

Your teacher may watch to see if you can...

- follow instructions carefully.

Aim

To find out which metals react with different metal sulfate solutions.

Method

Apparatus

- eye protection
- dropper pipette
- spatula
- spotting tile
- tweezers
- marker pen
- small pieces of copper, iron, magnesium, zinc
- solutions of copper sulfate, iron sulfate, magnesium sulfate, zinc sulfate

Safety

Wear eye protection.

Magnesium is highly flammable – make sure there are no naked flames in the laboratory.

Handle the metals with tweezers or a spatula.

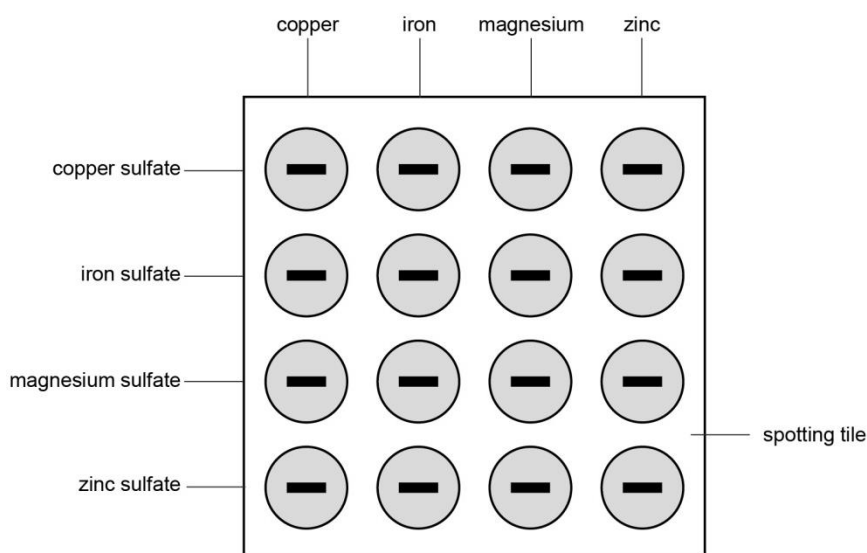
A Use the dropper pipette to put a few drops of copper sulfate solution in each of the four depressions across the top row in the spotting tile. Label this row with the name of the solution.

B Rinse the pipette with water.

C Repeat steps **A** and **B** for each of the solutions, using the diagram as a guide.

D For each solution, add a piece of copper to the first depression, a few iron filings to the second depression, a piece of magnesium to the third depression and a piece of zinc to the fourth depression.

E Leave all the mixtures for a few minutes, then observe them carefully to see if there is any sign of a reaction. Ignore any bubbles that you see.



Recording your results

- 1 Design a table to record your results.
- 2 Record your results in the table.

Considering your results/Conclusions

- 3 **a** Put the four metals in order of reactivity, with the most reactive first.
b Explain how you used your results to decide on the order of reactivity.
- 4 Write balanced equations for all the reactions that occurred.
- 5 **H** Write ionic equations for all the reactions that occurred.
- 6 **H** Explain what has been oxidised and what has been reduced in each of the ionic equations.

Name _____ Class _____ Date _____

Recording your results

1 Record your results in the table.

Put a tick (✓) in the box for any metal and metal sulfate solution combination in which there was a reaction.

Put a cross (X) in the box for any metal and metal sulfate solution combinations in which there was no reaction.

Solution	Copper	Iron	Magnesium	Zinc
copper sulfate				
iron sulfate				
magnesium sulfate				
zinc sulfate				

Considering your results/Conclusions

2 a Write the four metals in order of reactivity, with the most reactive first.

b Explain how you used your results to decide on the order of reactivity.

3 Write word equations for all the reactions that occurred.

4 Write balanced equations for all the reactions that occurred.

Name _____ Class _____ Date _____

1 Write word equations for the following reactions.

a sodium with water

b zinc with sulfuric acid

2 Write balanced equations for the following reactions.

a potassium with water

b magnesium with hydrochloric acid

3 Zinc reacts with copper nitrate solution to form zinc nitrate solution and copper.

a Give the formula of copper nitrate. _____

b Give the state symbol of copper nitrate solution. _____

4 Predict whether each of these reactions will take place. Either write the balanced equation or write 'no reaction'.

a $\text{Zn} + \text{MgO} \rightarrow$ _____

b $\text{Mg} + \text{CuO} \rightarrow$ _____

c $\text{Fe} + \text{CaO} \rightarrow$ _____

d $\text{Ca} + \text{MgSO}_4 \rightarrow$ _____

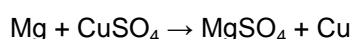
e $\text{Fe} + \text{ZnCl}_2 \rightarrow$ _____

f $\text{Zn} + \text{AgNO}_3 \rightarrow$ _____

g $\text{Mg} + \text{AgNO}_3 \rightarrow$ _____

h $\text{Cu} + \text{Ag}_2\text{SO}_4 \rightarrow$ _____

5  Magnesium reacts with copper sulfate solution.



a Write the ionic equation for this reaction. _____

b Write the two **half equations** for this reaction. _____

c Explain what has been oxidised and what has been reduced in this reaction.

1 The general reactions of metals that react with water and acids are:

metal + water \rightarrow metal hydroxide + hydrogen

metal + acid \rightarrow salt + hydrogen

2 A metal will displace metals below it in the **reactivity series** from their compounds.

e.g. zinc + copper sulfate \rightarrow copper + zinc sulfate

3 Some useful formulae: CaSO_4 , Cu^{2+} , CuSO_4 , KOH , Mg^{2+} , MgCl_2 , $\text{Mg}(\text{NO}_3)_2$, NO_3^- , $\text{Zn}(\text{NO}_3)_2$

Name _____ Class _____ Date _____

EASIER

1 The general reactions of metals that react with water and acids are:

metal + water → metal hydroxide + hydrogen

metal + acid → salt + hydrogen

2 A metal will displace metals below it in the **reactivity series** from their compounds.3 Some useful formulae: NaOH, MgSO₄

1 Write word equations for the following reactions.

a calcium with water

b zinc with hydrochloric acid

2 Write balanced equations for the following reactions.

a sodium with water

b magnesium with sulfuric acid

3 Describe an experiment to show that zinc is more reactive than copper, using zinc and copper sulfate solution. Include the observations you would make and a word equation for the reaction.

HARDER

S1 Describe the reactions you could carry out to find the order of reactivity for magnesium, tin, chromium and copper. You may use the metals and the metal nitrate solutions.

4 Explain how a magnesium atom forms a magnesium ion, Mg²⁺, when it reacts with a dilute acid.

Name _____ Class _____ Date _____

- 1 The general reactions of metals that react with water and acids are:
 metal + water → metal hydroxide + hydrogen
 metal + acid → salt + hydrogen
- 2 A metal will displace metals below it in the **reactivity series** from their compounds.
- 3 Some useful formulae: CaO, Ca(OH)₂, Cl⁻, Mg²⁺, MgCl₂, MgSO₄, ZnCl₂, ZnO, ZnSO₄

1 Describe what is seen when a small piece of sodium is added to water.

2 Write word equations for the following reactions.

a potassium with water

b iron with sulfuric acid

3 Write balanced equations for the following reactions.

a calcium with water

b zinc with hydrochloric acid

4 Magnesium reacts with copper chloride solution to form magnesium chloride solution and copper.

a Give the formula of magnesium chloride. _____

b Give the state symbol for magnesium chloride solution. _____

c State what you would see during this reaction.

5 Predict whether each of these reactions will take place. Either complete the balanced equation or write 'no reaction'.

a $\text{Ca} + \text{FeO} \rightarrow$ _____

b $\text{Cu} + \text{ZnO} \rightarrow$ _____

c $\text{Zn} + \text{FeO} \rightarrow$ _____

d $\text{Zn} + \text{CuSO}_4 \rightarrow$ _____

e $\text{Mg} + \text{ZnCl}_2 \rightarrow$ _____

f $\text{Zn} + \text{CuCl}_2 \rightarrow$ _____

g $\text{Cu} + \text{Ca}(\text{NO}_3)_2 \rightarrow$ _____

6 When sodium reacts with water, it forms a sodium ion, Na⁺.

a Explain what happens to a sodium atom when it becomes a sodium ion.

b What is meant by a **cation**? _____

c Magnesium is lower in the reactivity series than sodium. Explain whether sodium atoms or magnesium atoms form cations most readily.

- 1 Four metals, J, K, L and M, were heated with different metal oxides. The results are shown in the table.

Metal oxide	Metal J	Metal K	Metal L	Metal M
oxide of metal J		no reaction	no reaction	no reaction
oxide of metal K	reaction		no reaction	reaction
oxide of metal L	reaction	reaction		reaction
oxide of metal M	reaction	no reaction	no reaction	

- a Place the four metals in order of reactivity, with the most reactive first.
- b Give reasons for the order you have suggested.
- 2 Write balanced equations for the following reactions.
- a calcium with water
- b zinc with hydrochloric acid
- 3 Predict whether each of these reactions will take place. Either write the balanced equation or write 'no reaction'.
- a $\text{Ca} + \text{FeO} \rightarrow$
- b $\text{Cu} + \text{ZnO} \rightarrow$
- c $\text{Zn} + \text{FeO} \rightarrow$
- d $\text{Al} + \text{CuO} \rightarrow$
- e $\text{Mg} + \text{AgNO}_3 \rightarrow$
- f $\text{Ag} + \text{ZnSO}_4 \rightarrow$
- 4 When calcium reacts with water, it forms a calcium ion, Ca^{2+} .
- a Explain what happens to a calcium atom when it becomes a calcium ion.
- b Magnesium is lower in the **reactivity series** than calcium. Explain whether calcium atoms or magnesium atoms form **cations** more readily.

Extra challenge

- 5 Zinc reacts with copper nitrate solution.
- $$\text{Zn} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Zn}(\text{NO}_3)_2 + \text{Cu}$$
- a Write the ionic equation for this reaction.
- b State what is meant by a **spectator ion**.
- c Write the two **half equations** for this reaction.
- d Explain what has been oxidised and what has been reduced in this reaction.
- 6 Aluminium reacts with iron(III) oxide.
- $$2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$$
- a Write the ionic equation for this reaction.
- b Write the two half equations for this reaction.
- c Explain what has been oxidised and what has been reduced in this reaction.

Name _____ Class _____ Date _____

Progression questions
















Answer these questions.

1 What are the similarities and differences in the way different metals react with water, acids and salt solutions?

2 What happens to metal atoms when they react with water and acids?














3  How do you explain displacement reactions as redox reactions?

Now circle the faces in the 'Start' row in the table showing how confident you are of your answers.

Question	1	2	3
Start	    	    	    

Assessment

Using a different colour, correct or add to your answers above. You may need to use the back of this sheet or another piece of paper. Then circle the faces in the 'Check' row in the table.

Question	1	2	3
Check	    	    	    

Feedback

What will you do next? Tick one box.

 strengthen my learning
 strengthen then extend
 extend

Note down any specific areas you need to improve.

Action

You may now be given another activity. After this, note down any remaining areas you need to improve and how you will try to improve in these areas.
