Redox Reactions and Electrochemistry JEE Main PYQ - 1

Total Time: 25 Minute **Total Marks:** 40

Instructions

Instructions

1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Redox Reactions and Electrochemistry

1. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$ **(+4, -1)**
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$ **Jan 7 2020 Shift II**
Choose the correct option.

a. H_2O_2 acts as reducing and oxidising agent respectively in equation (A) and (B)

b. H_2O_2 acts as oxidising agent in equation (A) and (B)

c. H_2O_2 acts as reducing agent in equation (A) and (B)

d. H_2O_2 act as oxidizing and reducing agent respectively in equation (A) and (B)

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2. Which of the following equation depicts the oxidizing nature of H_2O_2? **(+4, -1)**

a. $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$ **Apr 8 2019 Shift II**

b. $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$

c. $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

d. $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$

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3. For standardizing NaOH solution, which of the following is used as a primary standard ? **(+4, -1)**

Jan 10 2019 Shift II

a. Ferrous Ammonium Sulfate

b. dil. HCl

c. Oxalic acid

d. Sodium tetraborate

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4. Given, $E^\circ_{Cr^{3+}/Cr} = -0.74\,V; E^\circ_{MnO_4^-/Mn^{2+}} = 1.51\,V \quad E^\circ_{Cr_2O_7^{2-}/Cr^{3+}} = -1.33\,V; E^\circ_{Cl/Cl^-} = 1.36\,V$ Based on the data given above strongest oxidising agent will be **(+4, -1)**

Apr 12 2014

a. Cl

b. Cr^{3+}

c. Mn^{2+}

d. MnO_4^-

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5. In which of the following reactions H_2O_2 acts as a reducing agent? (a) $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ (d) $H_2O_2 - 2e^- \rightarrow O_2 + 2H^+$ (c) $H_2O_2 + 2e^- \rightarrow 2OH^-$ (d) $H_2O_2 + 2OH^- - 2e^- \rightarrow O_2 + 2H_2O$ **(+4, -1)**

Apr 8 2019 Shift II

a. (a) and (b)

b. (c) and (d)

c. (a) and (c)

d. (b) and (d)

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6. At $298\,K$, the standard reduction potentials are $1.51\,V$ for $MnO_4^- \mid Mn^{2+} 1.36\,V$ for $Cl_2 \mid Cl^- 1.07\,V$ for $Br_2 \mid Br^-$, and $0.54\,V$ for $H_2|^-$. At $pH = 3$, permanganate is expected to oxidize: $\left(\frac{RT}{F} = 0.059\,V\right)$ **(+4, -1)**

April 11, 2015

a. Cl^-, Br^- and I^-

b. Cl^- and Br^-

c. Br^- and I^-

d. I^- only

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7. The number of electrons involved in the reduction of permanganate to manganese dioxide in acidic medium is _____ **(+4, -1)**

30Jan 2023 Shift II

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8. Oxidation number of Mo in Ammonophosphomolybdate **(+4, -1)**

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9. Copper becomes green when exposed to moist air for a long period. This is due to: **(+4, -1)**

April 12,2014

a. the formation of a layer of cupric oxide on the surface of copper.

b. the formation of a layer of basic carbonate of copper on the surface of copper.

c. the formation of a layer of cupric hydroxide on the surface of copper.

d. the formation of basic copper sulphate layer on the surface of the metal.

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10. Given $E^{\circ}_{Cl_2/Cl^-} = 1.36\,V$, $E^{\circ}_{Cr^{3+}/Cr} = -7\cdot 74\,V$ $E^{\circ}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V$, $E^{\circ}_{MnO_4^-/Mn^{2}+} = 1.51\,V$ Among the following, the strongest reducing agent is: **(+4, -1)**

2017

a. Cr^{3+}

b. Cl^-

c. Cr

d. Mn^{2+}

Answers

1. **Answer: c**

Explanation:

(A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

In this equation, H_2O_2 is reducing chlorine from +1 to -1

(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

In this equation, H_2O_2 is reducing iodine from 0 to -1

In (A) reduction of HOCl occurs so it will be a oxidising agent hence H_2O_2 will be a reducing agent.

In (B) reduction of I_2 occurs so it will be a oxidising agent and H_2O_2 will be a reducing agent.

Concepts:

1. Redox Reactions:

Redox Reaction:

Redox reactions are chemical reactions where oxidation and reduction take place simultaneously. In this type of reaction, there is a gain of electrons for one chemical species while the other loses electrons or simply involves transfer of electrons. The species that loses electrons is oxidized while the one that gains electrons is reduced.

Types of Redox Reactions:

Redox reactions can be differentiated into 4 categories namely combination reactions, decomposition reactions, displacement reactions, and disproportionation reactions. Each is explained separately below:

Combination Reaction:

In this, the molecules combine to form new compounds. For example, when magnesium reacts to nitrogen.

Decomposition Reaction:

Opposite to the combination reaction, here there is a breakdown of compounds to simpler substances. For example, electrolysis of water.

Displacement Reaction:

In this, the more reactive metal will displace the less reactive one in a chemical reaction. The reactivity of an element is represented in a series called the reactivity series (arranged in decreasing order of reactivity) which makes it easier to determine the chemical reaction and its products.

Disproportionation Reaction:

This is a peculiar type of reaction where an element showing a particular oxidation state will be oxidized and reduced simultaneously. Another thing to note is that these reactions will always have an element that can exhibit three oxidation states.

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2. Answer: b

Explanation:

I^- is oxidised to I_2 by H_2O_2.

So, the correct option is (B): $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$

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3. **Answer: c**

Explanation:

The solution that can be prepared directly by dissolving an accurately weighed amount of the substance in water and making up the volume to a known amount by water is known as primary standard solution. Oxalic acid is an example of primary standard while $NaOH$ is a secondary standard solution. Hence, strength of $NaOH$ solution can be determined by titrating against oxalic acid. This process is known as standardisation.

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4. **Answer: d**

Explanation:

Higher the standard reduction potential, better is oxidising agent. Among the given $E^{\circ}_{MnO_4^-/Mn^{2+}}$ is highest MnO_4^- is the strongest oxidising agent.

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5. **Answer: d**

Explanation:

The reducing agent oxidises itself.

(a) $H_2O_2^{-1} + 2H^+ + 2e^- \longrightarrow 2H_2O^{-2}$

(b) $H_2O_2^{-1} - 2e \longrightarrow O_2 + 2H^+$

(c) $H_2O_2^{-1} + 2e \longrightarrow 2OH^{-2}$

(d) $H_2O_2^{-1} + 2OH^- - 2e \longrightarrow O_2 + H_2O$

Note: Powers of 'O' are oxidation number of 'O' in the compound.

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6. **Answer: c**

Explanation:

Permanganate is expected to oxidise Cl^-, Br^- and I^- due to $E^\circ_{\text{eell}} > 0$.

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7. **Answer: 3 - 3**

Explanation:

The correct answer is 3.

$\overset{+7}{M}nO_4^- + 4H^+ + 3e^- \overset{+4}{M}nO_2 + 2H_2O$

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8. **Answer: 6 - 6**

Explanation:

$(NH_4)_3PMo_{12}O_{40}$ or $(NH_4)_3PO_4.12MoO_3$

$+3 + 5 + 12x - 80 = 0$

$12x = 80 - 8$

$12x = 72$

$x = 6$

So, the oxidation number of Mo is 6

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9. **Answer: b**

Explanation:

Copper when exposed to moist air having CO_2. It gets superficially coated with a green layer of basic carbonate $CuCO_3.Cu(OH)_2$.

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10. **Answer: c**

Explanation:

For Cr^{3+}, $E_{Cr^{3+}/Cr_2O_7^{2-}} = -1.33\,V$

For Cl^-, $E^\circ_{Cl^-/Cl_2} = -1.36\,V$

For Cr, $E^\circ_{Cr/Cr^{3+}} = 0.74\,V$

For Mn^{2+}, $E^\circ_{Mn^{2+}/MnO_4^-} = -1.51\,V$

Positive E° is for Cr, hence it is strongest reducing agent.

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