Competition for oxygen

Introduction

Mixtures of metals and metal oxides are heated over a Bunsen burner flame. Students observe the reactions and decide if a reaction occurs. Students should understand the idea of competition for oxygen. This experiment can be used as an introduction to the reactivity series, but it can also be used when students know how to predict the outcome of the reaction from the reactivity series.
This experiment should take around 60 minutes

Equipment

Apparatus

- Eye protection
- Bunsen burner
- Tripod
- Pipe clay triangle
- Crucible or cleaned beer bottle tops
- Tongs

Chemicals

- Magnesium oxide, 0.5 g
- Iron, 0.5 g
- Lead(II) oxide, 0.5 g
- Zinc, 0.5 g
- Copper(II) oxide, 0.5 g

Health, safety and technical notes

- Read our standard health and safety guidance here https://rsc.li/3GkGOZD
- Always wear eye protection.
- Magnesium oxide is of low hazard (see CLEAPSS Hazcard HC059b).
- Lead(II) oxide is a reproductive toxin, harmful if swallowed or inhaled, Specific Target Organ Toxin and dangerous for the environment (see CLEAPSS Hazcard HC056).
- Copper(II) oxide is harmful if swallowed and dangerous for the environment (see CLEAPSS Hazcard HC026).
- Zinc is highly flammable and dangerous for the environment (see CLEAPSS Hazcard HC108b).
- Iron is of low hazard, if iron powder is used it will be highly flammable (see CLEAPSS Hazcard HC055A).
- Under no circumstances should a mixture of copper oxide and magnesium be heated by students.
- In the reaction of copper(II) oxide and zinc, students should be told not to stir the mixture with a metal spatula.

Answers

Reaction mixture	Does this mixture react?
Magnesium oxide and iron	No
Lead oxide and iron	Yes
Lead oxide and zinc	Yes
Copper oxide and zinc	Yes

- Q2
    - Lead oxide + iron → iron oxide + lead
    - Lead oxide + zinc → zinc oxide + lead
    - Copper oxide + zinc → zinc oxide + copper

Notes

- This experiment uses lots of crucibles, which a school may not have. An alternative is to use beer bottle tops. The plastic insert of the tops should first be removed by heating them strongly in a fume cupboard.
- Some teachers recommend using ceramic paper rather than crucibles, as some products are difficult to remove from the crucible after reaction.
- One consideration is that using ceramic paper causes more mess and the Bunsen burners become clogged from spilt powders.
- Some teachers like to heat the mixture directly from above. Care is needed not to let powder be sprayed by the flame.
- Students must wear eye protection.
- Students must not lean over the reaction mixture.
- Some of the reactions may be unexpectedly violent.
- Ensure the room is well ventilated.
- If the mixtures are not given to the students pre-mixed, then students should be told to place the chemicals on a piece of paper and pass them back and forth to another piece of paper until they are well mixed. The mixture can then be placed in the crucible, or on the beer bottle top.