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GARAGES (ZO) GRAPTIER ASSESSMENT

Redox Reactions

Compare and contrast each pair of related terms

Reviewing Vocabulary

oxidation, reduction

when an atom gains one or more electrons. Oxidation occurs when an atom loses one or more electrons, and reduction occurs

2. oxidizing agent, reducing agent another substance. An oxidizing agent oxidizes another substance, and a reducing agent reduces

oxidation-reduction reaction, redox reaction

The terms are synonymous and are the same type of reaction

Use the following terms to complete the statements. A term may be used more than once

half-reaction

oxidation-reduction reaction

4. A chemical reaction in which electrons are transferred from one atom to another is a(n) oxidizing agent oxidation-number method reducing agent

oxidation-reduction reaction

5. Any kind of chemical unit involved in a process is a(n)

Redox equations can be balanced using the oxidation-number method

7. The chemical equation for a redox reaction can be written as two equations, an oxidation

half-reaction and a reduction half-reaction

A substance that accepts electrons from another substance is a(n) oxidizing agent

9. A substance that loses electrons to another substance is a(n)

reducing agent

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Understanding Main Ideas (Part A)

Determine the oxidation number of the boldface element in these ions.

‡ 3. Fe(NO₃)₂ +2 5. CrO₄²⁻

1. H₃AsO₄ -2. CaSO₄ -+6

4. AIN -3

6. I₂O₅

Balance the following equations, using the oxidation-number method for the redox part of the equation. Show your work.

7. $Cu_2O(s) + C(s) \rightarrow Cu(l) + CO(g)$

8. $HgO(s) \rightarrow Hg(l) + O_2(g)$

 $Cu_2O(s) + C(s) \rightarrow Cu(l) + CO(g)$

 $Cu_2O(s) + C(s) \rightarrow 2Cu(l) + CO(g)$

 $2HgO(s) \rightarrow 2Hg(l) + O_2(g)$ $HgO(s) \rightarrow Hg(l) + O_2(g)$

Write half-reactions for the following reactions. Identify each as being either oxidation

9. $Na(s) + H_2O(g) \rightarrow NaOH(s) + H_2(g)$

Na \rightarrow Na⁺ + 1e⁻, oxidation; 2H⁺ + 2e⁻ \rightarrow H₂, reduction

10. $\operatorname{ZnS}(s) + \operatorname{O}_2(g) \longrightarrow \operatorname{ZnO}(s) + \operatorname{SO}_2(g)$

 $S^{2-} \rightarrow S^{4+} + 6e^-$, oxidation; $O_2 + 4e^- \rightarrow 2O^{2-}$, reduction

Use your answers from questions 9 and 10 to help you balance the following equations.

11. $Na(s) + H_2O(g) \rightarrow NaOH(s) + H_2(g)$ $2(Na \rightarrow Na^+ + 1e^-); 2H^+ + 2e^- \rightarrow H_2(g)$ $2Na \rightarrow 2Na^+ + 2e^-$

 $2H^+ + 2e^- \rightarrow H_2(g)$

 $2Na(s) + 2H₂O(g) \rightarrow 2NaOH(s) + H₂(g)$

12. $ZnS(s) + O_2(g) \rightarrow ZnO(s) + SO_2(g)$ $2(S^{2-} \rightarrow S^{4+} + 6e^{-}); 3(O_2 + 4e^{-} \rightarrow 2O^{2-})$

 $2S^{2-} \rightarrow 2S^{4+} + 12e^{-}$

 $30_2 + 12e^- \rightarrow 60^{2-}$ $2ZnS(s) + 3O₂(g) \rightarrow 2ZnO(s) + 2SO₂(g)$

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Understanding Main Ideas (Part B)

Answer the following questions.

1. Explain how the oxidation-number method of balancing equations differs from balancing them by the conventional method, as you did in Chapter 10.

reaction and balancing the number of each by trial and error. The oxidation The conventional method is based on looking at what atoms are involved in the

redox reaction. number method is based on balancing the number of electrons transferred in a

element listed is a species $2K^+ + 2CI^- \rightarrow 2K + Cl_2$ Four; a species is any type of a chemical unit involved in a process. Each ion and

2. How many species are present in the following reaction? Explain your answer

Balance the following equations, using the oxidation-number method for the redox part of the equation. Show your work.

3.
$$\operatorname{HBr}(\operatorname{aq}) + \operatorname{KClO}_3(\operatorname{aq}) \to \operatorname{Br}_2(l) + \operatorname{KCl}(\operatorname{aq}) + \operatorname{H}_2(l)$$

$$6(+1) = +6$$

$$\operatorname{HBr}(\operatorname{aq}) + \operatorname{KClO}_3(\operatorname{aq}) \to \operatorname{Br}_2(l) + \operatorname{KCl}(\operatorname{aq}) + \operatorname{H}_2(l)$$

$$-6$$

$$6\operatorname{HBr}(\operatorname{aq}) + \operatorname{KClO}_3(\operatorname{aq}) \to \operatorname{3Br}_2(l) + \operatorname{KCl}(\operatorname{aq}) + \operatorname{3H}_2(l)$$

4. $Cl^-(aq) + Sn(s) + NO_3^-(aq) \rightarrow SnCl_6^{2-}(aq) + NO_2(g)$ in an acidic solution

CI⁻(aq) + Sn(s) + NO₃⁻(aq)
$$\rightarrow$$
 SnCl₆²⁻(aq) + NO₂(g)

$$4(-1) = -4$$
6Cl⁻(aq) + Sn(s) + 4NO₃⁻(aq) + 8H⁺(aq) \rightarrow SnCl₆²⁻(aq) + 4NO₂(g) + 4H₂O(l)

Show your work. Balance the following equation, using half-reactions for the redox part of the equation.

5.
$$FeCI_{2}(aq) + HCI(aq) + H_{2}O_{2}(aq) \rightarrow FeCI_{3}(aq) + H_{2}O(1)$$

$$2(Fe^{2+} \rightarrow Fe^{3+} + 1e^{-}); O_{2}^{2-} + 2e^{-} \rightarrow 2O^{2-}$$

$$2Fe^{2+} \rightarrow 2Fe^{3+} + 2e^{-}$$

$$O_{2}^{2-} + 2e^{-} \rightarrow 2O^{2-}$$

$$2FeCI_{2}(aq) + 2HCI(aq) + H_{2}O_{2}(aq) \rightarrow 2FeCI_{3}(aq) + 2H_{2}O(1)$$

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Thinking Critically

Answer the following questions.

1. In a reaction, more than one element can be oxidized or reduced. In terms of oxidation and reduction, explain what happens in the following reaction.

 $2H_2S(g) + SO_2(g) \rightarrow 3S(s) + 2H_2(g) + O_2(g)$

Sulfur in H_2S and oxygen in SO_2 are oxidized. Sulfur in SO_2 and hydrogen in H_2S

are reduced.

How many species are in an aqueous sodium chloride solution? Explain your answer Remember that sodium chloride is an ionic compound.

Three species exist in the solution: sodium ions, chloride ions, and water.

In aqueous solution, sodium chloride exists as sodium ions and chloride ions.

For each of the following, choose appropriate reactants, predict the formula(s) of the product(s), and write a balanced redox equation for the reaction. Do not use the same

and the half-reaction method for the other three. Show your work. You do not have to equation more than once. Use the oxidation-number method for three of the equations

3. A metal + a nonmetal

show the states of the reactants and products.

Sample answer: $4Na + O_2 \rightarrow 2Na_2O$

4. A nonmetal + a nonmetal

Sample answer: $C + 2Cl_2 \rightarrow CCl_4$

A metal + oxygen

Sample answer: $2Mg + O_2 \rightarrow 2MgO$

6. A metallic halide + a more active halide

Sample answer: $2KBr + F_2 \rightarrow 2KF + Br_2$

A metallic salt + a more active metal

Sample answer: $CuCl_2 + Fe \rightarrow FeCl_2 + Cu$

An active metal + a strong acid

Sample answer: $2K + 2HCI \rightarrow 2KCI + H_2$

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