12. Number of sodium atom present in 8 gram of sodium is \( X \times 10^{23} \), then value of 'X' is. [Take \( N_A = 6 \times 10^{23} \)] [Report your answer to nearest integer]

Ans. 2
Sol. Number of moles of sodium = \[ \frac{8}{23} \]

Number of sodium atoms = \[ \frac{8}{23} \times 6.023 \times 10^{23} = 2.09 \times 10^{23} \]

13. Colour of \( Fe^{2+} \) and \( Fe^{3+} \) ion in aqueous solution is respectively?

(A) Green, Yellow
(B) Brown, Yellow
(C) Red, Brown
(D) Yellow, Green

Ans. (A)

Sol.

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Example</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>3d^6</td>
<td>Fe^{+2}</td>
<td>Green</td>
</tr>
<tr>
<td>3d^5</td>
<td>Fe^{+3}</td>
<td>Yellow</td>
</tr>
</tbody>
</table>

14. For an octahedral aqueous complex of a metal ion \( CFSE = -0.8\Delta_0 \) and Magnetic moment (spin only) = 3.87 BM, then the metal ion is:

(A) Co^{2+}
(B) Mn^{4+}
(C) V^{2+}
(D) Cr^{3+}

Ans. (A)

Sol. \( CFSE \) for octahedral complex = \[ -0.4n_{t_2g} + 0.6n_{e_g} \Delta_0 + n(P) \]

As \( \mu=3.87 \) BM

so number unpaired electrons = 3.

<table>
<thead>
<tr>
<th>Metal ion</th>
<th>configuration</th>
<th>CFSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co^{2+} = 3d^7</td>
<td>t_{2g}^{2.2.1} e_{g}^{1.1}</td>
<td>( CFSE = -0.8\Delta_0 )</td>
</tr>
<tr>
<td>Mn^{4+} = 3d^3</td>
<td>t_{2g}^{1.1.1} e_{g}^{0.0}</td>
<td>( CFSE = -1.2\Delta_0 )</td>
</tr>
<tr>
<td>V^{2+} = 3d^3</td>
<td>t_{2g}^{1.1.1} e_{g}^{0.0}</td>
<td>( CFSE = -1.2\Delta_0 )</td>
</tr>
<tr>
<td>Cr^{3+} = 3d^3</td>
<td>t_{2g}^{1.1.1} e_{g}^{0.0}</td>
<td>( CFSE = -1.2\Delta_0 )</td>
</tr>
</tbody>
</table>
15. Chemical formula of phosgene is:
(A) $\text{COCl}_2$
(B) $\text{CaOCl}_2$
(C) $\text{CaCO}_3$
(D) $\text{COCl}$
Ans. (A)

Sol. Phosgene: $\text{COCl}_2$
IUPAC Name: Carbonyl dichloride

16. What is added to potassium ferrocyanide (Lassigne nitrogen test) to give Prussian blue colour.
(A) $\text{FeCl}_3$
(B) $\text{FeCl}_2$
(C) $\text{CoCl}_3$
(D) $\text{CoCl}_2$
Ans. (A)

Sol. $6\text{NaCN} + \text{FeSO}_4 \rightarrow \text{Na}_4[\text{Fe(CN)}_6]$  
$\text{Na}_4[\text{Fe(CN)}_6] + 4\text{Fe}^{3+} \rightarrow \text{Fe}_4[\text{Fe(CN)}_6]_{3\times x}\text{H}_2\text{O}$
Ferric ferrocyanide (Prussian blue complex)

17. Stereoisomer that are formed electrophilic addition of bromine to trans but-2-ene.
(A) (±)2,3-dibromobutane
(B) Meso-2,3-dibromobutane
(C) (+) 2,3-dibromobutane
(D) 2,2-dibromobutane
Ans. (B)

Sol. The reaction takes place via formation of cyclic bromonium ion, hence, the nucleophile attacks form the opposite side of the cyclic ring. Hence, the addition is antiaddition.
18. Monomer of Dacron:

(A) glyptal
(B) Salicylic acid
(C) Isoprene
(D) Terephthalic acid

Ans. (D)

Sol.

\[ n \text{HOH}_3\text{C} - \text{CH}_2\text{OH} + n \text{HOOC} - \text{COOH} \rightarrow [\text{OCH}_3 - \text{CH}_2 - \text{C} - \text{O}]_n \]

Ethylene glycol (Ethane-1, 2-diol)  Terephthalic acid (Benzene-1, 4-di carboxylic acid)  Terylene or dacron

19.

(A) Nitrobenzene
(B) Acetophenone
(C) Quinol
(D) Para Benzoquinone
Ans. (D)
Sol: Aniline undergoes oxidation with potassium dichromate and gives para benzoquinone.

20. BOD of clean water is:

(A) 7 ppm
(B) 5 ppm
(C) 3 ppm
(D) 9 ppm

Ans. (C)

Sol. Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.