



Answer all the questions below then check your answers

1. Answer the following questions:

a. What is oxidation?

b. What is a reducing agent?

c. What is a disproportionation reaction?

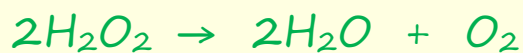
d. What is an oxidising agent?

2. Fill in the blank: In the reaction between chlorine and water, chlorine undergoes \_\_\_\_\_, that is it is both oxidised and reduced during the reaction.

3. Which of the following is can be used as an oxidising agent?

A) Hydrogen    B) Chlorine    C) Sodium    D) Potassium

b. Hydrogen peroxide can be decomposed to form water and oxygen gas as shown in the equation below. Which substance is being reduced in this reaction?



- A) Oxygen in  $\text{H}_2\text{O}_2$                       B) Hydrogen in  $\text{H}_2\text{O}_2$   
C) Oxygen in  $\text{O}_2$                          D) Water in  $\text{H}_2\text{O}$

4. Explain why chlorine is added to water.

a. Explain why the reaction of chlorine with water is a disproportionation reaction.

b. Write the equation for the reaction of chlorine with water and identify the products.

5. Complete the following disproportionation reaction equation:



6. Describe how bleach is manufactured, including the relevant chemical reactions.

7. List two advantages and two disadvantages of adding chlorine to water.



8. Explain in detail the concept of a disproportionation reaction using the decomposition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) to form water and oxygen gas as an example.

9. Complete the disproportionation reaction of chlorine in alkaline medium:



## Answers

1. Write definitions for the following terms:

a. What is oxidation?

Answer: Oxidation is the loss of electrons from a substance during a chemical reaction.

b. What is a reducing agent?

Answer: A reducing agent is a substance that donates electrons to another substance, reducing it. The reducing agent is oxidised when it donates electrons.

c. What is a disproportionation reaction?

Answer: A disproportionation reaction is a chemical reaction in which a single substance is both oxidized and reduced.

d. What is an oxidising agent?

Answer: An oxidising agent is an electron acceptor, it will oxidise substances it reacts with and it will be reduced in the process.

2. Fill in the blank: In the reaction between chlorine and water, chlorine undergoes \_\_\_\_\_, that is it is both oxidised and reduced during the reaction.

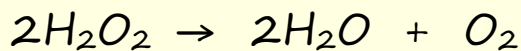
Answer: disproportionation

3. Which of the following is can be used as an oxidising agent?

A) Hydrogen    B) Chlorine    C) Sodium    D) Potassium

Answer: B) Chlorine

b. Hydrogen peroxide can be decomposed to form water and oxygen gas as shown in the equation below. Which substance is being reduced in this reaction?



A) Oxygen in  $\text{H}_2\text{O}_2$

B) Hydrogen in  $\text{H}_2\text{O}_2$

C) Oxygen in  $\text{O}_2$

D) Water in  $\text{H}_2\text{O}$

Answer: A) Oxygen in  $\text{H}_2\text{O}_2$ , the oxidation number of the oxygen changes from -1 to -2 in water.

4. Explain why chlorine is added to water.

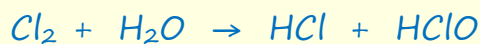
Answer: Chlorine is added to water as a disinfectant to kill bacteria and inactivate viruses, and other pathogens, making the water safe for drinking.

a. Explain why the reaction of chlorine with water is a disproportionation reaction.

Answer: When chlorine reacts with water, it forms hydrochloric acid (HCl) and hypochlorous acid or chloric (I) acid (HClO). In this reaction, chlorine is both reduced (forming HCl) and oxidised (forming HClO), thus it is a disproportionation reaction.

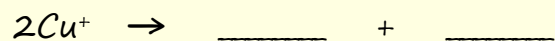
b. Write the equation for the reaction of chlorine with water and identify the products.

Answer: The reaction of chlorine with water is:



The products are hydrochloric acid (HCl) and hypochlorous acid or chloric (I) acid (HClO).

5. Complete the following disproportionation reaction equation:



6. Describe how bleach is manufactured, including the relevant chemical reactions.

Answer: Bleach is commonly manufactured by reacting chlorine gas with sodium hydroxide (NaOH). This process produces sodium hypochlorite (NaOCl), which is the active ingredient in bleach. The reactions are as follows:



This reaction results in the formation of sodium chloride (table salt), sodium hypochlorite (bleach), and water.

7. List two advantages and two disadvantages of adding chlorine to water.

Answer:

Advantages:

Kills harmful pathogens, reducing the risk of waterborne diseases.

Provides a residual disinfectant effect, which protects water from recontamination.

Disadvantages:

Can react with organic matter in water to form potentially harmful by-products.

May impart an unpleasant taste and odour to the water.

8. Explain in detail the concept of a disproportionation reaction using the decomposition of hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) to form water and oxygen gas as an example.

Answer: A disproportionation reaction is a type of redox reaction where a single substance is simultaneously oxidised and reduced, forming two different products. An example of a disproportionation reaction is the decomposition of hydrogen peroxide:



In this reaction, oxygen in the hydrogen peroxide is both reduced (to form water) and oxidised (to form oxygen gas). The oxygen that ends up in water has an oxidation state of -2, showing reduction, while the oxygen that forms oxygen gas has an oxidation state of 0, showing oxidation. This dual change in oxidation states of oxygen within the same molecule characterises a disproportionation reaction.

9. Complete the disproportionation reaction of chlorine in alkaline medium:

