



Disproportionation reactions

Answer all the questions below then check your answers

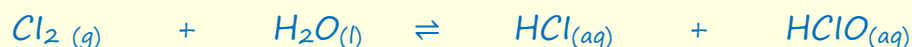
1. Write a word and balanced symbolic equation to show the reaction of chlorine with water.
 - a. What is a disproportionation reaction?
 - b. Explain why the addition of chlorine to water is an example of a disproportionation reaction.
 - c. Why is chlorine added to drinking water and water in swimming pool?
 - d. Explain why chlorine water must be made up fresh if it is to be used in the lab?
 - e. Explain what happens if universal indicator is added to chlorine water.
 - f. Write a balanced symbolic equation to show how bleach is made.
 - g. Using Le Chatelier's principle explain why it is a bad idea to add an acid to bleach in a confined space.
2. Bromine dissolves in water in a similar way to chlorine.
 - a. Write a balanced symbolic equation to show the products of this reaction.
 - b. Write ion-electron half equations to show the conversion of bromine to bromide and also bromine to bromate(I) ions

- c. What would happen to the brown colour of bromine water if an alkali was added to this equilibrium mixture?
3. If a solution of chlorine water containing chlorate(I) ions is heated it undergoes a disproportionation reaction to form chlorate(V) ions. Write an equation to show this disproportionation reaction.

Answers

1. Write a word and balanced symbolic equation to show the reaction of chlorine with water.

Chlorine + water \rightleftharpoons hydrochloric acid + chloric(I) acid



- a. What is a disproportionation reaction?

A reaction where a substance is both oxidised and reduced

- b. Explain why the addition of chlorine to water is an example of a disproportionation reaction.

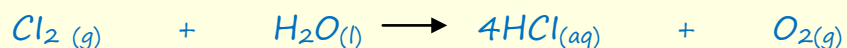
Chlorine is both reduced and oxidised when it forms hydrochloric and chloric(I) acids.

- c. Why is chlorine added to drinking water and water in swimming pools?

To kill bacteria

- d. Explain why chlorine water must be made up fresh if it is to be used in the lab?

When a bottle of chlorine water is left exposed to sunlight an unwanted side reaction occurs which releases oxygen gas and forms hydrochloric acid.



- e. Explain what happens if universal indicator is added to chlorine water.

Initially the universal indicator turns red due to the presence of hydrochloric acid but the colour quickly fades due to the presence of the chlorate(I) ion which acts as a bleach and removes the colour.

f. Write a balanced symbolic equation to show how bleach is made.

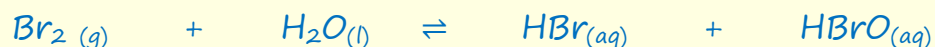


g. Using Le Chatelier's principle explain why it is a bad idea to add an acid to bleach in a confined space.

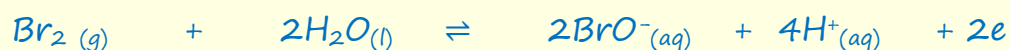
Adding an acid will reduce the concentration of sodium hydroxide and force the reaction to the left hand side which will release chlorine gas into the room.. This is the main reason why you should never mix acidic cleaners with bleach. Believe it or not but some cleaners have been killed by inadvertently adding an acidic cleaner to bleach in a confined space.

2. Bromine dissolves in water in a similar way to chlorine.

a. Write a balanced symbolic equation to show the products of this reaction.



b. Write ion-electron half equations to show the conversion of bromine to bromide and also bromine to bromate(I) ions



c. What would happen to the brown colour of bromine water if an alkali was added to this equilibrium mixture?

From Q2a if you add an alkali it will reduce the amount of hydrobromic and bromic acids, so position of equilibrium will move to the right hand side to produce more acid, so amount of bromine will be reduced and brown colour will fade

3. If a solution of chlorine water containing chlorate(I) ions is heated it undergoes a disproportionation reaction to form chlorate(V) ions. Write an equation to show this disproportionation reaction.

