Oxidation and Reduction Chemistry Questions with Solutions

Q1. The reaction in which oxidation and reduction co-occur is known as
(a) Redox reaction
(b) Oxiduction reaction
(c) Both a and b
(d) None of the above
Answer: (a) The reaction in which oxidation and reduction co-occur is known as a redox reaction.

Q2. Oxidation refers to the
(a) Gain of electrons
(b) Loss of electrons
(c) Loss of protons
(d) Gain of protons
Answer: (b) Oxidation refers to the loss of electrons.

Q3. Reduction refers to the
(a) Gain of electrons
(b) Loss of electrons
(c) Loss of protons
(d) Gain of protons
Answer: (b) Reduction refers to the gain of electrons.

Q4. The addition of oxygen from a compound is an example of ________?
(a) Reduction
(b) Oxidation
(c) Dehydrogenation
(d) Oxygenation
Answer: (b) The addition of oxygen from a compound is an example of oxidation.

Q5. The addition of hydrogen from a compound is an example of ________?
(a) Reduction
(b) Oxidation
(c) Dehydrogenation
(d) Oxygenation
Answer: (a) The addition of hydrogen from a compound is an example of reduction.

Q6. What is the oxidation number of chlorine in MgCl₂?
Answer: The oxidation number of chlorine in MgCl$_2$ will be:

\[ x + 2 \times (-1) = 0 \]
\[ x - 2 = 0 \]
\[ x = 2 \]

Q7. How many moles of K$_2$Cr$_2$O$_7$ are needed to react with one mole of H$_2$S in an acidic medium?

**Answer:** Chemical Equation: $K_2Cr_2O_7 + 4 H_2SO_4 + 3 H_2S \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7 H_2O + 3 S$

1 mol of potassium dichromate reacts with 3 moles of hydrogen sulfide.

Hence, the number of moles of K$_2$Cr$_2$O$_7$ that will be needed to react with one mole of H$_2$S in an acidic medium is $\frac{1}{3}$.

Q8. Consider the following reaction:
6 NaOH + 3 Cl$_2$ → 5 NaCl + A + 3 H$_2$O

What is the oxidation number of chlorine in A?

**Answer:** Here, A is NaClO$_3$.

6 NaOH + 3 Cl$_2$ → 5 NaCl + NaClO$_3$ + 3 H$_2$O

The oxidation number of chlorine in NaClO$_3$ will be:

\[ 1 + x + 3 \times (-2) = 0 \]
\[ 1 + x - 6 = 0 \]
\[ x - 5 = 0 \]
\[ x = 5 \]

Q9. How many electrons are involved in the following redox reaction?
Cr$_2$O$_7^{2-}$ + Fe$^{2+}$ + C$_2$O$_4^{2-}$ → Cr$^{3+}$ + Fe$^{3+}$ + CO$_2$

Note: The reaction is not balanced.

**Answer:** Foremost, we will balance the equation.

Cr$_2$O$_7^{2-}$ + 2 Fe$^{2+}$ + 2 C$_2$O$_4^{2-}$ → 2 Cr$^{3+}$ + 2 Fe$^{3+}$ + 4 CO$_2$

The oxidation number of chromium is +6 in Cr$_2$O$_7^{2-}$, reducing to +3 in Cr$^{3+}$. On balancing the equation, we will notice that 2 moles of chromium ion go from +6 to +3.

Hence, 6 electrons are involved in the overhead redox reaction.

Q10. Name the reagent that can be used to reduce Fe$^{3+}$ to Fe$^{2+}$.

**Answer:** We can use H$_2$O$_2$ in the presence of NaOH or Na$_2$O$_2$ in water to reduce Fe$^{3+}$ to Fe$^{2+}$.

Q11. Name the element that never shows a positive oxidation number.

**Answer:** Fluorine never shows a positive oxidation number.

Q12. Give examples of oxidation reactions that you encounter in your daily life.

**Answer:** Rusting of iron and rotting of wood are examples of oxidation reactions that we encounter daily.
Q13. What is oxidation?
Answer: Oxidation is a process in which electrons are lost, oxygen is added, or hydrogen is removed during a reaction by a molecule, atom, or ion.
Example: Fe (s) + O₂ (g) → Fe₂O₃ (g)

Q14. What is reduction?
Answer: Reduction is a process in which electrons are gained, oxygen is removed, or hydrogen is added during a reaction by a molecule, atom, or ion.
Example: Zn (s) + 2 H⁺ (aq) → Zn²⁺ (aq) + H₂ (g)

Q15. Identify the species being oxidized and reduced in the following reaction.
3 Hg²⁺ + Fe (s) → 3 Hg₂ + 2 Fe³⁺
Answer: Here, the oxidation state of Hg changes from +2 in Hg²⁺ to 0 in Hg₂. Hence it is reduced. And the oxidation state of Fe changes from 0 in Fe to +3 in Fe³⁺. Hence it is oxidised.

Practise Questions on Oxidation and Reduction

Q1. When K₂Cr₂O₇ is mixed with H₂SO₄ and thoroughly shaken with H₂O₂ in the presence of ether, then a floated blue-colored complex X is formed. What is the change in oxidation state and the percentage of Cr in the complex X?

Answer: When K₂Cr₂O₇ reacts with H₂O₂, a blue-colored compound is formed, which is CrO₅.
The oxidation number of Cr in CrO₅ is +6 because four oxygen atoms are involved in peroxide linkage.
So, the change in oxidation state from K₂Cr₂O₇ to CrO₅ is 0.
The percentage of chromium in the complex is (52 X 100) / 132 = 39.4%.
Hence, the change in oxidation state and the percentage of Cr in the complex X is 0 and 39.4% respectively.

Q2. Consider a titration of potassium dichromate solution with acidified Mohr's salt solution using diphenylamine as an indicator. What number of moles of Mohr's salt is required per mole of dichromate?

Answer: Reaction: Cr₂O₇²⁻ + Fe²⁺ → Fe³⁺ + Cr³⁺
Here, the n factor of Cr₂O₇²⁻ = 6
And the n factor of Fe²⁺ = 1.
So, 6 moles of Fe²⁺ are required to reduce one mole of dichromate.
Q3. Differentiate between oxidation and reduction.
Answer:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Oxidation</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Oxidation refers to the loss of electrons.</td>
<td>Reduction refers to the gain of electrons.</td>
</tr>
<tr>
<td>2.</td>
<td>In this, the electrons are lost.</td>
<td>In this, the electrons are gained.</td>
</tr>
<tr>
<td>3.</td>
<td>There is an increase in oxidation number.</td>
<td>There is a decrease in oxidation number.</td>
</tr>
<tr>
<td>4.</td>
<td>It increases the positive charge.</td>
<td>It decreases the positive charge.</td>
</tr>
<tr>
<td>5.</td>
<td>In this, an oxygen atom is added.</td>
<td>In this, an oxygen atom is removed.</td>
</tr>
<tr>
<td>6.</td>
<td>In this, a hydrogen atom is lost.</td>
<td>In this, a hydrogen atom is added.</td>
</tr>
</tbody>
</table>

Q4. Differentiate between oxidation number and oxidation state.
Answer:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Oxidation state</th>
<th>Oxidation number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>The oxidation state tells us about the degree of oxidation, i.e., the number of electrons gained, lost, or shared.</td>
<td>The oxidation number tells us about the charge on the central metal atom even after all the ligands are removed.</td>
</tr>
<tr>
<td>2.</td>
<td>It does not tell us about the charge on the central atom.</td>
<td>It tells us about the charge on the central atom.</td>
</tr>
</tbody>
</table>

Q5. How do we find the oxidation number of an element?
Answer: The oxidation number is the charge that a central metal atom will have even after all the ligands have been removed from that atom.

Rules for finding the oxidation number:

Rule 1: An atom has a zero oxidation number in its elemental form.
Example: The oxidation number of chlorine in the Cl₂ molecule is zero.

Rule 2: The oxidation number of an ion is equivalent to its charge.
Example: The charge of chlorine ion is -1, so the oxidation number of chlorine ion will be -1.

Rule 3: The oxidation number of alkali metals is +1, and alkaline earth metal is +2.
Example: The oxidation number of sodium is +1, while the oxidation number of calcium is +2.

Rule 4: Hydrogen has two probable oxidation numbers, i.e. +1 and -1.
Example: The oxidation number of hydrogen in NaH is -1, while the oxidation number in HCl is +1.

Rule 5: Oxygen has three probable oxidation numbers: +2, -2 and -1.
Example: The oxidation number of oxygen in $\text{H}_2\text{O}$ is -2, while the oxidation number in $\text{OF}_2$ is +2. In contrast, the oxidation number of oxygen is -1 in $\text{H}_2\text{O}_2$.

**Rule 6:** The oxidation number of fluorine in any compound is -1.
Example: The oxidation number of fluorine in HF is -1.

**Rule 7:** The oxidation number of halogen is typically equal to -1 except when bonded with oxygen or fluorine atom.
Example: The oxidation number of chlorine in $\text{HCl}$ is -1, while the oxidation number of chlorine in $\text{HClO}_4$ is +7.

**Rule 8:** The sum of the oxidation numbers of neutral compounds equals **zero**.
Example: The oxidation number of chlorine is -1 in $\text{HCl}$, while the oxidation number of hydrogen is +1, and their sum is equal to zero.