



Reaction between zinc powder and sulfur

Learning objectives

- Recall the definitions of elements, mixtures and compounds
- Describe the changes that take place during a chemical reaction
- Write chemical equations for the reactions
- Use energy changes to decide if a reaction is exothermic or endothermic

Introduction

When chemical reactions occur, atoms are rearranged to form different substances. The original elements, once combined, have different chemical and physical properties than when they were reactants.

Teacher demonstration

In this demonstration, you will observe an exothermic reaction of two elements, zinc and sulfur, to form the compound zinc sulfide. The two solids are mixed and heated in a test tube (or ignition tube) and changes in their properties can be observed. Careful observations will also reveal that some by-products are formed.

Complete the table.

Substance	Symbol	Appearance	Type of substance present: element mixture or compound?
Zinc			
Sulfur			
Zinc sulfide			



Questions

1. Give one observation that shows a chemical reaction has taken place between zinc and sulfur.

2. In the reaction you observed, zinc (Zn) reacted with sulfur (S) to produce zinc sulfide (ZnS).

(a) Write a word equation for this reaction.

(b) Write a symbol equation for this reaction. Include state symbols.

3. The reaction between zinc and sulfur is exothermic.

(a) Describe the observations that support this statement.

(b) Describe the energy changes that take place during the chemical reaction.

(c) Explain why the reaction needed to be heated at the start.

4. During the zinc and sulfur reaction, two by-products were formed, zinc oxide, ZnO, and sulfur dioxide, SO₂.

(a) State the meaning of the term **by-product**.

(b) List all the compounds present in the solid mixture at the end of the main chemical reaction.



(c) Write a symbol equation for the formation of each by-product.

(d) Identify the reactants for each by-product and explain where each reactant came from.

5. Suggest why this reaction has a percentage yield of less than 100%.

6. Zinc can be obtained from zinc sulfide by a smelting process.

Step 1 The zinc ore is roasted in air, converting it to zinc oxide.

Step 2 Coke and the roasted ore are fed into the top of the furnace, and air is blasted in at the bottom. The zinc oxide is reduced to zinc by carbon monoxide gas.

Step 3 To prevent the hot zinc from being re-oxidised, it is sprayed with molten lead, forming a mixture. As the mixture cools, the zinc separates out.

(a) Explain why it is so difficult to extract zinc from zinc sulfide.

(b) Write a symbol equation to show the process occurring in **step 1**.

(c) Write a symbol equation to show the process occurring in **step 2**.

(d) Explain why the zinc can be easily separated out in **step 3**.
